



ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER - 2007

DESIGN OF MACHINE ELEMENTS**SEMESTER - 5**

rs]

[Full Marks : 70

GROUP - A**(Multiple Choice Type Questions)**

the correct alternatives for the following :

 $10 \times 1 = 10$

According to I.B.R., the following type of joint is preferred for circumferential joint

- | | |
|-------------------|---------------------|
| a) lap joint | b) butt joint |
| c) welded joint | d) any one of these |
| e) none of these. | |

Shape of woodruff key is like

- | | |
|--------------------|---------------|
| a) cylinder | b) semicircle |
| c) sphere | d) trapezoid |
| e) tapered square. | |

In welded joint the throat of weld as compared to size of weld is

- | |
|----------------------|
| a) about same size |
| b) about 0.7 times |
| c) about 0.5 times |
| d) about 0.25 times |
| e) about 1.25 times. |

- iv) In thick cylinders, the radial stress across the thickness of cylinder is
- a) zero at outside and maximum at inside
 - b) minimum at outside and maximum at inside
 - c) maximum at outside and minimum at inside
 - d) uniform throughout
 - e) none of these.
- v) Oldham's coupling is used to connect two shafts which
- a) have lateral misalignment
 - b) whose axes intersect at a small angle
 - c) are not in exact alignment
 - d) is the simplest type of rigid coupling
 - e) all of these.
- vi) Multiple threaded screws
- a) increase the efficiency
 - b) increase the mechanical advantage
 - c) increase the self locking feature
 - d) decrease the efficiency
 - e) increase the load lifting capacity.
- vii) In the calculation of shear stress in helical spring the Wahl's correction factor is used to take care of
- a) combined effect of transverse shear stress and bending stress
 - b) combined effect of bending stress and curvature of the wire
 - c) combined effect of transverse shear stress and curvature of the wire
 - d) combined effect of torsional shear stress and transverse shear stress in wire.
- viii) An open coil helical spring is subjected to an axial force, the wire of the spring is subjected to
- a) direct shear only
 - b) combined shear and bending only
 - c) combined shear, bending and twisting only
 - d) combined shear and twisting only.



If a shaft made of ductile material is subjected to combined bending and twisting moments, which of the following failure theory would give the conservative value ?

- a) Maximum principal stress theory.
- b) Maximum shear stress theory.
- c) Maximum strain energy theory.
- d) Maximum distortion energy theory.

Two shafts A and B are made of the same material. The diameter of shaft B is twice that of shaft A. The ratio of power which can be transmitted by shaft A to that of B is

- a) $\frac{1}{2}$
- b) $\frac{1}{4}$
- c) $\frac{1}{8}$
- d) $\frac{1}{16}$

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following questions.

3 × 5 = 15

Explain clearly the change in the mechanical properties of steel due to the addition of following elements :

Nickel

Chromium

Manganese

Molybdenum

Vanadium.

Explain the different types of failures of riveted joints with neat sketches.

4. It is required to design a square key for fixing a gear on a shaft of 25 mm dia. 15 kW power at 720 rpm is transmitted from the shaft to the gear. The key is made of steel 50C4 ($\sigma_{yt} = 460 \text{ N/mm}^2$) and the factor of safety is 3. For key material the yield strength in compression can be assumed to be equal to their yield strength in tension. Determine the dimension of the key.
- (Take side of the square = 0.25 time the shaft dia.)
5. A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in the fig. 1. The maximum tensile and shear stress are 70 MPa and 56 MPa respectively.

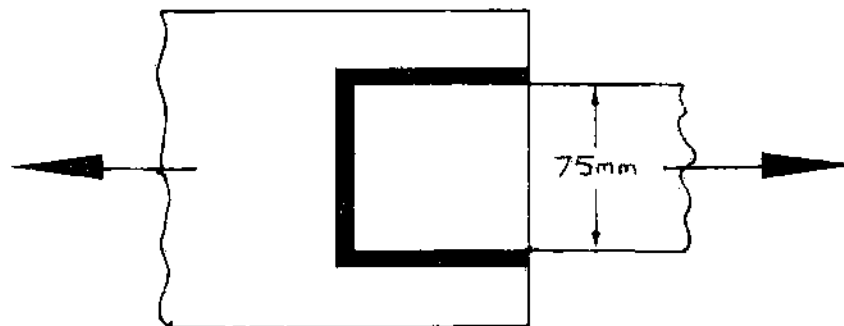


Fig. 1

- Find the length of each parallel fillet weld, if the joint is subjected to both static loading and fatigue loading. Take stress concentration factor for transverse weld as 1.5.
6. A shaft made of mild steel is required to transmit 100 kW at 300 rpm. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 150 N supported at a distance of 1 metre from the end respectively. Assuming the safe value of stress, determine the diameter of the shaft.

**GROUP - C****(Long Answer Type Questions)**Answer any *three* questions.

3 × 15 = 45

Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used :

Shear stress for shaft, bolt and key material	=	40 MPa
Crushing stress for bolt and key	=	80 MPa
Shear stress for cast iron	=	8 MPa

Draw a neat sketch of the coupling.

It is required to select a flat belt drive for a compressor running at 720 rpm which is driven by a 25 kW, 1440 rpm motor. Centre distance between the pulleys is 3 m. The belt is open type. The load correction factor is 1.3 and arc correction factor is 1.09. Dunlop's Hi-Speed belt rate is 0.9118 kW/mm width at 5.08 m/s belt velocity. Give the belt specification.

A single plate clutch of an automobile transmits a 300 N-m torque at 1500 rpm. The normal force on the friction surface exerted by 9 helical compression springs is 3900 N, so that the clutch is always engaged. The clutch is disengaged when an external force further compresses the springs. The spring index is 5 and the number of acting coils in each spring is 6. The springs are made of a material for which $G = 81370 \text{ N/mm}^2$, and $S_{ult} = 1540 \text{ N/mm}^2$. Permissible shear stress for the spring is 30% of the ultimate tensile strength. Design the springs and specify their dimensions.

A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of the left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley of 400 mm diameter is placed at 200 mm to the left of the right hand bearing and driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.



11. It is required to design a Knuckle joint as shown in Fig. 2. The axial force acting on the rod is 15 kN. The fork, eye and the pin are made of plain carbon steel 30 C8 with a tensile yield strength of 400 N/mm^2 . The compressive yield strength is the same as that in tension. Shearing yield stress is 0.577 Syt . Use a factor of safety 5 for all type of load.

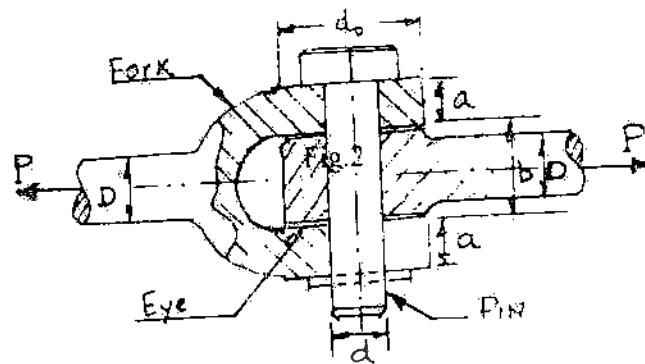


Fig. 2

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