11 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

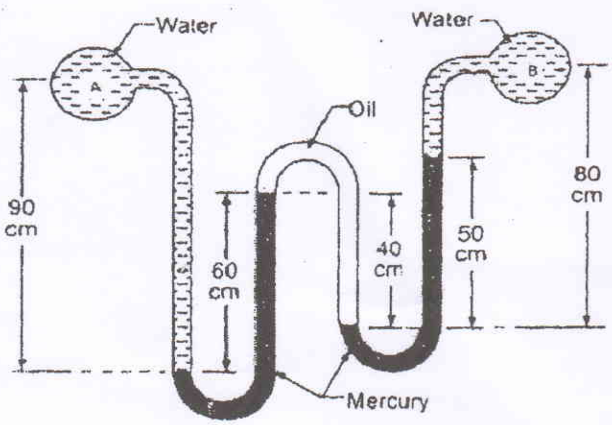
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Hydropower *(CE660)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt __All__ questions.*
- ✓ *The figures in the margin indicate __Full Marks__.*
- ✓ *Assume suitable data if necessary.*

1. Calculate the pressure difference between the points A and B. Specific gravity of oil is 0.8. [5]



2. Define total pressure and center of pressure in static fluid prove that the center of pressure for a vertically immersed plane surface is always below its centroid. [2+6]

3. Derive Bernoulli's equation with the help of Euler's equation of fluid motion for a real flow. Sketch HGL and EGL for the horizontal circular pipe of gradually expanding cross-section towards the direction of flow. [2+2]

4. Verify that for the most economical trapezoidal channel, the length of one channel side must be equal to half the length of the top-width of the section. [6]

5. The following are the data obtained in a stream-gauging operation. A current meter with a calibration equation V = (0.55N+0.04) m/s, where N = revolutions per second was used to measure the velocity at 0.6 depth. Calculate the discharge in the stream. [7]

6. What is water hammer? Write down the problems with water hammer. Water is flowing through a cast-iron pipe of diameter 150 mm and thickness 10 mm which is provided with a valve at its end. Water is suddenly stopped with closing the valve. Find the maximum velocity of water, when rise of pressure due to sudden closure of valve is 1.962 MN/m^2. Take K = 1.962 GN/m^2 and E = 117.7 GN/m^2. [1+2+5]

7. What do you mean by economical diameter of penstock pipe? How it can be achieved? [1+4]

8. Explain hydraulic tunnels and its design features. [1+5]

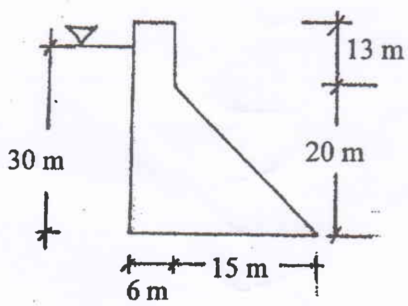
9. What is cavitation? What are its effects and how can it be avoided in reaction turbines? [1+2+2]

10. Explain the differences between Pre-feasibility and Feasibility studies in hydropower projects. [4]

11. Determine the firm and secondary energy for the following set of data of average monthly flows of river over a year. [8]

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q (m^3/s)	150	250	300	425	500	100	1250	1100	1000	1300	1600	500

12. Check the stability of concrete gravity dam against overturning and sliding. Consider $\mu = 0.7$, $\gamma_{concrete} = 24$ kN/m^3, average shear strength of material at the horizontal section (q) = 1400 kN/m. [8]



13. What is the function of a spillway? Describe with sketches the vertical and radius gate use in spillway. [2+4]

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Year / Part	III / II	Time	3 hrs.

Subject*: - Hydropower *(CE660)

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1. a) Define mass density, specific weight, specific volume and specific gravity. [2]

   b) A liquid compressed in a cylinder has a volume of 3600 cm^3 at pressure 4 MN/m^2 and a volume of 3200 cm^3 at pressure 8 MN/m^2. What is bulk modulus of elasticity? [4]

2. A vertical rectangular gate 4m × 2m (4 m side being vertical) is hinged at a point 10 cm below the centre of gravity of the gate. The depth of water is 6 m above the bottom of the gate. What is horizontal force must be applied at the bottom of the gate to keep it in vertical position? [8]

3. Define the following and give one practical example for each i) steady and unsteady flow ii) laminar and turbulent flow [4]

4. Find the normal depth of flow in a triangular channel having longitudinal slope of 0.0004 and side slopes of 1:1 when it carries 1 m^3/sec, manning roughness coefficient (n) = 0.014. [8]

5. Compute the stream flow for the measurement data given below. [10]

Distance (m)	0	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6
Depth (m)	0	0.3	1.29	2.16	2.55	2.22	1.68	1.41	1.05	0.63	0.42	0
Velocity (m/s) at 0.2d	0	0.42	0.57	0.78	0.87	0.81	0.75	0.69	0.63	0.54	0.45	0
Velocity (m/s) at 0.8d	0	0.21	0.36	0.54	0.60	0.30	0.51	0.45	0.39	0.33	0.30	0

6. Mean monthly flow for a Nepalese river is given below, the net head of river 150m, overall efficiency of 85%. Assume 10% of water of minimum flow is required to be left for environment and downstream user in the river. Determine the primary and secondary energy produced by the plant, if design discharge is set to 950 m^3/s. [10]

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Qm^3/s	100	120	140	300	350	1800	2000	2520	2000	900	650	500

   Assume any other date suitably if required.

