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B.Tech. DEGREE EXAMINATION, DECEMBER 2023
Fourth Semester

18MEC107T – APPLIED THERMAL ENGINEERING
(For the candidates admitted from the academic year 2020 - 2021)
(Std refrigeration tables and charts are permitted)

Note:

- (i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- (ii) **Part - B and Part - C** should be answered in answer booklet.

Time: 3 Hours

Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

- | | Marks | BL | CO | PO |
|--|-------|----|----|----|
| 1. If pressure ratio in Brayton cycle increases
(A) The efficiency of the cycle increases
(B) The efficiency of the cycle decreases
(C) There is no any effect of the efficiency of the cycle
(D) Cannot say | 1 | 2 | 1 | 1 |
| 2. How is the heat added in the otto cycle?
(A) Reversible at constant pressure
(B) Irreversible at constant pressure
(C) Reversible at constant volume
(D) Irreversible at constant volume | 1 | 1 | 1 | 1 |
| 3. How is the heat added to the Diesel cycle?
(A) Reversibly at constant pressure
(B) Irreversibly at constant pressure
(C) Reversibility at constant volume
(D) Irreversibly at constant volume | 1 | 1 | 1 | 1 |
| 4. The efficiency of Diesel cycle is _____ the efficiency of otto cycle
(A) Less than
(B) Greater than
(C) Equal to
(D) None of the mentioned | 1 | 1 | 1 | 1 |
| 5. The major constituent of natural gas is
(A) Butane
(B) Propane
(C) Ethane
(D) Methane | 1 | 1 | 2 | 1 |
| 6. Combustion reaction of fuels is a / an _____ reaction.
(A) Exothermic
(B) Endothermic
(C) Chain reaction
(D) Auto catalytic | 1 | 1 | 2 | 1 |
| 7. The internal energy of the combustion products is _____ compared to that of reactants.
(A) Less
(B) More
(C) Equal
(D) More or less depends on the state of fuel | 1 | 1 | 2 | 1 |
| 8. Adiabatic flame temperature of a fuel is dependent on the initial temperature of
(A) fuel
(B) air
(C) both air and fuel
(D) neither air nor fuel | 1 | 1 | 2 | 1 |

9. The relation between indicated power (IP), Friction power (FP) and Brake power (BP) is
 (A) $IP = FP - BP$ (B) $IP = FP + BP$
 (C) $BP = IP + FP$ (D) $BP = IP / FP$
10. Mean effective pressure is the
 (A) Mean of the pressure acting on the Piston during a cycle of operation
 (B) Mean of the injection pressure and inlet pressure
 (C) Mean of exhaust and inlet pressure
 (D) Mean of the pressure acting on the piston during a stroke of operation.
11. The ratio of indicated thermal efficiency to the corresponding air standard efficiency is called
 (A) Efficiency ratio (B) Relative efficiency
 (C) Overall efficiency (D) Mechanical efficiency
12. The quantity of heat lost to the cooling water in an IC engine is about
 (A) 10% (B) 30%
 (C) 50% (D) 70%
13. The capacity of a compressor in m^3/minute refers to _____.
 (A) Standard air (B) Free air
 (C) Compressed air (D) Compressed air at delivery pressure
14. The volumetric efficiency of a compressor
 (A) Increases with decrease in compression ratio
 (B) Decreases with decrease in compression ratio
 (C) Increase with increase in compression ratio
 (D) Decrease with increase in compression ratio.
15. Adiabatic compression is one in which _____.
 (A) Temperature during compression remains constant
 (B) No heat leaves or enters the compressor cylinder
 (C) Temperature rise follows a linear relationship
 (D) Work done is Maximum
16. The mass flow rate of air compressed in axial flow compressor is _____ centrifugal compressor
 (A) Unpredictable (B) Higher than
 (C) Lower than (D) Same as
17. One tonne of refrigeration is (TOR) equal to _____.
 (A) 1.5 kW (B) 2.5 kW
 (C) 3.5 kW (D) 4.5 kW
18. During the refrigeration cycle, heat is rejected by the refrigerant in
 (A) Compressor (B) Condensor
 (C) Evaporator (D) Expansion valve
19. Temperature recorded by an ordinary thermocouple known as
 (A) Wet bulb temperature (B) Dry bulb temperature
 (C) Dew point temperature (D) Saturation temperature

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|--|---|---|---|---|
| 30. In summer air conditioning RH of conditional space is generally kept | 1 | 1 | 6 | 1 |
| (A) 40% | | | | |
| (B) 50% | | | | |
| (C) 60% | | | | |
| (D) 100% | | | | |

