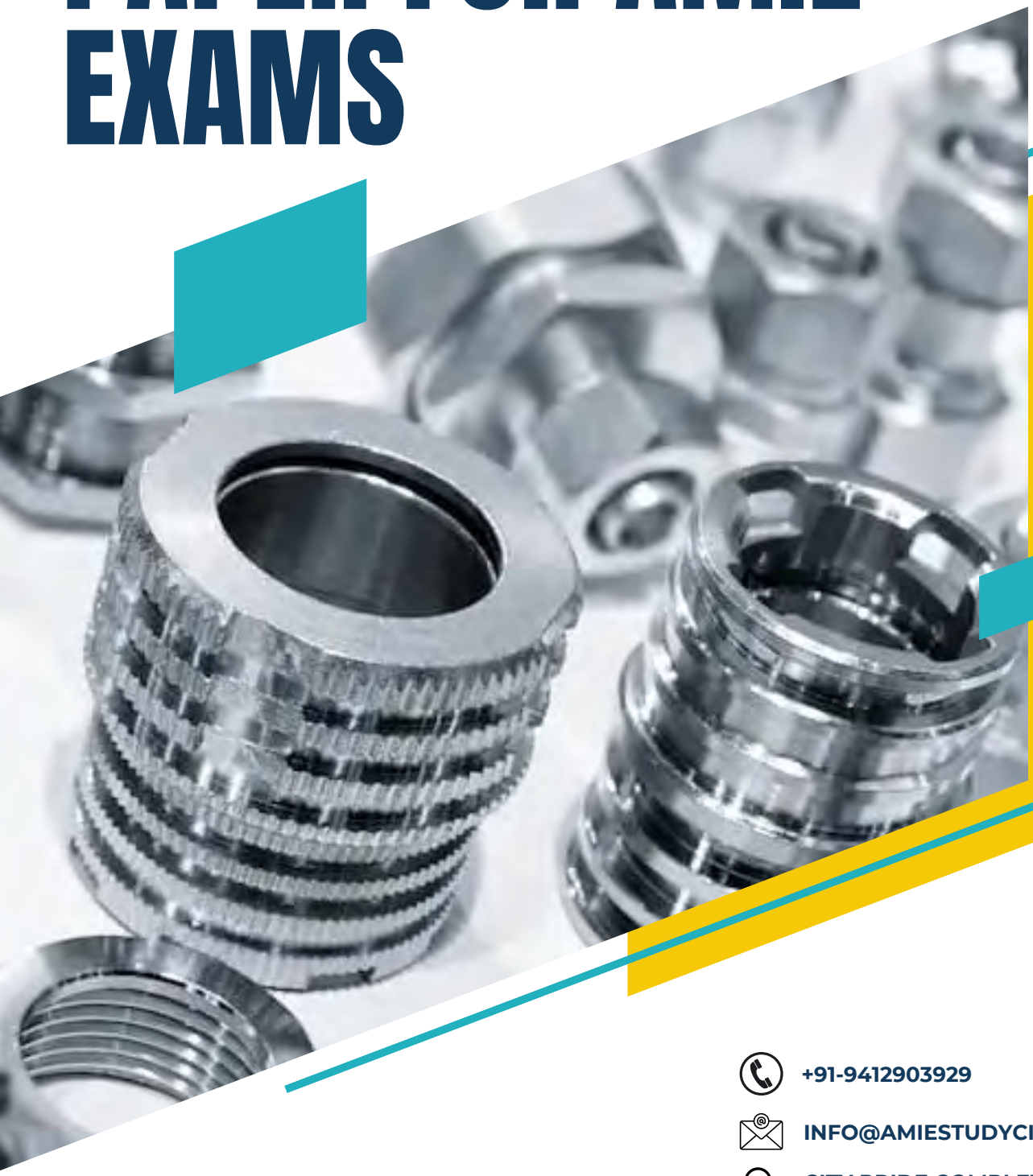
MODEL TEST PAPER FOR AMIE EXAMS



DESIGN OF MACHINE ELEMENTS

TEST PAPER 1

+91-9412903929

INFO@AMIESTUDYCIRCLE.COM

CITY PRIDE COMPLEX, NR IIT CAMPUS, ROORKEE

AMIESTUDYCIRCLE.COM

DESIGN OF MACHINE ELEMENTS

***Time**: Three Hours*

***Maximum Marks**: 100*

Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answer may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Describe seven steps in design procedure. Show them in blocks with feedback loops. 8

   (b) Discuss the significance of codes for design and design data handbooks. Discuss BIS codes commonly used in design. 6

   (c) Sketch stress-strain curves for mild steel and cast iron and compare them. 6

2. (a) Define the following mechanical properties and their importance in mechanical engineering design (i) yield strength (ii) ultimate stress (iii) hardness (iv) toughness (v) resilience (vi) ductility (vii) formability. 7

