KUMARAGURU
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Register Number: ……

B.E DEGREE EXAMINATIONS: NOV/DEC 2014

(Regulation 2009)

Fifth Semester

AUTOMOBILE ENGINEERING

AUE107: Machine Components Design

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. A steel with 0.8 percent carbon is known as
   a) Eutectoid steel b) Hypereutectoid steel
   c) Hypoeutectoid steel d) None of these
2. The metal suitable for bearings subjected to heavy load is
   a) Silicon bronze b) White metal
   c) Monel metal d) Phosphor bronze
3. When a shaft is subjected to a bending moment M and a twisting moment T, then the equivalent twisting moment is equal to
   a) M+T b) M^2+T^2
   c) $(M^2+T^2)^{0.5}$ d) $(M^2-T^2)^{0.5}$
4. A leaf spring in automobile is used
   a) To apply forces b) To measure forces
   c) To absorb shocks d) To store strain energy
5. When bevel gears having equal teeth and equal pitch angles connect two shafts whose axes intersect at right angle, then they are known as
   a) Angular bevel gears b) Crown bevel gears
   c) Internal bevel gears d) Mitre gears
6. If T is the actual number of teeth on a helical gear and α is the helix angle for the teeth, the formative number of teeth is written as
   a) $T \sec^3 \alpha$ b) $T \sec^2 \alpha$
   c) $T/ \sec^3 \alpha$ d) T cosec α
7. Due to the centrifugal force acting on the rim, the flywheel arms will be subjected to
   a) Tensile stress b) Compressive stress
   c) Shear stress d) None of these

8. The diameter of the hub of the flywheel is usually taken
   a) Equal to the diameter of the shaft
   b) Twice the diameter of the shaft
   c) Three times the diameter of the shaft
   d) Four times the diameter of the shaft
9. Teflon is used for bearings because of
   a) Low coefficient of friction
   b) Better heat dissipation
   c) Smaller space consideration
   d) All of these
10. The piston pin bearings in heavy duty diesel engines are
   a) Needle roller bearings
   b) Tapered roller bearings
   c) Spherical roller bearings
   d) Cylindrical roller bearings

PART B (10 x 2 = 20 Marks)

11. What are the factors to be considered for deciding the magnitude of factor of safety?
12. Define stress concentration and stress concentration factor.
13. What are the various stresses induced in the shafts?
14. What are the standard nominal widths used in automobile suspension springs?
15. Define circular pitch.
16. What is meant by contact ratio in gears?
17. State the formula for work done per cycle in four stroke engine.
18. State the types of stresses induced in a fly wheel?
19. Brief out assumptions in hydrodynamic lubricated bearing.
20. Classify the types of roller bearings?

PART C (5 x 14 = 70 Marks)

21. a) (i) What are the factors to be considered while designing machine parts to avoid fatigue failure? (7)

    (ii) A hydraulic press exerts a total load of 3.5 MN. This load is carried by two steel rods, supporting the upper head of the press. If the safe stress is 85 MPa and E= 210 kN/mm^2, find the diameter of the rods and extension in each rod in a length of 2.5 m. (7)

(OR)

b) (i) A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m^2 and – 150 MN/m^2. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety=2. (10)

(ii) Brief on the classifications of machine design. (4)

22. a) A hoisting drum 0.5 m in diameter is keyed to a shaft which is supported in two bearings and driven through a 12:1 reduction ratio by an electric motor. Determine the power of the driving motor, if the maximum load of 8 kN is hoisted at a speed of 50 m/min and the efficiency of the drive is 80%. Also determine the torque on the drum shaft and the speed of motor in r.p.m. Determine also the diameter of the shaft made of machinery steel, the working stresses of which are 115 MPa in tension and 50 MPa in shear. The drive gear whose diameter is 450 mm is mounted at the end of the shaft such that it overhangs the nearest bearing by 150 mm. The combined shock and fatique factors for bending and torsion may be taken as 2 and 1.5 respectively.

(OR)

b) (i) 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^2, find the axial load which the spring can carry and the deflection per active turn. (7)

(ii) Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced. (7)

23. a) (i) State the reasons for gear tooth failure. (4)

(ii) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has 20^o stub involute profiles. The static stress for the gear material (C.I) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. (10)

(OR)

b) A pair of cast iron bevel gears connect two shafts at right angles. The pitch diameters of the pinion and gear are 80 mm and 100 mm respectively. The tooth profiles of the gears are of 14½^o composite form. The allowable static stress for both the gears is 55 MPa. If the pinion transmits 2.75 kW and 1100 r.p.m., find the module and number of teeth on each gear from the standpoint of strength and check the design from the standpoint of wear. Take surface

endurance limit as 630 Mpa and modulus of elasticity for C.I as 84 kN/mm^2.

24. a) An otto cycle engine develops 50 kW at 150 r.p.p. with 75 explosions per min. The change of speed from the commencement to the end of power stroke must not exceed 0.5 % of mean on either side. Design a suitable rim section having width four times the depth so that the hoop stress does not exceed 4 MPa. Assume that the fly wheel stores 16/15 times the energy stored by the rim and that the work done during power stroke is 1.4 times the work done during the cycle. Density of rim material is 7200 kg/m^3.

(OR)

b) The areas of the turning moment diagram for one revolution of a multi-cylinder engine with reference to the mean turning moment, below and above line, are -32, +408, -267, +333, -310, +226, -374, +260 and -244 mm^2. The scale for abscissa and ordinate are: 1 mm= 2.4^o and 1 mm=650 N-m respectively. The mean speed is 300 r.p.m. with percentage speed fluctuation of ± 1.5 %. If the hoop stress in the material of the rim is not to exceed 5.6 MPa, determine the suitable diameter and cross section for the flywheel, assuming that the width is equal to 4 times the thickness. The density of the material may be as 7200 kg/m^3. Neglect the effect of the boss and arms.

25. a) (i) Explain the terms used in hydrodynamic journal bearing. (7)

(ii) A 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a radial clearance of 0.05 mm and the viscosity of the oil is 0.021 kg/m-s at the operating temperature. If the bearing is capable of dissipating 80 J/s, determine the maximum safe speed. (7)

(OR)

b) (i) Write a note on the life of bearings for various types of machines. (10)

(ii) A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500 N and an axial thrust load of 1500 N. Assuming light shock load, determine the rating life of the bearing. (4)

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