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## Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 Turbo Machines

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Define Turbo machine and with the help of a neat sketch explain the parts. (06 Marks)
- b. Differentiate between Turbo machines and positive displacement machines. (06 Marks)
- c. A test on turbine runner of 1.25 m diameter at 30 m head gave the following results:  
Power developed = 736 kW, runner speed = 180 rpm, fluid discharge = 2.7 m<sup>3</sup>/s. Compute the diameter, speed and discharge to develop 1472 kw under 45 m head at the same efficiency. (08 Marks)

**OR**

- 2 a. Show that the energy transfer in Turbo machines is equal to total enthalpy change. (06 Marks)
- b. Explain the following with the help of  $h-s$  plot of turbines :  
i) Total – to – Total efficiency  
ii) Total – to – static efficiency. (06 Marks)
- c. In a three stage steam Turbine, the pressure ratio of each stage is 2 and stge efficiency is 75%. Calculate :  
i) Polytropic efficiency  
ii) Overall efficiency  
iii) Reheat factor (08 Marks)

### Module-2

- 3 a. Express the Euler's Turbo machine equation in terms of various velocity components with the help of general velocity triangles. (06 Marks)
- b. Explain degree of reaction and utilization factor and derive relationship between them. (06 Marks)
- c. In a 50% reaction steam turbine, blade velocity, steam velocity at nozzle exit and nozzle angle are 98.5 m/s, 155 m/s and 18° respectively. The steam flow rate is 10 kg/s. Compute ;  
i) Blade angle at inlet  
ii) Power developed  
iii) Utilization factor. (08 Marks)

**OR**

- 4 a. Show that the theoretical head –discharge relationship in a radial flow turbo machine is  
$$H = U_2^2 - \frac{U_2 + \cot\beta_2}{A_2} Q$$
 (06 Marks)
- b. Show that  $R = \frac{\cot\beta_2 + 2}{4}$  for a radial outward flow turbo machine with following assumptions:  
i)  $U_2 = 2U_1$     ii)  $\beta_1 = 45^\circ$     iii) Radial velocity is constant. (06 Marks)



OR

- 8 a. Explain the need of draft tubes and mention draft tubes types with sketch. (06 Marks)
- b. Explain the working of a Kaplan Turbine with a schematic diagram. (06 Marks)
- c. In a Francis Turbine, the discharge is radial and blade speed at inlet is 25 m/s . The velocity of flow is constant and equal to 2.5 m/s. The water flow rate is 0.8 m<sup>3</sup>/s and velocity of whirl at inlet is 18 m/s. Calculate :
- i) Inlet blade angle    ii) Power developed    iii) Degree of reaction (08 Marks)

**Module-5**

- 9 a. Explain multi stage centrifugal pumps of series and parallel arrangement with a neat sketch. (06 Marks)
- b. Define minimum starting speed of centrifugal pump and derive an expression for it. (06 Marks)
- c. A three stage centrifugal pump running at 1000 rpm has impellers 40 cm in diameter and 2 cm width at outlet delivering 50 lit/s water. The blades curvature at outlet is 45° and they occupy 10% of flow area. The  $\eta_{\text{man}} = 90\%$  and  $\eta_o = 80\%$  . Compute :
- i) The head generated
- ii) Power required (08 Marks)

OR

- 10 a. Explain the phenomena of Pre whirl, surging and choking in a centrifugal compressor. (06 Marks)
- b. Explain the following with respect to centrifugal compressor :
- i) Slip factor
- ii) Power factor
- iii) Pressure Co-efficient (06 Marks)
- c. A centrifugal compressor compresses 30 kg/s of air at a rotational speed of 15000 rpm. The air enters the compressor axially. The conditions at the exit section are ; radius = 30 cm, relative velocity of air at the tip is 100 m/s at an exit angle of 80°.
- Calculate :
- i) Torque
- ii) Power required
- iii) Ideal head developed (08 Marks)

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