00871

No. of Printed Pages : 4

BIME-013

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

December, 2015

BIME-013 : TURBO MACHINES

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. All questions carry equal marks. Use of steam tables is allowed. Use of scientific calculator is permitted.*

1. (a) What do you mean by dimensionless number ? Name any four dimensionless numbers. Define and explain Reynolds' number, Froude's number and Mach number.

(b) The resisting force F of a supersonic plane during flight can be considered as dependent upon the length of aircraft L, velocity V, air viscosity μ, air density ρ, and bulk modulus of air K. Express the functional relationship between the variables and the resisting force in the form

$$\frac{F}{\rho L^2 V^2} = f\left[\frac{\mu}{\rho LV}, \frac{K}{\rho V^2}\right].$$ 7+7

2. (a) Describe the construction and working of a Pelton wheel turbine with a neat sketch.

(b) The water available for a Pelton wheel is 4 cumec and the total head from the reservoir to the nozzle is 250 m. The turbine has two runners with two jets per runner. All the four jets have the same diameters. The pipeline is 3000 metres long. The efficiency of power transmission through the pipeline and the nozzle is 91% and the efficiency of each runner is 90%. The velocity coefficient of each nozzle is 0·975 and the coefficient of friction '4f' for the pipe is 0·0045.

Determine

(i) the power developed by the turbine,

(ii) the diameter of the jet, and

(iii) the diameter of the pipeline. 7+7

3. (a) What is a centrifugal pump ? What is priming and why is it necessary in centrifugal pumps ?

(b) A centrifugal pump delivers water against a net head of 14·5 m and a design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and the outlet width is 50 mm. Determine the discharge of the pump, if the manometric efficiency is 95%. 7+7

4. (a) Draw the velocity diagrams of an axial flow compressor.

(b) An axial flow compressor is having eight stages with 50% reaction design, compressed air is in the pressure ratio of 4 : 1. The air enters the compressor at 20°C and flows through it with a constant speed of 90 m/s. The blades of the compressor rotate with a mean speed of 180 m/s. Isentropic efficiency of the compressor may be taken as 80%.

Calculate

(i) the work done by the machine, and

(ii) the blades angles.

Assume $\gamma = 1{\cdot}4$ and $C_p = 1{\cdot}005$ kJ/(kg K). 7+7

5. (a) Explain the difference between impulse and reaction turbines.

(b) A single row impulse turbine developed 135 kW at a blade speed of 175 m/sec using 2 kg of steam per second. Steam leaves the nozzle at 400 m/sec. Velocity coefficient of the blade is 0·9. Steam leaves the turbine blade axially. Determine the nozzle angle, blade angle at entry and at exit, assuming no shock. 7+7

6. (a) Describe with a neat diagram a closed cycle gas turbine. Also state its merits and demerits.

(b) A gas turbine unit receives air at 1 bar and 300 K and compresses it adiabatically to 6·2 bar. The compressor efficiency is 88%. The fuel has a heating value of 44186 kJ/kg and the fuel – air ratio is 0·017 kJ/kg of air. The turbine internal efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and the thermal efficiency. For products of combustion C_p = 1·147 kJ/kg K and $\gamma = 1{\cdot}333$. 7+7

7. Write short notes on any ***four*** of the following : $4 \times 3\frac{1}{2} = 14$

(a) Model and Prototype

(b) Slip Factor

(c) Axial Flow Pump

(d) Volute Casing of Centrifugal Pump

(e) Operating Characteristics of Pumps