

MAY-2007

## **2007-HIMACHAL PRADESH UNIVERSITY**

**B.E/B.TECH III SEMESTER DEGREE EXAMINATION**

**BASIC MECHANICAL ENGINEERING**

**(MECHANICAL ENGINEERING)**

PAPER ID : ME-1003

TIME-3 HOUR  
MARK-100

**NOTE: ANSWER ALL QUESTIONS**

### **SECTION-A [10\*8=80]**

1. 0.9Kg of gas at 1 bar and 15°C is compressed isentropically to 4 bar. The volume changes from 0.75 m<sup>3</sup> to 0.28- m<sup>3</sup>. Find the value of gas constant and specific heat at constant pressure. Also find change in internal energy.
2. Air compressor takes in air at 1 bar and 20°C and discharges into a line of inside diameter 10 mm at pressure 3 bar with velocity 7.7 ms<sup>-1</sup>. The compression is isentropic, calculate the work input assuming the inlet velocity to be very small.
3. State the Kelvin Planck and Clausius statements of the second law of thermodynamics and prove their equivalence.
4. A reversible heat engine is supplied 900 K J of heat from a heat source at 500K. The engine develops 500K J of net work and rejects heat to two heat sinks at 400K and 300K. Determine the engine thermal efficiency and magnitude of heat interaction with each of the sink.
5. A metallic bar of 50 mm diameter is subjected to a tensile load of 100 kN. The extension over its 300 mm length was found to be 0.08 mm and change of its diameter was 0.0035 mm. Determine the modulus of rigidity of the bar material.
6. A simply supported beam is loaded. Draw the shear force and bending moment diagrams and determine the maximum bending moment along with its location.
7. A beam is of square section of side 'a'. if the maximum allowable bending stress is  $V$ , find the moment of resistance when the beam section is placed such that
  - i) two sides are horizontal
  - ii) one diagonal is vertical
8. Two shafts of the same material and same length, one solid and the other hollow are to be designed for transmission of torque. The ratio of diameters in case of hollow shaft is to be 0.75. If the two shafts have to carry the same maximum stress, calculate the saving in weight in case of hollow shaft.

### **SECTION-B [10\*2=20]**

9. Attempt the following questions:
  - a) Define enthalpy. How is it related to internal energy?
  - b) State the limitations of first law of thermodynamics.
  - c) Explain what you understand by the term 'free expansion'.
  - d) What is the difference between adiabatic process and isentropic process?
  - e) State the third law of thermodynamics.
  - f) Define coefficient of performance.
  - g) State the difference between heat engine and heat pump.
  - h) Define internal energy. Is it a state function or process function?
  - i) Define an isolated system.
  - j) What is perpetual motion machine of second order? Why such a machine cannot be made in actual practice?