APJ Abdul Kalam Technological University

MODEL QUESTION PAPER

FOURTH SEMESTER B.TECH. MECHANICAL ENGINEERING

ME 204 THERMAL ENGINEERING

Time: 3 hours **Total marks: 100**

This question paper consists of three parts
All full questions carry 10 marks
Use of approved steam tables permitted

Part A

Answer any ***three full*** questions

1a	Two boilers one with super heater and other without super heater are delivering equal quantities of steam into a common main. The pressure in the boilers and main is 20 bar. The temperature of steam from a boiler with a super heater is 350°C and temperature of the steam in the main is 250°C.Determine the quality of steam supplied by the other boiler. Take Specific heat of superheated steam as 2.25 kJ/kg.	5 marks
1b	Explain the characteristic features of a fire tube boiler. How it is different from a water tube boiler?	5 marks
2a	Explain velocity compounded impulse steam turbine showing pressure and velocity variations along the axis. Why does a two row Curtis stage most often used as the first stage in large steam turbines?	5 marks
2b	What do you understand by reheat factor and condition line? Why reheat factor is greater than unity?	5 marks
3	Steam is the working fluid in an ideal Rankine cycle with superheat and reheat. Steam enters the first-stage turbine at 8.0 MPa, 480^0C, and expands to 0.7 MPa. It is then reheated to 440^0C before entering the second-stage turbine, where it expands to the condenser pressure of 0.008 MPa. The net power output is 100 MW. Determine(a) the thermal efficiency of the cycle, (b) the mass flow rate of steam, in kg/h, (c) the rate of heat transfer from the condensing steam as it passes through the condenser, in MW.	10 marks

4	The velocity of steam entering simple impulse turbine is 1000 m/s and the nozzle angle is 20^0. The mean peripheral velocity of the blades is 400 m/s and the blades are symmetrical. If the steam enters the blades without shock, what will be the blade angles? Neglecting friction effects on the blades, calculate tangential force on the blades and the diagram power for a mass flow of 0.75 kg/s. Also estimate axial thrust and diagram efficiency.	10 marks

Part B

Answer any ***three full*** questions

5a	Prove that theoretical efficiency of a regenerative Stirling cycle is equal to that of Carnot cycle, both operating within same temperature limits	5 marks
5b	"Supercharging is more preferred in C.I. Engines than S.I. Engines". Comment on the above statement.	5 marks
6a	List out required characteristics of a C.I. Engine fuels. How C.I. engine fuels are rated?	5 marks
6b	A twin cylinder two stroke engine has a swept volume of 150 cm^3. The maximum power output is 19 kW at 11000 rpm, brake specific fuel consumption (bsfc) is 0.11 kg/MJ and air-fuel ratio is 12. If ambient test conditions were 30^0C and 1 atmosphere, and the fuel has calorific value of 44 MJ/kg, calculate brake mean effective pressure and overall efficiency.	5 marks
7	Two engines are operating on Otto and Diesel cycles with following data: Maximum temperature = 1500 K, Exhaust temperature = 700 K, Assume ambient conditions are 1 bar and 300 K. Determine their air standard efficiencies and comment on your results.	10 marks
8	In a test of 4 cylinder 4 stroke engine 75 mm bore and 100 mm stroke engine, the following results were obtained at full throttle at a particular constant speed and with fixed setting of fuel supply of 6 kg/h. B.P with all cylinder working = 15.60 kW B.P with cylinder no.1 cut out = 11.10 kW B.P with cylinder no.1 cut out = 11.03 kW B.P with cylinder no.1 cut out = 10.88 kW B.P with cylinder no.1 cut out = 10.66 kW If the calorific value of fuel is 83600kJ/kg and clearance volume is 0.0001 m^3, calculate: (i) Mechanical efficiency (ii) Indicated thermal efficiency (iii) Air standard efficiency	10 marks

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Part C

Answer any ***four full*** questions

9a	Explain the effects of following parameters on knocking of S.I. Engines: i. Compression ratio ii. Fuel quality iii. Engine Speed	3 marks
9b	Explain various stages of combustion in C.I. Engines with a sketch of pressure vs crank angle diagram.	7 marks
10a	Describe the effects of knocking in S.I. Engines.	3 marks
10b	What are the design considerations for combustion chambers for SI Engine? Describe different types of S.I. Engine combustion chambers with diagrams.	7 marks
11a	How do you account the performance of biogas as an alternative fuel for C.I. Engines?	3 marks
11b	What is meant by 'Euro-Norms'? Explain different methods for controlling pollutant emission from I.C Engines?	7 marks
12a	"The back work ratio of a gas turbine plant is relatively higher than that of a steam power plant" . How do you evaluate the above statement?	3 marks
12b	Determine the pressure ratio across the compressor of an ideal Brayton cycle for the maximum net work output per unit of mass flow if the state at the compressor inlet and the temperature at the turbine inlet are fixed. Use a cold air-standard analysis and ignore kinetic and potential energy effects.	7 marks
13a	Discuss the effect of intercooling and reheating on a gas turbine performance.	3 marks
13b	Consider an open cycle constant pressure gas turbine. Air enters the compressor at 1 bar and 300K. Air pressure after compression is 4 bar. Take isentropic efficiencies of both compressor and turbine to be 85% .The air-fuel ratios used is 80:1. If the flow rate of air is 2.5 kg/s, find the power output and thermal efficiency of the cycle. Tale Cp =1 kJ/kgK and γ =1.4 for air and gases. Calorific value of fuel used = 42000 kJ/kg.	7 marks
14a	Give a short note on merits and demerits of gas turbine plant compared to internal combustion engines.	3 marks
14b	In an air standard Brayton cycle the minimum and maximum temperature are 300 K and 1200 K, respectively. The pressure ratio is that which maximizes the net work developed by the cycle per unit mass of air flow. Calculate the compressor and turbine work, each in kJ/kg air, and thermal efficiency of the cycle.	7 marks