Total number of printed pages: **Programme:PG/Semester:II/Code:PCEW2124**

2024

Hydraulic Structures

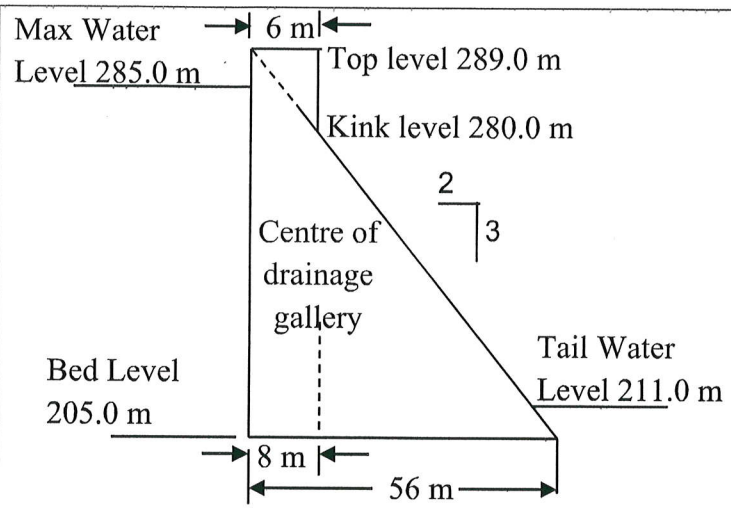
Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	What are the objectives of river training works? How are river training works classified? What are the functions of marginal bunds, guide bunds and spurs?	12
	b)	Name four different categories of cross-drainage works for different settings of canals with reference to natural drainage by providing suitable sketches.	8
2.	a)	What are different types of earthen dams? Draw sketches showing indicative profiles of phreatic surface within the body of these types.	6
	b)	Derive an expression for estimating seepage discharge by using a flow net through the body of an embankment of isotropic soil. Assume missing information, if any.	6
	c)	Calculate the exit gradient using Khosla's theory of seepage for assessing the failure potential of a weir on a permeable foundation, when the elevations at the upstream pond level and the top of the downstream apron are 158.0 m and 152.0 m respectively. The downstream cut-off is 10.3 m deep and the floor is 57.0 m long. Comment on this exit gradient with reference to the safe exit gradient varying from 0.17 for fine sand to 0.25 for shingle.	8
3.	a)	Write down the criteria for selecting a suitable site of a dam.	6
	b)	Describe the major causes of failure of gravity dams? What is the criterion for structural stability of such a dam against overturning.	6
	c)	What are the different forces acting on a gravity dam? By writing the expressions of pressure at key locations, draw diagrams showing the force of water pressure acting on the upstream face, and the force due to uplift pressure in presence of a drainage gallery acting at the base of a gravity dam.	8
4.	a)	Draw a typical section of a non-overflow section of a gravity dam showing different important levels and storages on its upstream side.	5
	b)	Calculate, for unit length of the non-overflow section of a concrete gravity dam shown below, i) the maximum vertical stress at the heel and the toe, ii) the major principal stresses at the toe, and iii) the shear stress on a horizontal plane near the toe. Assume unit weight of concrete as 23.5 KN/m3 and allowable stress in concrete as 2,500 KN/m2. Write down the assumptions that you would make for calculating the stresses.	15

			
5.	a)	On what basis is the profile of an ogee spillway determined? Write down the general formula for estimating the flow over an ogee spillway and the formula for calculating the effective length of the spillway crest. When and where on a spillway is a hydraulic jump formed?	6
	b)	Name with labelled sketches the types of energy dissipation arrangements necessary on the downstream of a dam spillway when (i) the sequent depth (y_2) and tail water curves (TWC) coincide at all spills (ii) the TWC lie below the y_2-curve at all spills (iii) the y_2-curve lie below the TWC at all spills, and (iv) the TWC lie above the y_2-curve at smaller spills and below the y_2-curve at larger spills	14
6.	a)	Why are canal falls necessary? What are the considerations made in deciding the locations of canal falls?	6
	b)	Name and provide sketches of the methods for aligning irrigation canals in order to (i) save the cost of cross-drainage works, (iii) irrigate only one side of the canal, and (iii) ensure gravity irrigation on both sides of the canal?	6
	c)	Describe the purpose of canal escapes. Name different types of canal escapes and different metering flumes by providing indicative sketches.	8
7.	a)	Write the formula for estimating hydroelectric power by naming the symbols and the units used. Draw an indicative arrangement for generating hydropower from the flow a river having a U-type bend around a high hill.	6
	b)	Name and state the functions of different canal regulators by providing a suitable sketch. At what locations of an irrigation water supply system are silt excluder and silt ejector provided?	8
	c)	Show that the critical velocity of an alluvial channel having 1.5 m depth of flow when computed using Kennedy's theory would be 0.784 ms^{-1} for a critical velocity ratio 1.1 and the Manning's roughness coefficient 0.018.	3
	d)	Show that the hydraulic mean radius of a channel designed by Lacey's theory would be 2.5 m for a mean velocity 1 ms^{-1} and silt factor 1.	3