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## P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2016/Jan - 2017

### Thermodynamics

Time: 3 hrs

Max. Marks: 100

- Note:** i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.  
 ii) Assume suitably missing data, if any.  
 iii) Use of Thermodynamic data hand book is permitted.

#### UNIT - I

- 1 a. Explain the terms : 6  
 State, Process and Property.
- b. Distinguish between : 6  
 i) Closed system and Open system      ii) Macroscopic and Microscopic properties  
 iii) System and Surrounding.
- c. A Centigrade and Fahrenheit thermometers are both immersed in a fluid and the numerical reading recorded on both the thermometer is same. Determine the temperature of the fluid expressed as  $K$  and  $R$  and also find that identical numerical value shown by the thermometer. 8
- 2 a. Derive an expression for displacement work in a, 10  
 i) Constant volume process    ii) Constant temperature process    iii) Polytrophic process.
- b. An aero plane of 30 tons mass travelling at 1000 km/hour. How much is its K.E. in kWh? If this aero plane rises vertically upwards at this speed with power off and in vacuum where average  $G = 9.81 \text{ m/s}^2$  through what vertical distance will it move? 10

#### UNIT - II

- 3 a. State and explain the first law of thermodynamics for a closed system undergoing cyclic and non-cyclic processes. 10
- b. Explain the concept of internal energy and show that it is a thermodynamic property of the system and it is a point function. 10
- 4 a. Derive steady flow energy equation stating the assumption made. 8
- b. A Centrifugal pump delivers 60 kg of water per second. The inlet and outlet pressure are 10 kPa and 400 kPa respectively. The suction is 2 m below and delivery is 8 m above the centerline of the pump. The suction and delivery pipe diameter are 20 cm and 10 cm respectively. Determine the capacity of the electric motor to run the pump. 12

#### UNIT - III

- 5 a. Define the two statements of II laws of thermodynamics. 4

- b. What are the limitations of I law of thermodynamics and define heat pump and heat engine. 6
- c. Define irreversibility and mention the factors which render a process irreversible. 10
- 6 a. Describe the working of a Carnot cycle and derive an expression for its thermal efficiency. 8
- b. Two Carnot engines are working in series between a source and a sink. The first engine receives heat from a reservoir at a temperature of 1000K and rejects the waste heat to another reservoir at the temperature  $T_2$ . The second heat engine receives the heat energy rejected by the first engine. It converts some of the energy into useful work and rejects the rest to a reservoir at temperature of 300 K. 12
- i) If both engines delivers equal power. Determine the efficiency of the each engine
- ii) If the thermal efficiency of both engines are same. Determine the intermediate temperature.

#### UNIT - IV

- 7 a. Obtain an expression for air standard efficiency of a Diesel cycle. 10
- b. Air in a piston-cylinder device of bore = 200 mm and stroke = 300 mm and a clearance volume = 7% of the stroke volume undergoes a diesel cycle. The pressure and temperature of air at the beginning of compression are 1 bar and 27°C. The maximum temperature in the cycle is 1900 K. Calculate; 10
- i) Compression ratio    ii) Cutoff ratio    iii) Heat transferred to the air in kJ/kg
- iv) Heat transferred from the air in kJ/kg    v) cycle efficiency.
- 8 a. Show that intermediate pressures in the two stage air compressor with a perfect inter cooling is a geometric mean with initial and final pressure. 10
- b. Explain the working principle of reciprocating compressor. 6
- c. What are the advantages of multi-staging? 4

#### UNIT - V

- 9 a. What are the different properties required for a good refrigerant? 10
- b. Define and explain : 10
- i) Dry bulb temperature    ii) Wet bulb temperature    iii) Humidity ratio
- iv) Dew point temperature    v) Relative humidity.
- 10 a. Explain the working principle of vapour compression refrigeration system with a neat diagram and also plot the same on P-h and T-S diagram. 8
- b. Explain how air washer can be used for the following processes with a diagram. Indicate the processes on the psychometric chart. 12
- i) Heating and humidification    ii) Cooling an Humidification
- iii) Cooling    iv) Cooling and Dehumidification.