BIME-023

DIPLOMA – VIEP– MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

December, 2015

BIME-023 : ENGINEERING THERMODYNAMICS

Time : 2 hours   *Maximum Marks : 70*

Note : Attempt any five questions. All questions carry equal marks. Use of Steam table and Mollier chart is allowed. Use of scientific calculator is permitted.

1. (a) What are the differences between a closed system and an open system ?

    (b) In a cyclic process the work transfers are + 20 J, – 10 J, – 10 J and + 30 J. What is the net heat transfer for this cyclic process ?

    (c) Define entropy.

    (d) Differentiate between isothermal process and adiabatic process.   *3+3+4+4*

2. (a) An indicator diagram for a four-stroke diesel engine cylinder gives the following results :

    Area of diagram = 150 mm^2

    Length of diagram = 53 mm

Engine speed = 300 rpm

Indicator spring constant = 1.6×10^8 N/m^3

Cylinder bore = 250 mm

Stroke = 450 mm.

Calculate the following :

(i) Mean effective pressure

(ii) Work done per machine cycle

(iii) Indicated power, in kW

(b) What are the different kinds of fuels ? Describe the important properties of fuels. Define the calorific value of a fuel. 7+7

3. (a) A 30 m high vertical column of a fluid of density 1878 kg/m^3 exists in a place where $g = 9.65$ m/s^2. What is the pressure at the base of the column ?

(b) A reversible heat engine operating between two reservoirs at t_1 and t_2 has an efficiency of 70%. A manufacturer of heat engines claims that he has designed an engine which when operating between the above two temperatures develops 80 kJ of work when supplied with 100 kJ of heat from the reservoir at t_1. Evaluate the validity of his claim. 7+7

4. (a) State and explain the first law of thermodynamics for a closed system undergoing a change of state.

   (b) What is a PMM1 ? Why is it impossible ?   7+7

5. (a) A mass of 1·5 kg of air is compressed in a quasi-static process from 0·1 MPa to 0·7 MPa for which pv = constant. The initial density of the air is 1·16 kg/m^3. Find the work done by the piston to compress the air.

   (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.   7+7

6. (a) State and explain the Clausius' statement of the second law of thermodynamics.

   (b) A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine ?   7+7

7. (a) Draw and explain the p-V or T-s diagram of an ideal working fluid in a vapour power cycle.

(b) A domestic food freezer maintains a temperature of − 15°C. The ambient air temperature is 30°C. If heat leaks into the freezer at a continuous rate of 1·75 kJ/sec, what is the least power necessary to pump this heat out continuously ? 7+7

8. (a) (i) What is universal gas constant ?
    (ii) What is the characteristic gas constant ?
    (iii) Show that for an ideal gas

$$C_p - C_v = R.$$

(b) Show that the efficiency of the Otto cycle depends only on the compression ratio. 7+7

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