**Reg. No. \_\_\_\_\_\_\_\_**

**Karunya University**

**(Karunya Institute of Technology and Sciences)**

(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

**Supplementary Examination - June 2011**

**Subject Title: DESIGN OF MACHINE ELEMENTS Time: 3 hours**

**Subject Code: ME257 Maximum Marks: 100**

#### **Answer ALL questions**

**PART – A (10 x 1 = 10 MARKS)**

1. Define factor of safety.

2. What are the factors affecting selection of material for machine element?

3. Name the applications of helical torsion springs.

4. State any two methods of solving problems involving combined steady or variable stresses.

5. Define Torsional stiffness of shaft.

6. List the advantages of splines over keys.

7. Define pitch and lead of a thread.

8. Differentiate between a cotter joint and a knuckle joint.

9. What is the function of a flywheel?

10. Name the materials to be used for IC engine connecting rod.

**PART – B (5 x 3 = 15 MARKS)**

11. State different theories of failures.

12. What is stress concentration and stress concentration factor?

13. List any three reasons for preferring hollow shaft over solid shaft.

14. What are the various forms of screw threads?

15. What are the types of stresses induced in a flywheel rim?

**PART – C (5 x 15 = 75 MARKS)**

16. A steel shaft ABCD having a total length of 3.5 m consists of three lengths having different sections as follows: AB is hollow having outside and inside diameters of 100 mm and 62.5 mm respectively, and BC and CD are solid. BC has a diameter of 100 mm and CD has a diameter of 87.5 mm. If the angle of twist is the same for each section, determine the length of each section. Find the value of the applied torque and the total angle of twist, if the maximum shear stress in the hollow portion is 47.5 MPa and shear modulus, C = 82.5 GPa.

(OR)

17. A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using two different theories of failure, and assuming a factor of safety of 2. Take E = 210 GPa and poisson's ratio = 0.25.

18. A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and maximum value of 50 kN. Determine the diameter of the bar by taking factor of safety of 1.5, size effect of 0.85, and surface finish factor of 0.9. The material properties of the bar is given by σu = 650 MPa: σy = 500 MPa and σ-1 = 350 MPa.

(OR)

[P.T.O]

19. Design a helical spring for a spring loaded safety valve from the following data.

a. Valve seat diameter = 65 mm b. Operating pressure = 0.7 N/mm2

c. Maximum pressure when the valve blows off freely = 0.75 N/mm2

d. Valve lift when pressure rises from 0.7 to 0.75 N/mm2  = 3.5 mm

e. Maximum permissible stress in the spring material = 550 N/mm2

f. Spring Index = 6 g. Modulus of Rigidity of spring material = 84kN/mm2

20. A shaft is supported on bearings P and Q, 800 mm apart. A 20° spur gear having 600 mm PCD is located 200 mm from the right of the left hand bearing P and a 700 mm diameter pulley is mounted 250 mm towards the left of the bearing Q . The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° wrap angle. The pulley weighs 2000 N. The maximum belt tension is 3000N. The tension ratio is 3:1. Selecting suitable material for the shaft, determine the shaft diameter for a factor of safety of 1.5. Assume Kb and Kt is 1.5.

(OR)

21. A rigid type coupling is used to connect two shafts transmitting 15 kW at 200 rpm. The shaft, keys and bolts are made of C45 steel and the coupling is made of cast-iron. Design and draw the coupling.

22. A bolt of 20 X 2.5 mm ISO metric threads is subjected to a preload of 35000 N. Factor of safety is 2.5 and the average stress at root area is 180 MPa. Find the maximum and minimum value of varying load on the part. Take Sy=630 MPa, Se=350 MPa, area of steel part is 700 mm2 and SCF= 3.85.

(OR)

23. Design and draw a knuckle joint to connect two mild steel bars under a tensile load of 25 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing.

24. Design a CI flywheel for a four stroke engine developing 150 kW at 200 rpm. Calculate the mean diameter of the flywheel if hoop stress is not to exceed 4 MPa. Total fluctuation of speed is to be 4% of mean speed. Work done during power stroke is 1.5 times the average work done during the cycle. Density of CI is 7200 kg/m3.

(OR)

25. Design a cast iron piston for a single acting four stroke engine for the following data:

Cylinder bore = 100 mm ; Stroke = 125 mm ;

Maximum gas pressure = 5 N/mm2 ;

Indicated mean effective pressure = 0.75 N/mm2 ;

Mechanical efficiency = 80% ;

Fuel consumption = 0.15 kg per brake power per hour ;

Higher calorific value of fuel = 42 × 103 kJ/kg ; Speed = 2000 r.p.m.

Any other data required for the design may be assumed.