Civil Services (Main) Examination, 2004

CIVIL ENGINEERING
(Paper II)

Time Allowed : Three Hours **Maximum Marks : 300**

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

There are EIGHT questions divided in two Sections.
Candidate has to attempt FIVE questions in all.
Question Nos. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE question from each Section.
The number of marks carried by a question/part is indicated against it.
Wherever any assumptions are made for answering a question, they must be clearly indicated.
Word limit in questions, wherever specified, should be adhered to.

SECTION 'A'

1. Answer any five of the following:

(a) Consider an initial investment P, depreciated in equal annual instalments to a salvage value L at the end of n years; and consider the average annual interest rate to be i. Determine the equivalent annual cost by this depreciation taken with the average interest. **12**

(b) Materials required per cu.m. of freshly mixed cement concrete are: 312 kg of dry cement, 855 kg of sand, 1010 kg of gravel and 145 kg of fresh water. Bulking, when mixing in the mixer, is 5%. What would be the density of the freshly mixed and poured cement concrete? What would be the total volume of fresh concrete that can be produced in a nominal 6 cu.m. mixer, in which loading during mixing can be only 65% of nominal capacity, per hour if its working cycle is: charging – 35 seconds, mixing – 170 seconds, discharging – 30 seconds and lost time – 18 seconds. **12**

(c) What are the several activities that can be taken as protective and restorative measures as part of post-construction termite-proofing? **12**

(d) Describe the common mistakes in linear measurements using chains and the measures to be adopted to eliminate these mistakes. **12**

(e) Enumerate the major policies and objectives of the Third Twenty-Year Road Development Plan (1981-2001) of India. **12**

(f) How are speed, travel time, volume and density of traffic on a road mutually related? Illustrate with sketches as appropriate. **12**

2. (a) Insulation for thermal lagging on steam pipes laid for central heating is available in several (alternative) thicknesses. Corresponding total initial costs of providing the insulation and the yet-persisting annual heat loss throughout the ducting are tabulated. The service life is expected to be 7 years. Adopting MARR of 8%, evaluate the optimum thickness to be adopted, through incremental annual cost (or benefit) analysis. **20**

(b) Describe in sequential detail the operations involved in laying and finishing Terrazzo flooring of 40 mm thickness. **20**

(c) What are the functions of a marshalling yard? List the factors to be considered in developing an efficient marshalling yard. **20**

3. (a) To implement a particular job segment within its line of business, a firm can purchase either equipment ‘A’ or equipment ‘B’. ‘A’ has a first cost of 2000 units and involves an annual operating cost of 1700 units over its useful life of 5 years. ‘B’ has a first cost of 3400 units and involves an annual operating cost of 1500 units over its useful life of 8 **20**

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years. What is the rate of return at which the firm can be indifferent between 'A' and 'B'?

(b)(i) Describe the methods commonly adopted to check the accuracy of an open traverse. **10**

(b)(ii) List the major disadvantages of Plane Tabling. **10**

(c) Explain, with sketches, the commonly adopted sub-surface drainage systems provided in national highways to lower the water table and to control seepage. **20**

4. (a) Cash flow for a simple project is given herewith. Taking a first trial value of 15%, determine the rate of return to the first decimal place of a per cent.

EoY	0	1	2	3	4	5	6
Cash Flow	−15	−10.5	+6	+9	+12	+8	+6

20

(b)(i) Describe the several stages of observation, recording and computation through which activity time rating is arrived at through concepts of time and motion study. **10**

(b)(ii) Describe, along with their functions, the major types of road markings commonly used in India. **10**

(c) Compare the capabilities of terrain features interpretation through aerial photographs vis-a-vis topographic maps. **20**

SECTION 'B'

5. Answer any five of the following:

(a) Why are canal falls provided in irrigation channels? With the help of sketches, describe and illustrate a trapezoidal notch fall, labelling all the salient features and their functions in flow management and safety. **12**

(b) What is meant by river training? What are its objectives? What are the in-situ features that help in this context? **12**

(c) Estimate the depth and frequency of irrigation required for a certain crop, given:

Root zone depth	90 cm
Field capacity	22%
Wilting point	12%
Apparent sp. gr. of soil	1.5
Consumptive use	22 mm/day
Efficiency of irrigation	60%

