

Indian Forest Service Exam, 2010

Sl. No. 1622

B-JGT-K-DJB

**CIVIL ENGINEERING**

**Paper—II**

Time Allowed : Three Hours

Maximum Marks : 200

**INSTRUCTIONS**

**Candidates should attempt Question Nos. 1 and 5 which are compulsory, and any THREE of the remaining questions, selecting at least ONE question from each Section.**

**All questions carry equal marks.**

**The number of marks carried by each part/ subpart of a question is indicated against each.**

**Answers must be written in ENGLISH only.**

**If any data is considered insufficient, assume suitable value and indicate the same in your answer.**

**Unless otherwise indicated, symbols and notations have usual meanings.**

**Section—A**

1. Answer any *four* parts of the following :

- (a) (i) What are the harmful substances in brick earth? 5
- (ii) What is efflorescence in bricks? What are its causes and remedies? 5
- (b) (i) Mention the principal types of dump trucks used in heavy construction. Compare rear dump and bottom dump trucks. 5

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- (ii) What are the objectives of channelisation with respect to road traffic? 5
- (c) (i) Distinguish between stratified rocks and foliated rocks. 2½
- (ii) What is meant by the natural bed of stone? Why is it necessary to set a stone along its natural bed? 2½
- (iii) What is the role of circulation diagram for planning of buildings? 5
- (d) Explain the following terms :  $2\frac{1}{2} \times 4 = 10$
- (i) Built-up Spray Grout (BUSG)
- (ii) Cant Deficiency
- (iii) Present Serviceability Index (PSI)
- (iv) Electronic Distance Measurement Instrument (EDM)
- (e) (i) What is tacheometry?
- (ii) What are the advantages of tacheometry?
- (iii) Where is tacheometry application very useful? 10
2. (a) (i) Discuss the effect of calcium ligno-sulphonate and sodium hydroxide admixtures on cement. 5

- (ii) Discuss briefly the various effects of adding puzzolana to cement concrete. 5
- (b) (i) What is guniting? Mention the uses of guniting in construction industry. 5
- (ii) What is gel-space ratio? 2½
- (iii) What is Dutt-Abraham law? 2½
- (c) (i) Explain structural evaluation and functional evaluation of highway pavement. 5
- (ii) Determine the loose volume of bituminous-mix required to be produced at hot-mix plant using the following data : 5
- Type of work—  
 Pre-mix bituminous carpet,  
 25 mm thick to be laid by  
 paver
- Carriage-way width—One lane
- Compacted density required  
 $= 2300 \text{ kg / m}^3$
- Loose density of mix  
 $= 1600 \text{ kg / m}^3$
- Speed of paver = 0.3 kmph

- (d) Following is the record of observations taken at stations *A*, *B*, *C*, *D* and *E* of a closed compass traverse *ABCDEA* by prismatic compass :

Station	Fore-bearing	Back-bearing
<i>A</i>	80°	140°
<i>B</i>	90°	260°
<i>C</i>	120°	269°
<i>D</i>	200°	301°
<i>E</i>	318°	18°

At what stations do you suspect local attraction? Calculate the correct bearings and included angles.

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3. (a) (i) A construction machine costs Rs 12,000 and has an expected life of 5 years and salvage value of Rs 2,000. It is anticipated to work 2000 hours in a year. Compute the yearly depreciation for the machine using—

- (1) the double-declining balance method;
- (2) sum of the years' digits method.

Rate of depreciation is 20% per year.

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- (ii) Discuss in detail the role of benefit-cost analysis for selecting an alternative in civil engineering projects.

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- (b) A maintenance project consists of the following 10 activities, whose precedence relationships are identified by their node numbers :

Activity	Initial node and final node	Duration (days)	Activity	Initial node and final node	Duration (days)
A	1-2	2	F	4-6	6
B	2-3	3	G	4-7	2
C	2-4	5	H	5-8	8
D	3-5	4	I	6-8	7
E	3-6	1	J	7-8	4

- (i) Draw the network.
- (ii) Calculate the earliest and the latest activity start times for each activity.
- (iii) Identify slack for events and float for activities. 10
- (c) An existing roundabout has uniform weaving section, having following dimensions :
- Width ( $W$ ) = 15 m
- Length ( $L$ ) = 50 m
- Average entry width ( $e$ ) = 8 m
- Future design hourly volume (DHV) is 2150 vehicles per hour with 12% trucks. What shall be the available reserved capacity? 10

