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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Examination December 2021 (2019 scheme)

Course Code: MET303

Course Name: THERMAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

Use of Steam tables, Refrigeration tables, Charts and Psychrometric charts are permitted

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Draw a simple layout showing the four basic components in a steam power plant and mention the function of each component.	3
2	Give the classification of boilers based on any three criteria and give one example for each type.	3
3	Define the degree of reaction for a steam turbine	3
4	Define reheat factor for multistage expansion in turbines and name three factors on which its value depends.	3
5	Define Brake thermal efficiency and volumetric efficiency of an IC Engine	3
6	What are the advantages of stratified charge engine?	3
7	What is the equivalence ratio of combustion and what is its significance?	3
8	What do you mean by Cetane number?	3
9	Why reversed Carnot cycle is practically impossible to execute?	3
10	List the basic psychrometric processes in air conditioning and represent all the processes in the Psychometric chart.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	A steam power plant operates on ideal Rankine cycle. The steam enters the turbine at 3MPa, 350°C and is condensed in the condenser at a pressure of 75 KPa. Determine thermal efficiency of the cycle. Take the required data from the Steam tables.	8
	b)	Draw the schematic of Binary vapour cycle and explain its working.	6

12 a) With neat sketch explain the working of La Mont Boiler. 7

b) Derive the expression for mass flow rate of steam through a nozzle and obtain the condition for maximum discharge 7

Module -2

13 a) The steam is supplied to an impulse turbine at a velocity of 1000 m/s at an angle of 20°. The blade velocity is 300 m/s and the blades are symmetrical. The mass flow rate of steam is 0.5 kg/s. Allowing a friction factor of 0.8 , determine (i) Blade efficiency (ii) Power developed (iii) Stage efficiency, if the nozzle efficiency is 95%. 9

b) With necessary diagrams explain the difference between velocity and pressure compounding in steam turbines 5

14 a) Draw the velocity triangle for a 50% reaction turbine and derive the expressions for work done and blade efficiency. 7

b) What is the purpose of governing of steam turbine? Explain any one method of governing. 7

Module -3

15 a) What is supercharging? What are the effects of supercharging the engine? 6

b) A six cylinder gasoline engine operates on the four stroke cycle. The bore of each cylinder is 80 mm and the stroke 100 mm. At a speed of 4000 rpm the fuel consumption is 20 kg/hr and the torque developed is 150 Nm. Calculate (i) the brake power (ii) the brake mean effective pressure (iii) brake thermal efficiency if the calorific value of the fuel is 43000 kJ/kg 8

16 a) With neat sketches explain the working of a Wankel engine. Mention its merits and demerits over the conventional IC engine. 8

b) Explain the procedure of Morse test to find out the Friction power of the Engine 6

Module -4

17 a) The petrol used in SI engine is assumed to have a chemical formula C_7H_{16}. Determine (a) the stoichiometric air fuel ratio (b) If 50% excess air is supplied, and then find the volumetric composition of the dry exhaust products. Air contains 23% Oxygen and 77% Nitrogen by mass. 6

b) Explain the different stages of combustion in SI Engine with the help of a Pressure - crank angle diagram. 8

18 a) Discuss any two emission control methods employed in reducing the emission in CI Engine 8

b) Make a comparison of knock in SI engine and CI Engine 6

Module -5

19 a) What is the effect of following operating conditions on the performance of a vapour compression refrigeration system (i) lowering the evaporator pressure (ii) Subcooling of the liquid refrigerant? 6

b) An ideal vapour compression system uses R-12 as the refrigerant. The system uses an evaporation temperature of 0°C and a condenser temperature of 40°C. The capacity of the system is 7 TR. Determine (i) the mass flow rate of refrigerant (ii) power required to run the compressor (iii) heat rejected in the condenser (iv) COP of the system. Take Cp for superheated vapour as 0.6 kJ/kg. 8

20 a) Define (i) Effective temperature (ii) Sensible heat factor 4

b) An air conditioner plant is required to supply 50 m^3 of air per minute at a DBT of 22°C and 50% RH. The atmospheric condition is 32°C with 65% RH. Calculate the mass of the moisture removed and capacity of cooling coil if the required effect is obtained by dehumidification and sensible cooling process. Also calculate the sensible Heat Factor 10

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