7. a) What do you mean by a spillway? Briefly describe on ogee spillway. [4]

   b) A concrete gravity dam has maximum reservoir level 250 m, base level of dam 200 m, tail water elevation 210 m, base width of dam 40 m, location of drainage gallery 10 m from upstream face which may be assumed as vertical. Compute hydrostatic thrust and uplift force per unit length of dam at its base level. Assume 50% reduction in net seepage head at the location of the drainage gallery. [5+5]

8. A conical draft tube having inlet and outlet diameters 1.5 m and 2.1 m discharges water at outlet with a velocity of 3 m/s. The total length of the draft tube is 7.5 m and 1.5 m of length of draft tube is immersed in water. If loss of head due to friction in draft tube is 0.2 × velocity head at the tube outlet, determine pressure head at inlet of the draft tube. Also find the efficiency of the draft tube. [6]

9. Why settling basin is essential in hydropower electric project in Nepal? Draw a layout plan and section of typical settling basin along with its design criteria. [3+3]

10. Describe the selection criteria of hydraulic turbines for hydroelectric power plants. [4]

11. Describe various types of spillways used in hydropower plants with neat sketches. [4]

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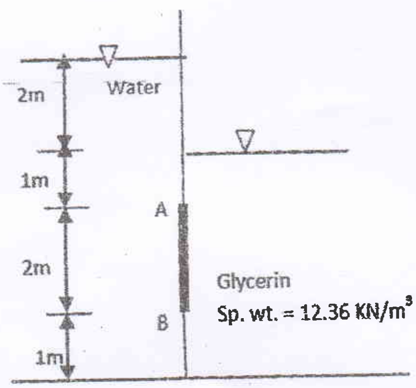
1. a) Classify the fluid flows with examples: (i) Laminar versus Turbulent (ii) Steady versus Unsteady. [2+2]

   b) Discuss surface tension and Capillarity. [4]

2. Find the net hydrostatic force per unit width on rectangular panel AB in the figure given below and determine its line of action. [10]



3. A pipe 5 cm diameter is 5 m long and carries a discharge of 0.005 m^3/s. Find the loss of head due to friction. The central 2 m length of the pipe is replaced by a pipe 7.5 cm diameter, the changes of section being sudden. Determine the loss of head due to these alternatives considering all losses. Take f = 0.01 for all pipes and contraction loss coefficient = 0.5. [4+6]

4. At known distances from an initial point on the stream bank, the measured depth and velocity of a river are shown in table. Calculate the corresponding discharge at this location. [8]

Distance from initial point (m)	0	10	20	30	40	50	60	70	80	90	99
Depth (m)	0	1.0	1.5	2.0	2.5	3.0	3.5	3.0	2.0	1.5	0
Mean velocity (m/s)	0	0.6	0.8	1.0	1.2	1.4	1.6	1.3	1.0	0.5	0

5. Following table shows the mean monthly flow of a typical river of Nepal. Estimate the primary and secondary energies available in the river throughout the year. Assume 10% of minimum flow of the series has to be released for environmental flow to the downstream from the dam. Take overall efficiency of the plant is 80% and effective head is 155 m. [10]

Month	1	2	3	4	5	6	7	8	9	10	11	12
Discharge, m3/s	1150	1140	1450	1830	1700	1550	1150	1000	850	400	480	960

Note: The months are as per Nepalese calendar i.e 1 as Baishakh and so on.

6. A concrete dam of trapezoidal section is of height 50 m with upstream vertical face. Top width, base width and freeboard are 4.5 m, 42 m and 5 m respectively. Check the stability of the dam against (i) Overturning (ii) sliding (iii) Tension and (iv) Crushing. The unit weight of water is 10 KN/m^3, the unit weight of concrete is 25 KN/m^3 and Crushing strength of the material 10 kg/cm^2. Take angle of internal friction (ϕ=37°), uplift coefficient 0.8. Consider self-weight, hydraulic pressure and uplift pressure only. Mention your recommendation. [8]

7. With considering turbulent effect, design a settling basin to remove the sediment size greater than 0.25 mm diameter. Assume design discharge of the basin is 10 m^3/s and trap efficiency as 95%. [8]

8. What is the main propose of spillway? List out the different type of spillway used in hydropower projects. [1+5]

9. a) Differentiate between impulse and reaction turbines with the help of their performance characteristics. [4]
   b) What is the purpose of governor in a turbine? How does a centrifugal pump works? [4+4]

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