MECH/CBGS/III/ thermo dynamics /02.12.16

K.G.C.E. EXAM KARJAT RAIGAD

Q.P. Code : 554900

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question **No.1** is **Compulsory.**
(2) Answer **any three** from remaining **five** questions.
(3) Assume suitable data wherever required.
(4) Assumptions made should be stated clearly.

1. (a) Explain thermodynamic equilibrium? What is a quasistatic process and quasistatic equilibrium ? **5**
   (b) An inventor claims that his engine has following specifications Power developed=76 kW, Fuel burned per hour=4 kg, Heating value of fuel =75000kJ/kg, Temperature limits 727°C and 27°C. Discuss the possibility of the claim. **5**
   (c) Explain Joule-Thompson Coefficient, state its significance. **5**
   (d) Derive expression for air standard efficiency of Otto cycle. **5**

2. (a) (i) Apply steady flow equation on boiler, turbine and nozzle. **5**
   (ii) Explain principle of increase of entropy. **5**

   (b) The power output of a steam turbine is 5MW. The inlet conditions are 2 MPa of pressure, 400°C of temperature, 50m/s of velocity and 10m of elevation. The exit conditions are 15kPa, 0.9 dry quality, 180m/s and 6m elevation. **10**
   Compute : (i) The magnitude of Δ h, Δ ke, Δ pe
   (ii) Work done per kg of steam
   (iii) Mass flow rate of steam.

3. (a) Three Carnot engines E1, E2, E3 operate in series between two heat reservoirs which are at temperature of 1000K and 300K. Calculate intermediate temperatures if amount of work produced by these engines is in the proportions of 5:4:3. **10**
   (b) (i) 1 kg of air expands in a non flow process from 10 bar and 167°C to 3 bar and 57°C. Calculate the maximum work that can be obtained from air. **5**
   (ii) Explain critical point. **5**

TURN OVER

4. (a) (i) Derive the Maxwell relations. 5

(ii) Define availability, dead state and irreversibility. 5

(b) Explain as how reheating and regeneration in Rankine cycle is beneficial? 10

5. (a) (i) A Diesel engine has compression ratio of 15 and cut off takes place at 6% of the stroke. Find the air standard efficiency. 5

(ii) Explain adiabatic flame temperature. 5

(b) (i) 5 kg of steam is throttled from 12 bar to 0.5 bar pressure. The temperature at the final state is 107°C. Find the following for the initial state: Dryness fraction, specific entropy, and specific volume, mass of liquid and mass of vapour. 5

(ii) What are the assumptions made for air standard cycle? 5

6. (a) The dry products of combustion of hydrocarbon fuel have the following Orsatanalysis: 0.8% CO_2, 1% CO, 8.8% 0_2 and 82.2% N_2. Determine the actual as well as theoretical air fuel ratio. The formula for hydrocarbon is of the form CxHy. Take molecular weight of air as 28.95. 10

(b) (i) Draw p-V and T -S diagrams of Atkinson cycle and Stirling cycle, state the processes 5

(ii) Explain higher and lower calorific values. 5
