Model Question Paper-2 with effect from 2019-20 (CBCS Scheme)

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Fourth Semester B.E. Degree Examination

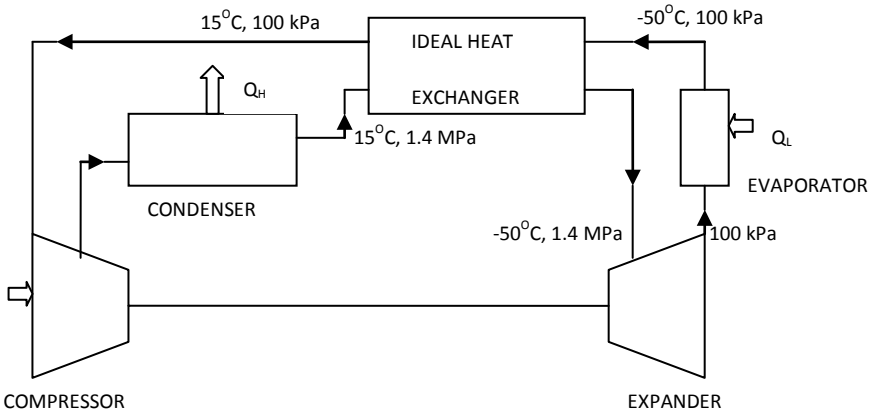
APPLIED THERMODYNAMICS

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of tables of thermodynamic tables is permitted.

		Module -1	*Bloom's Taxonomy Levels	Marks
Q. 01	a	With the help of P-V and T-S diagrams, explain the working of air-standard Otto cycle and obtain an expression for thermal efficiency in terms of compression ratio.	1,2	8
	b	An air-standard diesel cycle has a compression ratio of 20, and the heat transferred to the working fluid per cycle is 1800 kJ/kg. At the beginning of the compression process, the pressure is 0.1 MPa and the temperature is 15°C. Determine i) The pressure and temperature at each point in the cycle. ii) The thermal efficiency. iii). The mean effective pressure.	3	12
		OR		
Q. 02	a	Draw the schematic diagram, P-V diagram and T-s diagram and explain the working of a simple gas turbine cycle with a regenerator.	1,2	8
	b	In an air-standard Brayton cycle the air enters the compressor at 0.1 MPa and 15°C. The pressure leaving the compressor is 1.0 MPa, and the maximum temperature in the cycle is 1100°C. Determine 1. The pressure and temperature at each point in the cycle. 2. The compressor work, turbine work, and cycle efficiency. If an ideal regenerator is incorporated into the cycle, determine the thermal efficiency of the cycle.	3	12
		Module-2		
Q. 03	a	With the help of schematic, T-s diagrams explain the working of regenerative Rankine cycle. Obtain an expression for thermal efficiency in terms of enthalpies at various state points in the cycle.	1,2	8
	b	In a Rankine cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. The condenser pressure is 10 kPa. Determine the cycle efficiency. In above cycle if after expansion in the turbine to 400 kPa, the steam is reheated to 400°C in a reheater and then expanded in the low-pressure turbine to 10 kPa. Determine the cycle efficiency. Compare and conclude on the results obtained.	4	12
		OR		
Q. 04	a	With the help of T-s diagrams, explain the effect of following on the thermal efficiency of Rankine cycle: i) Increasing boiler pressure ii) Superheating of steam in the boiler	2	8

	b	Consider a regenerative cycle using steam as the working fluid. Steam leaves the boiler and enters the turbine at 4 MPa, 400°C. After expansion to 400 kPa, some of the steam is extracted from the turbine to heat the feedwater in an open feedwater heater. The pressure in the feedwater heater is 400 kPa, and the water leaving it is saturated liquid at 400 kPa. The steam not extracted expands to 10 kPa. Determine the cycle efficiency. Solve the problem with same operating conditions in case of a simple Rankine cycle without regeneration. Compare and conclude on the results thus obtained.	4	12
		Module-3		
Q. 05	a	With the help of a neat sketch explain the working of Orsat apparatus used for flue gas analysis.	1, 2	8
	b	Calculate the theoretical air–fuel ratio for the combustion of octane, C8H18. Determine the molal analysis of the products of combustion when octane, C8H18, is burned with 200% theoretical air, and determine the dew point of the products if the pressure is 0.1 MPa.	3	12
		OR		
Q. 06	a	Define the following terms: i) Enthalpy of formation ii) Combustion efficiency iii) Heat of reaction iv)Adiabatic flame temperature	1	8
	b	Methane (CH4) is burned with atmospheric air. The analysis of the products on a dry basis is as follows: CO2: 10%, O2: 2.37%, CO:0.53%, N2: 87.10%. Calculate the air–fuel ratio and the percent theoretical air and determine the combustion equation.	3	12
		Module-4		
Q. 07	a	Explain the measurement of friction power using Morse Test. Write appropriate equations to show how friction power is calculated.	2	8
	b	During the trial of a single cylinder four stroke oil engine, the following results were obtained: cylinder diameter = 20 cm; stroke = 40 cm; mean effective pressure = 6 bar, torque = 407 Nm; speed = 250 rpm; oil consumption = 4 kg/h; calorific value of fuel = 43 MJ/kg; cooling water flow rate = 4.5 kg/min; air used per kg of fuel = 30 kg; rise in cooling water temp=45°C; temp of exh gas = 420°C; room temp = 20°C; mean specific heat of exh gas = 1 kJ/kgK; specific heat of water = 4.18 kJ/kgK Find IP, BP and draw up a heat balance sheet for the test in kJ/h.	3	12
		OR		
Q. 08	a	Define the following terms with reference to IC Engines: i)Brake power iii) Indicated Power iii)Brake thermal efficiency iv) Volumetric efficiency	1	8
	b	An eight cylinder, 4 stroke engine of 9 cm bore and 8 cm stroke with a compression ratio of 7 is tested at 4500 rpm on a dynamometer which has 54 cm arm. During a 10 minutes test the dynamometer scale beam reading was 42 kg and the engine consumed 4.4 kg of gasoline having a calorific value of 44 MJ/kg. Air at 27°C and 1 bar was supplied to the carburetor at the rate of 6 kg/min. Find:	3	12

		i) The brake power developed ii) Brake mean effective pressure iii) BSFC iv) Brake thermal efficiency v) Volumetric efficiency vi) Air fuel ratio.		
		Module-5		
Q. 09	a	With the help of a sketch, explain the working of a vapour absorption refrigeration cycle.	1, 2	8
	b	Determine the COP for the air refrigeration cycle shown in the following figure.  	3	12
		OR		
Q. 10	a	Draw the schematic diagram of summer air conditioning system with ventilation air and zero bypass factor. Explain the working principle of the same. Show the cycle on a schematic psychrometric chart clearly indicating RSHF and GSHF lines.	1, 2	8
	b	An air conditioning system is to take in outdoor air at 10°C and 30% RH at a steady rate of 45 m^3/min and to condition it to 25°C and 60% RH. The outdoor air is first heated to 22°C in the heating section and then humidified by the injection of hot steam in the humidifying section. Assuming the entire process takes place at a pressure of 100 kPa. Determine: i) the rate of heat supply in the heating section ii) mass flow rate of steam required in the humidifying section.	3	12

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.