Reg. No.															

Question Paper Code	14222

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fourth Semester

Mechanical Engineering

20MEPC404 - APPLIED THERMAL SCIENCES

Regulations - 2020

(Use of Steam Tables, Mollier Chart, Refrigeration Tables are permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	What is the primary characteristic of the Otto cycle? (a) Constant pressure heat addition (b) Constant volume heat addition (c) Constant temperature heat addition (d) Constant entropy heat addition	1	K1	CO1
2.	Which component is responsible for heat addition in a Brayton cycle? (a) Compressor (b) Turbine (c) Heat exchanger (d) Combustor	1	K1	CO1
3.	The steam enters the nozzle at a (a) High pressure and a low velocity (b) High pressure and a high velocity (c) Low pressure and a low velocity (d) Low pressure and a high velocity	1	K1	CO2
4.	Which of the following is a steam turbine? (a) De-laval (b) Kaplan (c) Francis (d) Bulb	1	K1	CO3
5.	Which compression process assumes no heat transfer and is reversible? (a) Isentropic (b) Isothermal (c) Adiabatic (d) Polytropic	1	K1	CO4
6.	In multi-stage compression, what is typically used to reduce the temperature of the air between stages? (a) Super-cooling (b) Inter-cooling (c) Pre-cooling (d) Post-cooling	1	K1	CO4
7.	In the two-stroke engine, the process of replacing the exhaust gas in a cylinder with the fresh air/fuel mixture is known as (a) Scavenging (b) Compression (c) Suction (d) Exhaust	1	K1	CO5
8.	The compression ratio is the ratio of (a) Swept volume to Total volume (b) Total volume to Swept volume (c) Swept volume to Clearance volume (d) Total volume to Clearance volume	1	K1	CO5
9.	In the vapour compression refrigeration system, the condition of refrigerant is saturated liquid (a) After passing through the condenser (b) Before passing through the condenser (c) Before entering the compressor (d) After passing through the expansion valve	1	K1	CO6
10.	In the SI unit, one ton of refrigeration is equal to (a) 210 kJ/min (b) 21 kJ/min (c) 3.5 kJ/min (d) 420 kJ/min	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	K – Level	CO
11.	Write the assumptions made in deriving Air Standard Cycle efficiency.	2	K1	CO1
12.	Draw the Dual cycle on P-V and T-S Diagrams.	2	K2	CO1
13.	Define nozzle efficiency.	2	K1	CO2
14.	What are the main functions of steam nozzles?	2	K1	CO2
15.	Explain the principle of impulse turbine.	2	K2	CO3
16.	Classify steam turbines.	2	K1	CO3
17.	List out the applications of Air compressors.	2	K1	CO4
18.	Differentiate Swept Volume and Clearance volume.	2	K2	CO4
19.	Draw the theoretical valve timing diagram of SI engine.	2	K2	CO5

20.	What are the functions of piston rings?		2	K1	CO5
21.	What are the major applications of Refrigeration?		2	K1	CO6
22.	Name the various components used in simple vapour absorption system.		2	K1	CO6

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Derive the Air Standard efficiency for Constant Volume Cycle.	11	K3	CO1
		OR			
	b)	An engine with 200 mm cylinder diameter and 300 mm stroke works on theoretical Diesel Cycle. The inlet pressure and temperature of air are 1 bar and 300 K.The cut off is 8 % of the stroke. Calculate the following parameters (i) Theoretical air standard efficiency (ii) Pressure and Temperature at various points of the cycle. Assume that the compression ratio is 15 and working fluid is air.	11	K3	CO1
24.	a)	Derive the expression of maximum mass flow rate when steam passes through steam nozzle.	11	K2	CO2
		OR			
	b)	Air enters a frictionless adiabatic converging nozzle at 10 bar 500 K with negligible velocity. The nozzle discharges to a region at 2 bar. If the exit area of the nozzle is 2.5 cm^2, Calculate the flow rate of air through the nozzle.	11	K2	CO2
25.	a)	A single-stage impulse turbine is supplied steam at 6 bar and 220°C at the rate of 55 kg/min and it expands into a condenser at a pressure of 0.3 bar. The blade speed is 400 m/s and nozzles are inclined at 20°C to the plane of the wheel. The blade angle at the exit of the moving blade is 28°C. Neglecting friction losses in the moving blade, Identify (i) Velocity of the steam entering the blades (ii) Power developed, (iii) Blade efficiency and (iv) Stage efficiency.	11	K3	CO3
		OR			
	b)	Construct and explain the velocity and pressure compounding in detail and interpret the significance of compounding.	11	K3	CO3
26.	a)	A single cylinder single acting air compressor compresses 30m^3/s of air at a pressure of 1bar and 27^{o}C to 700kPa. Identify the power required for the compressor, if the compression is (i) Isothermal, (ii)Polytropic, (iii) Adiabatic. Take n=1.25.	11	K3	CO4
		OR			
	b)	A three stage air compressor with perfect intercooling takes 15 m^3 of air per minute at 95KPa and 27^{o}C and delivers the air at 3.5 Mpa. If the compression process is polytrophic ($PV^{1.3}$=C). Identify the Power required if the mechanical efficiency is 90%.	11	K3	CO4
27.	a)	Describe the working of Four stroke cycle Spark ignition engine with a suitable sketch.	11	K2	CO5
		OR			
	b)	Illustrate stages of combustion in SI engines? How much heat is released in each stage?	11	K2	CO5
28.	a)	Construct and explain the working of vapour compression refrigeration system.	11	K3	CO6
		OR			

b) A cinema hall of seating capacity 1500 persons has been provided with an air conditioned plant with the following data: *11 K3 CO6*

Outdoor conditions = 40°C DBT and 20°C WBT
Required conditions = 20°C DBT and 60% RH
Amount of air supplied = 0.3 m^3/min/person.
If the required condition is achieved first by adiabatic humidifying and then cooling, Identify: (i) The capacity of the cooling coil and (ii) Capacity of the humidifier.