

Ganpat University
M.Tech. (CAD/CAM) SEM-I Examination January 2013
3ME114 - Advanced Machine Design and Dynamics

Total Marks: 70

Duration: 3 hrs

Instructions:

1. Assume suitable data if necessary
2. Use of design data book is permitted.
3. Write your answer precisely and to the point.

SECTION-I

Q.1 (a) Derive equation for over damped vibration system with figure. Also draw and explain phase plane diagram for all damped type vibration system. [08]

(b) What is importance of phase plane diagram in vibration? Explain it for undamped free vibration system. [04]

OR

Q.1 (a) The foundation of a reciprocating engine is subjected to harmonic motion in x and y direction: [08]

$$x(t) = X \cos \omega t, \quad y(t) = Y \cos(\omega t + \phi)$$

Where X and Y are the amplitudes, ω is the angular velocity, and ϕ is the phase difference. Verify that the resultant of the two motions satisfies the equation of the ellipse given by

$$\frac{x^2}{X^2} + \frac{y^2}{Y^2} - \frac{2xy}{XY} \cos \phi = \sin^2 \phi$$

(b) How many arbitrary constants must a general solution to a second-order differential equation have? How are those constants determined? [04]

Q.2 (a) Explain the fundamental of Non-linear vibration system with any two examples. [06]

(b) What is the concept of Vibration Absorber? Derive the equation for Undamped Dynamic Vibration Absorber with figure. [06]

OR

Q.2 (a) What is importance of pointcare' map? Explain the concept of bifurcation and orbit in nonlinear vibration system. [06]

(b) A motor generator set is designed to operate in speed range of 2000 to 4000 r.p.m. Its natural frequency is found to be near to the 3000 r.p.m. When a cantilever carrying a trial mass of 2 Kg is tuned at this speed, the resulting natural frequencies are found to be 2500 r.p.m and 3500 r.p.m. Design vibration absorber so that the natural frequencies of the total system fall outside the operating speed of the set. [06]

Q.3 Attempt any two questions. [11]

(a) State and explain challenges of product development process

(b) Write a short note on point care' map.

(c) Explain the concept of critical damped vibrating system.

SECTION-II

- Q.4 (a) What is reliability? Explain the reliability on the basis of time of survival and based on strength. [04]
- (b) A simply supported beam of a square cross-section has a span of 2m. It carries a centrally concentrated load of (6, 0.2) KN. The yield stress for a material is (220, 20) MPa. Design the beam for a reliability of 98% when statistical factor of safety $n = 1.1$. [08]

OR

- Q.4 (a) Explain the Robert Lasser bath tub curve with neat sketch. [04]
- (b) A beam with square cross section is simply supported over a span of 3 m and carries a constant concentrated load of (10, 0.5) KN. The yield strength of the material (300, 25) MPa. Design the beam of 95% reliability. [08]
- Q.5 (a) Explain the procedure to design the mechanical component based on the creep. [03]
- (b) A support rod in a boiler carries a constant tensile stress of 68 MPa. The rod is made of medium carbon steel for which following data are available. [08]

Strain rate (hr^{-1}), α	Stress (MPa), σ	Temperature ($^{\circ}\text{C}$)
5×10^{-3}	136	540
5×10^{-7}	41	540

Calculate the life time of the rod at 540°C before it elongates by 10%.

OR

- Q.5 (a) Define stress concentration. Explain different factors for correcting endurance limit in brief. [03]
- (b) The work cycle of a mechanical component subjected to completely reversed bending stress consists of the following three elements: [08]
1. $\pm 300 \text{ N/mm}^2$ for 70 % of the time.
 2. $\pm 200 \text{ N/mm}^2$ for 20 % of the time.
 3. $\pm 50 \text{ N/mm}^2$ for remaining time.

The material for the component has 600 MPa ultimate strength and corrected endurance limit is 350 MPa. Determine the life of the component.

- Q.6 **Attempt any three questions.** [12]
- (a) What is profilometry? Discuss the profilometer to measure the surface roughness.
- (b) Define c.l.a. and r.m.s. How are they useful in contact of rough surfaces?
- (c) Write short note on sliding friction.
- (d) Explain factors affecting on wear behavior.
- (e) Test oil viscosity at $40^{\circ}\text{C} = 10 \text{ cs}$ and test oil viscosity at $100^{\circ}\text{C} = 2 \text{ cs}$ for the Gulf coast oil, the viscosity at $40^{\circ}\text{C} = 20 \text{ cs}$ and for the Pennsylvanian oil, the viscosity at $40^{\circ}\text{C} = 5 \text{ cs}$. Find out the viscosity index for the test oil.

End of Paper