

Printed Pages: 02

ME201

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**B TECH**  
**(SEM-II) THEORY EXAMINATION 2017-18**  
**ENGINEERING MECHANICS**

**Time: 3 Hours****Total Marks: 100**

- Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.  
 2. Use of steam table and Mollier diagramis permissible.

**SECTION A**

1. **Attempt all questions in brief.** **2 x 10 = 20**
- a. What is meant by quasi-static process?
  - b. Explain, how the Zeroth law of thermodynamics can be used for temperature measurement.
  - c. Differentiate between open system and closed system.
  - d. Define heat engine and heat pump.
  - e. Using second law of thermodynamic show that free expansion is an irreversible process.
  - f. Define entropy. Also explain how it is a measure of irreversibility.
  - g. What is meant by Mollier diagram? Explain.
  - h. Define Neutral axis and pure bending.
  - i. Define pure torsion and torsional rigidity.
  - j. Define stress and how it is different from pressure.

**SECTION B**

2. **Attempt any three of the following:** **10 x 3 = 30**
- a. In an unknown temperature scale freezing point of water is  $0^{\circ}X$  and boiling point of water is  $1000^{\circ}X$ . Obtain a conversion relation between degrees X and degree Celsius. Also determine the absolute zero in degree X.
  - b. Derive steady flow energy equation .  
An air compressor requires shaft work of 200 kJ/kg of air and the compression of air causes increase in enthalpy of air by 100 kJ/kg of air. Cooling water required for cooling the compressor picks up heat of 90 kJ/kg of air. Determine the heat transferred from compressor to atmosphere.
  - c. Give a neat sketch of “separating and throttling calorimeter “for dryness fraction measurement. Determine enthalpy, specific volume, entropy for mixture of 10% quality at 0.15 MPa
  - d. A bar 3 m long is made of two bars one of copper having  $E=105 \text{ GN/m}^2$  and other of steel having  $E=210 \text{ GN/m}^2$ . Each bar is 25 mm broad and 12.5 mm thick. This compound bar is stretched by a load of 50kN. Find the increase in length of the compound bar and stress produced in the steel and copper. The length of copper as well as of steel bar is 3m each.
  - e. If stresses on two perpendicular planes through a point are  $60 \text{ N/mm}^2$  tension,  $40 \text{ N/mm}^2$  compressions and  $30 \text{ N/mm}^2$  shear stress, find the stress component and resultant stress on a plane at  $60^{\circ}$  to that of the tensile stress.

## SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Explain the concept of continuum. What do you understand by macroscopic and microscopic viewpoint?
  - (b) A vessel of 5 m<sup>3</sup> capacity contains air at 100 kPa and temperature of 300K. Some air is removed from vessel so as to reduce pressure and temperature to 50 kPa and 7°C respectively. Find the amount of air removed and volume of this mass of air at initial states of air. Take R = 287 J/kg.K for air.
4. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Show the equivalence of two statements of 2nd law of thermodynamics.  
A domestic refrigerator maintains temperature of – 8°C when the atmospheric air temperature is 27°C. Assuming the leakages of 7.5 kJ/min from outside to refrigerator determine power required to run this refrigerator. Consider refrigerator as Carnot refrigerator.
  - (b) Define entropy and discuss the significance of clausiusinequality.  
During a free expansion 2 kg air expands from 1 m<sup>3</sup> to 10m<sup>3</sup> volume in an insulated vessel. Determine entropy change of (a) the air (b) the surroundings (c) the universe.
5. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Differentiate between SI and CI engine and Two stroke and Four stroke engine
  - (b) A gas engine working on the Otto cycle has a cylinder of diameter 200mm and stroke 250 mm. The clearance volume is 1570 cc. Find the air standard efficiency. Assume  $C_p = 1.004 \frac{kJ}{kgK}$  and  $C_v = 0.717 \frac{kJ}{kgK}$
6. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Sketch the stress strain curve for ductile material and Brittle material and explain its salient features.
  - (b) Derive the Bending equation and state the assumption made while deriving the bending equation.
7. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Derive the Torsion equation state the assumption made while deriving the bending equation.
  - (b) Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being the half the external diameter. Both the shaft have the same material and length.