Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S,FE) (FT/WP), (S3 PT) Examination May 2025 (2019 Scheme)

Course Code: MET 303
Course Name: THERMAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

Use of steam tables, refrigeration tables, and psychrometric chart are permitted

PART A

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

1		Represent a binary vapor cycle in a P-V or T-S diagram.	3
2		Describe the regenerative cycle and explain its representation on P-V and T-S diagrams.	3
3		Define the terms a) Diagram efficiency (b) Stage efficiency.	3
4		Distinguish between pressure compounding and velocity compounding.	3
5		Why Willian's line method is not used to estimate frictional power in petrol engines?	3
6		Define the fuel-air cycle and discuss the key assumptions made.	3
7		Identify and explain any six engine variables that affect knocking in SI engines and describe how each variable contributes to the occurrence of knocking.	3
8		Explain the psychrometric chart with a neat plot.	3
9		Summarize the bypass factor and sensible heat factor.	3
10		Define and compare relative humidity and absolute humidity.	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 an ideal reheat Rankine cycle between the pressure limits of 9 MPa and 10 kPa. The mass flow rate of steam through the cycle is 25 kg/s. Steam enters both stages of the turbine at 500°C. If the moisture content of the steam exiting the low-pressure turbine should not exceed 10%; determine (a) the reheat pressure, (b) total rate of heat input in the boiler, (c) the thermal efficiency of the cycle.	10
	b	Compare vapor power cycles and gas power cycles, and evaluate their respective	4

applications with relevant examples.

12 a) Describe with figures, the working of any three boiler accessories. 6

b) Illustrate and describe the working principle of a Lamont boiler with a neat sketch. 8

Module -2

13 a) Calculate the throat and exit diameters of a convergent-divergent nozzle, which will discharge 820 kg of steam per hour at a pressure of 8 bar superheated to 220°C into a chamber having a pressure of 1.5 bar. The friction loss in the divergent portion of the nozzle may be taken as 0.15 of the isentropic enthalpy drop. 6

b Explain three different methods of compounding in an impulse turbine and discuss their impact on turbines. 8

14 a) Derive the expression for critical pressure ratio for a nozzle. 7

b) Derive an expression for degree of reaction of a turbine. 7

Module -3

15 a) Differentiate between turbocharging and supercharging, and assess their impact on engine performance. 5

b) A six-cylinder, gasoline engine operates on the four-stroke cycle. The bore of each cylinder is 80 mm and the stroke is 100 mm. The clearance volume per cylinder is 70 cc. At the speed of 4100 rpm, the fuel consumption is 5.5 gm/sec. and the torque developed is 160 Nm. Calculate: (i) Brake power, (ii) The brake mean effective pressure, (iii) Brake thermal efficiency if the calorific value of the fuel is 44000 kJ/kg and (iv) The relative efficiency on a brake power basis assuming the engine works on the constant volume cycle r = 1.4 for air. 9

16 a) Describe the Morse test and explain how it is used to determine the frictional power of an engine. 8

b) Explain the effect of dissociation, specific heat and exhaust blowdown on the fuel air cycle. 6

Module -4

17 a) With the help of a P-θ diagram explain the stages of combustion in an SI Engine. 8

b) List the major pollutants emitted by an SI engine and explain the emission control methods for one of them. 6

18 a) Distinguish between octane number and cetane number and explain their 6

significance in fuel performance.

b) Explain any three combustion chamber designs of CI engines with neat sketches. 8

Module -5

19 a) Compare air refrigeration and vapour compression refrigeration systems with P-V or T-S diagrams. 8

b) Identify and describe six factors that influence human comfort. 6

20 a) Clarify the concept of winter air conditioning and explain how it functions to provide comfort in cold conditions. 8

b) An air conditioning plant is required to supply 40 m^3 of air per minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. 6

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