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CBCS SCHEME

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21ME52

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026
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.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define : i) BSFC ii) Indicated thermal efficiency with necessary expression. **(04 Marks)**

b. Explain Willan's Line method of determining the friction power of an IC engine. **(06 Marks)**

c. During a trail of a single cylinder four stroke oil engine, the following results were obtained Cylinder diameter = 20 cm ; Stroke = 40 cm ; MEP = 6 bar ; Torque = 407 Nm ; Speed = 250 rpm ; Oil consumption = 4 kg/hr ; Calorific value of fuel = 43 mJ/kg ; Cooling water flow rate = 4.5 kg/min ; Air used per kg fuel = 30 kg ; Rise in cooling water temperature = 45°C ; Temperature of exhaust gases = 420°C ; Room temperature = 20°C ; Mean specific heat of exhaust gases = 1.0 kJ/kg K. Find the mechanical efficiency , indicated thermal efficiency and draw up an energy balance sheet for the test in kJ/min and percentage basis. **(10 Marks)**

OR

2 a. What are the advantages of multistage compression? **(04 Marks)**

b. Derive an expression for the volumetric efficiency of a single stage air compressor in terms of the pressure ratio, clearance and 'n' of polytrophic index. **(06 Marks)**

c. An air reciprocating compressor with a bore of 15cm, a stroke of 20cm and a clearance of 5% runs at 300 rev/min. the suction and delivery pressure are 1 bar and 12 bar respectively.
i) Calculate the ideal volumetric efficiency and the power input assuming the index of compression and expansion to be 1.3.
ii) Find also the theoretical maximum percentage saving in work possible had the compression been carried out in two stage instead of in a single stage. **(10 Marks)**

Module-2

3 a. What are the desirable properties of good refrigerant? **(04 Marks)**

b. With a neat sketch, explain the working of vapour absorption refrigeration system. **(08 Marks)**

c. A 5 ton R – 12 refrigeration plant has saturated suction temperature of -5°C. The condensation takes place at 32°C. Assuming isentropic compression , find
i) COP of the plant ii) Main flow rate of refrigerant iii) Power required to run the compressor in kW iv) Heat rejected in the condenser in kW. Take the following properties of R – 12.

T °C	P bars	h_f kJ/kg	h_g kJ/kg	s_g kJ/kg K
32	7.85	130.5	264.5	1.542
-5	2.61	-	249.3	1.557

Take Cp (Super heated vapor) = 0.615 kJ/kg – K. **(08 Marks)**

OR

4 a. Define the following terms as applied to an air water vapour mixture :
i) Relative humidity
ii) Dew point temperature
iii) Wet bulb temperature
iv) Adiabatic saturation temperature. **(04 Marks)**

b. With a neat sketch, describe the working of summer air conditioning system for hot and dry weather. **(10 Marks)**

c. Moist air at 30°C , 1.01325 bar has a relative humidity of 80%. Determine without using the psychometric chart :
i) Partial pressure of water vapour and air
ii) Specific humidity
iii) Specific volume
iv) Dew point temperature. **(06 Marks)**

Module-3

5 a. Define and classify turbo - machine. **(06 Marks)**

b. Derive an expression relating utilization factor and the degree of reaction. **(06 Marks)**

c. In a turbine stage with 50% reaction, the tangential blade speed is 98.5 m/s. the steam velocity at the nozzle exit is 155 m/s and the nozzle angle is 18°. Assuming symmetric inlet and outlet velocity triangles, compute the inlet blade angle for the rotation and the power developed by the stage for a flow rate of 10 kg/s. Also the utilization factor. **(08 Marks)**

OR

6 a. Explain with a neat sketch, the working of a reciprocating pump. **(06 Marks)**

b. With a schematic diagram, explain the working of an external gear pump. **(06 Marks)**

c. It is desired to have a discharge of water of $0.01 m^3/min$ using a reciprocating pump running at 42 rpm. The bore - to - stroke ratio is to be 1 : 1.5. It is expected that the slip will be 12%. Determine the bore and stroke for i) Single acting pump ii) Double acting pump.
If the total head is 30m and the overall efficiency is 82%, determine the power required. **(08 Marks)**

Module-4

7 a. Classify Hydraulic Turbines with examples. **(04 Marks)**

b. Draw a neat sketch of Francis turbine with typical velocity triangles and explain the function of draft tube. **(08 Marks)**

c. A three – jet pelton wheel is required to generate 10,000 kW under a head of 400m. the blade angle at outlet is 15° and reduction in relative velocity over the buckets is 5%. If overall efficiency is 80%, $C_v = 0.98$ and speed ratio = 0.46. Find
i) Diameter of jet
ii) Total flow in m^3/s
iii) Force exerted by a jet on the buckets. **(08 Marks)**

OR

8 a. Define the following with respect to centrifugal pump :

i) Static head
ii) Manometric head
iii) Net Positive Suction Head (NPSH)
iv) Manometric efficiency. **(08 Marks)**

b. What is Minimum starting speed of a centrifugal pump? Derive an expression for minimum starting speed of the centrifugal pump. **(06 Marks)**

c. The impeller of a centrifugal pump is 30 cm in diameter and 5 cm wide at inlet, vanes are curved backward at 35°Thickness of vanes occupy 20% of peripheral area and velocity of flow is constant. The discharge is 75ℓ/s when rotating at 800 rpm. Calculate pressure rise in impeller and percentage of work converted to kinetic energy. **(06 Marks)**

Module-5

9 a. Explain Slip and Slip coefficient with velocity diagram. **(06 Marks)**

b. With sketch and velocity triangles, explain different vane shapes of the centrifugal compressor. **(06 Marks)**

c. A backward swept centrifugal fan develops a pressure of 75 mm WG. It has an impeller diameter of 89 cm and runs at 720 rpm. The blade angle at the tip is 39° and the width of the impeller is 10 cms. Assuming a constant velocity of flow of 9.15 m/s and density of 1.2 kg/m^3, determine the fan efficiency , discharge , power required , stage reaction , pressure coefficient. **(08 Marks)**

OR

10 a. What is the necessity for compounding steam turbine? List different methods of compounding and discuss pressure compounding with neat sketch. **(10 Marks)**

b. In a single stage impulse steam turbine the mean diameter of the blades is 1m. It runs at 3000 rpm. The steam is supplied from a nozzle at a velocity of 350 m/s and the nozzle angle is 20°. The rotor blades are equiangular. The blade friction factor is 0.86. Draw the velocity diagram and calculate the power developed if the axial thrust is 117.72 N. **(10 Marks)**

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