Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: MET303
Course Name: THERMAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

Use of steamtable, refrigeration table, psychrometric chart etc. are permitted

PART A

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

1		Draw the T-S diagram of a regenerative cycle. Mention it's advantages.	3
2		What do you meant by supersaturated or metastable flow through nozzle?	3
3		Explain nozzle governing used in steam turbines.	3
4		Define blade efficiency and stage efficiency of a steam turbine.	3
5		Differentiate between turbocharging and supercharging.	3
6		Explain the procedure for conducting a Morse test.	3
7		How the air movement in SI engine and CI engine combustion chamber differ?	3
8		How Cetane number of a fuel is determined?	3
9		Explain the effect of superheating and undercooling in vapour compression refrigeration.	3
10		Define bypass factor and sensible heat factor.	3

PART B

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

Module -1

11	a)	A high pressure boiler delivers steam at 90 bar and 480°C. The steam is expanded in the first stage of turbine to 12 bar and withdrawn and passed on the reheater. The expansion now takes place in the second stage of the steam turbine, down to the condenser pressure of 0.07 bar. Calculate (a) the efficiency of the cycle and (b) the work output and (c) pump work.	14
12	a)	With the help of a figure explain the working of a Benson boiler and mention its merits and demerits over other high pressure boilers.	9
	b)	Superheated steam enters a convergent–divergent nozzle at 20 bar and 300°C. The exit pressure is 4.5 bar. Assuming frictionless flow up to the throat ($pv^{1.3}$ = const.)	5

and a nozzle efficiency of 90%, determine (a) the flow rate for a throat area of 30 cm^2 and (b) exit area.

Module -2

13 a) A single-stage steam turbine is supplied with steam at 5 bar, 200°C at the rate of 50 kg/min. It expands into a condenser at a pressure of 0.2 bar. The blade speed is 400 m/s. The nozzles are inclined at an angle of 20° to the plane of the wheel and the outlet blade angle is 30°. Neglecting friction losses, determine the power developed and blade efficiency. 14

14 a) With the help of figures explain velocity compounding, pressure compounding and pressure-velocity compounding. 9

b) Explain degree of reaction of a steam turbine. 5

Module -3

15 a) With the help of figure explain the working of Wankel engine. Mention its relative merits and demerits over conventional engines. 9

b) How friction power is determined using retardation test. 5

16 a) A single cylinder four-stroke oil engine works on a diesel cycle. The following readings correspond to full load conditions: Area of indicator diagram = 3 cm^2, Length of the diagram = 5 cm, Spring constant = 12 bar/cm. Speed of the engine = 500 rpm, Load on the brake = 400 N, Spring reading = 50 N, Diameter of brake drum = 120 cm, Fuel consumption = 2.75 kg /h, Calorific value of fuel = 42000 kJ/kg, Diameter of cylinder = 16 cm, Stroke length of piston = 20 cm. Determine (a) the friction power, (b) the mechanical efficiency, (c) the brake thermal efficiency, (d) the indicated mean effective pressure and (e) specific fuel consumption. 14

Module -4

17 a) With help of a p-θ diagram explain stages of SI engine combustion. 7

b) Discuss major pollutants coming from SI engines. How catalytic converter helps to reduce emissions? 7

18 a) With the help of figure discuss open type combustion chamber and swirl chamber in CI engine and their advantages and disadvantages. 10

b) Explain knocking with the help of auto-ignition theory. 4

Module -5

19	a)	A refrigeration cycle uses Freon −12 as the working fluid. The temperature of the refrigerant in the evaporator is −10°C. The condensing temperature is 40°C. The cooling load is 150 W and the volumetric efficiency of the compressor is 80%. The speed of compressor is 720 rpm. Calculate the mass flow rate of the refrigerant and the displacement volume of the compressor.	14
20	a)	Discuss the procedure for cooling load estimation for summer air conditioning.	9
	b)	Derive the air standard efficiency of reversed Brayton cycle.	5

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