

INDIAN MARITIME UNIVERSITY

Time Bound Assignment September/October 2020

B Tech (ME) Arrear Examinations

Applied Thermodynamics-I UG11T3203

Date: 25/09/2020

Time: 3 Hrs

Maximum Marks: 70

Pass Marks: 35

PART-A (Marks: 10×2 = 20 Marks)
(All Questions are compulsory)

1. What are the four basic components of a steam power plant?
2. Define mean effective pressure as applied to gas power cycles.
3. Compare Rankine cycle with Carnot cycle in terms of efficiency and work ratio.
4. Draw P-v and T-s diagrams dual combustion cycle.
5. Define mole fraction and mass fraction.
6. What are the advantages of using a multistage compressor?
7. What is slip and slip factor?
8. What is a centrifugal compressor? Define briefly.
9. What are the compressed air motors?
10. State Amagat's law of partial volumes.

PART-B (Marks: 5×10 = 50 Marks)
(Answer any 5 of the following 7 Questions)

11. a) Explain the methods to improve the efficiency of the Rankine cycle.
(5 Marks)
b) Explain with the help of T-s diagram the ideal reheat Rankine cycle.
(5 Marks)
12. a) Derive the expression for efficiency in Otto cycle or constant volume cycle.
(5 Marks)
b) An ideal Diesel engine has a diameter 150 mm and stroke 200 mm. The Clearance volume is 10 percent of the swept volume. Determine the compression ratio, cut-off ratio and the air standard efficiency of the engine if the cut-off takes place at 6 percent of the stroke.
(5 Marks)
13. a) In a laboratory experiment, the following observations were noted during the test of a four stroke Diesel engine: Area of indicator diagram=420 mm² Length of indicator diagram=62 mm; spring number = 1.1 bar/mm; Diameter of piston = 100 mm; Length of stroke = 150 mm; Engine speed is 450 rpm. Determine, a) Indicated mean effective pressure, and b) Indicated power
(5 Marks)

- b) Define:** - a) Brake power b) Friction power c) Mechanical efficiency
d) Specific fuel consumption e) Indicated thermal efficiency
(5 Marks)

14. a) Explain Dalton's law of partial pressure. **(5 Marks)**

b) A vessel of volume 0.4 m^3 contains 0.45 Kg of carbon monoxide and 1 kg of air, at 15° C . Calculate the partial pressure of each constituent and the total pressure in the vessel. The gravimetric analysis of air is taken as 23.3% oxygen and 76.7% nitrogen. Take the molar masses of carbon monoxide, oxygen and nitrogen as 28 , 32 and 28 kg/kmol

(5 Marks)

15. a) What are the methods to improve isothermal efficiency of reciprocating compressor? **(4 Marks)**

b) A single stage single acting reciprocating air compressor takes $1 \text{ m}^3/\text{min}$ of air at 1.013 bar and 15° C and delivers it at 7 bar . Assuming stroke to bore ratio of 1.5 and expansion and compression to be polytropic with the value of $n=1.35$. Calculate Indicated Power of the compressor and cylinder bore required if compressor runs at 300 rpm . **(6 Marks)**

16. a) Describe the construction and working of centrifugal compressor with neat sketch. **(6 Marks)**

b) Draw the pressure-velocity variation curve for impeller and diffuser section of Centrifugal compressors? **(4 Marks)**

17. a) In a two stage, single acting reciprocating air compressor 4.5 kg of air per minute is compressed from 1 bar and 15°C through a pressure ratio of 9 to 1 . Both stages have the same pressure ratio, and the law of compression and expansion in both stages is $pV^{1.3}=C$. If inter-cooling is perfect, calculate intermediate pressure, indicated power and volumetric efficiency. Assume that clearance volume for both the stages are 5% of their respective swept volumes. **(6 Marks)**

b) Write any four differences between reciprocating and centrifugal compressors? **(4 Marks)**

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