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Question Paper Code: 31573

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER 2015

Fifth Semester

Mechanical Engineering

01UME503 – DESIGN OF MACHINE ELEMENTS

(Approved Design Data book is permitted)

(Regulation 2013)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What are the various phase of design process?
2. State Rankine's theory.
3. Why is maximum shear stress theory used for shaft?
4. Under what circumstances flexible couplings are used?
5. What is the meaning of bolt $M24 \times 2$?
6. Name the possible modes of failure of riveted joints.
7. What is surge in springs?
8. Is there any relation between co-efficient of fluctuation of energy and co-efficient of steadiness?
9. What is known as self-acting bearing?
10. Define connecting rod.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) A cast iron pulley transmits 10 kW at 400 rpm. The diameter of the pulley is 1.2m and it has four straight arms of elliptical cross-section, in which the major axis is twice the minor axis. Determine the dimensions of the arm if the allowable bending stress is 15 MPa. (8)
- (ii) An unknown weights falls through 10mm onto a collar which is rigidly attached to the lower end of a vertical bar 3m long and 600 mm² cross section. The maximum instantaneous extension is 2mm. What is the corresponding stress and the value of the weight? Take $E = 200 \text{ kN/mm}^2$. (8)

Or

- (b) A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 550 MPa and the yield strength is 400 MPa. The bending moment at the pulley varies from -150 N-m to +400 N-m as the torque on the shaft varies from -50 N-m to +150 N-m. Obtain the diameter of the shaft for an indefinite life. The stress concentration factors for the keyway at the pulley in bending and in torsion are 1.6 and 1.3 respectively. Take the following values: Factor of safety = 1.5; Load correction factors = 1.0 in bending, and 0.6 in torsion; Size effect factor = 0.85; Surface effect factor = 0.88. (16)
12. (a) Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 r.p.m. The angle of lap of the belt is 180° and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. (16)

Or

- (b) Design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5. Select suitable material for various parts of the coupling. (16)
13. (a) A steel bolt of M16x2 is 300mm long carries an impact load of 5000 Nm. If the threads stop adjacent to the nut and $E = 2.1 \times 10^5 \text{ MPa}$. (i) find the stress in the root area, (ii) find the stress if the shank area is reduced to root area. What can be inferred from the above? (16)

Or

- (b) A cylindrical beam of size 60 mm is attached to support by a complete circumferential fillet weld of 6 mm . Find (i) torque and (ii) bending moment that can be applied if limiting shear stress is 140 MPa . (16)
14. (a) A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 400 N to 1000 N . The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa , find: (i) Size of the spring wire, (ii) Diameter of the spring, (iii) Number of turns of the spring, and (iv) Free length of the spring. The compression of the spring at the maximum load is 30 mm . The modulus of rigidity for the spring material may be taken as 80 kN/mm^2 . (16)

Or

- (b) A four-stroke single cylinder gas engine runs at a constant load and delivers 25 kW at 300 rpm . The maximum fluctuation of energy per cycle may be taken as 0.65 times the useful work per cycle. Design a suitable rim flywheel of rectangular section to limit the variation of speed during the cycle to $\pm 2\%$ of the mean speed. The flywheel is made of cast iron. (16)
15. (a) Load on a hydrodynamic full journal bearing is 30 kN . The diameter and speed of the shaft are 150 mm and 1200 rpm respectively. Diametral clearance 0.2 mm . Sommerfeld number is 0.631. L/D ratio 1:1. Calculate temperature rise of oil, quantity of the oil, and amount of heat generated. (16)

Or

- (b) A single row deep groove ball bearing operating at 2000 rpm is acted by a 10 kN radial load and 8 kN thrust load. The bearing is subjected to a light shock load and the outer ring is rotating. Determine the rating life of the bearing. (16)

