B.Tech Odd Semester (CBCS) Exam., December—2016

AGRICULTURAL ENGINEERING

(3rd Semester)

Course No. : AECC-03

(Thermodynamics and Heat Engines)

Full Marks : 50
Pass Marks : 15

Time : 2 hours

Note : 1. Attempt *any* **five** questions.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the margin indicate full marks for the questions.

1. *(a)* What are the different types of work? Explain in each case.

(b) In a steam power station, steam flows steadily through a 0·2 m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be P 4 MPa, t 400 °C, h 3213 6 kJ/kg and v 0 073 m^3/kg.

At the turbine end, the conditions are found to be P 3 5 MPa, t 392 °C, h 3202 6 kJ/kg and v 0 084 m^3/kg. There is a heat loss of 8·5 kJ/kg from the pipeline. Calculate the steam flow rate. 6+4=10

2. *(a)* Explain the working of an electrical resistance thermometer.

(b) List the various types of thermometers and also state their respective thermometric properties.

(c) A Pt resistance thermometer has a resistance of 4 at 0 °C and 6 5 at 100 °C. Calculate the temperature when the resistance indicated is 7 8 . 3+4+3=10

3. *(a)* Derive the expression for conservation of energy for a control volume.

(b) A piston cylinder assembly contains 2 kg of nitrogen gas (N_2). The gas expands from an initial state, where T_1 700 K and P_1 5 bars to a final state where P_2 2 bars. During the process, the pressure and specific volume are related by $PV^{1\ 2}$ = constant. Assuming ideal gas behaviour and neglecting KE and PE effects, determine the work done during the process in kJ. 5+5=10

4. *(a)* Define the following :

(i) Nozzles

(ii) Throttling device

(iii) Heat exchanger

(iv) Turbine

(b) A turbine is supplied with steam at gauge pressure of 1·6 MPa. After expansion in turbine, steam flows into a condenser which is maintained at vacuum of 780 mm of Hg. The barometric pressure is 772 mm of Hg. Express the inlet and exhaust steam pressure in Pa (absolute). Given, density of Hg is 13 6 10^3 kg / m^3. 4+6=10

5. *(a)* A Diesel engine has a compression ratio of 14 and cut-off takes place at 6% of the stroke. Find the air-standard efficiency.

(b) Write a short note on Carnot cycle.

(c) State the Clausius and Kelvin-Planck statements of second law of thermo-dynamics. 4+3+3=10

6. *(a)* Evaluate the entropy change in a closed system with proper equations.

(b) Water flows through a turbine in which friction causes the water temperature to rise from 35 °C to 37 °C. If there is no heat transfer, how much does the entropy of the water change in passing through the turbine? (Water is incompressible and the process is isochoric.)

(c) State the increase in entropy principle. 5+3+2=10

7. With proper figures, derive the expression of air-standard Otto cycle thermal efficiency. 10

8. *(a)* In an air-standard Diesel cycle, the compression ratio is 16 and at the beginning of isentropic compression, the temperature is 15 °C and pressure is 0·1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480 °C. Calculate *(i)* cut-off ratio, *(ii)* heat supplied per kg of air and *(iii)* cycle efficiency.

(b) Derive an expression for coefficient of performance of refrigeration cycle with proper figures. 6+4=10

★ ★ ★