

2125
M.E. (Mechanical Engineering)
Third Semester
MME-301: Advanced Machine Design

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, selecting atleast two questions from each Section. Assume suitably the missing data. All questions carry equal marks.

x-x-x

Section – A

1. What are the primary considerations in selecting materials for machine elements. Also, discuss the impact of surface finish, tolerances, and fits on the reliability and performance of mechanical components.
2. Explain the concept of endurance limit and factors influencing it. Compare the Goodman, Soderberg, and Gerber criteria for fatigue design under fluctuating stresses.
3. A crowned cam roller-follower has a gentle radius transverse to its rolling direction to eliminate the need for critical alignment of its axis with that of the cam. The cam's radius of curvature and dynamic load vary around its circumference. What is the size of the contact patch between cam & follower and what are the worst-case stresses. The roller radius is **1 in** with a **20-in** crown radius at **90°** to the roller radius. The cam's radius of curvature at the point of maximum load is **3.46 in** and it is flat axially. The rotational axes of the cam and roller are parallel, which makes the angle between the two bodies zero. The force is **250 lb**, normal to the contact plane. **Assumptions to be used:** Materials are steel. The relative motion is rolling with **<1 %** sliding.
4. Discuss the nature and propagation of longitudinal stress waves in elastic media during impact loading. Also, explain the complete mechanism of torsional impact on circular shafts.

Section – B

5. (a) Explain how vibration-based design can be used to improve machine performance in brief.
(b) Describe the steps involved in structural dynamic modification and illustrate with an example of a drilling machine. (4,6)
6. Define thermal stresses. How do time-dependent properties such as creep and stress relaxation affect the design of components operating at high temperature.

P.T.O.

(2)

7. A set of bearings in a gearbox follows a Weibull distribution with parameters having Shape parameter $\beta = 1.8$ and Scale parameter $\eta = 4000$ hours

Find: (i) Reliability at 2000 hours

(ii) The time corresponding to 90% reliability

(iii) Mean time to failure (MTTF).

8. (a) Define Design vector, Design constraints, and Objective function.

(b) Describe the multi-objective optimization process in detail using the response surface method (RSM) for a mechanical design problem

(3, 7)

x-x-x