CBCS SCHEME

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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 m^3/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 m^3/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 $E = UV_m[\tan\upsilon_1 - \tan\upsilon_2]$ and $R = \frac{V_m}{2U}[\tan\upsilon_1 + \tan\upsilon_2]$. **(10 Marks)**

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