

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (OLD) - EXAMINATION – SUMMER 2017****Subject Code: 151903****Date: 01/05/2017****Subject Name: Fluid Power Engineering****Time: 02:30 PM to 05:00 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 efficiency of propulsion when the inlet orifices face the direction of motion of the ship is given by **07**

$$\eta = \frac{2u}{V + 2u}$$

where V is absolute velocity of issuing jet and u is the velocity of ship

- (b)** A jet of water of diameter 4 cm having a velocity 18 m/s and strikes on the series of vanes. The vanes are so arranged that each vane appears successively before that jet in the same position and always moves with a velocity of 6 m/s. Calculate (i) force on the vane (ii) work done (iii) efficiency of system **07**

- Q.2 (a)** Show that the work done per second per unit weight of water in reaction turbine is given as **07**

$$W = \frac{1}{g} (V_{w1}u_1 \pm V_{w2}u_2)$$

- (b)** Explain the governing of Pelton wheel. **07**

OR

- (b)** Kaplan turbine develops 3 MW under a net head of 6m. In order to avoid cavitation, the pressure head at entry to the draft tube must not drop more than 5 m below atmosphere. The diameter of the draught tube at inlet is 3 m and efficiency of draught tube 80%. The overall efficiency of turbine is 86%. Calculate the maximum height at which the runner may be set above the tail race level. Assume $(p_a/\rho g) = 10$ m of water **07**

- Q.3 (a)** Show that the minimum speed for starting of a centrifugal pump is given by **07**

$$N_{\min} = \frac{120\eta_{mano} \times V_{w2} \times D_2}{\pi(D_2^2 - D_1^2)}$$

- (b)** A centrifugal pump delivers oil at the rate of 120 liters/sec against a pressure of 0.6 MPa. Calculate the power required to drive the pump when the overall efficiency of the pump is 70%. Assume specific gravity of oil is 0.85. **07**

OR

- Q.3 (a)** Describe the working of single stage reciprocating pump. **04**

- (b)** define following in relation with reciprocating pump **03**
(i) slip (ii) % slip (iii) negative slip

- (c)** Single acting reciprocating pump has a piston diameter 0.2 m and stroke 0.38 m. It runs at 50 rpm. An air vessel fitted on delivery side of the pump. The diameter and length of delivery pipe are 0.1 m and 50 m respectively. Calculate the power saved in overcoming friction in delivery pipe with air vessel. Take friction factor 0.01. **07**

- Q.4 (a)** Show that the minimum work input to compress the air in two stage reciprocating compressor is given by **07**

$$W_{\min} = \frac{2n}{n-1} p_1 V_1 \left\{ \left(\frac{p_3}{p_1} \right)^{\frac{n-1}{2n}} - 1 \right\}$$

- (b)** A single stage reciprocating air compressor takes in 7.5 m³/min of air at 1 bar and 27°C. The air is compressed to 5.5 bar polytropically with index n = 1.3. The clearance is 6% of stroke volume. Calculate (i) temperature of air delivered (ii) volumetric efficiency (iii) air power (iv) shaft power if $\eta_{\text{mech}} = 90\%$. (v) electric motor capacity if $\eta_{\text{motor}} = 96\%$. **07**

OR

- Q.4 (a)** Define degree of reaction (R) for a centrifugal compressor stage and prove that **07**

$$R = \frac{1 - \phi^2 \cos^2 \beta_2}{2(1 - \phi \cot \beta_2)}$$

where ϕ is flow coefficient

- (b)** Define following terms with reference to centrifugal compressor **04**
 (i) Isentropic efficiency (ii) Slip factor (iii) Power input factor (iv) Pressure coefficient
(c) Explain surging and choking in centrifugal compressor. **03**

- Q.5 (a)** With a suitable sketch explain the construction and working of axial flow compressor. **07**

- (b)** Define following terms with reference to axial flow compressor **04**
 (i) flow coefficient (ii) blade loading coefficient (iii) work done factor (iv) radial equilibrium
(c) Explain various losses associated in a stage of axial flow compressor. **03**

OR

- Q.5 (a)** Explain with the help of neat sketch the working and principle of hydraulic press. **07**

- (b)** Explain with neat sketch the working of air lift pump. **07**
