

**III B.Tech II Semester Supplementary Examinations, Apr/May 2006**  
**PRINCIPLES OF MACHINE DESIGN**  
**(Mechatronics)**

**Time: 3 hours****Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 Mpa, find the maximum value of the torque without causing yielding of the shaft according to
  - (a) the maximum principle stress;
  - (b) the maximum shear stress;
  - (c) the maximum distortion strain energy theory of yielding. [5+5+6]
2. A cast gear wheel is driven by a pinion and transmits 100 kW at 375 rpm. The gear has 200 machine cut teeth having  $20^\circ$  pressure angle and is mounted at the center of a 0.4 m long shaft. The gear weights 2000 N and its pitch circle diameter is 1.2 m. Design the gear shaft. Assume that the axes of the gear and pinion lie in the same horizontal plane. [16]
3. Design a hydrodynamic full journal bearing of 200 mm x 200 mm to support 20 kN. Calculate the operating parameters and check for necessity for cooling. Speed of journal is 1500 rpm. [12+4]
4. Assume that a flange coupling has the following specifications.  
Number of bolts , 6  
Size of bolts ,12 mm diameter  
Preloading of bolts, 22 kN in each bolt  
Inner diameter of contact, 175 mm  
outer diameter of contact, 200 mm  
speed of rotation of coupling, 300 rpm  
coefficient of friction = 0.15  
shaft diameter, 50 mm  
shaft material is steel with an ultimate tensile strength 586 MPa and yield point tension of 10 MPa.  
Determine
  - (a) The maximum power capacity based upon friction such that slip occurs between faces of contact.
  - (b) Compare the shaft horse power capacity with friction horse power capacity. Assume steady load conditions and that the shaft in torsion only. [8+8]
5. Determine the thickness of a 120 mm wide uniform plate for safe continuous operation if the plate is to be subjected to a tensile load that has a maximum value of

250 kN and a minimum value of 100 kN. The properties of the plate material are as follows:

Endurance limit stress = 225 MPa, and yield point stress = 300 MPa. The factor of safety based on yield point may be taken as 1.5. [16]

6. Determine the dimensions of an I-Section connecting rod for a petrol engine from the following data:

Diameter of the piston = 110 mm;

Mass of the reciprocating parts = 2 kg;

Length of the connecting rod from center to center = 325 mm;

Stroke length = 150 mm;

R.P.M = 1500 with possible over speed of 2500;

Compression ratio = 4:1;

Maximum explosion pressure =  $2.5 \text{ N/mm}^2$ . [16]

7. A V-belt drive is to transmit 15 kW to a compressor. The motor runs at 1150 rpm and the compressor is to run at 400 rpm. Determine the size and the number of belts required. [16]

8. A pair of spur gear is to be designed to transmit 15 kW. Pinion has 24 teeth runs at 250 rpm. Velocity ratio is 2.8:1. Assume pinion is made by alloy steel has design compressive stress  $950 \text{ N/mm}^2$ , design bending stress  $320 \text{ N/mm}^2$  and hardness number 280. Assume wheel is made by C 45 steel has design compressive stress  $500 \text{ N/mm}^2$ , design bending stress  $140 \text{ N/mm}^2$  and hardness number 175. [16]

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