UNIVERSITY OF PUNE

[4363]-111

T. E. (Mechanical Engineering)

Examination - 2013

Machine Design- I

(2008 Pattern)

Total No. of Questions : 12 **[Total No. of Printed Pages :6]**

[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

*(1) Answers three questions from **Sections I** and three questions from **Section II**.*

*(2) Answers to the **two sections** should be written in **separate answer-books**.*

(3) Black figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

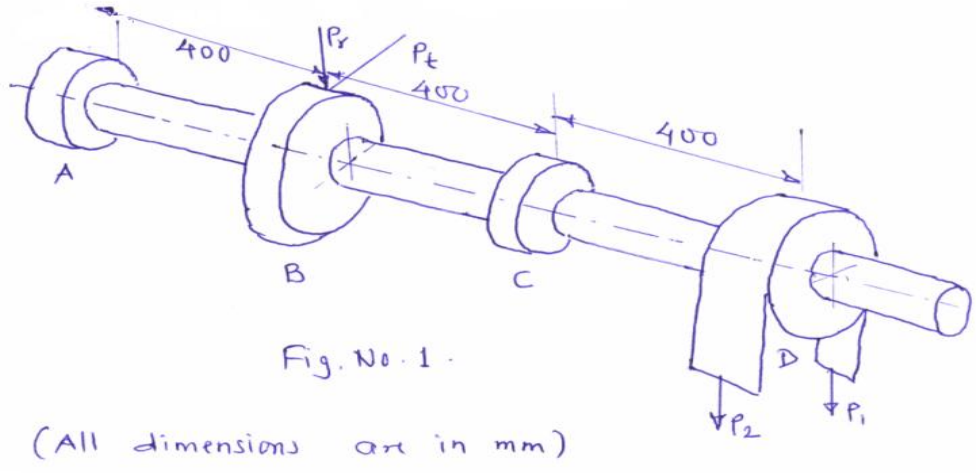
(5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(6) Assume suitable data, if necessary.

SECTION I

Q.1) A transmission shaft supporting a spur gear B and pulley D as shown in fig.1. The shaft is mounted on two bearings A and C. The diameter of pulley and gear are 500 and 350 mm respectively 20 KW power at 500 rpm is transmitted from the pulley to the gear: P_1 and P_2 are the belt tensions in the tight and loose sides. While P_t and P_r are tangential and radial components of the gear tooth force. Assume $P_1 = 3\ P_2$ and $P_r = P_t \tan(20°)$. The gear and pulley are keyed to the shaft. The material for the shaft is 50 C4 (Sut = 700N/mm^2 and Syt = 460N/mm^2)

Determine the shaft diameter using ASME code if $K_b=K_t=1.5$ [16]



OR

Q.2 (a) Explain the steps for design of muff or sleeve coupling. [6]

b) Design a flange coupling for steel shaft transmitting 20 KW power at 250rpm Maximum torque is 30% greater than full load torque. Material properties are as follow:

1) Allowable shear stress for shaft & key = 40 MPa
2) Allowable shear stress for bolts = 30 MPa
3) Allowable crushing stress for shaft & key = 80 MPa
4) Allowable shear stress for flange = 14 MPa
5) Allowable compressive stress for bolts = 60 MPa

Take 4 bolts on P.C.D. -3d [10]

Q.3 (a) Explain different types of threads used for power screws. Give advantages and limitations of each type. [8]

b) A two start trapezoidal is used in a screw jack to raise a load of 300kN. The screw has nominal diameter as 90mm, pitch as 12mm and helix angle (half thread angle) of 15°. Coefficient of friction is screw thread is 0.15. Neglecting collar friction calculate:-

1) Torque required to raise the load
2) Torque required to lower the load
3) Screw efficiency [8]

Q.4 (a) Derive the expression for maximum efficiency of square thread. [8]

b) In a steam engine cylinder, the cylinder head is subjected to steam pressure of 0.8 N/mm^2.The cylinder head is held in position by means of 12 bolts and soft gasket is used to make joint leak proof. The effective diameter of cylinder is 400 mm. find the size of bolts so that the stresses in the bolts is not to exceed 100 MPa. Assume:-
Initial tension due to tightening = 2840d
K=0.5 for soft gasket, and take d_c=0.84d [8]

