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Roll No. :

337551(37)

**B. E. (Fifth Semester) Examination,
April-May 2021**

(New Scheme)

(Mech. Engg. Branch)

MACHINE DESIGN-I

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

***Note : Attempt all questions of total 16 marks.
Design Data Book of PSG or Design Data
Book of V. B. Bhandari is permitted.***

1. (a) Draw SN curve for steel and explain : 2
- (i) Design for infinite life
 - (ii) Design for finite life

[2]

- (b) A cantilever beam made of cold drawn steel 20C8 ($S_{ut} = 540 \text{ N/mm}^2$) is subjected to a completely reversed load of 1000 N as shown in fig. The notch sensitivity factor q at the fillet can be taken as 0.85 and the expected reliability is 90%. Determine the diameter d of the beam for a life of 10000 cycles. 7

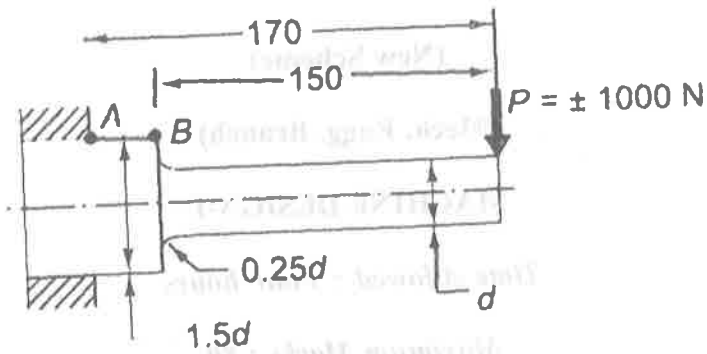
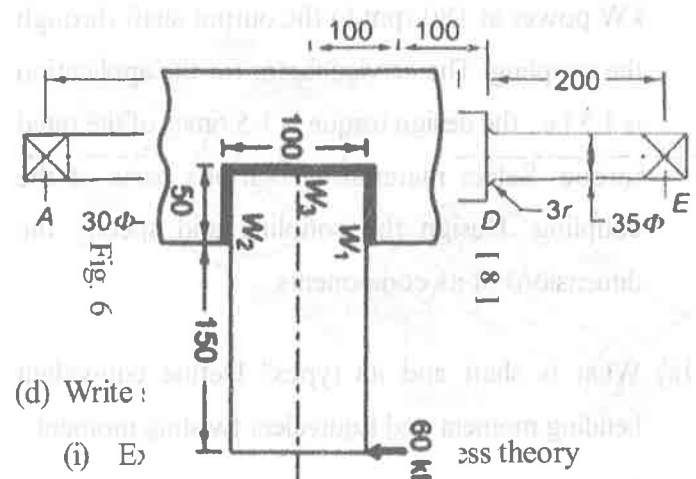


Fig. 1

- (c) A rotating shaft subjected to a non-rotating force of 5 kN and simply supported between two bearings A and E as shown in figure. The shaft is machined from plain carbon steel 30C8 ($S_{ut} = 500 \text{ N/mm}^2$) and the expected reliability is 90%. The equivalent notch radius at the fillet section can be taken as 3 mm. What is the life of the shaft? 7

[3]



(d) Write :

- Explain maximum shear stress theory
- Explain distortion energy theory

2. (a) What is function of key and its types? 2

- (b) Design and draw a cotter joint to support a load varying from 50 kN in compression to 50 kN in tension. The material used is carbon steel grade 30C8 for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress = 400 N/mm^2 ; shear stress = 200 N/mm^2 and crushing stress = 800 N/mm^2 . 14

- (c) It is required to design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5

[4]

kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5 i.e., the design torque is 1.5 times of the rated torque. Select material for various parts of the coupling. Design the coupling and specify the dimensions of its components. 14

3. (a) What is shaft and its types? Define equivalent bending moment and Equivalent twisting moment. 2
- (b) The layout of an intermediate shaft of a gear box supporting two gears *B* and *C* is shown in fig. The shaft is mounted on two bearings *A* and *D*. The pitch circle diameters of gears *B* and *C* are 900 and 600 mm respectively. The material of the shaft is steel FeE 580 ($S_{ut} = 770$ and $S_{yt} = 580$ N/mm²). The factors k_b and k_t of ASME code are 1.5 and 2.0 respectively. Determine the shaft diameter using the ASME code. Assume that gears are connected to the shaft by means of keys. 14

