

AU – 2557

Third Semester B. Tech. (Food, Pulp and Paper, Oil and Paint Petro Tech.) (CGS)
Examination

APPLIED THERMODYNAMICS

Paper – 3 CT 04

(USC – 11004)

P. Pages : 4

Time : Three Hours]

[Max. Marks : 80

- Note :** (1) Separate answer book must be used for each section in the subject Geology, Engineering material of civil branch and Separate answer book must be used for Section A and B in Pharmacy and Cosmetic Tech.
- (2) Answer **Three** questions from Section A and **Three** questions from Section B.
- (3) Assume suitable data wherever necessary.
- (4) Illustrate your answer wherever necessary with the help of neat sketches.
- (5) Use of slide rule, logarithmic tables, Steam tables, Mollier's chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Chart and Refrigeration charts is permitted.
- (6) Use pen of Blue/Black ink/refill only for writing the answer book.

SECTION A

1. (a) What is quasi static process ? 6
- (b) Prove that heat transferred in polytropic process :
- $$Q = \frac{r-n}{r-1} \times \text{polytropic W.D.}$$
- 7

OR

2. (a) Apply steady flow energy equation to a nozzle and derive an equation for velocity at exit. 5
- (b) The velocity and enthalpy of fluid at the inlet of a certain nozzle are 50 m/s and 2800 kJ/kg respectively. The enthalpy at the exit of nozzle is 2600 kJ/kg. The nozzle is horizontal and insulated so that no heat transfer takes place from it. Find : 1 velocity of the fluid at exit of the nozzle; 2. mass flow rate, if the area at inlet of nozzle is 0.09 m^2 and the specific volume is $0.185 \text{ m}^3/\text{kg}$; and 3 exit area of nozzle, if the specific volume at the exit of nozzle is $0.495 \text{ m}^3/\text{kg}$. 8

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P.T.O.

3. (a) What are primary fuels ? List some important primary fuels. 6
(b) Describe with neat sketch 'Orsat Apparatus'. 7

OR

4. (a) A sample of fuel has the following percentage composition :
Carbon = 86 percent ; Hydrogen = 8 percent
Sulphur = 3 percent ; Oxygen = 2 percent
Ash = 1 percent
For an air-fuel ratio of 12:1, calculate :
(i) Mixture strength as a percentage, rich or weak.
(ii) Volumetric analysis of the dry products of combustion. 13
5. (a) How do boiler accessories differ from mountings ? 6
(b) What are the advantages of artificial draught over natural draught ? 8

OR

6. (a) Define the chimney efficiency and find out expression for the same. 6
(b) With a chimney height 45 meters, the temperature of flue gases with natural draught was 370°C . The same draught was developed by induced draught fan and the temperature of the flue gases was 150°C . Mass of the flue gases formed is 25 kg per kg of coal fired. The boiler house temperature is 35°C . Assuming $C_p = 1.004 \text{ kJ/kgK}$ for the flue gases. Determine the efficiency of the chimney. 8

SECTION B

7. (a) Explain with neat sketch :
(i) Receiver type compound steam engine.
(ii) Surface Condenser. 8
(b) What is diagram factor ? State the reasons why its value is less than unity. 5

OR

8. (a) State the advantages of compounding a steam engine. 5
- (b) A double acting steam engine with a bore of 300 mm and stroke of 400 mm runs at 300 r.p.m. The inlet is at 8 bar and the back pressure is 1.2 bar. The cut-off occurs at 30% of the stroke. Determine the power developed, taking the diagram factor as 0.8. If the steam is dry saturated at 8 bar at the point of cut-off, determine the steam consumption in kg/hr. 8
9. (a) Explain 'otto cycle' and derive an expression for efficiency. 6
- (b) Differentiate S.I. engine with C.I. engine. 8

OR

10. (a) Discuss the 'lubrication' of an I.C. engine. 5
- (b) Following observations were recorded during a test on a single cylinder oil engine :
- Bore = 300 mm ; Stroke = 450 mm ;
- Speed = 300 r.p.m. ; i.m.e.p = 6 bar ;
- net brake load = 1.5 kN ; broke
- brake drum diameter = 1.8 meters ;
- brake rope diameter = 2 cm
- Calculate :
- (i) Indicated power ;
- (ii) Brake power ;
- (iii) Mechanical efficiency. 9
11. (a) When multistage compression used for air ? What are its advantages ? 6

- (b) Prove that the work done/kg of air in a compressor is given by :

$$W = RT_1 \frac{n}{n-1} \left[\left(\frac{p_2}{p_1} \right)^{\frac{n-1}{n}} - 1 \right] \quad 7$$

OR

12. (a) Enumerate the application of compressed air. 6
- (b) A two stage compressor takes in 2.82 m^3 of air per minute at a pressure of 1.05 bar and temperature of 22°C . It delivers the air at 8.44 bar. The compression is carried out in each cylinder according to the law $p v^{1.2} = \text{constant}$. The air is cooled to its initial temperature in inter cooler. Neglecting clearance, find the minimum power required to drive the compressor. 7



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