Q.5 (a) Write a short note on 'Bolt of uniform strength'. [4]

b) A steel plate subjected to 10kN of load and fixed to a vertical channel by means of four identical bolts as shown in fig.2. The bolts are made of plain carbon steel 40c8 (Syt=380 N/mm^2) and factor of safety is 2. Determine the nominal diameter of the bolt. [4]

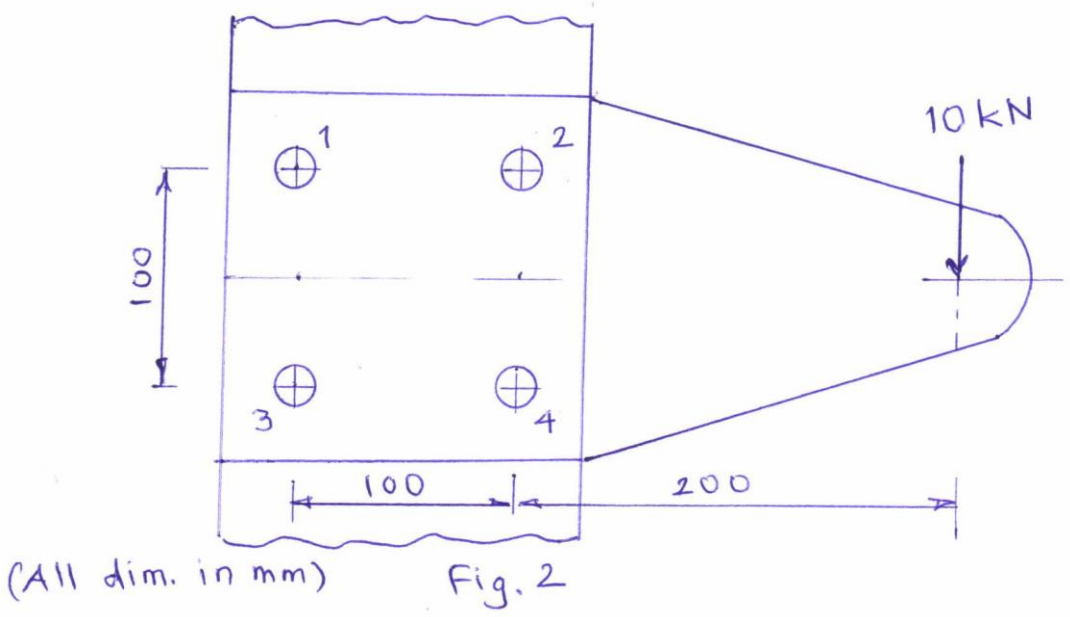


Fig. 2

OR

Q.6) Fig.3 shows an eccentrically loaded bracket is welded to the support. The permissible shear stress for the weld material is 55 N/mm^2 and the load is static. Determine the throat and kg dimensions for the weld. [18]

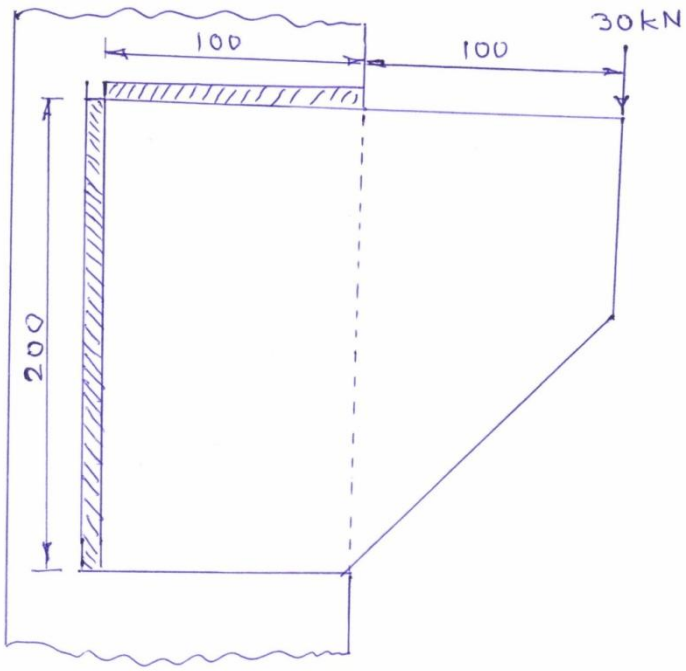


Fig. No. 3
(All dimensions are in mm)