Assume 50% depletion of available moisture as the indicator to begin application of irrigation water. **12**

(d) List the tests to be performed to determine impurities in water. In this context, explain the terms "Hardness" and "pH" of water – in terms of causes, classification as appropriate, and effects due to consumption and the tests relevant therein. **12**

(e) What considerations rule in the selection of pumps for a water supply scheme with a lake as a source? What are the appurtenances to be installed in the pipeline through the pump up to the overhead reservoir at the area being served? **12**

(f) Describe with a sketch the storm water relief weir for a sewerage system. **12**

6. (a) For a station *L*, the recorded annual 24-hr maximum rainfall are given below. Compute the necessary data to estimate: (a) 24-hr maximum rainfall with a specified return period; and (b) probability of a rainfall of not less than a specified depth occurring in 24 hours at station *L*. Indicate the above features on a sketch (not necessarily plotted to exact data) prescribing the coordinate parameters.

1. Year	1960	61	62	63	64	65	66	67	68	69	
2. Rain fall, cm	14.2	13.1	7.5	14.9	12.4	14.2	7.0	16.1	8.3	9.2	
1. Year	70	71	72	73	74	75	76	77	78	79	80

20

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2. Rain fall, cm	7.0	13.4	7.5	14.0	15.2	6.5	9.7	13.1	8.8	14.7	11.2

(b) Draw a schematic diagram (in plane view) of a barrage on an alluvial river, with provision for overflow and fish passage, for diversion of flow into a main canal, including for sediment extraction. On the diagram, label the several features and the schematic flow paths. **20**

(c)(i) Why are coagulants required in the sedimentation phase of water treatment? What factors affect the dosage of coagulants? **10**

(c)(ii) A coagulation-cum-sedimentation tank is to be designed for the water works of a town having a population of 1.5 lakh. The average demand of water is 135 lpd/head and maximum demand is 1.5 times the average. The detention period is 6 hours. Flow rate is to be in the range near 1000 lph/m^2 of plan area. Design a system of rectangular sedimentation tanks. **10**

7. (a) Ordinates of a 4-hr unit hydrograph (u.h.g.) on a catchment are tabulated. Derive the ordinates of a 2-hr u.h.g. for the same catchment.

Time (hr)	0	4	8	12	16	20	24	28
Ordinate of 4-hr u.h.g. (m^3/s)	0	23	54	60	25	14	6	0

20

(b)(i) What are oxidation ponds? What are their merits and demerits? **10**

(b)(ii) Design an oxidation pond for a colony of 2000 persons wherefrom the sewage flow is 150 lpd/head with a 5-day BOD of 300 ppm, providing a BOD loading of 200 kg/day/ha. **10**

(c)(i) Find the requisite size of a combined circular sewer serving an area of 100 ha with a population of 60000 persons and supplied with water at 250 lpd/head. Take time of entry and time of flow of rain water to be 5 and 15 minutes, respectively. Runoff coefficient in rational formula is 0.45. Permissible velocity in the sewer is 3 m/sec. **10**

(c)(ii) What do you understand by "Limiting Velocity" in sewer design? State the methods by which such a velocity is maintained. **10**

8. (a) In a subsurface pipe drainage system, it is desired to keep the highest level of the water table at 1.5 m below the ground surface. The depth of impervious layer from land surface is 10.0 m and the depth of the drain below the land surface is 2.0 m. The mean annual rainfall in the area is 96 cm; and the coefficient of permeability is 6×10^{-6} m/s. Design the spacing of the drain pipes. **20**

(b)(i) In single, as well as multiple, purpose water resources projects, how are benefits classified? Give brief explanation for each; also indicate the distinction between "with/without" and "before/after" considerations. **10**

(b)(ii) What are the sources of radio-active wastes and the localities where they are incident generally? What methods can be used for handling them to avert hazards to the public? What are the chance factors in the failure of such preventive handling and disposal methods? **10**

(c) Describe the practices adopted in India for Industrial Zoning to control air pollution at the planning stage? Within the industrial units individually, what are the methods to be enforced for control of industrial pollution? **10**

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