Indian Forest Service
(Main) Exam, 2021

ZCVB-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.*

*Questions no. **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.*

SECTION A

Q1. (a) What are the oxide compositions of Ordinary Portland Cement ? Mention the typical percentage ranges for each one of them. *8*

(b) With respect to the Construction Project Management, what are the various types of costs associated with a project ? Draw a graphical representation of project cost curves. *8*

(c) How are cranes categorised into different classes ? Also explain in brief the application of cranes in construction projects. *8*

(d) Design a turnout taking off from a MG straight track for 1 in $8\frac{1}{2}$ crossing number with an angle of switch 1°28′00″. Take heel divergence as 11·75 cm. Show all the values on a neat sketch. *8*

(e) A steel tape of 30 m nominal length was used to measure a line AB by suspending it between supports at A and B. The length between A and B was measured as 28·765 m with tape making slope angle 4°15′. The tension applied was 80 N and the temperature was 5°C. Determine the corrected horizontal length between A and B. Assume the following data : *8*

Standard temperature	=	20°C
Standard tension	=	50 N
Weight of tape	=	0·2 N/m
Cross-sectional area	=	2 mm^2
Modulus of elasticity	=	2×10^5 N/mm^2
Coefficient of expansion	=	12×10^{-6} per °C

Q2. (a) Two tangents intersect at chainage 40 chains and 50 links, the deflection angle being 50°. Calculate the necessary data for setting out the curve of radius 350 m using Rankine's method. Use $\pi = 3{\cdot}14$; Peg interval = 30 m and 30 m chain length with 100 links. *15*

(b) Following data is given for the design of a two phase fixed signal at a four legged road intersection having North-South and East-West approach roads :

Parameter	Approach Road			
	North	South	East	West
Design traffic volume (pcu/hr)	500	400	300	250
Saturation traffic flow (pcu/hr)	1500	1250	1200	1100

Design the signal by Webster's method. Take all red time per cycle as 10 sec. *10*

(c) Draw an activity on arrow diagram to represent the following project. Calculate activity times, activity floats and also determine the critical path of the project. *15*

Activity	*Duration (days)*
1 – 2	2
1 – 3	3
2 – 4	4
3 – 4	5
4 – 5	6

Q3. (a) (i) Explain with suitable examples the work breakdown structure in Project Management. *5*

(ii) Explain in brief and with neat sketches, the common errors that are being encountered in networking diagram while scheduling a project. *5*

(iii) What do you understand by PERT ? Define three time estimates of PERT. *5*

(b) What is curing of concrete ? Explain in brief various methods that are being adopted at the site for curing of concrete. *10*

(c) (i) Define design traffic for pavement design. Calculate it for a two-lane road using the following data : *10*

Design life = 12 years

Present day traffic = 1800 CV per day

Construction period = 2 years

Vehicle Damage Factor = 3·5

Traffic growth rate = 7·5% per annum

(ii) With the help of neat sketch, explain how subsurface drainage system is provided to lower the high water table in highway construction. *5*

Q4. (a) (i) What are the most common harmful ingredients of brick earth and how are they affecting the engineering properties of brick ? *10*

(ii) Briefly explain the differences between brick masonry and stone masonry for the construction of foundation, walls, columns or any other component of a building. *5*

(b) Design the length of valley curve which is formed by a descending gradient of 1 in 30 meeting an ascending gradient of 1 in 25. *15*

Assume following data :

Design speed = 100 km/h

Driver reaction time = 2·5 sec

Coefficient of friction = 0·35

Allowable rate of change of centrifugal acceleration C = 0·6 m/sec^3

(c) In the layout of broad gauge railway track, a branch line of 344 m radius diverges from main line curve of radius 860 m in reverse direction. Determine the maximum permissible speed on the main line if restricted speed on branch line is 35 km/h. Use Cant deficiency as 7·6 cm and revised formulae for permissible speed. *10*

SECTION B

Q5. (a) Discuss different factors/processes which may affect the behaviour of a river, described in terms of variation of river cross-section shape and its plan form, briefly. *8*

(b) A water resources project has benefits equal to 200 million rupees (M ₹) at the end of first year and increases at a uniform rate to 1000 M ₹ at the end of 10^{th} year. The benefits from the project remain constant at 1000 M ₹ per year until the end of 40^{th} year, after which benefits decrease to zero at a uniform rate at the end of 50^{th} year. What is the present value of benefits, if rate of interest is 5% ? *8*

(c) An area of 30 ha of crops will be irrigated using a tube well working for 10 hours per day. Irrigation is to be applied at 60% soil water depletion. The available water holding capacity of the soil is 18 cm per meter depth of soil. The mean depth of root zone of crops is 90 cm. The conveyance and water application efficiencies are 75% and 80%, respectively. The mean daily consumptive use of water by the crops is 5 mm/day. Determine (a) Net irrigation requirement, (b) Gross irrigation requirement, (c) Irrigation period, and (d) Required capacity of the irrigation system. *8*

(d) What are the most common constituents of alkalinity and what are their sources and impacts ? How is alkalinity measured ? *8*

(e) Enumerate eight powers conferred on the Central Government of India by the Environment (Protection) Act, 1986 to ensure enforcement of several acts and regulations concerning environmental pollution control and safety. *8*

Q6. (a) (i) A town discharges 0·20 m^3/s of treated wastewater into a stream. The treated wastewater has a BOD_5 of 12 mg/*l* and a k of 0·12 d^{-1} at 20°C. The stream has a flow rate of 0·43 m^3/s and an ultimate BOD of 5·0 mg/*l*. The DO of the stream is 6·5 mg/*l* and DO of the wastewater is 1·0 mg/*l*. The stream temperature and the wastewater temperature is 10°C. Compute the DO and initial ultimate BOD after mixing. Take temperature coefficient = 1·135. *5*

(ii) Clean water at 20°C is passed through a bed of uniform sand at a filtering velocity of 5·0 m/h. The sand grains are 0·4 mm in diameter with a shape factor of 0·85 and a specific gravity of 2·65. The depth of the bed is 0·67 m and the porosity is 0·4. Determine the head loss through the bed. Take ρ_w = 998·2 kg/m^3 and $\mu = 1{\cdot}002 \times 10^{-3}$ kg/m.s at 20°C.

