

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S3 (PT) (S) Examination June 2024 (2019 Scheme)

**Course Code: MET 303****Course Name: THERMAL ENGINEERING**

Max. Marks: 100

Duration: 3 Hours

*Use of Steam tables, Refrigeration tables, and Psychrometric charts are permitted***PART A***(Answer all questions; each question carries 3 marks)*

		Marks
1	Draw the P-V and T-S diagram for the modified Rankine cycle	3
2	Why Carnot cycle is not used as steam power cycle? List any two reasons with the aid of T-s diagram	3
3	List the difference between throttle governing and nozzle governing	3
4	What is meant by condition line in multistage turbine?	3
5	Mention the advantages and disadvantages of a rotary engine.	3
6	Draw the theoretical and actual indicator diagram of a four stroke petrol engine.	3
7	Write down the general combustion equation for the stoichiometric combustion of hydrocarbons with formula C_nH_{2n+2} .	3
8	What is pre-ignition and why does it occur in SI Engine	3
9	Show the simple vapour compression cycle on T-s and p-h diagram	3
10	Define bypass factor and mention its significance	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 a theoretical reheat cycle. The steam from boiler at 150 bar and 550 °C expands through the high pressure turbine. It is reheated at constant pressure of 40 bar to 550 °C and expanded through the low pressure turbine to the condenser pressure of 0.1 bar. Draw the T-s diagram and find the quality of steam at turbine exhaust and thermal efficiency of the cycle. Neglect pump work
- b) With a neat sketch, explain the working of Benson Boiler

- 12 a) Explain the working and analysis, with the schematic and T-s diagram, of regenerative cycle with one open feed water heater. 7
- b) A nozzle is to be designed to expand steam at the rate of 0.10 kg/s from 500 kPa, 210 °C to 100kPa. Neglect inlet velocity of steam. For a nozzle efficiency of 0.9, determine the exit area of the nozzle. 7

Module -2

- 13 a) A Parson's Reaction turbine running at 400 rpm with 50% reaction develops 75kW per kg of the steam. The exit angle of the blade is 20° and the steam velocity is 1.4 times the blade velocity. Determine (i) Blade velocity (ii) Blade inlet angle. 7
- b) Describe the various methods of compounding in an impulse turbine. 7
- 14 a) Derive an expression for maximum blade efficiency for a single stage impulse turbine in terms of blade speed ratio 7
- b) The steam leaves the nozzle of a single row impulse turbine with a velocity of 900 m/s. The nozzle angle is 20° and blade angles are 30° at inlet and outlet. Calculate the blade velocity and work done per kg of steam. Assume the flow over the blade is frictionless. 7

Module -3

- 15 a) A test on a 6-cylinder, 4-stroke engine was conducted and the following observations were made. Bore of the cylinder = 12cm, stroke of the piston = 12 cm, Speed of the engine = 2400 rpm. The BP of the engine is measured by hydraulic dynamometer for which power is given by $BP = \frac{WN}{23400}$ kW, where W is the load in Newton and N is the speed in RPM. The air consumption is measured by air-box method. Load on the dynamometer = 480 N, Air orifice diameter = 6 cm, Discharge coefficient of orifice = 0.6, Head causing the flow through orifice = 36 cm of water, Ambient pressure and temperature are 1 bar and 20 °C respectively, Fuel consumption = 18.6 kg/hr. C V of the fuel used = 43000 kJ/kg. Find (i) Brake mean effective pressure (ii) Specific Fuel consumption (iii) Brake thermal efficiency and (iv) Volumetric efficiency. 10
- b) Discuss the effect of variable specific heat in actual cycle of IC Engine 4

- 16 a) Explain the procedure of Heat balance test and its significance 8
b) What is exhaust blow down? Explain with the help of P-v diagram. 6

Module -4

- 17 a) Explain the different stages of combustion in CI Engine with the help of a Pressure - crank angle diagram. 8
b) Explain the phenomenon of detonation in SI Engine based on auto ignition theory 6
- 18 a) What are the basic requirements of a good combustion chamber? With neat sketches explain the different types of combustion chamber used in SI Engine 8
b) Write a short note about the pollutants from SI and CI engines. 6

Module -5

- 19 a) Derive an expression for COP of a Reversed Brayton Cycle for air refrigeration system. 5
b) A vapour compression refrigeration system uses R-12 as a refrigerant. The maximum and minimum pressure of the cycle are 8 bar and 1.2 bar respectively. At the compressor inlet, the vapour temperature is $-12\text{ }^{\circ}\text{C}$ and the temperature of the liquid at the condenser outlet is $30\text{ }^{\circ}\text{C}$. The required refrigerating load is 2.2 kW. The compressor runs at 600 rpm and has a volumetric efficiency of 75%. Find COP and swept volume of compressor. 9
- 20 a) What are the requirements of comfort air conditioning? 6
b) Explain the summer air conditioning system with the help of a schematic. 8
