Register Number .....

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Fifth Semester

U07ME502 DESIGN OF MACHINE ELEMENTS-I

(Common to Mechanical Engineering & Mechatronics Engineering)

Three hours **Maximum Marks: 100**

Use of Standard Design Data Book is permitted.

Assume missing data suitably and state clearly.

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

) **The failure** theory that is best suited for brittle materials is

(A) maximum shear stress theory (B) maximum strain theory

(C) maximum strain energy theory (D) distortion energy theory

) **If one** principal stress is zero at a point, then the other principal stress, compared to the **maximum** shear stress at that point will be

(A) same (B) twice (C) half (D) thrice

) **The angle** of twist of a shaft with diameter 'd' is

(A) directly proportional to d^2 (B) inversely proportional to d^2

(C) directly proportional to d^4 (D) inversely proportional to d^4

) **A taper** key which fits half in the key way of the hub and half in the key way of shaft is **known** as

(A) sunk key (B) flat saddle key

(C) tangent key (D) hollow saddle key

) **If threads** on a bolt are left hand, threads on the nut will be

(A) right hand with same pitch (B) left hand with same pitch

(C) right hand with fine pitch (D) left hand with fine pitch

) **In transverse** fillet welded joint, the size of the weld is equal to

(A) 0.5 * throat of weld. (B) throat of weld.

(C) $\sqrt{2}$ * throat of weld (D) 2 * throat of weld.

) **Stiffness** of a spring can be increased by

(A) increasing the number of turns (B) increasing the free length

(C) decreasing the number of turns (D) decreasing the spring wire diameter

8) In a cranked lever, the handle is subjected to

(A) bending moment (B) twisting moment

(C) combined bending and twisting moments (D) axial load and bend

9) The radii of the journal and the bearing are equal in

(A) zero film bearing (B) fitted bearing

(C) thick film bearing (D) thin film bearing

10) In estimating the stresses in flywheel rim, the portion of the rim between a pair considered as a _____ beam loaded uniformly.

(A) cantilever (B) simply supported (C) fixed (D) double cantil

PART B (10 x 2 = 20 Marks)

11. Classify impact loads. Give one example for each.
12. For static loading, stress concentration is ignored for ductile materials and co for brittle materials. Why?
13. How are hollow shafts superior to solid ones?
14. What is a counter shaft?
15. Why is V-thread preferred in fasteners?
16. Which weld is preferred, parallel or transverse? Why?
17. What is 'Nipping' in leaf springs?
18. When are non-ferrous materials used in springs?
19. What situations demand the use of needle roller bearings?
20. Cast iron flywheels can be used for power transmission at all speeds. Comme

PART C (5 x 14 = 70 Marks)

21. (a) A fuel pump pusher rod is to be designed for a repeated axial load of 1 material of the rod has yield strength of 400 MPa and an endurance limit o for repeated axial loading. The fatigue strength of the material for repe loading is 252 MPa at 100,000 cycles. For a factor of safety of 2, dete required diameter of the pusher rod for a finite life of 100,000 cycles and for life. Take K_f = 1, size factor = 0.85 and surface finish factor = 0.9.

(OR)

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 this torque without causing yielding of the shaft according to maximum principal stress theory.

22. (a) A steel shaft is mounted on two bearings 250 mm apart and carries a bevel gear of 242 mm pitch diameter at distance of 160 mm from the RH bearing. At the pitch point of the gear, a tangential force 1970 N, a radial force 227 N and an axial load 680 N act. Determine the necessary diameter of the shaft. Neglect keyway effect.

(OR)

(b) Determine the dimensions of flange coupling that connects a motor and a pump shaft. The power to be transmitted is 2 kW at a shaft speed of 960 rpm. Select suitable materials for the parts of the coupling and list the dimensions.

23. (a) The cover of a pressure vessel is held in place by ten M20 bolts. The pressure is 1.4MPa and the effective area of the exposed cover is $0.2m^2$.Ratio of bolt stiffness to part stiffness is 1/4. Each bolt is tightened initially before the pressure is applied to 27kN. Find whether the joints will separate.

(OR)

(b) A plate 100mm wide and 12.5 mm thick is to be welded to another plate by means of single transverse and double parallel fillet welds. Determine the length of weld run in each case, if the joint is subjected to varying loads. The recommended design stress in tension is not to exceed $70N/mm^2$ and in shear $56N/mm^2$ for static loading.

24. (a) (i) A locomotive semi-elliptical spring of span 1 m carries 75 kN load at its center. The spring has 3 full length leaves and 15 graduated leaves with a central band of 125 mm. All the leaves are to be stressed to 450 N/mm^2 when fully loaded. The ratio of the total spring depth to width is 2. Take E = 2 x 105 N/mm^2. Determine (i) Width and thickness of the leaves (7)

(ii) Initial gap that should be provided before the application of band load (5)

(iii) Load on the band after the spring is assembled. (4)

(OR)

(b) Design a tension spring to be used for a balance to measure 0 to 2000 N over a s length 100mm. The spring is to be enclosed in a casing whose inside diamete mm. Approximate number of coils is 30. Take the modulus of rigidity as 0.8 x 1 Also, calculate the maximum shear stress induced.

25. (a) (i) Explain the variation of coefficient of friction with bearing characteristic num sliding contact bearings.

(ii) Explain optimum design of hydrodynamic journal bearings.

(OR)

(b) The torque developed by an engine is given by the equation,

$$T = 14250 + 2200 \sin 2\theta - 1800 \cos 2\theta$$

where T is the torque in N-m and θ is the crank angle displacement inner dead center position. The resisting torque of the machine is co throughout the work cycle. The coefficient of fluctuation of speed is 0.01, engine speed is 150 rpm. A solid circular steel disc, 50 mm thick is used flywheel. The mass density of steel is 7800 kg/m^3. Calculate the diameter o flywheel disc.

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