[5155] - 7
M.E. (Mechanical) (Design Engineering)
ADVANCED MACHINE DESIGN
(2008 Pattern)

Time :3 hours]

[Max. Marks :100

Instructions to the candidates:
   1)   Answer any THREE questions from each section.
   2)   Answer three questions from section I and 3 questions from Section II.
   3)   Answers to the two sections should be written in separate books.
   4)   Neat diagrams must be drawn wherever necessary.
   5)   Figures to the right indicate full marks.
   6)   Use of logarithmic tables slide rule mollier charts electronic pocket calculator and steam tables is allowed.

SECTION 1

Q1) a)   Show with neat sketch various forces acting on inner & outer ring of ring spring with their equations. **[6]**

   b)   A disc spring is made at 3mm sheet with an outside diameter of 125 mm & an inside diameter of 50mm. The spring is dished to 4.5mm. The maximum stress to be 560 N/mm^2. Determine; **[10]**

      i)   load carrying capacity of spring

      ii)   The deflection at this load

      iii) Stresses produced at outer edge

Q2) a)   What are the factors influences the endurance limit of machine part? **[6]**

   b)   A machine component is subjected to two-dimensional stresses. The tensile stress in the X - direction varies from 40 to 100 N/mm^2, while the tensile stress in the y direction varies from 10 to 80 N/mm^2. The frequency of variation of these stresses is equal. The corrected endurance limit of the component is 270N/mm2. The ultimate tensile strength of the material of component is 660 N/mm^2. Determine factor of safety. **[10]**

Q3) a)   Explain the phenomena of creep. What is effect of temperature time & stress on it? How do you calculate permissible life under given stress?**[8]**

P.T.O.

b) A cantilever beam has a rectangular cross section 5cm wide and 9cm deep. The length of beam is 200 cm with a load of 12000 N on it at the end. The material is carbon steel with n = 7 and B = 40×10^{-39} (cm²/N)^n per day. Find permanent deflection after 10 years. **[8]**

Q4) a) Discuss in brief the classical lamination theory (CLT) using the assumptions of CLT, derive relations for the force & moment resultants in terms of mid. Surface strains & curvatures in a multilayered laminate.**[8]**

b) For a graphite epoxy unidirectional lamina, find the following. **[8]**

   i) Compliance matrix.

   ii) Minor poisson's ratio

   iii) Strains in 1-2 coordinate system, if the applied stresses are $\delta_1 = 2$ MPa, $\delta_2 = -3$ MPa, $\tau_{12} = 4$ MPa

   The engineering elastic constants of the unidirectional graphite/ epoxy lamina are.

   $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $V_{12} = 0.28$; $G_{12} = 7.17$ GPa

Q5) Write short notes on : **[18]**

   a) Transverse shear effects in composite laminates.

   b) Low cycle and high cycle fatigue

   c) Design for brittle fracture.

SECTION II

Q6) a) Explain the concept of 'Geometric programming' **[6]**

b) In a light weight equipment shaft is transmitting a torque of 900 N-M & 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 maximum shear stress theory of failure. Use following data. **[10]**

Material	Mass density (Kg/m3)	Material cost/wt. (Rs/N)	Yield strength (MPa)	Shear modulus (GPa)
M1	8500	16	130	80
M2	3000	32	50	26.7
M3	4800	480	90	40
M4	2100	32	20	16

Q7) a) Explain the term peaking & topping as applied to gear. **[6]**

b) Two 20° full depth gear at 20 & 30 teeth are to be designed on the basis of extended centre distance system using the recommended values for clearance $f = \left(\dfrac{0.25}{Pd}\right)$. Make the calculations for Pd = 1.

Find the following.

i) Values at q_1 and q_2

ii) The actual angle ϕ

iii) The radius of actual pitch circle & centre distance.

iv) The tooth thickness on actual pitch circle. **[10]**

Q8) a) Explain factorial design & regression analysis. **[8]**

b) If a device has a failure rate of 2×10^{-6} failure /hr, what is its reliability for an operating period of 500 hr? If there are 2000 components in the test, how many failures are expected in 500 hrs. ? Assume that strict quality constrol has eliminated premature failures, so we can assume a constant failure rate. **[8]**

Q9) a) Design the various design considerations for connecting rod at 1.c. engine. **[6]**

b) The bore diameter of 4 stroke diesel engine is 150 mm. The maximum gas pressure inside the cylinder is 3.5 MPa. The cylinder head is made of FG 200 (Sut = 200 N/mm²) and Fos is 5. Determine thickness of cylinder head.

Studs are used to fix the cylinder head to the cylinder & obtain a leakproof joint. They are made of steel FeE 250 (Sut = 250 N/mm²) and Fos is 5. Determine;

    i)   Number of studs,

    ii)   Nominal diameter of studs

    iii) Pitch of studs   **[10]**

Q10) Write short note on following;   **[18]**

    a)   Hybrid materials & applications

    b)   Multivariable search method

    c)   Design for fatigue failure

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