

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- VI (NEW) EXAMINATION – SUMMER 2016

Subject Code: 2160602

Date: 09/05/2016

Subject Name: Applied Fluid Mechanics

Time: 10:30 AM to 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) State and prove the conditions under which the trapezoidal section of an open channel will be most economical. **07**
- (b) A smooth pipe of diameter 400 mm and length 800 m carries water at a rate of $0.40 \text{ m}^3/\text{s}$. determine the head lost due to friction, wall shear stress, centre line velocity and thickness of laminar sub-layer. Take kinematic viscosity of water as 0.018 stokes and coefficient of friction, $f = 0.0791 / (R_e)^{1/4}$ **07**
- Q.2** (a) Enlist the various major and minor energy losses in pipes? Derive an expression for head loss due to sudden enlargement of pipe **07**
- (b) Two reservoirs are connected by two pipes in series of lengths 200 m and 300 m and of diameters 20 cm and 30 cm respectively. The difference of head between the two reservoir water surfaces is 10m. The friction factors for the two pipes are 0.02 and 0.015 respectively. Determine the flow rate. **07**
- OR**
- (b) Derive an expression for velocity distribution of viscous flow through a circular pipe and prove that the ratio of maximum velocity to average velocity is 2 **07**
- Q.3** (a) Explain the following flow characteristics in the open channel **07**
- 1) Steady flow and unsteady flow
 - 2) Uniform flow and Non-uniform flow
 - 3) Laminar flow and turbulent flow
 - 4) Subcritical, Critical and super critical flow
- (b) In a rectangular channel of 0.5 m width, a hydraulic jump occurs at a point where depth of water flow is 0.15 m and Froude number is 2.5. Determine **07**
- 1) The specific energy
 - 2) The critical and subsequent depths
 - 3) Loss of Head
 - 4) Energy (Power) dissipated
- OR**
- Q.3** (a) Explain with diagram the Specific Energy Curve and Discharge Curve and derive the mathematical expression for minimum specific energy and maximum discharge in terms of depth of flow **07**
- (b) A trapezoidal channel is 5 m wide at bottom and has a side slope of 0.5H: 1V. The bed slope of the channel is 0.0003. Find the discharge of the most economical section. Assume Manning's coefficient $n = 0.02$ **07**
- Q.4** (a) Draw a general layout of a Hydroelectric power plant using an impulse turbine and define the following: **07**
- 1) Gross Head
 - 2) Net Head
 - 3) Hydraulic Efficiency
 - 4) Overall Efficiency of Impulse turbine
- (b) For a Pelton Wheel Turbine, find (a) quantity of water required, (b) diameter of the wheel, (c) number of jets, (d) number and size of buckets on the wheel, **07**

given the following data:
Speed of the wheel = 550 rpm Head = 350 m
Shaft power of wheel = 8000 kW Overall Efficiency = 86%
Assume a jet ratio of 10, Coefficient of velocity = 0.98 and Speed ratio = 0.46

OR

- Q.4 (a)** 1) What is priming? Why is it necessary in centrifugal pump? **03**
2) What is cavitation? What are its effects? Give necessary precaution against cavitations in pumps. **04**
- (b)** An oil of viscosity 0.02 Ns/m^2 flows between two stationary parallel plates which are 1 m wide and maintained 10 mm apart. The velocity midway between the plates is 2 m/s. Calculate (i) the pressure gradient along flow, (ii) the average velocity and (iii) discharge **07**
- Q.5 (a)** Discuss the Distorted and Undistorted Models. What are the merits and demerits of Distorted Models? **07**
- (b)** A plate $450 \text{ mm} \times 150 \text{ mm}$ has been placed longitudinally in a stream of crude oil having specific gravity 0.925 and kinematic viscosity of 0.9 stoke, which flows with velocity of 6 m/s. Calculate **07**
1. The friction drag on the plate
 2. Thickness of the boundary layer at the trailing edge
 3. Shear stress at the trailing edge

OR

- Q.5 (a)** Discuss the phenomenon of boundary layer separation. What are the different methods of preventing the separation of boundary layer? **07**
- (b)** An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 litres/sec through a 1.2 m diameter pipe. Tests were conducted on a 12 cm diameter pipe using water at 20°C . If the viscosity of water at 20°C is 0.01 poise, find: **07**
- 1) Velocity of flow in the model
 - 2) Rate of flow in the model