(d) Explain and distinguish between the following terms with respect to measurements in surveying : 10

- (i) Accuracy
- (ii) Precision
- (iii) Error
- (iv) Discrepancy
- (v) Mistake

4. (a) (i) For observations having equal weights, determine the most probable value of angle  $B$  from the following equations : 5

$$B = 32^{\circ} - 30' - 40''$$

$$3B = 90^{\circ} - 30' - 50''$$

$$4B = 120^{\circ} - 55' - 30''$$

(ii) What are the factors affecting the selection of Front Shovel in construction industry? 5

(b) (i) With respect to road traffic, distinguish between the following terms : 6

- (1) Normal Traffic Growth
- (2) Generated Traffic Growth
- (3) Development Traffic Growth
- (4) Current Traffic Growth

(ii) Distinguish between a mosaic and a map. 4

(c) Calculate the maximum permissible speed on curve of high-speed BG track having following data :

(i) Degree of curve =  $1^\circ$

(ii) Amount of superelevation = 8 cm

(iii) Length of transition curve = 130 m

(iv) Maximum speed of the section likely to be sanctioned = 153 kmph

Assume maximum cant deficiency for high-speed track = 10 cm.

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(d) (i) A line PQ measures 12 cm on a photograph snapped by a camera with focal length of 22.5 cm. The same line measures 4.0 cm on a map drawn to a scale of  $\frac{1}{45000}$ .

Determine the flying height of the aircraft, if the average altitude is 360 m.

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(ii) Discuss briefly the common cause of track derailment on curves and over crossing and turnout.

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**Section—B**

5. Answer any *four* parts of the following :

(a) (i) Rainfall records of 100 years were scanned and it was found that the probability of a precipitation of 350 mm in a day is 0.025. Find the probability of three precipitations of one day magnitude exceeding 350 mm in the next 15 years.  $2\frac{1}{2}$

(ii) Thiessen's weights of 4 rain gauges A, B, C and D covering a river basin are 0.16, 0.24, 0.32 and 0.28 respectively. If the average depth of rainfall for the basin is 45 mm and the individual rainfalls at B, C and D are 55 mm, 40 mm and 45 mm respectively, what is the rainfall at A?  $2\frac{1}{2}$

(iii) What volume of water is required to be added to an evaporation pan of 1.22 m diameter placed in a catchment area experiencing 10 mm rainfall, the total evaporation on that day being 5 mm?  $2\frac{1}{2}$

(iv) Calculate the rate of water to be released at the head of a sluice in order to irrigate 10000 hectares of land, out of which 20 percent is wastage. The duty of water is 800 hectares/cumec.  $2\frac{1}{2}$



- (b) (i) The cumulative depth of infiltration in an experiment on a tube infiltrometer is given by the equation  $F = 0.2 t^{0.55}$ , where  $F$  is in centimetres and  $t$  in minutes. Find the equation for the infiltration rate and also the average infiltration rate. Calculate the respective values at the end of 45 minutes. 5
- (ii) Gross commanded area for a reservoir is 75000 hectares, 80% is cultivable commanded area. Calculate the reservoir capacity in hectare-metres, if the canal losses are 10%, reservoir losses are 12.5%. Other data are as follows : 5

<i>Crop</i>	<i>Base period (days)</i>	<i>Duty (hectares/cumec)</i>	<i>Irrigation intensity (%)</i>
Paddy	130	800	10
Wheat	120	1750	15
Cotton	180	1800	12
Sugarcane	360	1200	20

- (c) (i) What is meant by coincident draft and how is it used in estimating design draft for design of distribution system? 5
- (ii) Explain any three methods of estimating the future population of a city. What are their relative merits? 5

