Q.P.Code:13215

(3 Hours)   Total Marks:80

NB:

- Question No. 1 is compulsory.
- Attempt any three questions from the remaining.
- Assumption made should be clearly stated.
- Use of standard Design Data Book by PSG, Mahadevan is permitted.

Q.1   Answer any **four** of the following   20

(a)   What is preferred Number? How to use it, explain with example.

(b)   Draw and explain different fatigue stress cycle.

(c)   Explain overhauling of screw and self-locking of screw.

(d)   What is surge in spring? How it can be eliminated.

(e)   What is the necessity of theories of failures? Discuss different theories of failures.

Q.2   (a)   Why the cotter in the Cotter joint is kept as weakest part, explain.   4

(b)   A knuckle joint is to be design to connect two Mild Steel bars under a tensile load of 150 KN. The allowable stresses are 75Mpa in tension, 50Mpa in shear and 150 Mpa in crushing. (Assume empirical relations as Diameter of knuckle pin d_1 = d, Outer diameter of eye d_2 = 2d, diameter of knuckle pin head and collar d_3 =1.5d, thickness of single eye t = 1.25d, thickness of fork t_1 = 0.75d, thickness of pin head t_2 = 0.5d)

    1. Draw neat sketch of knuckle joint.   3
    2. Find the diameter of the rod (d).   2
    3. Using empirical find all dimensions.   3
    4. With neat sketches for failure cross section areas check all components under different failures.   8

Q.3   (a)   Show the variation of the tangential stress and radial stress across the cylinder   4
thickness and derive the Lame's equation for the thickness of thick cylinder subjected to an internal pressure only.

(b)   A transmission shaft supporting a spur gear B and pulley D is shown in Fig. 1. The   16
shaft is mounted on two bearings A and C. The diameter of pulley and the pitch circle diameter of the gear are 400 mm and 300 mm respectively. The pulley transmits 15 kW power at 550 rpm to the gear. P_1 and P_2 are belt tensions in tight and loose sides, while P_t and P_r are tangential and radial components of gear tooth force. Assume P_1 = 3P_2 and P_r = P_t tan (20^0)

Turn Over

The gear and pulley are keyed to the shaft. The material of the shaft is steel 50C4 (σ_{ut} =700 N/mm^2 and σ_{ut} = 460 N/mm^2). The factors k_b and k_t are 1.25 each. Determine the shaft diameter.
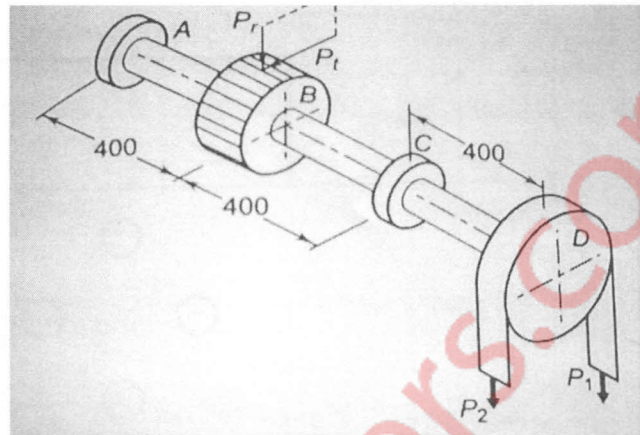

Fig.1

Q.4 (a) Design a cast iron protective type flange coupling to transmit 15 kW at 900 rpm from an electric motor to compressor. The service factor may be assumed as 1.35. The following permissible stresses may be taken. Allowable shear stress for shaft, bolt and key material is 40MPa, Allowable crushing stress for bolt and key is 80 N/mm^2 and Allowable shear stress for cast iron is 8 N/mm^2.   12

(b) Design a Helical valve spring for an operating load range of 600N to 1200N. The compression at the maximum load is 25mm. Take the spring index 6 and permissible endurance shear stress for the spring material as 480Mpa and yield stress in shear is 960MPa and G = 80KN/mm^2.   08

Q.5 (a) Draw neat sketch for the fatigue test set up. How the experimental data is generated and analyzed, explain.   10

(b) The circular rod is subjected to 700KN tensile to 300KN compressive varying axial load. Find the diameter of the rod using soderberg criteria and assuming following data. Endurance limit = 280Mpa, tensile yield strength =350Mpa, factor of safety =2, correction factor for loading = 0.7, surface factor = 0.8, size factor = 0.85, stress concentration factor = 1.   10

Q.6 (a) Select suitable standard hook for the lifting load of 100KN of trapezoidal cross section and find the stress induced at the most critical cross section of the hook.   10

Turn Over

(b)   A bracket is supported by four rivet of equal diameter as shown in fig. 2. Determine
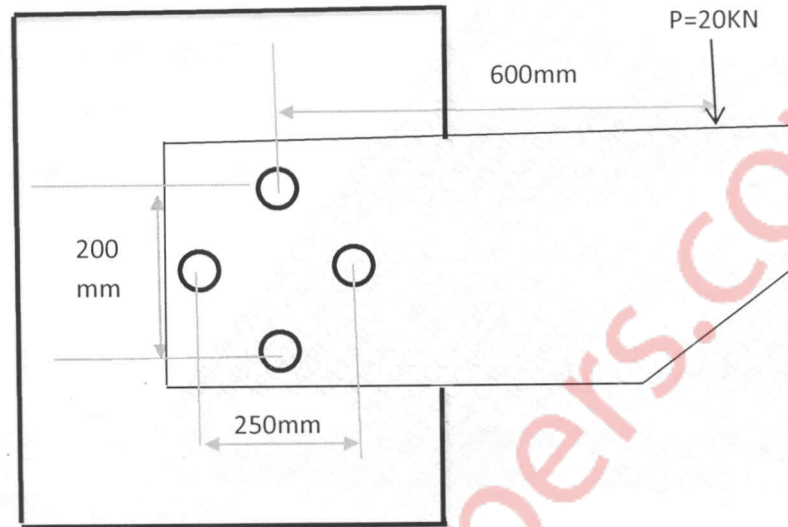the size of the rivet taking the permissible shear stress as 60MPa.

10

Fig: 2

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Question 3(b), please read Sigma ut = 460N/mm2 as Sigma yt = 460N/mm2

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Q. 6b, read rivet as bolt

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