PART – B (5 × 4 = 20 Marks)

Answer ANY FIVE Questions

- | | Marks | BL | CO | PO |
|---|-------|----|----|----|
| 21. What are the assumptions in air standard? | 4 | 3 | 1 | 1 |
| 22. Explain the concept of regeneration which has been used in Brayton cycle with neat sketch. | 4 | 3 | 1 | 1 |
| 23. The percentage analysis of a gas by volume is given as $CO_2 = 5.5\%$, $CO = 38.3\%$, $CH_4 = 0.4\%$, $O_2 = 0.1\%$, $H_2 = 52.8\%$, $N_2 = 2.9\%$. Find the percentage analysis by mass. | 4 | 3 | 2 | 1 |
| 24. Draw the theoretical and actual P-V diagrams for SI engine and discuss briefly. | 4 | 3 | 3 | 1 |
| 25. Classify air compressors. | 4 | 3 | 4 | 1 |
| 26. Draw the layout of a vapour compression refrigeration system and state the function of each of the component. | 4 | 3 | 5 | 1 |
| 27. Name any four psychrometric processes and represent them in the psychrometric chart. | 4 | 3 | 5 | 1 |

PART – C (5 × 12 = 60 Marks)

Answer ALL Questions

- | | Marks | BL | CO | PO |
|--|-------|----|----|-----|
| 28. a. Derive the expression for air standard efficiency of the Dual cycle. | 12 | 1 | 1 | 1 |
| (OR) | | | | |
| b. The compression and expansion ratios of an oil engine working on air standard dual cycle are 9 and 5 respectively. The initial pressure and temperature are 1 bar and 30°C respectively. The heat liberated at constant pressure is twice the heat liberated at constant volume. The expansion and compression follow the law $PV^{1.25} = \text{const.}$ Determine.
(i) Pressure and Temperature at all salient points
(ii) The mean effective pressure of the cycle
(iii) Thermal efficiency of the cycle
(iv) Power developed of the engine, if eight cycles complete in a second.
Take cylinder bore = 250 mm and stroke = 400 mm. | 12 | 3 | 1 | 1,2 |
| 29. a. With a neat sketch explain in detail the working of Orsat's apparatus for flue gas analysis. | 12 | 1 | 2 | 1 |
| (OR) | | | | |
| b. A stream boiler used pulverized coal in the furnace. The ultimate analysis of coal by mass is given as C = 78%, H ₂ = 3%, O ₂ = 3%, S = 1%, ash 10%, moisture = 5%, excess air supplied is 30%. Calculate the mass of air to be supplied and mass of products of combustion per kg of coal burnt. | 12 | 3 | 2 | 1,2 |

30. a. Describe the methods of measurement of brake power using different types of dynamometer. 12 1 3 1

(OR)

- b. A four cylinder four stroke petrol engine has a bore of 57 mm and a stroke of 90 mm its rated speed is 2800 rpm, torque is 55.2Nm. The fuel consumption is 6.74 lit/hr. The density of petrol is 735 kg/m³ and petrol has a calorific value of 44200 kJ/kg. Calculate BP, b_{map} , brake thermal efficiency and brake specific fuel consumption. 12 3 3 1,2

31. a. With a neat sketch, explain the construction and working of 12 1 4 1
 (i) Vane type compressor
 (ii) Roots blower

(OR)

- b. A single stage double acting compressor has a free air delivery (F.A.D) of 14 m³/min measured at 1.013 bar and 15°C. The pressure and temperature in the cylinder during induction are 0.95 bar 32°C. The delivery pressure is 7 bar and index of compression and expansion, $n = 1.3$, The clearance volume is 5% of the swept volume. Calculate: 12 3 4 1,2
 i. Indicated power required
 ii. Volumetric efficiency

32. a. With a neat sketch, explain in detail the working of vapour absorption refrigeration system. 12 4 5 1

(OR)

- b. A simplex R-12 plant is to develop 4 tonnes of refrigeration the condenser and evaporator Temperatures are 35°C and -15°C respectively. Determine 12 3 5 1,2
 (i) The mass flow rate of refrigerant in kg/sec
 (ii) Volume flow rate handled by compressor in m³/sec
 (iii) The compressor discharge temperature
 (iv) The pressure ratio
 (v) Heat rejected to condenser in kW
 (vi) Power required to drive the compressor

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