   (b) Discuss the importance of safety, ecological and societal consideration in design. 5

   (c) What do you understand by stress concentration? Define and differentiate between form stress factor and stress concentration factor. If K_t = stress concentration factor and K_f = fatigue strength reduction factor, then define match sensitivity index. If steel bar has $K_t = 1.5$ and notch sensitivity index of 0.85, find K_f. 8

3. (a) A long straight tube 76 mm internal diameter and 2.5 mm thick, is subjected to an internal pressure of 5.6 N mm^2. Consider it as a thin cylinder. If the tube is subjected to a twisting moment of 70 N-m, elastic limit stress = 282 8

N/mm^2, determine the factor of safety by (i) maximum principal stress theory; (ii) maximum shear stress theory and (iii) distortion energy theory.

(b) Sketch the distribution of circumferential and radial stress across the thickness of a thick cylindrical shell subjected to internal pressure. How the longitudinal Stress is evaluated? 6

(c) A cast steel cylinder of 350 mm inside diameter is to contain liquid at a pressure of 13.5 N/mm^2. It is closed at both ends by flat cover plates which are made of alloy steel and are attached by bolts. Determine the wall thickness of the cylinder, if the maximum hoop stress in the material is limited to 55 MPa. Also, calculate the minimum thickness necessary for the cover plates, if the working stress is not to exceed 65 MPa. 6

4. (a) Discuss bolts of uniform strength in detail. What are different stresses set up in a bolt due to initial tightening? Explain these stresses in detail. 6

(b) A power screw, having double start square thread of 25 mm nominal diameter, 21 mm core diameter and 5 mm pitch, acted upon by an axial thrust of 10 kN. The outer diameter of collar is 50 mm and inner diameter of collar is 20 mm. The coefficient of friction at the screw is 0.2. The screw rotates at 12 rpm. Calculate the (i) stresses in screws (ii) torque required to rotate the screw and (iii) power required to drive it. Take $\mu = 0.15$. 8

(c) What are the advantages of welded joints over riveted joints? Explain the basic procedure for design of longitudinal butt-joint and circumferential lap-joint for a cylinder boiler shell. 6

Group B

5. (a) (a) State following theories of failure: (i) Maximum normal stress (ii) Maximum shearing stress. A shaft of diameter d is subjected to a torque T and a bending moment M. Find expressions for equivalent bending moment and equivalent torque. 8

(b) A shaft transmits 20 kW power and rotates at 500 rpm. The material of the shaft is 50 C4 (σ_{yt} = 460 N/mm^2) and the factor of safety is 2. Determine the diameter of shaft (i) on the basis of shear strength, and (ii) on the basis of its torsional rigidity, if the angle of twist permissible is 3^0 per metre length and modulus of rigidity of shaft material is 79300 N/mm^3. 6

(c) State the maximum shear stress theory and deduce the criterion of failure for the same. A cantilever member 0.1 m long having cross-section of 0.05 m x 0.25 m supports a load of 27.5 kN. What is the maximum shear stress and where does it occur? 6

6. (a) Explain what do you understand by A. M. Wahl's factor and state its importance in the design of helical springs. 6

(b) A spring is made from a wire of 1.25 mm diameter and 780 N/mm^2 as its yield strength. For a mean diameter of 12.5 mm and 14 active coils of the spring, determine (i) static load corresponding to the yield point of the material and deflection corresponding to that; (ii) stiffness of the spring; and (iii) pitch of the wire so that solid stress will not exceed the yield point. Take C = 0.85 x $l0^5$ N/mm^2. 8

(c) How are the bearings classified? How will you define the dynamic equivalent load for rolling contact hearings. Derive an equation for dynamic load rating for rolling contact bearings under variable load. 6

7. (a) Distinguish between hydrodynamic bearings and hydrostatic bearings. Define bearing number and Sommerfield number. 8

(b) Explain different causes of gear tooth failures and suggest possible remedies to avoid such failures. 6

(c) Define formative or virtual number of teeth on a helical gear. Derive the expression used to obtain its value. 6

8. (a) Why is dynamic loading not a problem in worm gear? Do you think that heat balance is an important aspect in the design of gears? Explain. 6

(b) State the applications of the cotter joint. Explain various types of failure to be considered in designing a cotter joint. Write strength equation for each failure along with neat sketches. 8

(c) Sketch the cross section of a V belt and label its important parts. What are the advantages and disadvantages of V belt drive over flat belt drive. 6

Group C

9. Answer the following in brief: 20

(i) The factor of safety and allowable stress

(ii) Design of keys

(iii) Construction of leaf springs

(iv) BIS code

(v) Hardness and Toughness

(vi) The efficiency of a Riveted Joint

(vii) Tolerance and Fit

(viii) Stress concentration factor.

(ix) Notch sensitivity factor

(x) Define ductility and malleability.

(Refer our course material for answers)