

- 7 a. Explain the following, with suitable equations :
- i) Current ratio      ii) Interval measure      iii) Debt ratio      iv) Inventory turnover
  - v) Net profit margin. (10 Marks)
- b. The total sales at a firm is Rs 6,40,000. It has a gross profit margin of 15 percent and a current ratio of 2.5. The firm's current liabilities are Rs 96,000, inventories Rs 48000 and cash Rs 16,000.
- i) Determine the average inventory to be carried by the firm, if an inventory turnover of 5 times is expected? (Assume a 360 – day year).
  - ii) Determine the average collection period if the opening balance of debtors is intended to be Rs 80,000. (Assume a 360 – day year). (10 Marks)
- 8 a. List the steps involved in the financial planning. (04 Marks)
- b. List the basic elements of a profit (Budget) plan. (04 Marks)
- c. Explain i) Operating budgets      ii) Financial budgets      iii) Capital budgets. (12 Marks)

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10ME56

**Fifth Semester B.E. Degree Examination, December 2012**  
**Turbomachines**

Time: 3 hrs.

Max. Marks:100

**Note:1. Answer FIVE full questions, selecting  
at least TWO questions from each part.  
2. Use of steam tables and Mollier chart is permitted.**

**PART – A**

- 1 a. Deducing an expression, explain the significance of second law of thermodynamics applied to a turbo machine. (06 Marks)
- b. The quantity of water available for a hydroelectric power station is 260 m<sup>3</sup>/s under a head of 1.73 m. Assuming the speed of the turbine to be 50 rpm and their efficiency to be 82.5%, find the number of turbine required. Assume specific speed 890 rpm. (04 Marks)
- c. A Francis turbine model is built to scale of 1 : 5. The data for model is P = 4 KW, N = 3500 rpm, H = 2 m and for prototype, H = 6 m. Assume that the overall efficiency of the model as 70%, calculate i) Speed of the prototype ii) Power of the prototype. Use Moody's equation. (10 Marks)
- 2 a. Derive an expression for stage efficiency of a compressor in terms of stage pressure ratio. Indicate the process on T-S diagram. (10 Marks)
- b. A gas turbine has 2 stages and develops 20 MW power. The inlet temperature is 1450 K. The overall pressure ratio is 7.5. Assume that the pressure ratio of each stage is same and the expansion isentropic efficiency of 0.88. Calculate i) Pressure ratio at each stage ii) Polytropic efficiency iii) Mass flow rate iv) Stage efficiency and power of each stage. (10 Marks)
- 3 a. In an inward flow radial hydraulic turbine for maximum utilization factor show that,
$$\alpha_1 = \cot^{-1} \sqrt{\left( \frac{1-R}{1-\epsilon} \right)} \epsilon$$
where  $\alpha_1$  = Nozzle angle, R = Degree of reaction,  $\epsilon$  = Utilization factor.  
Assume radial velocity component is constant throughout and there is no tangential component of absolute velocity at outlet. (06 Marks)
- b. Draw velocity triangles for the following types of vanes of centrifugal pumps and compressors: i) Backward vane ii) Radial vane iii) Forward curved vane. (06 Marks)
- c. The mean diameter of an axial flow steam turbine is 50 cm. The maximum utilization factor is 0.90 and the degree of reaction is 0.50. The mass flow rate of steam is 10 kg/s. The speed of the blade is 2000 rpm. Calculate i) Inlet and exit absolute velocities ii) Power developed. (08 Marks)
- 4 a. For a radial flow turbo machine show that degree of reaction,  $R = \frac{2 + \cot \beta_2}{4}$ , where  $\beta_2$  = discharge blade angle. (10 Marks)
- b. A mixed flow turbine handling water operates under a static head of 65 m. In steady flow the static pressure at the rotor inlet is 3.5 atm (gauge). The absolute velocity at the rotor inlet is directed at an angle of 25° to the tangent so that whirl velocity is positive. The absolute velocity at the exit is purely axial. If the degree of reaction for the machine is 0.47 and the utilization factor is 0.896. Compute the tangential blade speed as well as the inlet blade angle. Find the work output per unit mass flow of water. (10 Marks)

**PART – B**

- 5 a. For a 50% reaction steam turbine, show that  $\alpha_1 = \beta_2$  and  $\alpha_2 = \beta_1$ , where  $\alpha_1$  and  $\beta_1$  are the inlet angles of fixed and moving blades,  $\alpha_2$  and  $\beta_2$  are the outlet angles of fixed and moving blades. (08 Marks)
- b. Dry saturated steam at 10 bar is supplied to a single rotor axial flow impulse turbine, the condenser pressure being 0.5 bar. The nozzle efficiency is 94% and the nozzle angle is  $18^\circ$  to the wheel plane. The rotor blades are equiangular and move at a speed of 450 m/s. If the blade velocity coefficient for the moving blades is 0.92, find i) the specific power output ii) rotor efficiency iii) stage efficiency iv) axial thrust v) direction of exit steam velocity. (12 Marks)
- 6 a. With a mathematical expression, define the following terms associated with Pelton wheel:  
 i) Hydraulic efficiency ii) Mechanical efficiency  
 iii) Overall efficiency iv) Volumetric efficiency (08 Marks)
- b. Mention the functions of draft tube. (02 Marks)
- c. The following data are given for a francis turbine net head = 70 m, speed = 600 rpm, power at the shaft = 367.5 kW, overall efficiency = 85%, Hydraulic efficiency = 95%, Flow ratio = 0.25, Width ratio = 0.1, outer diameter to inner diameter ratio = 2.0. The thickness of vanes occupy 10% of the circumferential area of runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine i) Guide blade angle ii) Runner vane angles iii) Diameter of runner at inlet and outlet. iv) Width of wheel at inlet. (10 Marks)
- 7 a. What are the applications of multi-stage centrifugal pumps? With a neat sketch, explain centrifugal pumps in series and parallel. (08 Marks)
- b. What is priming? How priming will be done in centrifugal pumps? (04 Marks)
- c. A centrifugal pump lifts water under a static head of 36 m of water of which 4 m is suction lift. Suction and delivery pipes have both 150 mm in diameter. The head loss in suction pipe is 1.8 m and 7 m in delivery pipe. The impeller is 380 mm in diameter and 25 mm wide at mouth and revolves at 1200 rpm. Its exit blade angle is  $35^\circ$ . If the manometric efficiency of the pump is 82%, find the discharge and pressure at the suction and delivery branches of the pump. (08 Marks)
- 8 a. Define the following terms of centrifugal compressor: i) overall pressure ratio ii) pressure coefficient iii) slip factor iv) power factor. (08 Marks)
- b. Explain the phenomenon of surging in centrifugal compressor. (04 Marks)
- c. An axial flow compressor with 50% reaction is having a flow coefficient of 0.54. Air enters the compressor at stagnation condition of 1 bar and  $30^\circ\text{C}$ . The total-to-total efficiency across the rotor is 0.88. The total-to-toal pressure ratio across the rotor is 1.26. The pressure coefficient is 0.45 and the work done factor is 0.88. The mass flow rate is 15 kg/s. Calculate  
 i) The mean rotor blade speed ii) Rotor blade angles at inlet and exit  
 iii) Power input to the system (08 Marks)

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