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 thermodynamic data hand book is permitted.

		Module -1	*Bloom's Taxonomy Level	Marks
Q.01	a	With the help of P-v and T-s diagrams, show that for the same maximum pressure, temperature and the same heat rejection of the cycle, $\eta_{Diesel} > \eta_{Dual} > \eta_{Otto}$	L2	08
	b	In an air standard Diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15.0°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate (i) the cut-off ratio (ii) the heat supplied per kg of air (iii) the cycle efficiency and (iv) the mean effective pressure.	L3	12
		OR		
Q.02	a	With the help of pressure and crank angle diagram, explain the stages of combustion in SI engine.	L2	08
	b	In a test on a three cylinder four-stroke internal combustion engine with 22.0 cm bore and 26.0 cm stroke, the following were the observations during a trial period of one hour: Fuel consumption = 8.0 kg, calorific value = 45,000 kJ/kg, total revolutions of the crank shaft 12,000, mean effective pressure = 6 bar, net load on brake = 1.5 kN, brake drum dia = 1.8 m, rope dia = 3.0 cm, mass of cooling water = 550 kg, inlet temperature of water = 27.0°C, exit temperature of water =55 °C, air consumed =300 kg, ambient temperature =30.0°C, exhaust gas temperature = 310.0°C, specific heat of gases = 1.1 kJ/kgK. Calculate (i) indicated and brake power (ii) mechanical efficiency, and (iii) indicated thermal efficiency. Also draw a heat balance sheet in kJ/min.	L3	12
		Module-2		
Q. 03	a	Show that the efficiency of air standard Brayton cycle is a function of isentropic pressure ratio.	L2	08
	b	An ideal gas turbine cycle with two stages of compression and two stages of expansion has an overall pressure ratio of 8.0. Air enters each stage of the compressor at 300 K and each stage of the turbine at 1300 K. Determine the back work ratio and the thermal efficiency of gas turbine, assuming (i) no regenerators, and (ii) ideal regenerator with 100 percent effectiveness.	L3	12
		OR		
Q.04	a	Compare the advantages of a gas turbine over a steam turbine and Internal combustion engine.	L2	08
	b	A gas turbine power plant operating on an ideal Brayton cycle has a pressure ratio of 8. The gas temperature is 300 K at the compressor inlet and 1300 K at the turbine inlet. Utilizing the air standard assumptions, determine (i) gas temperature at the exits of the compressor and the turbine, (ii) the back work ratio, and (iii) the thermal efficiency.	L3	12
		Module-3		

Q. 05	a	With the help of a schematic and T –s diagram, explain the working of regenerative vapor power cycle with one feed water heater.	L2	08
	b	A steam power plant operates on theoretical reheat Rankine cycle. Steam enters the high pressure turbine at 15 Mpa and 600°C and is condensed in the condenser at a pressure of 10 kPa. If the moisture content of the steam at the exit of the low pressure turbine is not to exceed 10.4 percent, determine (i) the pressure at which the steam should be reheated and (ii) the thermal efficiency of the cycle. Assume the steam is reheated to the inlet temperature of the high pressure turbine.	L3	12
		OR		
Q. 06	a	With the help of T-s diagrams, explain the effects of varying boiler pressure and condenser pressure on the performance of a simple Rankine cycle.	L2	08
	b	A steam power plant operates on simple ideal Rankine cycle. Steam enters the turbine at 3 MPa and 350°C and is condensed in the condenser at a pressure of 75 kPa. Determine the thermal efficiency of this cycle.	L3	12
		Module-4		
Q. 07	a	State the desirable properties of refrigerants for vapor compression refrigeration systems.	L1	08
	b	An NH_3 refrigerator operates between evaporating and condensing temperatures of -16°C and +50°C respectively. The vapor is dry saturated at the compressor inlet, the compression process is isentropic and there is no undercooling of the condensate. Calculate: (i) the refrigerant effect per kg (ii) the mass flow rate and power input per ton of refrigeration, and (iii) COP of the refrigerator.	L3	12
		OR		
Q. 08	a	Define the following terms as applied to an air-water vapor mixture. (i) Relative humidity (ii) Dew point temperature (iii) wet bulb temperature (iv) adiabatic saturation temperature.	L1	08
	b	An air conditioning system is to take in outdoor air at 10°C and 30 percent relative humidity at a steady rate of 45 m^3/min and to condition it to 25°C and 60 percent relative humidity. 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, and (ii) the mass flow rate of the steam required in the humidifying section.	L3	12
		Module-5		
Q. 09	a	Define: (i) Isothermal efficiency (ii) Mechanical efficiency (iii) adiabatic efficiency (iv) Volumetric efficiency.	L1	08
	b	In a two stage reciprocating air compressor, 1.5 kg/min mass of air is compressed from 1 bar to 25 bar and the index of compression is 1.20. If the work of compression is minimum and the air is cooled in the intercooler so that its temperature is brought back to initial temperature of 15°C. Determine: (i) Heat rejected during compression (ii) Heat rejected in the intercooler, and (iii) Power required to drive the compressor. Assume C_p as 1.0 kJ/kg-K and C_v as 0.714 kJ/kg-K.	L3	12
		OR		
Q. 10	a	Write a note on (i) Shape of nozzle for uniform pressure drop, and (ii) Supersaturated flow.	L1	08
	b	A nozzle expands steam from 14 bar and 300°C to 6 bar. If the flow rate is 1.0 kg/s, find the throat area and exit area. What should be the coefficient of velocity if the exit velocity is 550 m/s.	L3	12