Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Design of Hydraulic Structures **Semester: VII**
Programme: B Tech Civil Engineering **Time: 03 hrs.**
Max. Marks: 100 **Course Code: CEEG 421**
Instructions: Write your assumptions carefully and attempt all the questions

Set A

SECTION A

S. No.		Marks	CO
Q1.	Spillway is the safety valve of a dam. Comment on the statement.	**4**	**CO1**
Q2.	Determine the thickness of the arch dam of outside diameter 12m at a depth of 30m, compressive strength of concrete is 2500 kN/m^2.	**4**	**CO2**
Q3.	Explain the post construction measures for silt control in reservoirs.	**4**	**CO3**
Q4.	What are the objectives of river training?	**4**	**CO3**
Q5.	What is cavitation? How does it lead to pitting?	**4**	**CO4**
	SECTION B		
Q6.	A 25 MW hydel plant working under a head of 35m at 30 % load factor is functioning as a peak load plant. Calculate the discharge required if it has to function as a base load station, with an overall efficiency of 80%. What will be the maximum load factor if the discharge is 40 cumecs?	**10**	**CO4**
Q7.	With the help of a neat sketch, explain the design and specifications of the guide banks.	**10**	**CO3**
Q8.	A common load is shared by two hydel stations; one being a base load station with 20 MW capacity and the other being a standby with 25 MW capacity. The yearly output of the standby station is 10 x 10^6 kWh and that of base load plant as 110 x 10^6 kWh. The peak load taken by stand by station is 12 MW and the station works for 2500 hours during the year. The base load station takes a peak load of 18 MW. Find out: a) Annual load factors for both stations b) Plant use factors for both stations c) Capacity factors for both stations	**10**	**CO4**
	OR		
Q8.	A hydro-electric power plant based on the Loch Sloy in Scotland has an effective head of 250 m. If the flow rate of 16 m3/s can be maintained, determine: a) The total power input to the turbine assuming a hydraulic efficiency of 98%; b) The pressure difference across the turbine.	**10**	**CO4**

Q9.	The record of rainfall at station A covering a period of 22 years is given below. a) Estimate the annual rainfall with return periods of 10 and 50 years b) What would be the probability of an annual rainfall of magnitude equal or exceeding 100 cm.	**10**	**CO3**

Year	Annual Rainfall (cm)	Year	Annual Rainfall (cm)
1960	130	1971	90
1961	84	1972	102
1962	76	1973	108
1963	89	1974	60
1964	112	1975	75
1965	96	1976	120
1966	80	1977	160
1967	125	1978	85
1968	143	1979	106
1969	89	1980	83
1970	78	1981	95

SECTION-C

Q10.	The following data refer to the non-overflow section of a gravity dam: R.L. of top of the dam = 315 m R.L. of bottom of the dam = 260 m Full reservoir level = 312 m Top width of the dam = 12 m Upstream face is vertical. Downstream face is vertical upto R.L.304 m; and thereafter, the downstream face slopes at 0.7 (H):1 (V) upto base. Drainage holes are located 8 m away from the upstream face. Unit weight of masonry $=23\,kN/m^3$ Reduction of uplift at drainage hole = 50% Coefficient of friction between masonry and foundation material = 0.8 Determine: (i) Factor of safety against overturning; (ii) Factor of safety against sliding (iii) Maximum pressure on foundation (iv) Maximum principal stress in the masonry of the dam at the base. Consider only the forces due to water thrust, uplift, earthquake (inertial forces due to weight of masonry only) and the self-weight.	**20**	**CO1**

	OR		
Q10.	Design the practical profile of a gravity dam made of stone masonry given the following data: R.L. of base of dam =190 m R.L. of HFL of reservoir =230 m Specific Gravity of masonry =2.4 Safe compressive stress in masonry $= 1200\,kN/m^2$	**20**	**CO1**
Q11.	Design a suitable section for the overflow portion of a concrete gravity dam having the downstream face sloping at a slope of 0.7H: 1V. the design discharge is 10000 cumecs. The height of the spillway crest is kept at RL 204.0 m. The average river bed level at the site is 100 m. The spillway length consists of 6 spans having a clear width of 10m each.	**20**	**CO2**

