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Question Paper Code	13645
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B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Fourth Semester

Mechanical Engineering

20MEPC404 - APPLIED THERMAL SCIENCES

Regulations - 2020

(Use of Steam Tables, Molier Chart, Refrigeration Tables is permitted)

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

	Marks	K – Level	CO
1. In the diesel cycle, the compression process is (a) Isothermal (b) Adiabatic (c) Constant pressure (d) Constant volume	1	K1	CO1
2. What is a defining feature of the dual cycle? (a) Constant volume and constant pressure heat addition (b) Only constant volume heat addition (c) Only constant pressure heat addition (d) No heat addition	1	K1	CO1
3. A steam nozzle covert (a) The heat energy of steam into kinetic energy (b) The potential energy of steam into kinetic energy (c) The kinetic energy of steam into mechanical energy (d) The heat energy of steam into mechanical energy	1	K1	CO2
4. The following are the method for compounding except (a) Velocity compounding (b) Pressure compounding (c) Volume compounding (d) Reaction turbine	1	K1	CO3
5. Aero planes employs following type of compressor..... (a) Radial flow (b) Axial flow (c) Centrifugal (d) Combination of above	1	K1	CO4
6. Volumetric efficiency of air compressors is of the order of..... (a) 20 to 30% (b) 40 to 50% (c) 60 to 70% (d) 70 to 90%	1	K1	CO4
7. In a four-stroke cycle engine, one cycle is completed in the following degree of the crankshaft (a) 720 (b) 360 (c) 540 (d) 180	1	K2	CO5
8. In a two-stroke engine, ports are operated by movement of (a) Crank (b) Piston (c) Connecting rod (d) Piston pin	1	K1	CO5
9. The COP of a vapour compression plant in comparison to vapour absorption plant is (a) More (b) Less (c) Same (d) Depends on the size of the plant	1	K2	CO6
10. The sequence of components in the vapour compression refrigeration system is (a) Compressor, Condenser, Expansion device, Evaporator (b) Compressor, Condenser, evaporator, Expansion device (c) Expansion devise, Compressor, Condenser, Evaporator (d) Compressor, Evaporator, Condenser, Expansion device	1	K2	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. Write any four major differences between Otto and diesel cycle.	2	K2	CO1
12. Define the following terms (i) Compression ratio (ii) Cut off ratio.	2	K1	CO1
13. If the enthalpy drops in a steam nozzle of efficiency 92% is 100 kJ/kg, determine the exit velocity of steam.	2	K2	CO2
14. Express the effects of friction on the flow through a steam nozzle.	2	K2	CO2

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| 15. Define degree of reaction. | 2 | K1 | CO3 |
| 16. Enumerate the energy losses in steam turbines. | 2 | K2 | CO3 |
| 17. List different types of Compressors. | 2 | K1 | CO4 |
| 18. Draw the P-V diagram for a single stage reciprocating air compressor. | 2 | K2 | CO4 |
| 19. Compare Petrol and Diesel engines. | 2 | K2 | CO5 |
| 20. What is the function of push rod and rocker arm? | 2 | K1 | CO5 |
| 21. Define the COP of refrigeration. | 2 | K1 | CO6 |
| 22. What are the properties of good refrigerants? | 2 | K1 | CO6 |

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

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| 23. | a) | An engine working on Otto Cycle has a volume of 0.45 cubic meter, pressure 0.1 MPa and temperature 303 K at the beginning of compression stroke. At the end of compression stroke, the pressure is 11 bar and 201 KJ of heat is supplied at constant volume, Calculate the following: a) Pressure, Temperature and Volume at salient points in the cycle b) Efficiency. | 11 | K2 | CO1 |
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| | b) | Derive an expression to find the air standard efficiency of Diesel cycle with P-V and T-S diagrams. | 11 | K2 | CO1 |
| 24. | a) | In a steam nozzle, the steam expands from 4 bar to 1 bar. The initial velocity is 60 m/s and the initial temperature is 200°C. Calculate the exit velocity if the nozzle efficiency is 92%. | 11 | K2 | CO2 |

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| | b) | Derive an expression for maximum discharge through convergent divergent nozzle for steam. | 11 | K2 | CO2 |
| 25. | a) | Construct neat diagram and explain velocity compounding, pressure compounding, pressure-velocity compounding. | 11 | K3 | CO3 |

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| | b) | In De-laval turbine, the steam enters the wheel through a nozzle with a velocity of 500 m/s and at an angle of 20° to the direction of the motion of the blade. The Blade speed is 200 m/s and the exit angle of the moving blade is 25°. Identify the inlet angle of the moving blade exit velocity of steam and its direction and work done per kg of steam. | 11 | K3 | CO3 |
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| 26. | a) | Derive the expression for Work done of multi stage air compressor. | 11 | K2 | CO4 |
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| | b) (i) | Describe in detail the working principle of single stage reciprocating air compressor with a neat sketch. | 6 | K2 | CO4 |
| | (ii) | With neat sketch, Explain the working of any two Rotary compressors. | 5 | K2 | CO4 |

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| 27. | a) | Explain the principle of Magneto ignition system enumerate its advantage and disadvantages. | 11 | K2 | CO5 |
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| | b) | Explain why cooling is necessary in IC engine with a neat sketch describe the working of water cooling system used for multi cylinder engine. | 11 | K2 | CO5 |
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| 28. | a) | Develop a layout and explain the following refrigeration: Ammonia water system. | 11 | K3 | CO6 |
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OR

- b) An ammonia refrigerator produces 30 tons of ice at 0°C in a day of 24 hours. The temperature range in the compressor is from 25°C to -15°C . The vapour is dry saturated at the end of compression. Assume a COP of 60% of theoretical value. Identify the power required to drive the compressor. Assume latent heat of ice is 335kJ/kg , for properties of NH_3 , refer the table below. 11 K3 CO6

Temperature $^{\circ}\text{C}$	h_f (kJ/kg)	h_g (kJ/kg)	s_f (kJ/kgK)	s_g (kJ/kgK)
25	298.9	1465.8	1.124	5.039
-15	112.34	1426.5	0.4572	5.549