

CBGS SCHEME



21ME52

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025 Thermo Fluids Engineering

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of thermodynamics data handbook is permitted.

Module-1

- 1 a. Explain Morse test. (06 Marks)
- b. A test on 3 cylinder, 4 stroke IC engine with 22 cm bore and 26 cm stroke. The following observations were made during trial period of 1 hour.
- Fuel consumption = 8 kg
Air consumption = 300 kg
Ambient temperature = 30°C
Calorific value of fuel = 45000 kJ/kg
Net load on the brake = 1.5 kN
Brake drum diameter = 1.8 m
Rope diameter = 3 cm
Mass of cooling water = 550 kg
Inlet and exit temperature of cooling water = 27°C and 55°C
Total revolution of crank = 12000
MEP = 6 bar
Exhaust gas temperature = 310°C
Specific heat of exhaust gas = 1.1 kJ/kg
- Calculate mechanical efficiency. Draw heat balance sheet in kJ/min. (14 Marks)

OR

- 2 a. Define with respect to a compressor:
- (i) Isothermal efficiency (ii) Adiabatic efficiency (iii) Mechanical efficiency
(iv) Overall efficiency (v) Volumetric efficiency (10 Marks)
- b. A single-cylinder reciprocating air compressor has a bore of 120 mm and stroke of 150 mm and is driven at a speed of 1200 rpm. It is compressing air from a pressure of 120 kPa and temperature of 20°C, to a temperature of 215°C. Assuming polytropic compression with $n = 1.3$, no clearance and volumetric efficiency of 100%, calculate:
- (i) Pressure ratio
(ii) Indicated power
(iii) Shaft power with mechanical efficiency of 80%
(iv) Volume flow rate (10 Marks)

Module-2

- 3 a. With a neat sketch, explain vapour absorption refrigeration. (08 Marks)
- b. A simple R-12 plant is to develop 5 tonnes of refrigeration. The condenser and evaporator temperature are 40°C and -10°C respectively. Determine:
- (i) Refrigerant flow rate in kg/s (ii) Volume flow rate in m³/s
(iii) Compressor exit temperature (iv) Pressure ratio
(v) Heat rejected to condenser in KW (vi) COP (12 Marks)

OR

- 4 a. Define dry bulb temperature, wet bulb temperature, specific humidity, relative humidity. (04 Marks)
- b. With a neat sketch, explain winter air conditioning system with process on psychometric graph. (06 Marks)
- c. For a hall to be air conditioned, the following conditions are given:
 Outdoor conditions = 40°C DBT, 20°C WBT
 Required comfort condition = 20°C DBT, 60% RH
 Seating capacity of hall = 1500
 Amount of outdoor air supplied = 0.3 m³/min per person
 If the required condition is achieved first by adiabatic humidification and then by cooling, estimate, the capacity of cooling coil and the capacity of humidifier. (10 Marks)

Module-3

- 5 a. Define turbomachine. With neat sketch, explain its different parts. (06 Marks)
- b. Define degree of reaction and utilization factor. (04 Marks)
- c. The velocity of steam outflow from a nozzle in delaval turbine is 1200 m/s. The nozzle angle is 22° and rotor blades are equiangular. Assuming relative velocity of fluid at inlet and exit are equal. The tangential speed of rotor is 400 m/s. Compute:
 (i) The blade angles at inlet and exit
 (ii) Power output in KW if mass flow rate is 1 kg/s
 (iii) Utilization factor (10 Marks)

OR

- 6 a. Differentiate between turbomachine and positive displacement machine. (08 Marks)
- b. With a neat sketch, explain the construction and working of internal gear pump. (08 Marks)
- c. Define slip, slip coefficient and negative slip. (04 Marks)

Module-4

- 7 a. With a neat sketch, explain the parts of Pelton wheel. Also draw its velocity triangles. (08 Marks)
- b. Explain the need of draft tube. (02 Marks)
- c. A Kaplan turbine working under a head of 20 m develops 1172 KW shaft power. The outer diameter of the runner is 3.5 m and hub diameter is 1.75 m. The guide blade angle at the extreme edge of the runner is 35°. The hydraulic and overall efficiency of the turbine are 88% and 84% respectively. If the velocity of whirl is zero at outlet. Find:
 (i) Runner vane angles at inlet and outlet
 (ii) Speed of the turbine (10 Marks)

OR

- 8 a. Explain the following with mathematical expression:
 (i) Manometric efficiency
 (ii) Static head
 (iii) Volumetric efficiency
 (iv) Manometric head (08 Marks)
- b. Derive expression for minimum starting speed of centrifugal pump. (06 Marks)
- c. The outer diameter of the impeller of centrifugal pump is 40 cm and width of the impeller at outlet is 5 cm. The pump is running at 800 rpm and working against a total head of 1.5 m. The vane angle at outlet is 40° and manometric efficiency is 75%. Find:
 (i) Velocity of flow at outlet
 (ii) Velocity of water leaving the vane
 (iii) Blade speed at outlet (06 Marks)

Module-5

- 9 a. Explain with the help of schematic diagram, velocity compounding and pressure compounding steam turbine. (08 Marks)
- b. Dry saturate steam at 10 bar is supplied to a single rotor impulse wheel, the condenser pressure being 0.5 bar. The nozzle efficiency 0.94 and nozzle angle at rotor inlet is 18° to the wheel plane. The rotor blades which move at a speed of 450 m/s are equiangular. If the coefficient of velocity for the rotor blades is 0.92, find power output/unit mass flow rotor and rotor efficiency. (12 Marks)

OR

- 10 a. Explain the surging phenomena in compressor with the help of characteristic curve. (05 Marks)
- b. Explain reaction staging in steam turbines. (05 Marks)
- c. Draw the velocity triangle for an axial flow compressor and show that
 $E = UV_m[\tan \alpha_1 - \tan \alpha_2]$ and $R = \frac{V_m}{2U}[\tan \alpha_1 + \tan \alpha_2]$. (10 Marks)
