

GUJARAT UNIVERSITY
B. E. Sem III (Mech./Auto.) (New) Examination
Thermodynamics

Thursday 3rd January, 2008]

[Time : 3 Hours
Max. Marks : 100

- Instructions :** (1) Attempt all questions.
 (2) Answer to the two sections must be written in separate answer books.
 (3) Assume suitable data if required.
 (4) Figures to the right indicate full marks.
 (5) Use of steam table, Mollier chart and calculator is permissible.
 (6) Draw neat sketches wherever necessary.

SECTION - I

- 1 (a) Derive an expression for air standard efficiency of Dual cycle and draw cycle on P.V. plane. 16
 (b) A diesel engine takes in air at pressure 1 bar and temperature 30°C. The pressure at the end of compression is 30 bar and the cut off is 6% of the stroke. Calculate (i) the compression ratio (ii) the percentage clearance (iii) the heat supplied in kJ/Kg (iv) the heat rejected in kJ/Kg (v) thermal efficiency and (vi) mean effective pressure in bar.

- 2 (a) Write limitations of the first law of thermodynamics. 16
 (b) Explain the thermodynamic Temperature scale.

OR

- 2 (a) State and explain second Law of thermodynamics. 16
 (b) Define Clausius Inequality and prove it.

- 3 Write note on (any three) of the following : 18
 (a) Comparison of Otto, Diesel and Dual cycle
 (b) Available and unavailable energy
 (c) Reversibility and irreversibility
 (d) Prove the equivalence of Clausius and Kelvin-Planck statements.
 (e) Entropy and concept of work.

SECTION - II

- 4 (a) Draw Rankine cycle on three usual thermodynamic planes and derive an expression for its thermal efficiency. 16
 (b) Write comparison of Carnot and Rankine cycle.
 (c) Dry and saturated steam at pressure 10.5 bar is supplied to a turbine and expanded isentropically to pressure 0.075 bar. Calculate.
 (i) Heat supplied in kJ/Kg (ii) Change of entropy during heat rejection in kJ/Kg-k (iii) Heat rejected in kJ/Kg (iv) Theoretical thermal efficiency (v) the overall thermal efficiency.

P. T. O.

- 5 (a) Explain with a neat sketch the working of Bomb calorimeter. 16
 (b) Explain minimum Air requirement for solid fuel.
 (c) Explain Adiabatic flame temperature.

OR .

- 5 (a) Derive the General energy equation for steady flow process. 16
 (b) Explain Engineering application of steady flow energy equation.
 (c) In a gas turbine unit, the gas flow through the turbine is 15 kg/sec. and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/Kg and 400 kJ/Kg respectively and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate,
 (i) The rate at which heat is rejected to the turbine, and
 (ii) The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m³/kg.

- 6 Attempt (any three) of the following : 18
 (a) Explain Thermodynamic system and control volume.
 (b) Explain zeroth Law of Thermodynamics
 (c) Write comparison of first and second Law of thermodynamics
 (d) With usual notations, prove that $C_p - C_v = \frac{T\beta^2 v}{k}$
 (e) Explain Clausius - Clapeyron equation.
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