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No. of Printed Pages—4

ME—502

Seat No.

B. TECH

FIFTH SEMESTER EXAMINATION, 2002-2003

MACHINE DESIGN - I

Time : 2 Hours

Total Marks : 50

Note : (1) Answer ALL the questions.

(2) Missing data, if any, may be suitably assumed.

(3) Only Data Book is allowed related to design.

1. Answer any TWO of the following :— (6×2=12)

(a) (i) What do you understand by "Mechanical Engineering Design" ?

(ii) Explain the importance of aesthetic consideration in Machine Design.

(iii) What are Preferred Numbers ? How will you find the number belonging to R₁₀ series ?

(b) (i) What do you mean by the term "Mechanical properties of materials" ?

(ii) What is the main reason for the use of alloy steels in machine parts ?

(iii) Discuss the important non-metallic materials used in engineering practice.

(c) How will you designate the following materials :—

(i) Grey cast-iron with an ultimate tensile strength of 300 N/mm².(ii) Plain Carbon steel with a minimum tensile strength of 320 N/mm².

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(iii) Plain Carbon steel with a minimum yield strength of 200 N/mm^2 .

(iv) Alloy steel with composition :

Carbon = 0.35% to 0.45 %

Chromium = 0.9% to 1.20%

(v) Plain Carbon steel with 0.4% carbon and 0.8% manganese.

(vi) Cast steel with a minimum tensile strength of 450 N/mm^2 and a yield strength of 230 N/mm^2 .

2. Answer any TWO of the following :— (6×2=12)

(a) A cylindrical shaft, made of steel of yield strength 760 MPa , is subjected to static load consisting bending moment of 15 kN-m and a torsional moment 25 kN-m . Determine suitable diameter of shaft using maximum shear stress theory and maximum strain energy theory, assuming a factor of safety 2.5.

(Take $E = 200 \text{ GPa}$ & Poisson's ratio = 0.25)

(b) A solid shaft of steel Fe 620 ($S_{ut} = 620 \text{ N/mm}^2$ and $S_{yt} = 380 \text{ N/mm}^2$) is subjected to an alternating torque, which varies from -200 N-m to $+400 \text{ N-m}$. The shaft is ground and the expected reliability is 90%. Neglecting stress concentration, calculate the shaft diameter for infinite life. The factor of safety is 2.5. Use the distortion energy theory of failure.

(c) (i) Define and differentiate between failure stress, design stress and working stress.

- (ii) What is meant by "Stress Concentration"? How do you take it into consideration in case of a component subjected to dynamic loading ?
- (iii) What information do you obtain from "Soderberg diagram" ?

3. Answer any TWO of the following :— (6.5×2=13)

- (a) Design a double riveted butt joint with two cover plates for longitudinal seam boiler shell, 0.75 m diameter, to carry a maximum steam pressure of 1.55 N/mm². Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa, compressive stress in plate and rivet 140 MPa, and shear stress in the plate and rivet 56 MPa.
- (b) Design the rectangular key for a shaft of 75 mm diameter. The shearing and crushing stresses for key material are 50 MPa and 75 MPa respectively.
- (c) (i) What are the various modes in which a riveted joint may fail ?
- (ii) What are the assumptions made in the design of welded joint ?
- (iii) What are the advantages of flexible coupling ? How do you classify flexible coupling ?

4. Answer any TWO of the following :— (6.5×2=13)

- (a) Design a spring for a boiler safety valve of 60 mm diameter required to blow off at a steam pressure of 1.25 N/mm². The initial compression of spring is 40 mm and lift is limited to 20 mm. The maximum shear stress

in the material of wire is limited to 600 MPa. The modulus of rigidity for spring material is 85 kN/mm^2 . Take spring index = 6.

- (b) A double-threaded power screw, with metric trapezoidal thread, is used to raise a load of 400 kN. The nominal diameter is 100 mm and the pitch is 12 mm. The coefficient of friction at screw thread is 0.15. Neglecting collar friction, design the power screw and calculate the torque required to raise and to lower the load and also find the efficiency of the screw.
- (c) Explain any *Two* of the following :—
- (i) Give the design procedure for the design of compressive spring of an I.C. Engine. Indicate the procedure for checking of this spring for buckling.
 - (ii) Give, in detail, the design procedure for the design of a leaf spring of an automobile.
 - (iii) Show that if the power screw is to be self-locking, its efficiency can not be more than 50 %.