

Roll No

MMPD-102**M.E/M.Tech., I Semester**

Examination, June 2013

Advance Machine Design*Time : Three Hours***RGPVONLINE.COM****Maximum Marks : 70**

Note: Attempt any five questions.
Missing data if any may be assumed suitably.
All questions carry equal marks.
Usage of Design data book is permitted.

1. a) Explain various theories of failure graphically.
- b) A transmission shaft of cold drawn steel 27Mn2 ($S_{ut}=500\text{N/mm}^2$ and $S_{yt}=300\text{N/mm}^2$) is subjected to a fluctuating torque which varies from -100 N-m to + 400 N-m. The factor of safety is 2 and the expected reliability is 90%. Neglecting the effect of stress concentration, determine the diameter of the shaft.
Assumes the distortion energy theory of failure.

OR

2. a) Define creep and explain the characteristic creep curve for a ductile material.
- b) An edge cracked beam carries a crack of 5 mm length in its central plane. A load of 1000 kg is applied opposite to the crack so that the crack would tend to open due to bending. Calculate the SIF (K) of crack if the beam has the following dimensions.
Depth of beam (w) = 25 mm
Thickness (t) = 10 mm and

Span (s) = 100 mm

If two loads of 50 kg each are placed at 25mm from central plane, What would SIF of crack?

3. a) What are different methods of wear measurement? Explain in brief.
- b) A solid circular shaft, 15mm in diameter, is subjected to torsion shear stress, which varies from 0 to 35 N/mm² and at the same time, is subjected to an axial stress that varies from 15 to 30 N/mm². The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of steel FeE 400 ($S_{ut}=540$ N/mm² and $S_{yt}=400$ N/mm²) and the corrected endurance limit of the shaft is 200 N/mm². Determine the factor of safety.
4. a) A 3600 hydrodynamic bearing operates under the following conditions :

Radial load	= 50 KN
Journal diameter	= 150 mm
Bearing length	= 150 mm
Radial clearance	= 0.15 mm
Minimum film thickness	= 0.03 mm
Viscosity of lubricant	= 8 cP

 What is the minimum speed of operation for the journal to work under hydrodynamic conditions?
- b) A flat spiral spring is required to provide a maximum torque of 1000 N-mm. It is made of steel strip ($E = 207\,000$ N/mm²) and the maximum bending stress in the strip should not exceed 750 N/mm². The ratio of width to thickness of the strip is 10. The spring turns through 2.5 revolutions with respect to the retaining drum to provide the required torque.
Calculate the thickness, width and length of strip.

5. a) A transmission shaft is supported between two bearings, which are 750 mm apart. Power is supplied to the shaft through a coupling, which is located to the left of the left hand bearing. Power is Transmitted from the diameter, which is located at the distance of 200mm to the right of the left hand bearing. The weight of the pulley is 300N and the ratio of the belt tension of tight and slack sides is 2:1. The belt tensions act in vertically downward direction. The shaft is made of steel FeE 300 ($S_{yt}=300$ N/mm²) and the factor of safety is 3. Determine the shaft diameter, if it transmits 12.5 kW power at 300 rpm from the coupling to the pulley. Assume ($S_{sy} = 0.5S_{yt}$)
- b) A pair of spur gears with 20° pressure angle consists of a 25 teeth pinion meshing with a 60 teeth gear. The module is 5 mm, while the face width is 45 mm, the pinion rotates at 500 rpm. The gears are made of steel and heat treated to a surface hardness of 220 BHN. Assume that dynamic load is accounted by means of the velocity factor. The service factor and the factor of safety are 1.75 and 2 respectively. Calculate
 - i) Wear strength of gears
 - ii) The static load that the gears can transmit without pitting; and
 - iii) Rated power that can be transmitted by gears.
6. It is required to design a two-stage spur gear reduction unit with 200 full-depth involute teeth. The input shaft rotates at 1440 rpm and receives 10 kW power through a flexible