No. of Printed Pages : 4 **BIME-013**

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2012

BIME-013 : TURBO MACHINES

01885

Time : 3 hours *Maximum Marks : 70*

Note: Answer any five questions. Assume missing data suitably if any.

1. (a) What are the usage of dimensional analysis ? Discuss each with an example. 6

   (b) The power developed by a hydraulic turbine P is dependent on mass density ρ of the liquid, rotational speed N, diameter of the runner D, working head H and the gravitational acceleration g. Perform dimensional analysis for P. 8

2. (a) With a neat sketch of a single jet horizontal shaft Pelton turbine explain its concept, velocity diagram. 8

   (b) A Pelton wheel working under a head of 800 M develops 13230 kW of power running at 600 rpm with an overall efficiency of 85%. The ratio of jet diameter to wheel diameter is 1/15, the coefficient of velocity for the nozzle is 0.97 and the speed ratio is 0.46. Calculate the rate of flow, diameter of wheel and number of jets. 6

3. (a) Why is the efficiency of Kaplan turbine nearly constant irrespective of speed variation under load ? Give the differences between impulse and reaction turbines. 8

(b) A Kaplan turbine with runner 1.25 m diameter, discharges 12 m^3/sec. In order to avoid cavitation, the pressure head at entry to the draft tube must not be more than 1.5 m below atmospheric pressure. Estimate the maximum height at which the runner may be set relative to the tail water level. Assume draft tube has an efficiency of 70%. 6

4. (a) Discuss the influence of exit blade angle on the performance and efficiency of a centrifugal pump. Assume radial flow at entrance. 8

(b) A centrifugal pump has an impellar whose outer and inner radii are 0.25 m and 0.1 m respectively. The outlet vane angle is set back at 25° to the tangent. When rotated at 1450 rpm, the pump has a constant flow velocity of 3.5 m/sec. Assuming radial entrance, work out the manometric head imparted by the pump. Take slip factor = 0.98 6

5. (a) What is priming of a centrifugal pump ? Explain clearly why priming is essential before starting a centrifugal pump. 7

(b) What is cavitation in centrifugal pump ? How it is formed ? What are its effect remedial functions needed to prevent it ? 7

6. (a) Derive an expression for the polytropic efficiency of centrifugal compressor in terms of inlet pressure, delivery pressure, inlet temperature and the ratio of specific heats. 8

(b) An axial flow compressor comprises a number of similar stages with equal work done per stage and the velocity of flow is uniform throughout the compressor. The following data are : Overall stagnation pressure ratio = 3.5, stagnation inlet temperature = 60°C, relative air angle at rotor inlet = 130°, relative air angle at rotor outlet = 100°, blade velocity = 185 m/sec, degree of reaction = 0.5, overall stagnation adiabatic efficiency = 0.87. The data refer to mean blade height and the measurement of angle is done in the same sense from the blade velocity diagram. Calculate stagnation outlet temperature and number of stages. 6

7. (a) Derive the expression for maximum blade efficiency in a single stage impulse turbine. 8

(b) Steam issues from the nozzles of a impulse turbine with a velocity of 1000 m/sec. The nozzle angle is 20°. Mean blade velocity is 400 m/sec. The blades are symmetrical. The mass flow rate is 1000 kg/hr. Friction factor = 0.8, Nozzle efficiency = 0.95. Determine blade angles, axial thrust, work done per kg of steam, power developed, blade efficiency, stage efficiency. 6

8. Write short notes on *any two* of the following. **2x7=14**

(a) Slip, surging and chocking in centrifugal compressor

(b) Turbine compounding

(c) Gas turbine