Applied Thermodynamics VTU CBCS Question Paper Set 2018

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%, O_2-9% 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 CO_2-8%, CO-0.9%, O_2-8.8%, N_2-82.5%. 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 reciprocatory air compressor:
(i) Isothermal efficiency (ii) Adiabatic efficiency
(iii) Mechanical efficiency (iv) Overall efficiency **(08 Marks)**

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.
(ii) The steam rate. **(08 Marks)**

OR

6 a. Derive an expression for the air standard efficiency of diesel cycle. With the help of PV and TS diagrams. Show $\eta_{diesel} = 1 - \frac{1}{(\gamma)^{\gamma-1}}\left[\frac{\alpha^{\gamma-1}}{\sqrt{(\alpha-1)}}\right]$ **(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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