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**Reg. No. :**

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**Question Paper Code: 94702**

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2024

Fourth Semester

Mechanical Engineering

19UME402 - Applied Thermal Engineering

(Regulations 2019)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Compression ratio of Otto cycle is CO1- U  
(a)  $V_1/V_2$                       (b)  $V_3/V_2$                       (c)  $V_2/V_1$                       (d)  $V_2/V_3$
2. Heat addition takes place in diesel cycle at CO1- U  
(a) V=C                      (b) P=C                      (c) T=C                      (d) S=C
3. The ratio of the volume of charge admitted at N.T.P. to the swept volume of the piston is called CO1- U  
(a) mechanical efficiency                      (b) overall efficiency  
(c) volumetric efficiency                      (d) relative efficiency
4. Spark plug is used in CO1- U  
(a) Petrol engine    (b) Marine engine    (c) Diesel engine                      (d) Stirling engine
5. The steam governor is used to CO1- U  
(a) Store energy    (b) Convert energy    (c) Maintain speed    (d) Balancing weight
6. A nozzle is used to CO1- U  
(a) Increase velocity                      (b) decrease velocity  
(c) Increase pressure                      (d) Decrease pressure
7. Positive displacement compressor CO1- U  
(a) Centrifugal compressor                      (b) Axial compressor  
(c) Reciprocating compressor                      (d) Roots blower

8. The volume of air sucked by the compressor during its suction stroke is CO1- U  
(a) free air delivery (b) swept volume  
(c) compressor capacity (d) none of these

9. The formation of frost on cooling coils in a refrigerator CO5- U  
(a) increases heat transfer (b) improves C.O.P. of the system  
(c) increases power consumption (d) reduces power consumption

10. The formation of frost on cooling coils in a refrigerator CO5- U  
(a) increases heat transfer (b) improves C.O.P. of the system  
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PART – B (5 x 2= 10 Marks)

11. Illustrate the factors that affect the air standard efficiency of diesel CO1- U  
cycle.
12. Summarize major parts of I.C. Engines. CO1- U
13. What are the different loss involved in Steam Turbine CO1- U
14. Classify the various types of air-compressors. CO1- U
15. Classify any four commonly used refrigerants CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) An engine of 250 mm bore and 375 mm stroke works on Otto CO2- App (16)  
cycle. The clearance volume is  $0.00263 \text{ m}^3$ . The initial  
pressure and temperature are 1 bar and  $50^\circ\text{C}$ . If the maximum  
pressure is limited to 25 bar, find the following: (i) The air  
standard efficiency of the cycle. (ii) The mean effective  
pressure for the cycle.

Or

- (b) An engine with 200 mm cylinder diameter and 300 mm CO2- App (16)  
stroke works on theoretical diesel cycle. The initial pressure  
and temperature of air used are 1 bar and  $27^\circ\text{C}$ . The cut-off  
is 8% stroke. Determine: (i) Pressures and Temperatures at  
all salient points (ii) Theoretical air standard efficiency (iii)  
Mean effective pressure (iv) Power of engine if the working  
cycles per minute are 380. Assume that compression ratio is  
15 and working fluid is air. Consider all conditions to be  
ideal.

17. (a) Explain the working of Simple carburetor with neat sketch CO1- U (16)  
Or  
(b) Explain about full pressure lubrication system in I.C Engine. CO1- U (16)
18. (a) Dry saturated steam enters a steam nozzle at a pressure of 12 bar and is discharged to a pressure of 1.5 bar. If the dryness fraction of a discharged steam is 0.95, what will be the final velocity of steam? Neglect initial velocity of steam. CO3- App (16)  
Or  
(b) Steam at 20 bar and 250°C enter a group of convergent – divergent nozzles. The backup pressure of nozzle is 0.07 bar. Neglect the losses in the convergent part. Assume a loss of 10% of enthalpy drop available in the divergent part. Find the number of the nozzles required to discharge 13.6 kg/s. the throat area of each nozzles is 3.97cm<sup>2</sup>. Also determine the the area of exits of each nozzle. CO3- App (16)
19. (a) Derive the work done by a two stage reciprocating air compressor with intercooler and derive the condition for minimum work input and the expression for minimum work required for stage reciprocating compressor? CO6- App (16)  
Or  
(b) A single acting reciprocating air compressor has cylinder diameter and stroke of 200mm and 250 mm respectively. The compressor sucks air at 1.1bar and 28<sup>0</sup> C and delivers at 9bar while running at 300 rpm. Find (i) Indicated power of the compressor (ii) Mass of air delivered by the compressor per min. The compression follows the law  $PV^{1.35} = C$ . assume  $n_{vol} = 80\%$ , and  $n_{mech} = 85\%$ .. CO6- App (16)

20. (a) An airplane using 20 TR bootstrap air refrigeration system has ambient conditions of 0.9 bar and 15°C. Ram air pressure after isentropic compression is 1.1 bar. Main compressor exit pressure is 3.5 bar, and exit pressure of secondary compressor is 4.5 bar. The carbine is required to be maintained at 1 bar and 25°C. Isentropic efficiency of each compressor is 85% and that of cooling turbine is 90%. The effectiveness of both heat ex-changers is 60%. Find (i) Mass flow rate of air passing through the carbine (ii) Power required, (iii) COP of the system. Assume  $C_p=1.01$  kJ/kg K. CO5- App (16)

Or

- (b) Explain With a neat sketch, explain vapour compression refrigeration system. CO5- App (16)