

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SECOND SEMESTER M. TECH DEGREE EXAMINATION, MAY 2016

**Mechanical Engineering**

**(Machine Design)**

**04ME 6504 DESIGN ENGINEERING**

Max. Marks: 60

Duration: 3 Hours

*Use of approved design data handbooks are permitted*

**PART A**

*Answer All Questions*

*Each question carries 3 marks*

1. Explain the considerations of a good design.
2. What is creep? Define and explain laws of creep.
3. What are residual stresses? Explain any one method to determine residual stresses.
4. Write short notes on "Design for Assembly".
5. Explain deflection of shaft by conjugate beam method.
6. What are polydyne cams?
7. Explain reliability function, hazard rate and failure rate.
8. How can the aesthetics requirements be met with in industrial product design.

**PART B**

*Each question carries 6 marks*

9. Explain in detail the discrete steps in engineering design process.

**OR**

10. Explain in detail the organization for design.

11. Explain about the Griffith's crack theory of fracture.

**OR**

12. An 18 per cent chromium and 8 per cent nickel steel at 1500 °F had the following creep rates

$$\sigma_1 = 3000 \text{ psi} \qquad \dot{\epsilon}_1 = 0.128 \text{ per cent per } 1000 \text{ h}$$

$$\sigma_2 = 4000 \text{ psi} \qquad \dot{\epsilon}_2 = 0.644 \text{ per cent per } 1000 \text{ h}$$

(a.) Determine the constants of the hyperbolic sine law, and the creep rate for a stress of 1500 psi

(b.) Determine the creep rate by the exponential law, and the creep rate at 1500 psi; and compare with the rate of part (a.).

13. Explain in detail on "Design for wear and corrosion resistance".

**OR**

14. A Belleville spring is made of silicon steel. The spring is compressed completely flat when it is subjected to an axial force of 4500 N. The corresponding maximum stress is  $1375 \times 10^6 \text{ N/m}^2$ . Assume,  $d_o/d_i = 1.75$  and  $h/t = 1.5$ . Calculate (i.) thickness of the washer; (ii.) free height of the washer minus thickness (h); (iii.) outer diameter of the washer; (iv.) inner diameter of the washer.

15. Explain in detail the salient features used for “Design for Forgings”.

**OR**

16. In designing a product for casting, what are the various factors to be considered? Can any alternate process than casting be thought of? If so, when can a change in process be considered?

17. A hollow shaft of 0.5 m outside diameter and 0.3 m inside diameter is used to drive a propeller of a marine vessel. Shaft is mounted on bearings 6 m apart and it transmits 5600 kW at 1500 rpm. Maximum axial propeller thrust is 500 kN and shaft weighs 70 kN. Determine (i.) maximum shear stress developed in the shaft; (ii.) angular twist between the bearings

**OR**

18. Sketch the dynamical model for a polydyne cam and derive an expression for the cam displacement

19. What is reliability? Explain in detail the different techniques employed in improving the reliability.

**OR**

20. Explain the various hazard rate models.