[5]

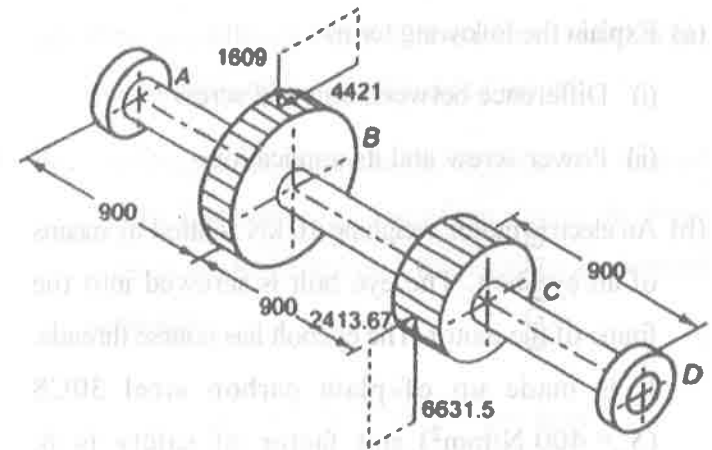


Fig. 3

- (c) A centrifugal clutch consists of four shoes each having mass of 1.5 kg. In the engaged position, the radius to the centre of gravity of the shoe is 110 mm, while the inner radius of the drum is 140 mm. The coefficient of friction is 0.3. The pre-load in the spring is adjusted in such a way that the spring force at the beginning of engagement is 700 N. The running speed is 1440 rpm. Calculate :
- The speed at which the engagement begins and
 - The power transmitted by the clutch at 1440 rpm.

4. (a) Explain the following terms :

(i) Difference between bolt and screw

(ii) Power screw and its application

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(b) An electric motor weighing 10 kN is lifted by means of an eye bolt. The eye bolt is screwed into the frame of the motor. The eyebolt has coarse threads. It is made up of plain carbon steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and factor of safety is 6. Determine the size of bolt.

12

(c) A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts as shown in fig. The bolts are made of plain carbon steel 45C8 ($S_{yt} = 380 \text{ N/mm}^2$) and the factor of safety is 3. Specify the size of bolts.

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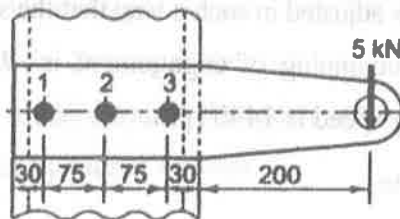


Fig. 4

5. (a) What are different types of riveted butt joint? What are the different types of welded joints?

4

(b) The bracket as shown in fig. is to carry a load of 50 kN. Determine the size of the rivet if the shear stress is not to exceed 60 MPa. Assume all rivets of same size.

12

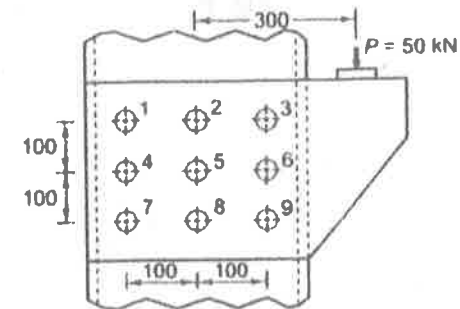


Fig. 5

(c) A welded connection of steel plates as shown in fig is subjected to an eccentric force of 60 kN. Determine size of weld if the permissible shear stress is limited to 100 N/mm^2 . Assume static conditions. All dimensions are in mm.

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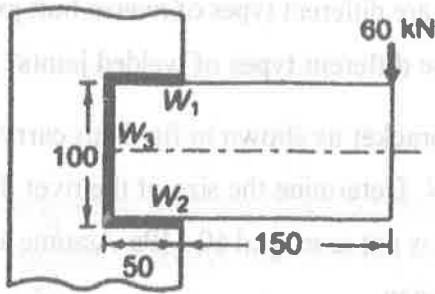


Fig. 6

