Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 160602 **Date: 23/11/2011**
Subject Name: Applied Fluid Mechanics
Time: 10.30 am -1.00 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)** Prove that the loss of pressure head for viscous flow through a pipe given by **07**

$$h_f = \frac{32\,\mu VL}{\gamma d^2}$$

Where μ = dynamic viscosity of the fluid, V = mean velocity, L = length of pipe, d = pipe diameter, γ = unit weight of fluid.

(b) Explain the following terms: **07**

(i) Couette flow
(ii) Shear velocity
(iii) Velocity defect
(iv) Laminar sub-layer thickness
(v) Hydrodynamically Rough boundary
(vi) Celerity
(vii) Gradual closure of valve

Q.2 **(a)** Obtain the Von-Karman momentum integral equation for boundary layer flow. **07**

(b) Air is flowing over a flat plate of length 1.3 m and width 0.9 m at a velocity of 8.4 m/s. Assuming that laminar boundary layer length exists upto a Reynolds number $5x10^5$, determine (i) the maximum distance upto which laminar boundary layer flow exists and (ii) maximum thickness of boundary layer. Take kinematic viscosity of air = 0.14 stokes. The velocity profile for the laminar boundary layer flow is given by $\frac{u}{V} = 2(\frac{y}{\delta}) - (\frac{y}{\delta})^2$ **07**

OR

(b) Explain the following terms: **07**

(i) Skin drag
(ii) Pressure drag
(iii) Streamlined body
(iv) Bluff body
(v) Magnus effect
(vi) Stagnation point
(vii) Wake formation

Q.3 **(a)** Show that for an optimal (efficient) trapezoidal channel (i) top width is equal to twice the length of one of the sloping sides and (ii) hydraulic mean depth is half the depth of flow **08**

(b) The discharge of water through a rectangular channel with 6 m width and 2 m depth of flow is 18 cumecs. Calculate (i) specific energy of **06**

flowing water (ii) critical depth (iii) critical velocity and (iv) minimum specific energy

OR

Q.3	**(a)**	Explain the following terms: (i) Uniform flow (ii) Supercritical flow (iii) Rapidly varied flow (iv) Gradually varied flow	**08**
	(b)	A sluice gate discharges water into a horizontal rectangular channel with a velocity of 8 m/s with a depth of flow 0.5 m. The width of channel is 6m. Determine whether hydraulic jump will occur and if so find its height and loss of energy	**06**
Q.4	**(a)**	Classify turbines based on direction of flow through the runner. Explain any one in detail	**08**
	(b)	A Pelton wheel is to be designed for following specifications (i) Power = 750 kW (ii) Head = 200m (iii) Speed = 800 rpm (iv) overall efficiency = 86 % (v)Jet diameter is one-tenth the wheel diameter Take coefficient of velocity = 0.98, speed ratio = 0.45 Determine (i) wheel diameter, (ii) diameter of jet (iii) width of bucket (iv) depth of buckets (v) number of buckets (vi) number of jets	**06**

OR

Q.4	**(a)**	Explain the following terms (i) Draft tube (ii) Specific speed of turbine (iii) Unit power (iv) Priming of a pump	**08**
	(b)	Explain the working principle of a centrifugal pump. Draw the characteristics curves for a centrifugal pump working under constant speed.	**06**
Q.5	**(a)**	Determine the dimensions of the following quantities (i) Angular acceleration (ii) Kinematic viscosity (iii) Shear stress	**06**
	(b)	A pipe of diameter 2 m is transporting oil of specific gravity 0.85 and dynamic viscosity 0.04 poise at a rate of 4 cumecs. Model tests were conducted on a 10 cm diameter pipe using water at 20^{o}C. Compute the velocity and discharge in the model. Viscosity of water at 20^{0}C = 0.01 poise.	**08**

OR

Q.5	**(a)**	Explain the Buckingham's π-theorem for dimensional analysis.	**06**
	(b)	Explain the dimensionless numbers (i) Reynolds number (ii) Froude number (iii) Weber number (iv) Mach number	**08**
