

CBCS Scheme

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15MR43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018 Applied Thermodynamics

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.
2. Use of Thermodynamics Data Hand Book is permitted.

Module-1

- 1 a. Define : (i) Theoretical air (ii) Enthalpy of combustion (iii) Adiabatic flame temperature (iv) Enthalpy of formation. (08 Marks)
b. The following is the percentage of coal sample on mass basis C-82%, H-6%, O₂-9% and ash-3%. Determine minimum air required for complete combustion and volumetric analysis of products of combustion assuming 10% excess air is supplied. (08 Marks)

OR

- 2 a. With a neat sketch, explain ORSAT apparatus. (08 Marks)
b. The products of combustion of an unknown hydrocarbon C_xH_y having compositions as measured by an orsat apparatus CO₂-8%, CO-0.9%, O₂-8.8%, N₂-82.5%. Determine actual and theoretical Air-Fuel ratio. (08 Marks)

Module-2

- 3 a. Explain (i) William's line method (ii) Morse test (08 Marks)
b. Morse test is performed on a four stroke four cylinder petrol engine at a constant speed and the following power is measured
with all cylinders working = 15.6 kW
with No 1 cylinder cut off = 11.1 kW
with No 2 cylinder cut off = 11.3 kW
with No 3 cylinder cut off = 10.8 kW
with No 4 cylinder cut off = 11.0 kW
The bore and stroke of each cylinder is 75 mm and 100 mm respectively. The clearance volume is 100 CC. The fuel consumed is 6 kg/hr. Determine (i) IP (ii) FP (iii) Brake thermal efficiency (iv) Air standard efficiency. (08 Marks)

OR

- 4 a. Define the following with respect to a reciprocating air compressor:
(i) Isothermal efficiency (ii) Adiabatic efficiency (08 Marks)
(iii) Mechanical efficiency (iv) Overall efficiency
b. With the help of P-V diagram, explain effect of clearance volume of volumetric efficiency. (08 Marks)

Module-3

- 5 a. With the help of T-S diagram, explain simple Rankine cycle. (08 Marks)
b. A Rankine cycle using water as the working fluid operates between the pressure limits of 10 kPa and 15000 kPa. The maximum temperature of the cycle is 600°C. Determine
(i) The cycle thermal efficiency. (08 Marks)
(ii) The steam rate.

OR

- 6 a. Derive an expression for the air standard efficiency of diesel cycle. With the help of PV and TS diagrams. Show $\eta_{\text{diesel}} = 1 - \frac{1}{(\gamma)^{\gamma-1}} \left[\frac{\alpha^{\gamma-1}}{\sqrt{(\alpha-1)}} \right]$ (08 Marks)
- b. An engine of 250 mm bore and 375 mm stroke works on otto cycle. The clearance volume is 0.00263 m^3 . The initial pressure and temperature are 1 bar and 50°C . If the maximum pressure is limited to 25 bar find (i) Air standard efficiency of the cycle. (ii) Mean effective pressure for the cycle. (08 Marks)

Module-4

- 7 a. Derive an expression for thermal efficiency of Brayton cycle with the help of PV and TS diagrams. Explain the processes. (08 Marks)
- b. With neat sketches, explain (i) Intercooling (ii) Reheating (08 Marks)

OR

- 8 a. With a neat sketch explain turbo jet. (08 Marks)
- b. In a gas turbine plant working on Brayton cycle with a regenerator of 75% effectiveness, the air at the inlet to the compressor is at 0.1 MPa and 30°C . The pressure ratio is 6 and maximum cycle temperature is 900°C . If turbine and compressor have an efficiency of 80%. Find the percentage increase in cycle efficiency due to regenerator. (08 Marks)

Module-5

- 9 a. Define : (i) Refrigerating effect (ii) Ton of refrigeration (iii) Relative COP. (06 Marks)
- b. With a neat sketch explain vapour compression refrigeration. (10 Marks)

OR

- 10 a. Derive an expression for the following:
 (i) Specific humidity (W)
 (ii) Degree of saturation (μ) (08 Marks)
- b. The atmospheric air at 101.325 kPa has 30°C DBT and 15°C DPT. Without using the Psychrometric chart, calculate
 (i) Partial pressures of air and water vapour.
 (ii) Specific humidity.
 (iii) Relative humidity.
 (iv) Enthalpy of moist air. (08 Marks)

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