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BME-019

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) / BTMEVI

Term-End Examination

00443

December, 2016

BME-019 : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted. Use of steam table is also allowed. Assume missing data, if any.*

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1. (a) State the thermodynamic definition of work. Also differentiate between heat and work.

(b) A platinum resistance thermometer has a resistance of 2·8 ohm at 0°C and 3·8 ohm at 100°C. Calculate the temperature when the resistance indicated is 5·8 ohm. *5+5*

2. (a) Define an isolated system. What is thermodynamic cycle ?

(b) An engine cylinder has a piston of area 0·12 m^2 and contains gas at a pressure of 1·5 MPa. The gas expands according to a process which is represented by a straight line on a pressure-volume diagram. The final pressure is 0·15 MPa. Calculate the work done by the gas on the piston, if the stroke is 0·30 m. *5+5*

3. (a) Explain vapour compression refrigeration cycle with the help of a block diagram.

(b) A single-cylinder, single-acting, 4-stroke engine of 0·15 m bore develops an indicated power of 4 kW when running at 216 rpm. Calculate the area of the indicator diagram that would be obtained with an indicator having a spring constant of 25×10^6 N/m^3. The length of the indicator diagram is 0·1 times the length of the stroke of the engine. *5+5*

4. Determine the total work done by a gas system following an expansion process as shown in Figure 1. *10*

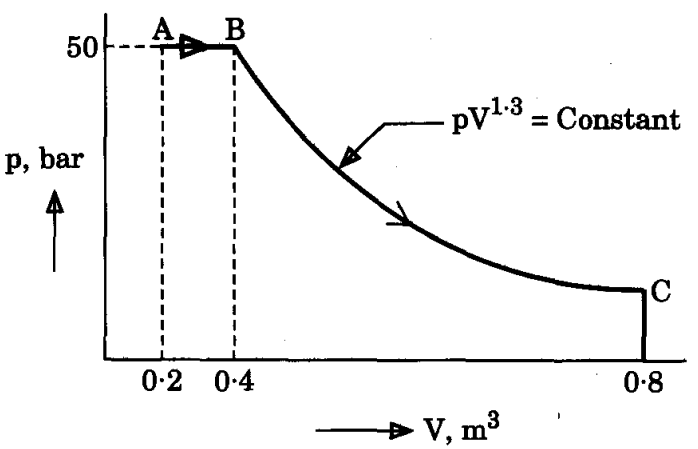

Figure 1

5. (a) Briefly explain the equivalence of Kelvin-Planck and Clausius statements of the second law of thermodynamics.

(b) In a cyclic process, heat transfers are + 19·3 kJ, – 29·5 kJ, – 2·95 kJ, + 15·5 kJ and + 30·5 kJ. What is the net work for this cyclic process ? *5+5*

6. (a) What is an ideal gas ? What is the difference between universal gas constant and characteristic gas constant ?

(b) A domestic refrigerator is loaded with food and the door is closed. During a certain period the machine consumes 1 kWh of energy and the internal energy of the system drops by 5000 kJ. Find the net heat transfer for the system. *5+5*

7. (a) Show the work (W) in non-flow process for polytropic process pV^n = Constant is given by

$$W = \frac{p_1V_1 - p_2V_2}{n-1},$$

where symbols carry usual meanings.

(b) A cyclic heat engine operates between a source temperature of 100°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine ? *5+5*

8. (a) Define 'change of state', 'path' and 'process'. What are 'intensive' and 'extensive' properties ?

(b) A heat engine receives half of its heat supply at 1000 K and half at 500 K while rejecting heat to a sink at 300 K. What is the maximum thermal efficiency of the heat engine ? *5+5*

9. (a) Define entropy. Show that entropy is a property of a system.

(b) Find the enthalpy, entropy and volume of steam at 1·4 MPa, 380°C. *5+5*

10. (a) What is a heat pump ? How does it differ from a refrigerator ?

(b) Determine the ideal COP of an absorption refrigerating system in which the heating, cooling and refrigeration take place at 197°C, 17°C and – 3°C respectively. *5+5*