Registration no: | | | | | | | | | | |

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B.Tech
BE2103

2nd Semester Back Examination 2016-17
THERMODYNAMICS
BRANCH(S): ALL
Time: 3 Hours
Max Marks: 70
Q.CODE: Z1187

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

Q1 **Answer the following questions:** **(2 x 10)**

a) Define process, path and state.
b) What is the difference between extensive and intensive property. Explain with example.
c) What do you mean by exact and inexact differential ? Explain with the examples like heat, work and energy.
d) What is pure substance?
Is iced water a pure substance? Why?
e) State and explain zeroth law of thermodynamics.
f) What is a thermal energy reservoir? Explain Kelvin–Planck expression of the second law of thermodynamics.
g) State and explain Fourier's law of heat conduction.
h) How does the boiling process at supercritical pressures differ from the boiling process at subcritical pressures?
i) A mass of 5 kg of saturated water vapor at 300 kPa is heated at constant pressure until the temperature reaches 200°C. Calculate the work done by the steam during this process.
j) An ideal heat engine operates between two temperatures 600 K and 900 K. What is the efficiency of the engine?

Q2 **a)** Determine the atmospheric pressure at a location where the barometric reading is 740 mm Hg and the gravitational acceleration is g=9.81 m/s^2. Assume the temperature of mercury to be 10^{o}C, at which its density is 13,570 kg/m^3. **(2)**

b) An oil pump is drawing 35 kW of electric power while pumping oil with ρ=860 kg/m^3 at a rate of 0.1 m^3/s. The inlet and outlet diameters of the pipe are 8 cm and 12 cm, respectively. If the pressure rise of oil in the pump is measured to be 400 kPa and the motor efficiency is 90 percent, determine the mechanical efficiency of the pump. **(8)**

Q3 **a)** A piston–cylinder device initially contains 50 L of liquid water at 40°C and 200 kPa. Heat is transferred to the water at constant pressure until the entire liquid is vaporized. **(5)**
(*a*) What is the mass of the water?
(*b*) What is the final temperature?
(*c*) Determine the total enthalpy change.

b) Derive the euler's equation from steady flow energy equation for a control volume. **(5)**

Q4 **a)** Prove the equivalence between clausius and Kelvin-plank's statement of 2^{nd} law of thermodynamics. **(5)**

b) An insulated rigid tank is divided into two equal parts by a partition. Initially, one part contains 4 kg of an ideal gas at 800 kPa and 50°C, and the other part is evacuated. The partition is now removed, and the gas expands into the entire tank. Determine the final temperature and pressure in the tank. **(5)**

Q5 **a)** State and explain Carnot's theorem. **(5)**

b) Steam enters an adiabatic turbine at 5 MPa and 450°C and leaves at a pressure of 1.4 MPa. Determine the work output of the turbine per unit mass of steam if the process is reversible. **(5)**

Q6 **a)** Derive the Tds relations. **(5)**

b) 50-kg block of iron casting at 500 K is thrown into a large lake that is at a temperature of 285 K. The iron block eventually reaches thermal equilibrium with the lake water. Assuming an average specific heat of 0.45 kJ/kg.K for the iron, determine (*a*) the entropy change of the iron block, (*b*) the entropy change of the lake water. **(5)**

Q7 A rigid tank with a volume of 2.5 m^3 contains 15 kg of saturated liquid–vapor mixture of water at 75°C. Now the water is slowly heated. Determine the temperature at which the liquid in the tank is completely vaporized. Also, show the process on a *T-v* diagram with respect to saturation lines. **(10)**

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Steam power plant.

b) Refrigeration cycle

c) Compressibility factor

d) IC Engines