- (d) (i) Discuss the circumstances under which the following types of pumps may be used : 5
- (1) Reciprocating pump
  - (2) Centrifugal pump
  - (3) Airlift pump
- (ii) Explain the significance of nitrogen and phosphorus from the point of view of water quality. 5
- (e) (i) Explain the relationship between HOCl and OCl<sup>-</sup> occurring at various pH levels with the help of a suitable sketch. 5
- (ii) A cofferdam is designed for a 30-year flood and constructed. It takes 6 years to complete the main dam construction. What is the risk of the cofferdam failure before the main dam is completed? What return period in the design of cofferdam would have reduced the risk to 12%? 5
6. (a) (i) Define trap efficiency of a reservoir. What are the measures that are to be taken to control the sediment yield into a reservoir? 5
- (ii) In a recuperation test on an open well, the water level was depressed by 4 m and it was observed to rise by 2.5 m in 90 minutes. What is

- the specific capacity of the well?  
What would be the yield from the well under a depression of 3 m, if the diameter of the well is 7.5 m? 5
- (b) (i) Draw a neat sketch (plan) of a diversion scheme headworks showing all the components. 5
- (ii) Following are the data of a canal fall :
- FSL = 10 m  
Bed level = 7 m  
Bed width = 16 m  
Discharge = 45 cumecs  
Crest length of the fall = 10 m  
(the cross-section being rectangular)  
Coefficient of discharge = 1.7
- Design fall crest. 5
- (c) (i) What is 'river training'? Draw neat sketches (plans) of attracting spur and repelling spur. 5
- (ii) Write short notes on chlorination and desalination. 5
- (d) In a continuous flow settling tank 3 m deep and 50 m long, what flow velocity of water would you recommend for effective removal of 0.025 mm particles at 25 °C? The specific gravity of particles is 2.65 and the kinematic viscosity for water may be taken as  $0.01 \text{ cm}^2 / \text{sec}$ . 10

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7. (a) The cross-section of a trapezoidal gravity dam has a top width of 5 m, bottom width 20 m, height 30 m, out of which 2 m is freeboard. Check the stability of the dam section neglecting uplift forces. 10
- (b) (i) Draw neat sketches of different types of keys for shear resistance in a gravity dam. 5
- (ii) A homogeneous earthen dam is 22 m high and has a freeboard of 2 m. A flow net constructed indicates 12 potential drops and 4 channels. Calculate the discharge per metre length of the dam, if the coefficient of permeability of the dam material is  $2.75 \times 10^{-3}$  cm/s. 5
- (c) (i) What do you understand by a hydraulically equivalent section? Mention the conditions when two conduits are hydraulically equivalent. 5
- (ii) In the context of emission of gaseous effluents from a chimney, briefly describe various types of plume behaviour with the help of suitable diagram(s). 5
- (d) (i) Explain the term 'time of concentration' and its significance in design of storm sewers. 5

(ii) The 5 days' BOD of a waste is 280 mg/litre. The ultimate BOD is reported as 400 mg/litre. At what rate is the waste being oxidised? 5

8. (a) (i) A weir has 50 vertical gates each of 9.75 m span, maximum reservoir level = 11.0 m, crest level = 6.5 m, coefficient of end contraction for piers = 0.021, coefficient of end contraction for abutments = 0.11, coefficient of discharge for the weir = 1.70. Compute the maximum flood discharge which can safely pass over the weir without exceeding the full reservoir level. Neglect velocity of approach. 5

(ii) The bed slope of an irrigation canal is to be fixed at the rate of 1 m in 5 km length, the average silt size carried is 0.35 mm. Design the cross-section of the channel using Lacey's theory, when the side slopes are  $45^\circ$ . 5

(b) (i) Define mass curve of a rainfall and rainfall hyetograph. With neat sketches, explain how the hyetograph is derived from the mass curve. 5

- (ii) The following flows are recorded in the driest year at a project site. Determine the minimum capacity of the reservoir to allow the available volume of water to be drawn off at a uniform rate assuming that there is no loss of water over the spillway. Use arithmetic method : 5
- (220, 162, 150, 114, 102, 112, 190, 276, 332, 305, 257, 252) million metre<sup>3</sup>
- (c) (i) Draw a sketch of a grease trap and describe its working. 5
- (ii) Compare the working of a septic tank and an Imhoff tank. 5
- (d) (i) Explain the significance of the following heavy metals in the atmosphere : 5
- Cadmium, Nickel, Mercury, Lead
- (ii) The mean concentration of SO<sub>2</sub> at STP in Delhi is 42 µg / m<sup>3</sup>. What is the equivalent concentration in ppm at 25 °C and 1 atm? 5

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