CBCS SCHEME

USN | | | | | | | | | | |

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
Q.1	a.	With P-V and T-S diagrams, derive air standard efficiency of diesel cycle. State the assumptions made.	10	L3	CO1
	b.	The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process, the pressure is 1 bar and the temperature is 300K. The heat transfer to the cycle is 1900 kJ/kg of air. Calculate i) pressure and temperature at the end of each process of the cycle ii) Thermal efficiency iii) Mean effective pressure.	10	L3	CO1
		OR			
Q.2	a.	With a p – θ diagram, explain the stages of combustion in SI engine.	10	L2	CO1
	b.	In a test on three cylinder four stroke IC engine, with 22 cm bore and 26 cm stroke, the following observations were made during a trail period of 1 hour. Fuel consumption = 8 kg ; Air comsumption = 300 kg ; Ambient temperature = 30° C ; Calorific value of fuel = 45000 kJ/kg ; Net load on the brake = 1500 N ; Brake drum diameter = 1.8 m ; Rope diameter = 3 cm ; Mass of cooling water circulated = 550 kg ; Inlet and exit temperature of cooling water = 27 °C and 55 °C. Total revolutions of the cycle = 12000 m.e.p = 6 bar. Exhaust gas temperature = 310 °C ; C_p for exhaust gases = 1.1 kJ/kg K. Calculate IP , BP , Mechanical efficiency and indicated thermal efficiency. Draw up heat balance sheet on minute basic.	10	L3	CO1
		Module – 2			
Q.3	a.	With a block diagram and T – S diagram, explain , how intercooling , reheating and regenerating improves thermal efficiency of gas turbine plant.	10	L2	CO2
	b.	In a regenerative gas turbine cycle, air enters the compressor at 1 bar, 15°C. The pressure ratio is 6. The isentropic efficiency of compressor and turbine is 0.8 and 0.85 respectively. The maximum temperature in the cycle is 800 °C. The effectiveness of regenerator is 0.78. Assume C_p = 1.005 kJ/kg K, γ = 1.4 for air and C_p = 1.4 kJ/kg K , γ = 1.32 for combustion products. Find the cycle efficiency.	10	L3	CO2
		OR			
Q.4	a.	With a neat diagram, explain the working of Turbo prop. Also draw T – S diagram.	10	L2	CO2
	b.	With a neat sketch, explain the working of Rocket engine.	10	L2	CO2

		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working of Reheat Rankine cycle. Show the processes on P – V and T – S diagrams.	**10**	**L2**	**CO3**
	b.	A simple Rankine cycle works between the pressures of 30 bar and 0.04 bar. The initial condition of steam being dry saturated. Calculate the cycle efficiency , work ratio and specific steam consumption.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With a T – S diagram, explain the effect of following parameters on Ranking cycle efficiency. i) Pressure of steam at inlet to turbine. ii) Pressure of steam at the end of expansion.	**10**	**L2**	**CO3**
	b.	A regenerative cycle operated with steam supplied at 30 bar and 300 °C and condenser pressure of 0.08 bar. The extraction points for two open type feed water heaters are at 3.5 bar and 0.7 bar. Calculate thermal efficiency of the plant neglecting pump work.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a schematic diagram, explain the working of vapour absorption refrigeration system. Show the processes on T – S diagram.	**10**	**L2**	**CO4**
	b.	An ammonia vapour compression refrigeration system operates between evaporator pressure of 1.9 bar and condenser pressure of 15.6 bar. The vapour has a dryness fraction of 0.864 at entry to the compressor. Determine COP and refrigeration effect produced for a work input of 1 kW.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	With a neat schematic diagram, explain the working of summer air conditioning for hot and dry weather. Show the processes on psychrometric chart.	**10**	**L2**	**CO4**
	b.	Following data refers to an air conditioning system to be designed for an industrial process for hot and wet climate. Outside conditions : 30°C DBT , 75% RH Required inside conditions : 20°C DBT , 60% RH. The required condition is achieved first by cooling and dehumidifying and then by heating. Find i) Capacity of cooling coil in TOR ii) Capacity of heating coil in kW iii) Amount of water vapour removed per hour.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	For a single acting reciprocating air compressor, show that the clearance volume do not effect the work of compression.	**10**	**L4**	**CO5**

	b.	Air at 1 bar and 27°C is compressed to 7 bar by a single stage reciprocating compressor according to the law $PV^{1.3} = C$. The free air delivered was 1 m^3/min. Speed of compressor = 300 rpm , Stroke to bore ratio = 1.5 , Mechanical efficiency = 85% and motor transmission efficiency = 90%. Determine i) IP and Isothermal efficiency ii) Cylinder dimensions iii) Power of the motor.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive Critical pressure ratio expression for a flow through steam nozzle.	**10**	**L4**	**CO5**
	b.	Dry saturated steam at a pressure of 11 bar enters a C – D nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic frictionless, determine i) exit velocity of steam ii) Ratio of cross – sectional area at exit to throat. Assume condition for maximum discharge.	**10**	**L3**	**CO5**

* * * * *