Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech
BE 2103

First Year Special Examination – 2014

THERMODYNAMICS

BRANCH(S) : AEIE, AUTO, BIOTECH, CHEM, CIVIL, CSE, EC, EEE, ELECTRICAL, ENV, ETC, IEE, IT, MANUFACT, MECH, MME, TEXTILE

QUESTION CODE : G 544

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) Classify the different thermodynamic systems.

(b) When a system is said to be in thermodynamic equilibrium ?

(c) Distinguish between energy of a non flow system and flow system.

(d) Define moving boundary work, gravitational work, and acceleration work.

(e) What is internal latent heat and how it is related to enthalpy of vaporization ?

(f) Prove that for a constant pressure process dq=dh.

(g) How heat is transferred during conduction ?

(h) Define a throttling process and write the steady state equation for the same.

(i) What are mass fraction and mole fraction and how they are related ?

(j) Differentiate between a heat pump and a refrigerator.

P.T.O.

2. (a) Prove that Carnot engine gives maximum efficiency amongst all other engines operating between same temperature limits. 5

(b) In a throttling calorimeter the steam is admitted at 10 bar. Then it is throttled to 1.5 bar pressure and 110°C. Determine the dryness fraction of steam. 5

3. (a) Prove that violation of Kelvin Planck statement leads to violation of Clausius statement. 4

(b) Air at 5.20 bar receives an amount of heat at constant volume so that its temperature rises from 383 K to 923 K. It is then expanded polytropically according to $Pv^{1.32}$ = Constant to initial temperature and finally it is compressed isothermally to its original volume. If the mass of the air is 0.5 kg Calculate (i) pressure at end state, (ii) work transfer and heat transfer during each process. 6

4. A compressor takes air at 100 kN/m^2 and delivers the same at 550 kN/m^2 . The compressor discharges 16 m^3 of air/min. The density of air at inlet and exit are 1.2 kg/m^3 and 5 kg/m^3. The power of the motor driving the compressor is 40 kW. The heat lost to the cooling water circulated around the compressor is 30 kJ/kg of air passing through the compressor. Neglecting the PE and KE, determine the change in specific internal energy., 10

5. Draw a schematic of a thermal power plant, describe the different components including the accessories of it and discuss how the electric power is generated ? 10

6. A vessel of 6.0 m^3 capacity contains two gases A and B in proportion of 45% and 55% respectively at 30°C. If the gas constant R for the gases is 0.288 kJ/kg-K and 0.295 kJ/kg-K and total weight of mixture is 2.0 kg, calculate

(a) the partial pressure,

(b) the total pressure,

(c) the mean value of R for the mixture. 10

7. A reversible heat engine works between three reservoirs A,B,C. The engine absorbs an equal amount of heat from the thermal reservoir A and B kept at temperatures T_A and T_B respectively and rejects heat to the thermal reservoir C at T_C. The efficiency of the engine is 'n' times that of the reversible engine operating between the thermal reservoir A and C. Prove that

$T_A / T_B = (2n - 1) + 2(1 - n) T_A/T_C$ 10

8. Write short notes on the following : 2.5 × 4

(a) Entropy generation

(b) Barometer

(c) Combined mode of heat transfer

(d) Compressed liquid.