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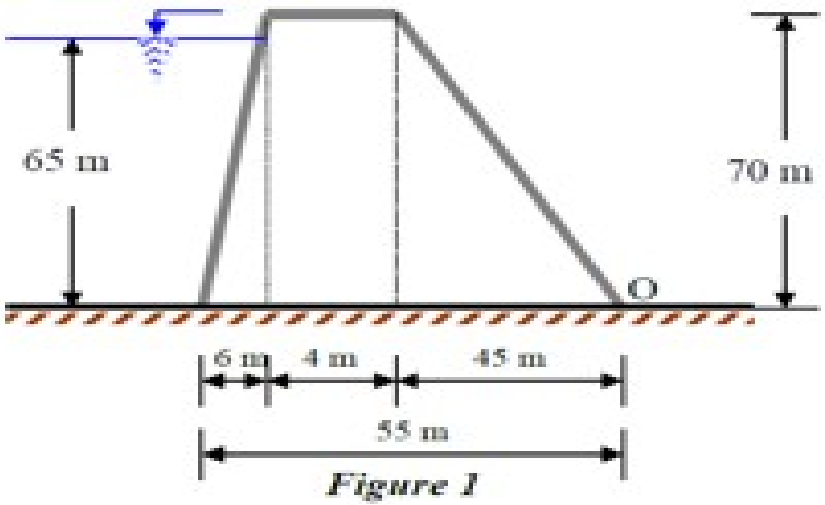
Set B

SECTION A

S. No.		Marks	CO
Q1.	How does the coefficient of discharge varies with the submergence of the spillway by the tail water?	**4**	**CO1**
Q2.	What do you understand by E-flows in case of reservoir planning? Explain its relevance.	**4**	**CO2**
Q3.	Explain the role of density currents in silting of reservoirs.	**4**	**CO3**
Q4.	Give a typical layout of diversion headwork.	**4**	**CO3**
Q5.	Explain the function of draft tube in turbine.	**4**	**CO4**
	SECTION B		
Q6.	A run-off the river scheme plant with an installed capacity of 5000 kW operates at 28% load factor when it serves as a peak load station: a) What should be the minimum discharge in the stream, so that it may serve as a base load station? The plant efficiency may be assumed to be 100% when working under a head of 20m. b) Also calculate the maximum load factor of the plant when the discharge in the stream is 35 cumecs.	**10**	**CO4**
Q7.	With the help of a neat sketch, explain the different types of groynes.	**10**	**CO3**
	OR		
Q7.	Explain the design and specifications of levee section for different heights.	**10**	**CO3**
Q8.	A proposed hydropower plant to be built using a reservoir with a typical head of 10m and estimated power of 30 MW. You are given the task to select an appropriate type of turbine for this site if the generator requires the turbine to run at a fixed speed of 60 rpm.	**10**	**CO4**
Q9.	A proposed reservoir has a capacity of 500 ha-m. The catchment area is 125 km^2, and the annual streamflow averages 12 cm of runoff. If the annual sediment production is 0.03ha-m/ km^2, what is the probable life of reservoir before its capacity is reduced by 10 % of its initial capacity.	**10**	**CO3**

C/I	0.01	0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.5	0.7
η%	43	60	74	80	84	87	93	95	96	97

SECTION-C

Q10.	Analyze the stability of given gravity dam (Figure 1) for the following conditions: Friction coefficient between concrete-foundation is 0.70, respectively. Allowable shear stress at the foundation level is 2200 kN/m2, allowable compressive and shear stresses in concrete are 2700 kN/m2, and 2400 kN/m2, respectively. Allowable compressive stress in foundation material is 2700 kN/m2. Take specific weights of concrete and water as 24 kN/m3, and 10 kN/m3, respectively. Consider earthquake forces as well.  *Figure 1*	**20**	**CO1**
	OR		
Q10.	a) Test the stability of the dam of 36m height with 9m crest width, 3m free board, u/s slope 3H:1V, d/s slope 2. 5H:1V, φ = 26°, C= 2440 kg/m^2. Assume the unit weights as required b) Derive an expression for the location of phreatic line by analytical method with downstream filter.	**10+10**	**CO1**
Q11.	a) A rectangular channel carrying a supercritical stream is to be provided with a hydraulic jump type of energy dissipater. It is desired to have an energy loss of 10.0 m in the hydraulic jump when the inlet Froude number is 17. What	**10+10**	**CO2**

	are the sequent depths of this jump? b) In a hydraulic jump taking place in a horizontal apron below an Ogee shaped weir the discharge per unit width is 1 $m^3/s/m$ and the energy loss is 5 m. Estimate the depths at the toe and heel of the jump.		