



**B.E DEGREE EXAMINATIONS: MAY 2015**

(Regulation 2009)

Fifth Semester

**MECHATRONICS ENGINEERING**

MCT112: Design of Machine Elements

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. The ratio between maximum stresses to working stress is known as \_\_\_\_\_
  - a) Factor of safety
  - b) Rigidity
  - c) Young's modulus
  - d) Polar moment of inertia
2. \_\_\_\_\_ is the increase in local stresses at points of rapid change in cross section or discontinuities.
  - a) Stress concentration
  - b) Stress concentration factor
  - c) Stress Distribution
  - d) Factor of safety
3. \_\_\_\_\_ is used to transmit axial load from one machine element to other.
  - a) Cotter Joint
  - b) Knuckle Joint
  - c) Key Joint
  - d) Parallel Joint
4. Function of coupling is to connect
  - a) Engine to gear box
  - b) Gear box to differential
  - c) driving machine to the shaft of a driven machine
  - d) Connecting shafts
5. A bolt of uniform strength has equal strength at the
  - a) Length of the thread
  - b) Pitch length
  - c) Length of the bolt
  - d) thread and shank portion
6. Peeling is the type of failure general by occurs is \_\_\_\_\_ joints
  - a) Welding
  - b) Bolted
  - c) Rivited
  - d) Bonded

7. The ratio of mean or pitch diameter to the diameter of wire for the spring is called
- a) Pitch
  - b) the spring index
  - c) PCD
  - d) Pitch circle
8. Types of Helical springs are
- a) Open and closed coil
  - b) Short and long coil
  - c) Open and long coil
  - d) Small and medium coil
9. \_\_\_\_\_ is a sliding contact bearing which gives lateral support to the rotating shaft.
- a) A Fitted bearing
  - b) A journal bearing
  - c) Hydrostatic bearings
  - d) Rolling contact bearing
10. For heavy load and slow speed application the suitable bearing is
- a) Ball bearing
  - b) Roller bearing
  - c) Hydrostatic bearing
  - d) Hydrodynamic bearing

**PART B (10 x 2 = 20 Marks)**

- 11. List the types of variable stresses?
- 12. Give examples for curved beams. How its analysis varies from that of a straight beam.
- 13. Define the term critical speed.
- 14. Name any two rigid couplings.
- 15. List the function of a coupling between two shafts?
- 16. What is meant by bolt of uniform strength?
- 17. Why what's factor is to be considered in the design of springs?
- 18. Define in springs.
- 19. Explain the term dynamic load carrying capacities of rolling contact bearing.
- 20. How does the function of flywheel differ from that of governor?

**PART C (5 x 14 = 70 Marks)**

21. a) 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.

**(OR)**

- b) A steel rod is subjected to a reversed axial load of 180 kN. Find the diameter of the rod for a factor of safety of 2. Neglect column action. The material has an ultimate tensile strength of 1070 MPa and yield strength of 910 MPa. The endurance limit in reversed bending may be assumed to be one-half of the ultimate tensile strength. Other correction factors may be taken as follows: For axial loading = 0.7; For machined surface = 0.8 ; For size = 0.85 ; For stress concentration = 1.0.

22. a) Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.

(OR)

- b) Design a clamp coupling to transmit 30 kW at 100 r.p.m. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3.

23. a) Explain the advantages and Disadvantages of Welded Joints over Riveted Joints.

(OR)

- b) The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm<sup>2</sup>. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.

24. a) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm<sup>2</sup>, find the axial load which the spring can carry and the deflection per active turn.

(OR)

- b) A closely coiled helical spring is made of 10 mm diameter steel wire, the coil consisting of 10 complete turns with a mean diameter of 120 mm. The spring carries an axial pull of 200 N. Determine the shear stress induced in the spring neglecting the effect of stress concentration. Determine also the deflection in the spring, its stiffness and strain energy stored by it if the modulus of rigidity of the material is 80 kN/mm<sup>2</sup>.

25. a) A 150 mm diameter shaft supporting a load of 10 kN has a speed of 1500 r.p.m. The shaft runs in a bearing whose length is 1.5 times the shaft diameter. If the diametral clearance of the bearing is 0.15 mm and the absolute viscosity of the oil at the operating temperature is 0.011 kg/m-s, find the power wasted in friction.

(OR)

- b) A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is  $20 \times 10^6$  revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing.

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