

R18

Code No: 154BA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year II Semester Examinations, February - 2024

HYDRAULICS AND HYDRAULIC MACHINERY

(Civil Engineering)

Time: 3 Hours

Max. Marks: 75

Note: i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

- 1.a) Differentiate between pipe flow and open channel flow. [2]
- b) Derive the expression of critical depth for rectangular channel. [3]
- c) Define hydraulic jump and its classification. [2]
- d) Differentiate between gradually varied flow and rapidly varied flow. [3]
- e) What is homogeneity of dimensions? On what principle it is based. [2]
- f) Differentiate geometric, dynamic and kinematic similarities between models and prototypes. [3]
- g) Briefly explain the Francis turbine. [2]
- h) State the function of draft tube and its application. [3]
- i) Briefly explain load factor and capacity factor. [2]
- j) Define cavitation, its effects and precautions. [3]

PART – B

(50 Marks)

- 2.a) Find the slope of the bed of a rectangular channel of width 5m when depth of water is 2m and the rate of flow is given as $20\text{m}^3/\text{s}$. Take Chezy's constant $C=50$.
- b) Explain the condition for a trapezoidal section to be most economical. Also, give the expression of hydraulic mean depth in this case. [5+5]

OR

- 3.a) Find the discharge through a trapezoidal channel of width 8 m and side slope of 1 horizontal to 3 vertical. The depth of flow of water is 2.4 m and the value of Chezy's constant $C = 50$. The slope of the bed of the channel is given 1 in 4000.
- b) Determine the maximum discharge of water through a circular channel of diameter 1.5m when bed slope of channel is 1 in 1000. Take $C = 60$. [5+5]
- 4.a) Depth of flow of water, at a certain section of a rectangular channel of 4m wide, is 0.5m. This discharge through the channel is $16\text{ m}^3/\text{s}$. If a hydraulic jump takes place on the downstream side, find the depth of flow after the jump.
- b) A wide rectangular channel carries a discharge of $4\text{ m}^3/\text{s}$ per meter width of the channel on a bed slope of 0.001 and Manning's $n = 0.025$. A weir across the channel raises the water depth at the weir site to 4 m. Compute the flow profile from the weir to an upstream section where the depth of flow is 5% greater than normal depth. [5+5]

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OR

- 5.a) The depth of flow of water, at a certain section of a rectangular channel of 2m wide is 0.3 m. The discharge through the channel is $1.5 \text{ m}^3/\text{s}$. Determine whether a hydraulic jump will occur and if so, find its height and loss of energy. [5+5]
- b) Explain the direct step method for gradually varied flow. [5+5]
- 6.a) What are distorted models? What is the significance of distorted models? Explain the scale ratios for distorted models.
- b) The lift L depends on airplane wing of chord length l at an angle of attack α , when kept in a fluid with velocity V , density ρ , and viscosity μ . If the speed of sound in fluid is a , find a relationship using Pi theorem among involved parameters. [5+5]

OR

7. A model ship, 1/100 size of its prototype has 0.12 N of resistance when simulating a speed of 5 m/s of the prototype. Water is the fluid in both cases. What is the corresponding resistance in the prototype? Frictional force can be neglected. [10]
- 8.a) Design a Pelton wheel for a head of 60 m when running at 200 r.p.m. The Pelton wheel develops 95.6475kW shaft power. The velocity of buckets = 0.45 times the velocity of jet. Overall efficiency = 0.85 and coefficient of velocity = 0.98
- b) Define specific speed and its significance. Derive an expression for it. [5+5]

OR

- 9.a) What are unit quantities? Briefly explain the important unit quantities which must be studied under unit head.
- b) Define the following
i) Hydraulic Efficiency
ii) Mechanical Efficiency [5+5]
- 10.a) Explain Hydropower projects based on hydraulic characteristics.
- b) Sketch the details of a typical powerhouse and show all components with their functions. [5+5]

OR

- 11.a) Explain the efficiencies of centrifugal pumps in detail.
- b) Differentiate between renewable and non-renewable energy sources. [5+5]

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