

Total No. of Questions : 10]

SEAT No. :

P4007

[Total No. of Pages : 4

[4860] - 103

**M.E. (Mechanical) (Design Engineering)**

**ADVANCED MACHINE DESIGN**

**(2008 Pattern) (Revised)**

*Time : 3 Hours]*

*[Max. Marks : 100*

*Instructions to the candidates :*

- 1) *Answer any three questions from each section.*
- 2) *Answers to the two sections should be written in separate books.*
- 3) *Neat diagram must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of logarithmic tables, calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

**SECTION - I**

- Q1)** a) Give the design procedure of helical spring for minimum weight. [6]
- b) A semi-elliptic multi-leaf spring is used for the suspension of vehicle. It consists of two extra full-length leaves & ten graduated - length leaves including the master leaf. The centre-to-centre distance between the spring eyes is 1.2m. The leaves are made of steel ( $S_{yt} = 1500 \text{ N/mm}^2$ ) and ( $E = 207000 \text{ N/mm}^2$ ); Use factor of safety is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are prestressed so as to equalize stresses in all leaves. Determine ; [10]
- i) The cross section of leaves.
  - ii) The deflection at the end of spring.

**P.T.O.**

- Q2)** a) What is the cumulative fatigue damage? How the life of component subjected to different values of fluctuating stresses in cycle is estimated. [6]
- b) A transmission shaft carries a pulley midway between the two bearings. The bending moment of the pulley varies from 200 Nm to 600Nm, as the torsional moment in the shaft varies from 70 Nm to 200 Nm. The frequencies of variation of bending & torsional moments are equal to the shaft speed. The shaft is made of steel ( $S_{at} = 540 \text{ N/mm}^2$  &  $S_{yt} = 400 \text{ N/mm}^2$ ). The corrected endurance limit of the shaft is  $200 \text{ N/mm}^2$ . Determine the diameter of the shaft using a factor of safety of 2. [10]
- Q3)** a) Estimate the procedure for estimating the life of member subjected to creep. [8]
- b) Explain the following terms in context to creep. [8]
- i) Stress relaxation.
- ii) Estimated time to rupture.
- Q4)** a) Write in short about composite material & increasing use of these materials in mechanical engineering with specific application. [6]
- b) A graphite fibre/epoxy composite contents 50.6% graphite fibre by volume. The graphite fibres are 12.7 micro meter in diameter & the modulus of elasticity in transverse direction is 13.79 GPa. The epoxy material has a corresponding value of 3.5 GPa. Evaluate the modulus of elasticity along principle axis. Comment on effect of temperature & presence of moisture on composite. [10]
- Q5)** Write short note on the following : [18]
- a) Design for manufacturing & assembly.
- b) Vibration & surging of helical springs.
- c) Design for fatigue failure.

## SECTION - II

- Q6)** a) Suggest a simple method of handling multiple objectives in an optimization problem. [6]
- b) In a light weight equipment shaft is transmitting a torque of 900 Nm & is to have a rigidity of 90 Nm/degree. Assume a factor of safety is 1.5 based on yield strength. Design a shaft with minimum weight. What will be the change in design for minimum cost. Assume max. shear stress theory of failure. Use following data. [10]

Material	Mass density (kg/m <sup>3</sup> )	Material cost/wt. (Rs/N)	Yield strength (MPa)	Shear modulus (GPa)
Alloy steel	8500	16	130	80
Al. alloy	3000	32	50	26.7
Titanium alloy	4800	480	90	40
Magnesium alloy	2100	32	20	16

- Q7)** a) What is need of profile corrections of gears. Explain how it is carried out. [6]
- b) Two 20° full depth gears of 20 and 30 teeth are to be designed on the extended centre distance system using the recommended values for clearance  $f = \left( \frac{0.25}{P_d} \right)$ . Make the calculations for  $P_d = 1$ . [10]

Find the following :

- The values of  $q_1$  and  $q_2$ .
- The actual pressure angle  $\phi$ .
- The radii of the actual pitch circles & centre distance.
- The tooth thickness on actual pitch circle.

- Q8)** a) Explain factorial design & regression analysis. [8]
- b) Prove that reliability w.r.t. time 't' is  $R(t) = \text{Exp} \left[ - \int_0^t h(t) \cdot dt \right]$ . [8]

**Q9)** a) Why 'I' section is selected for connecting rod of high speed I.C. Engine. [6]

b) Design a piston for single acting four stroke engine with following specifications : [10]

Cylinder bore	= 0.30 m
Stroke	= 0.375 m
Max gas pressure	= 8 MPa
Brake Mean effective pressure	= 1.15 MPa
Fuel consumption	= 0.22 kg/kW/hr
Speed	= 500 rpm

**Q10)** Write a short note on the following : [18]

- a) Analysis of variance (ANOVA)
- b) Multivariable search method.
- c) S and S<sub>o</sub> spur gears.