SECTION II

Q.7 (a) What are the advantages of split type flywheel over solid one piece flywheel [4]

b) the following data is given for rimmed flywheel of grey cast iron:

- Mean radius of rim = 1
- Thickness of the rim = 100mm
- Width of the rim = 200mm
- Number of spokes = 4
- cross sectional are of each spoke = 6500 mm^2
- Speed of rotation = 720 rpm
- Mass density of flywheel = 7200 kg/m^3

Calculate:

1) The maximum tensile stress in the rim
2) Axial stress in each spoke [12]

OR

Q.8 (a) What is coefficient of fluctuation of speed? What is coefficient of fluctuation of energy? Explain its significance in design of flywheel [4]

b) A machine with a constant resisting torque is driven by an I.C. engine.
The torque developed by the engine is given by an expression:
T=4000=1500sin θ=+4000sin 2θN-m.
A rimmed flywheel made of grey cast iron FG 150 (p=7000 kg/m^3) is used to maintain speed of the engine between 200 rpm and 210 rpm. The rim contributes 90% of the required mass moment of inertia. A maximum diameter of the flywheel is limited to 2.1 m. if the factor of safety is 7.5, design the flywheel. Neglect the effect of restrain of arm on the flywheel rim. [12]

Q.9 (a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 MPa. It is held on its seat by closed coil helical spring. The maximum lift of the valve is 10 mm. design a suitable compression spring of spring index 5 and providing an initial compression of 35mm. the maximum shear stress in the material of the wire is limited to 500N/mm^2 . the modulus of rigidity of the spring material is 80000 N/mm^2 .
Calculate :
a) diameter of spring wire, b) mean coil diameter, c) number of active turns, and d) Pitch of the coil. [10]

b) Explain the following terms used for helical spring. [8]
1) Wahl factor
2) Active and inactive coils.
3) Spring Index
4) Spring rate

OR

Q.10 (a) A concentric spring consists of two helical compression spring having the same free length. The composite spring is subjected to a maximum force of 2000N. the wire and mean coil diameter of the outer spring are 10 and 80 mm respectively. The numbers of active coils in inner and outer springs with G = 81370N/mm$^{2.}$
Calculate :
1) Force transmitted by each spring,
2) Maximum deflection of the spring and
3) maximum torsional shear stress induced in each spring. [10]

b) Draw a neat sketch of multi leaf spring and show its essential parts. Also explain nipping of leaf spring. [8]

Q.11 (a) Explain the procedure for the selection of wire ropes from manufacturer's catalogue. [6]

b) A pulley of 1000mm diameter is driven by an open type flat belt from a 25kW 1440 r.p.m . electric motor. The pulley on the motor shaft is 250mm diameter and the centre distance between the two shaft is 2 m.The allowable tensile stress for the belt material is 2 n/mm^2 and the coefficient of friction between the belt and pulley is 0.28. The density of belt material is 900 kg/m^3 . if the width of the belt is 125mm, determine:

1) The thickness of the belt,
2) The length of the belt, and
3) The initial tension required in the belt. [10]

OR

Q.12 (a) a compressor is to run at 250 r.p.m. and requires 90 kW. The drive is provided by V belts from an electric motor running at 750 r.p.m. the diameter of the pulley on the compressor shaft is restricted to 1 meter whereas the centre distance between the pulleys is limited to 1.75 meter. The belt speed should not exceed 1600m/min. Determine the number of V belts required to transmit the power if each belt has a cross sectional area of 375 mm^2 , density 1000 kg/m^3 and an allowable tensile stress of 2.5 MPa. The groove angle of the pulley is 35°.
The coefficient of friction between the belt and the pulley is 0.25.
Also calculate the length of each belt. [12]

b) How wire ropes are designated? State their applications. [4]