CBCS SCHEME - Make-Up Exam

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BME401

Fourth Semester B.E/B.Tech. Degree Examination, June/July 2025
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

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 of Thermodynamic data handbook is permitted.

		Module – 1	M	L	C
1	a.	Derive expression for efficiency of otto cycle.	8	L3	CO1
	b.	An air stand old dual cycle has a compression ratio of 16 and compression begins at 1 bar , 50°C. The maximum pressure is 70 bar. The heat transferred to air at constant pressure is equal to that at constant volume. Estimate a1 pressure and temperature at cardinal point b1 cycle efficiency. Assume C_v = 0.718 kJ/kg k , C_p = 1.00.5kJ/kg k , R = 0.287 kJ/kg k.	12	L2	CO1
		OR			
2	a.	Explain with neat diagram, combustion in CI engine.	10	L2	CO1
	b.	The following observations were recorded in a test of one hour duration on single cylinder oil engine working on h-s cycle. Bore = 300mm , stroke = 450mm, Fuel used = 8.8 kg, Calorific value = 41800 kJ/kg. Speed = 200 rpm , Mean effective pressure = 5.8 bar, Brake friction load = 1860 N , Quantity of cooling water = 650 kg , Temperature rise = 22°C. Diameter of brake wheel = 1.22m. Find i) Mechanical efficiency ii) Draw heat balance sheet on minute basis & percentage basis.	10	L3	CO1
		Module – 2			
3	a.	Derive expression for efficiency of Brayton cycle (Gas turbine cycle).	8	L3	CO2
	b.	Air enters the compressor of a turbine plant operating on Brayton cycle at 101.325 Kpa , 27°C and pressure ratio is 6. If turbine works equals 2.5 time the compressor work, determine the maximum temperature in the cycle and cycle efficiency. Take Cp = 1.005 kJ/kg k , r = 1.4.	12	L3	CO2
		OR			
4	a.	Explain briefly with T – S diagram the following gas turbine cycle : i) Regeneration ii) Intercooling iii) Reheating.	10	L2	CO2
	b.	With a neat sketch, explain working of Turbojet and Ramjet engine.	10	L2	CO2

		Module – 3			
5	a.	With a schematic diagram and its T – S diagram , explain the Rankine cycle and also derive its thermal efficiency.	**10**	**L2**	**CO5**
	b.	In a Carnot cycle the upper and lower limit pressure are 28 bar and 0.15 bar. Dry saturated steam is supplied to the plant. Evaluate i) Dryness fraction of steam of the beginning of compression ii) Find Carnot efficiency and Rankine efficiency.	**10**	**L3**	**CO3**
		OR			
6	a.	With a schematics and T – S diagram, explain working of reheat vapour power cycle and deduce an expression for cycle efficiency.	**10**	**L2**	**CO3**
	b.	In a single – heater regenerative cycle, the steam enters the turbine at 30 bar , 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find efficiency and steam rate of cycle.	**10**	**L3**	**CO3**
		Module – 4			
7	a.	Explain the working of vapour compression refrigerator and analyse it for i) Heat rejected ii) COP iii) Power consumption iv) Compressor displacement.	**10**	**L2**	**CO4**
	b.	A vapour compression refrigeration of 10 tonnes capacity. Using Freon - 12 as the refrigerant has an evaporator temperature of -10°C and condenser temperature of 30°C. Determine i) Compressor superheated discharge temperature ii) Cop iii) Mass flow rate of refrigerant. Obtain properties using data hand book.	**10**	**L3**	**CO4**
		OR			
8	a.	Analyse the following Psychrometric processes : i) Mixing of air steams ii) Cooling and dehumidification iii) Heating and humidification.	**9**	**L4**	**CO4**
	b.	Saturated air at 3°C is required to be supplied to a room where the temperature must be held at 22°C with a relative humidity of 55%. The air is heated and then water at 10°C is sprayed to give the required humidity. Determine i) Mass of spray water required per m^3 of air at room conditions. ii) Temperature to which air must be heated. Neglect an power. Assume total pressure as constant at 1.0132 bar.	**11**	**L3**	**CO4**
		Module – 5			
9	a.	Derive expression for work done by a reciprocating compressor with clearance volume.	**8**	**L3**	**CO5**

	b.	A reciprocating air compressor has 5 percent clearance with a bore of 25cm and length of stroke 30cm. The compressor operates at 500 rpm. The air enters the cylinder at 27° and 95 kPa and discharges at 2000 kPa. If n – 1.3 for compression and expansion processes. Determine i) Volumetric efficiency ii) Volume of air handled at inlet condition iii) Power required	**12**	**L3**	**CO5**
		OR			
10	a.	Derive an expression of critical pressure ratio which gives maximum discharge through the nozzle.	**8**	**L3**	**CO5**
	b.	Steam at a pressure of 6.85 bar and 0.9 dry expands through a nozzle having a throat area of 4.65 cm^2. The back pressure is 1.03 bar. Determine i) Mass of steam flow per minute ii) Area of mouth of nozzle for maximum discharge iii) Final velocity of steam	**12**	**L3**	**CO5**

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