

**ANNA UNIVERSITY - 2007**  
**B.E/B.TECH MODEL EXAMINATION**  
**DESIGN OF MACHINE ELEMENTS**  
**(PRODUCTION ENGINEERING)**

TIME-3HOUR  
MARK-100

ANSWER ALL QUESTIONS

**PART - A (10 X 2 = 20 MARKS)**

1. What are alloy steels? State the effect of the following alloying elements in steel.  
i) Chromium ii) Manganese iii) Vanadium iv) Sulphur
2. The recommended class of transition fit between the recess and the spigot of a rigid coupling is 60H6-j5. Find the dimensions of the two components.
3. Define endurance limit of a material under fluctuating stresses.
4. Explain the possible ways to reduce the severity of stress concentration by correcting the geometric shape.
5. Sketch a modified Goodman diagram for bending stress due to fluctuating stress and the equation for factor of safety.
6. Distinguish between helical compression and tension springs.
7. What are the advantages of helical gear over spur gear?
8. Give two applications for outer-race fixed ball bearings and inner-race fixed ball bearings.
9. Sketch and explain Geometric progression saw tooth diagram.
10. Mention any four available software for modeling and analysis.

**PART - B (5 X 16 = 80 MARKS)**

11. A plate pin-type flexible coupling is used to transmit 15kW power at 100 r.p.m. There are six pins and their pitch circle diameter is 200mm. The permissible shear and bending stress in the pin are 35 and 152 N/mm<sup>2</sup>. The coupling is made of C.I. and the permissible shear stress is 10N/mm<sup>2</sup> and tensile stress is 60N/mm<sup>2</sup>. Design and sketch the coupling.
- 12.a) A plate subjected to a tensile force of 5kN is shown in Figure 12a. The plate is grey cast iron FG200 and the factor of safety is 2.5. Determine the thickness of the plate.

OR

- 12.b) A transmission shaft of cold drawn steel 27Mn 2 (ultimate strength = 500N/mm<sup>2</sup> and yield strength 300 N/mm<sup>2</sup>) is subjected to a fluctuating torque which varies from - 100N-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.
- 13.a) A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 600 N/mm<sup>2</sup> and the yield strength is 450N/mm<sup>2</sup>. The bending moment at the pulley varies from -200N.m to 400 N.m and the torque on the shaft varies from - 100 N.m to 250 N.m. Design a suitable shaft for infinite life. Assume the following additional parameter:

Factor of safety = 1.5  
Load correction factor  
a) in bending = 1.0 b) in torsion = 0.6  
size factor = 0.85 surface factor = 0.9  
Stress correction factor  
a) in bending = 1.6 b) in torsion = 1.3

OR

13.b) Design a suitable spring for the exhaust valve of a petrol engine. The spring should be capable of exerting a net force of 360N when the valve is open and 220N when it is closed. The maximum inside diameter of the spring is 25mm. The compression in spring is 8mm.

14.a) Design a spur gear which is required to transmit 10kW power. The speeds of the driving motor and the driven machine are 400 r.p.m. and 200 r.p.m. respectively. The approximate center-distance may be taken as 600mm. The teeth have 20° full-depth involute profile. Assume that the gear is made of cast iron FG200, having allowable strength of 75 N/mm<sup>2</sup> and 180BHN core hardness.

OR

14.b) A V-belt drive is required to transmit 16kW power to a compressor. The motor r.p.m. is 1440 and the speed reduction ratio is 3.6. Design the belt drive.

15.a) A hydrodynamic full journal bearing is to carry a load of 25 kN at a speed of 300 r.p.m. The journal diameter is 150 mm and length of bearing is 75mm. SAE 30 oil is used with an average operating temperature of 55°C. If the radial clearance is 0.075 mm. Calculate the power loss, the side leakage and the minimum film thickness.

OR

15.b) Determine the geometric dimensions of a 6-station Geneva wheel for the driving crank radius of 100mm.