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BIME-013

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

Term-End Examination

00682 **December, 2017**

BIME-013 : TURBO MACHINES

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume missing data suitably.*

1. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5N^2\rho\ \phi\left[\frac{\mu}{D^2N\rho}\right].$$

Prove this by the method of dimensional analysis. *10*

2. A Pelton wheel has a mean bucket diameter of 0·8 m and is running at 1000 rpm. The net head on the Pelton wheel is 400 m. If the side clearance angle is 15° and discharge through nozzle is 150 litres/sec, find

(a) Power available at the nozzle, and

(b) Hydraulic efficiency of the turbine. *10*

3. What is Cavitation ? How can it be avoided in centrifugal pumps ? *10*

4. With a suitable sketch, explain the working principle of an axial flow compressor. *10*

5. Briefly explain the phenomena of surge and choking in a centrifugal compressor. *10*

6. A centrifugal compressor takes in gas at 0°C and 0·7 bar and delivers at 1·05 bar. The efficiency of the process compared with the adiabatic compression is 83%. The specific heat of the gas at constant pressure and constant volume are 1·005 kJ/kg-K and 0·717 kJ/kg-K respectively.

   Calculate the final temperature of the gas and work done per kg of gas. *10*

7. What is the head generated when a Pelton wheel develops 920 hp ? The rate of flow is 0·55 m^3/sec. What is the total head loss, if operating head is 145 m ? *10*

8. A turbine is to operate under a head of 25 m and the discharge is 9 m^3/sec. If the turbine efficiency is 90%, determine the power generated by the turbine. If the speed of the turbine is 200 rpm, then what is the specific speed of the turbine ? *10*

9. A centrifugal pump is required to lift 0·0125 m^3/sec of water from a well with depth 30 m. If the motor is 5 kW, find the efficiency of the pump. *10*

10. In a gas turbine plant, air enters the compressor at 1 bar and 7°C. It is compressed to 4 bar with an isentropic efficiency of 82%. The maximum temperature at the inlet to the turbine is 800°C. The isentropic efficiency of the turbine is 85%. The calorific value of the fuel used is 43·1 MJ/kg. The heat losses are 15% of the calorific value.

Calculate the following : *10*

(a) Compressor work in kJ/kg

(b) Heat supplied in kJ/kg

(c) Turbine work in kJ/kg

(d) Net work in kJ/kg

(e) Thermal efficiency

Assume C_{pa} = 1·005 kJ/kg-K,

γ_a = 1·4,

C_{pg} = 1·147 kJ/kg-K,

γ_g = 1·33.
