

Seat  
No.

--	--	--	--	--	--



मासला - 006

## Machine Design (1030)

P. Pages : 2

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Neat diagrams must be drawn whenever necessary.
5. Figures to the right indicate full marks.
6. Use of electronic pocket calculator is allowed.
7. Assume suitable data, if necessary.

### SECTION - I

1. a) State and explain maximum principal stress theory of failure. Where do you use this theory ? 5  
b) Explain the effect of small inelastic strains on load carrying capacity of component. 5  
c) Determine the size of the contact patch and the maximum contact stresses for a 20mm diameter steel ball rolled against a 30mm diameter aluminium ball with 800 N. Show the pressure distribution and contact zones of spherical contact. 6
2. a) State and explain the Paris equation for approximating crack growth. 4  
b) Explain three different modes of fracture with neat diagrams. 6  
c) Calculate the stress concentration at the tip of an elliptical crack having major and minor radii  $a = 100$  nm and  $b = 1$  nm. 6
3. a) "Fatigue cracks usually start on the surface". Justify. How designers make use of this statement in improving fatigue life of component ? 5  
b) Explain the creep behavior with suitable strain load duration and strain rate - load duration curves. 6

- c) An additional constant tensile load of 11.2kN is be applied to a rotating factue specimen where fluctuating bending stress is 280 MPa,  $S_y = 560\text{MPa}$ ,  $S_u = 700\text{MPa}$ ,  $S_e = 350\text{MPa}$ . Based on modified Goodman criteria, find whether or not the design is safe.

7

### SECTION - II

4. a) Explain the theory of component failures derived from the interaction of stress and strength distributions. Explain how this theory relates to the behavior of the component hazard function. 6
- b) Explain following terms as related to reliability engineering. 6
- Mean Time to Failure (MTTF)
  - Mean Time Between Failures (MTBF)
  - Mean Time To Repair (MTTR)
  - Availability (A)
- c) Suppose that a unit has a design - life reliability of 0.95. 6
- Estimate the reliability if two of these units are put in active parallel and there are no common - mode failures.
  - Estimate the maximum fraction of common failures that is acceptable if the parallel units in (i) are to retain a system reliability of at least 0.99.
5. a) State and explain various types of fiber - reinforced composite. 5
- b) State and explain the equations for upper and lower bound to the elastic modulus of a composite. 5
- c) The elastic constants of a  $0^\circ$  unidirectional carbon fiber reinforced PEEK lamina are  $E_{11} = 132.2\text{GPa}$ ,  $E_{22} = 4.90\text{GPa}$  and  $\nu = 0.35$ . Write the compliance and stiffness matrices for the same material if the fiber orientation angle is i)  $30^\circ$  ii)  $60^\circ$  iii)  $90^\circ$ . 6
6. a) Explain fault tree analysis (FTA) by giving suitable example. 4
- b) State and explain the guidelines for design for safety. 6
- c) State and explain with suitable examples design guidelines for manufacture (DFM). 6

\*\*\*\*\*