

# Question Paper 2016

## Mechanical Engineering (Paper II)

1. (a) Draw and explain the P-T (Pressure-Temperature) diagram for a pure substance. (15)  
(b) With the assumptions, derive the Steady Flow Energy Equation SFEE. (15)  
(c) A system receives 50 kJ of heat while expanding with volume change of  $0.14 \text{ m}^3$  against an atmosphere of  $1.2 \times 10^5 \text{ N/m}^2$ . A mass of 90 kg in the surrounding is also lifted through a distance of 5.5 m.
  - (i) Calculate the change in energy of the system
  - (ii) The system is returned to its Initial volume by an adiabatic process which requires 110 kJ of work. Find the change in energy of the system.
  - (iii) For the combined processes of (i) and (ii), calculate the change in energy of the system. (15)
- (d)
  - (i) Define the second law of thermodynamics using Clausius and Kelvin-Planck statements.
  - (ii) Describe the working of the Carnot cycle. (15)
  - (iii) What do you mean by the term 'Entropy'? (15)
2. (a) With the help of P-V and T-S diagrams derive the thermal efficiency expression for air standard Otto cycle. (15)  
(b) An air standard Diesel cycle has a compression ratio of 14. The air conditions before compression are 1 bar and  $27^\circ\text{C}$ . The maximum temperature of the cycle is  $2500^\circ\text{C}$ . Determine the
  - (i) temperature and pressure at salient points of the cycle.
  - (ii) network output per unit mass of air
  - (iii) thermal efficiency. (15)
- (c) Derive the network output and thermal efficiency expressions for a simple Rankine cycle with schematic and T-S diagrams. (15)  
(d) Give the differences between fire tube and water tube boilers with examples. (15)
3. (a) Define the following (15)
  - (i) Steady and Unsteady flow
  - (ii) Uniform and Non-uniform flows
  - (iii) Laminar and Turbulent flows
  - (iv) Compressible and Incompressible flows
  - (v) Rotational and Irrotational flows
- (b) A U tube manometer is used to measure the pressure of water in a pipeline, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to the atmosphere. The contact of water and mercury is in the left limb. Calculate the pressure of water in the main line. If the difference in the level of mercury in the limbs of the U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. (15)
- (c) What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? (15)  
(d) Give the differences between impulse turbine and reaction turbine. (15)
4. (a) Explain the following terms. (15)
  - (i) Angle of repose
  - (ii) Angle of friction
  - (iii) Cone of friction
- (b) A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm.

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- Calculate (15)
- (i) Stress at elastic limit
  - (ii) Young's modulus
  - (iii) Percentage reduction in area
  - (iv) Percentage elongation
  - (v) Ultimate tensile stress
- (c) Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. (15)
- (d) A cantilever of length 2 m carries a uniformly distributed load of 2 kN/m length over the whole length and a point load of 3 kN at the free end. Draw the shear force and bending moment diagrams. (15)
5. (a) Derive the condition for transmitting the maximum power in a belt drive. (15)
- (b) With the help of a diagram define the terminologies of a gear. (15)
- (c) Explain the term height of the governor. Derive an expression for the height in the case of watt governor. (15)
- (d) Write short notes on cams and followers. (15)
6. (a) With the help of diagrams explain the different types of flames obtained in the oxy acetylene welding process. Also give the advantages and disadvantages of oxy acetylene gas welding.
- (b) Briefly explain the different types in the casting process and their remedies. (15)
- (c) Explain the different taper turning methods used in the Lathe machine tool. (15)
- (d) With the help of a diagram, explain two different method of the milling process. (15)