CBCS SCHEME

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BME401

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2026
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

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Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use Thermodynamics Data hand book is permitted.

		Module – 1	M	L	C
Q.1	a.	With the help of PV and TS diagram, derive an expression for air standard diesel cycle.	10	L3	CO1
	b.	An ideal Otto cycle has a compression ratio of 8. The conditions at the beginning of compression stroke are 100 kPa and 17°C. If the heat added during the cycle is 800 kJ/kg, find (i) Temperatures and pressures at all salient points of the cycle. (ii) Network output (iii) Thermal efficiency of the cycle	10	L3	CO1
		OR			
Q.2	a.	Explain, with the help P-θ diagram, the phenomenon of combustion in S.I engines.	10	L2	CO1
	b.	The following observations are recorded in 60 minute duration on a single cylinder, 4-stroke, S.I. engine : Bore = 220 mm, Stroke = 300 mm, Fuel used = 4 kg, Calorific value of fuel = 42000 kJ/kg, Speed of the engine = 300 rpm, m.e.p = 5 bar, Load on the brake drum = 600 N, Spring balance reading = 30 N, Diameter of the brake drum = 1.4 m, Quantity of cooling water = 500 kg Temperature rise of the cooling water = 20°C, A/F ratio = 16, Exhaust gas temperature = 410°C, Sp.heat of exhaust gas = 1.1 kJ/kgK, Ambient temperature = 30°C. Calculate : (i) IP (ii) BP (iii) Brake thermal efficiency (iv) Indicated thermal efficiency (v) BSFC Also draw a heat balance sheet on minute basis.	10	L4	CO1
		Module – 2			
Q.3	a.	With a neat schematic and cycle on T-S diagram, derive an expression for efficiency of an ideal regenerative gas turbine cycle.	10	L3	CO2
	b.	Air enters the compressor of an open cycle gas turbine at a pressure of 1 bar and temperature of 20°C. The pressure of air after compression is 4 bar. The isentropic efficiency of compressor and turbine are 80% and 85% respectively. The air fuel ratio is 90 : 1. If the flow rate of air is 3 kg/s, $\gamma = 1.4$ and $C_p = 1.0$ kJ/kg for both air and gas the calorific value of fuel is 41800 kJ/kg, find the power developed and the thermal efficiency of the cycle.	10	L3	CO2

		OR			
Q.4	**a.**	With neat sketch and cycle on T-S diagram, explain the working of Ramjet engine.	**10**	**L2**	**CO2**
	b.	In a reheat gas turbine cycle, comprising one compressor and two turbines, air is compressed from 1 bar, 27°C to 6 bar. The highest temperature in the cyle is 900°C. The expansion in the first stage turbine is such that the work output from it just equals the work required by the compressor. Air is reheated between the two stages of expansion to 850°C. Calculate : (i) Intermediate pressure between HP and LP turbine (ii) Cycle efficiency	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Discuss the effect of : (i) Condenser pressure (ii) Boiler pressure (iii) Super heat on the performance of a Rankine cycle.	**10**	**L2**	**CO3**
	b.	In a reheat vapour power cycle, the initial steam pressure and the maximum temperature are 150 bar, and 550°C respectively. If the condenser pressure is 0.1 bar and the moisture content at the condenser inlet is 5%, determine (i) Reheat pressure (ii) Cycle efficiency (iii) Steam rate if the steam is reheated to 550°C	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With a schematic diagram, and the cycle on T-S or h-s diagram, derive an expression for an efficiency of practical regenerative Rankine cycle.	**10**	**L3**	**CO3**
	b.	Steam at 30 bar, 350°C is supplied to a steam turbine in a practical regenerative cycle and the steam is bled at 4 bar. The bled steam comes out as dry saturated steam and heats the feed water in an open feed water heater to its saturated liquid state. The rest of the steam in the turbine expands to condenser pressure of 0.1 bar. Assuming the turbine efficiency to be same before and after bleeding , determine : (i) Turbine efficiency (ii) Quality of steam at inlet of the condenser (iii) Mass of steam bled per kg of boiler steam and (iv) Cycle efficiency.	**10**	**L4**	**CO3**
		Module – 4			
Q.7	**a.**	Derive an expression for COP of vapour compression refrigeration system. Show the schematic diagram and cycle on p-h chart.	**6**	**L2**	**CO4**

	b.	List the desirable properties of refrigerant.	4	L1	CO4
	c.	An ammonia vapour compression refrigerator works between an evaporator pressur of 1.2 bar and a condenser pressure of 12 bar. The refrigerant leaves the evaporator at -20°C and leaves the condenser at +20°C. Determine the COP and power required per ton of refrigeration. Determine also the bore and stroke of the compressor cylinder if the speed is 200 rpm, volumetric efficiency is 0.8 and stroke is 1.5 times the bore.	10	L4	CO4
		OR			
Q.8	a.	With a neat schematic diagram and the processes on the skeleton of psychrometric chart, explain the summer air conditioning system for hot and dry weather conditions.	10	L2	CO4
	b.	It is required to design an air conditioning plant for a small office room for the following winter conditions: Outdoor conditions : 14°C DBT and 10°C WBT Required conditions : 20°C DBT and 60% RH Amount of free air circulation : 0.3 m^3/min/person, Seating capacity of office : 60 The required condition is achieved first by heating and then by adiabatic humidifying. Determine : (i) Heat capacity of coil in kW and the surface temperature of the coil if the by-pass factor is 0.4 (ii) Capacity of the humidifier.	10	L3	CO4
		Module – 5			
Q.9	a.	What are the uses of compressed air?	4	L1	CO5
	b.	Derive an expression for volumetric efficiency of reciprocating compressor in terms of clearance ratio, pressure ratio and index compression.	6	L3	CO5
	c.	In a two stage reciprocating air compressor, 1.5 kg/min of air is compressed from 1 bar to 25 bar and the index of compression is 1.2. If the work of compression is minimum and the air is cooled in the inter cooler so that its temperature is brought back to initial temperature of 15°C, determine : (i) Heat rejected in the intercooler and (ii) The power required to drive the compressor	10	L3	CO5
		OR			
Q.10	a.	Derive an expression of critical pressure ratio for maximum discharge through the nozzle.	10	L3	CO5

	b.	A steam nozzle is supplied steam at 15 bar, 350°C and discharges at 1 bar. If the diverging portion of the nozzle is 80 mm long and the throat diameter is 6 mm, determine the cone angle of divergent portion. Assume 12% of the total available enthalpy drop is lost in friction in the divergent portion. Also determine the velocity and temperature of the steam at throat.	10	L3	CO5

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