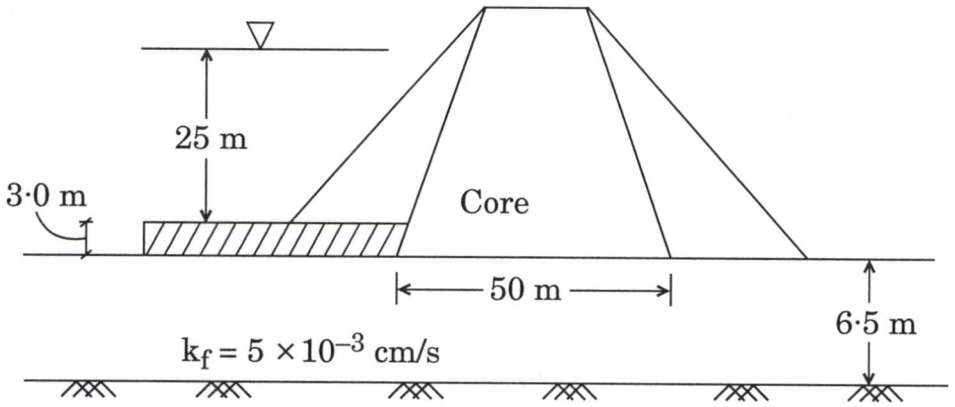
The filter medium is now to be expanded to a porosity of 0·7 by hydraulic backwash. Determine the required backwash velocity and the resulting expanded depth. *10*

(b) Describe the lime soda method of removing hardness of water. What are its advantages and disadvantages ? *10*

(c) (i) A lake of surface area 2·0 sq. km has volume of water as 13×10^6 m^3 at the beginning of March. Average temperature during March, in the lake area was 27°C, Net solar radiation was 220 W/m^2, density of water in the lake was 997 kg/m^3, specific heat of air was 1005 J/kg.K and atmospheric pressure was 101·3 kPa. Water was lost from the lake due to evaporation. Determine the volume of water available in the lake at the end of the month of March. Use Priestley-Taylor method for estimation of evaporation from the lake. *10*

(ii) A soil has Sorptivity S = 5 $cm.h^{-1/2}$ and hydraulic conductivity k = 0·4 cm/h. Calculate the ponding time and cumulative infiltration at ponding under a rainfall of 6 cm/h. *5*

Q7. (a) Determine the length of Upstream Blanket to be provided up to the core in an embankment dam to reduce the foundation seepage by 40%. Dam section is shown below :



Also determine the seepage through the foundation after provision of Blanket. Also determine the head loss by the Blanket. Take permeability of Core/Blanket material as 2×10^{-6} m/s. Permeability of foundation material is 5×10^{-3} cm/s. Thickness of impervious blanket is 3·0 m. *15*

(b) (i) In a watershed, there are five rain gauge stations i.e. A, B, C, D and E. The normal annual precipitation at these stations is 120 cm, 80 cm, 100 cm, 110 cm and 130 cm, respectively. On a particular day during a storm, precipitation recorded by these rain gauges are 10 cm, 8 cm, 6 cm and 9 cm, i.e. by the rain gauges A, B, C and D respectively. Rain gauge E was not functional during this storm. Estimate the precipitation at station E during that storm. *5*

(ii) Derive expressions for the flexibility and sensitivity of an Irrigation outlet. Also discuss the classification of Irrigation outlets based on their flexibility. *10*

(c) (i) Write a brief note on ill-effects of improper disposal of solid wastes on human health and environment. *5*

(ii) Calculate the design flow for which a separate sewer is to be designed with given rate of water supply as 220 litres per capita per day for a population of 15000. Assume that 75% of water supplied contributes to the sewage. *5*

Q8. (a) (i) A 15·0 m wide channel is constructed with a depth of 2·0 m and bed slope of 1 : 3000. The bed material consists of grain size of 0·25 mm and having a fall velocity of 0·025 m/s in still water. Determine the quantity of Bed Load moved by the channel using Peter-Meyer's equation. Adopt channel Rugosity coefficient as 0·20 and unit weight of water as 1000 kg/m^3. Specific gravity of bed material is 2·65. *8*

(ii) Derive the governing equation for three-dimensional transient flow through a saturated anisotropic porous medium. *7*

(b) (i) Draw a labelled sketch of the radial system of pipes in distributing water and comment on its suitability. *5*

(ii) In two periods each of 20 years, a city has grown from 40,000 to 1,60,000 and then to 2,50,000. Determine :

(1) the saturation population;

(2) the equation of the logistic curve;

(3) the expected population after the next 20 years. *10*

(c) (i) Differentiate between : *6*

(1) B. coli index and M.P.N.

(2) Manifold and Lateral drains

(ii) What is meant by Sludge Blanket Filtration ? *4*