

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov.-Dec. 2017

B. Tech in Mechanical Engineering, Semester V

Roll No.....

ME504: Design of Machine Elements-I

Time: 3 hours

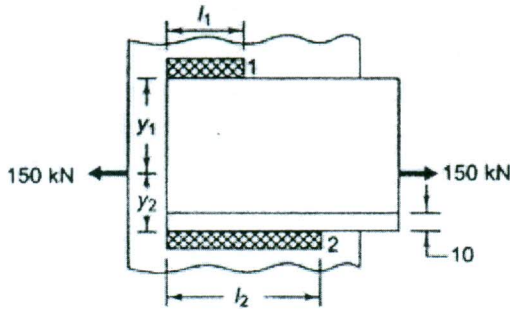
Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	A bolt is designed on the basis of _____ with a large factor of safety. a) direct tensile stress b) direct compressive stress c) direct bending stress d) direct shear stress	
ii.	A locking device extensively used in automobile industry is a a) jam nut b) castle nut c) sawn nut d) ring nut	
iii.	Which of the following has threads at both ends? a) Bolt b) Tap bolt c) Stud d) none of these	
iv.	A screw is specified by its a) major diameter b) minor diameter c) pitch diameter d) pitch	
v.	The transverse fillet weld joints are designed for a) tensile strength b) compressive strength c) bending strength d) shear strength	
vi.	The strength of the un-riveted plate (P) per pitch length is equal to a) $p.d.\sigma_t$ b) $p.t.\sigma_t$ c) $(p-d).\sigma_t$ d) $(p-d).t.\sigma_t$	
vii	Failure of a material is called fatigue failure when it fails a) at the elastic limit b) below the elastic limit c) at yield point d) below the yield point	
viii	The stress which vary from a minimum value to a maximum value of the same nature is called a) repeated stress b) yield stress c) fluctuating stress d) alternating stress	
ix.	When a load W is applied suddenly on a bar of cross section area, the stress induced in the bar will be a) W/A b) $W/2A$ c) $2W/A$ d) $3W/A$	
x.	An aluminium member is designed on the basis of a) yield stress b) elastic limit stress c) proof stress d) ultimate stress	

Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	Distinguish between design synthesis and design analysis?	
ii.	Distinguish between interchangeable and selective assemblies?	
iii.	Why cotter is provided with taper? Why is taper provided only on side?	
iv.	Distinguish between closely coiled and openly coiled helical springs?	

Q.3A	Mention the factors to be considered while designing machine parts to avoid fatigue failure?	05
Q.3B	What is 'over hauling' of power screw? What is the condition for 'over hauling'?	05
Q.4A	A plate clutch consists of one pair of contacting surfaces and transmits 25 kW power at 725 rpm. The outer diameter is 3 times the inner diameter. The coefficient of friction is 0.2 and the permissible intensity of pressure is 1 N/mm ² . Assuming the uniform pressure theory, calculate the inner and outer diameters.	05
Q.4B	Derive the expression for Torque Transmitting Capacity, M_t for single disk friction clutches under Uniform Pressure Theory in terms diameters and axial force.	05
Q.5A	For designing a helical spring subjected to a maximum force of 1250 N and deflection at maximum force is 30 mm. The spring index can be taken as 6. The spring material is of Grade-I, and the constants A and m can be taken as 1753 and 0.182 respectively ($G = 81370 \text{ N/mm}^2$). Take the necessary data and calculate: i) Wire diameter? ii) Mean coil diameter?	05
Q.5B	Justify the objectives of series and parallel combinations of spring and derive the expression for combined stiffness for series and parallel combinations.	05
Q.6A	An ISA 200×100×10 angle is welded to steel plate by means of fillet welds as shown in Fig. 6.1. The angle is subjected to static force of 150 kN and the permissible shear stress for the weld is 70 N/mm ² . Determine the length of the weld at the top and bottom.	05
 Fig. 6.1		
Q.6B	Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter of the socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor safety is 4. The width of the cotter is five times of thickness. Calculate: i) width and thickness of the cotter on the basis of shear failure; and ii) width and thickness of the cotter on the basis of bending failure.	05
OR		
Q.6B	A solid CI disk, 0.5 m dia. and 0.2 m thick, is used as a flywheel. It is rotating at 350 rpm. It is brought to rest in 1.5 s by means of brake. Calculate: i) the energy by then brake; and ii) the torque capacity of the brake.	05

(Given the mass density of the CI as 7200 kg/m^3 ; radius of gyration, $k=d/\sqrt{8}$)

- Q.7A A steel plate subjected to force of 5 kN and fixed to a channel by means of three identical bolts as shown in the Fig. 7.1. The bolts are made of plain carbon steel 30C8 ($S_{yt}=400 \text{ N/mm}^2$) and factor safety is 3. Determine the diameter of the shank

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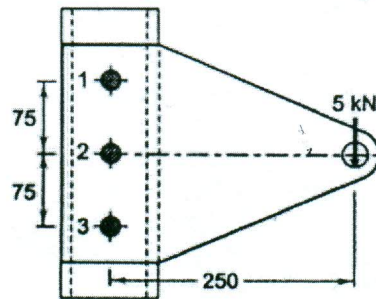


Fig. 7.1

- Q.7B A double threaded power screw, used for lifting the load, has the nominal diameter of 30 mm and pitch of 6 mm . The coefficient of friction at the screw threads is 0.1 . Neglecting collar friction, calculate:
i) efficiency of the crew with square threads; and
ii) efficiency with Acme threads ($2\theta=29^\circ$)

05

OR

- Q.7B Plot a graph of efficiency v/s helix angle, which varies from 0 to 60° , for a square threaded screw. The coefficient of friction at the threads is 0.15 and the collar friction is negligible.

05

- Q.8A A bracket attached to a horizontal column by means three identical rivets as shown in the Fig.8.1. The maximum permissible shear stress for the rivets is 60 N/mm^2 . Calculate:

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- i) Which is subjected to maximum shear force?
ii) What is the magnitude of maximum force?
iii) Determine the diameter of rivet.

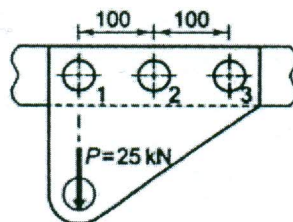


Fig. 8.1

- Q.8B Two rods are connected by means of a knuckle joint as shown in the Fig. 8.21. The axial force P acting on the rods is 25 kN . The rods and the pin are made of plain carbon steel 45C8 ($S_{yt}=380 \text{ N/mm}^2$) and the factor of safety is 2.5 . The yield strength in shear is 57.7% of the yield strength in tension. Calculate:

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- i) the diameter of rods;
ii) the diameter of the pin;
iii) check for stresses in eye; iv) check for stresses in fork

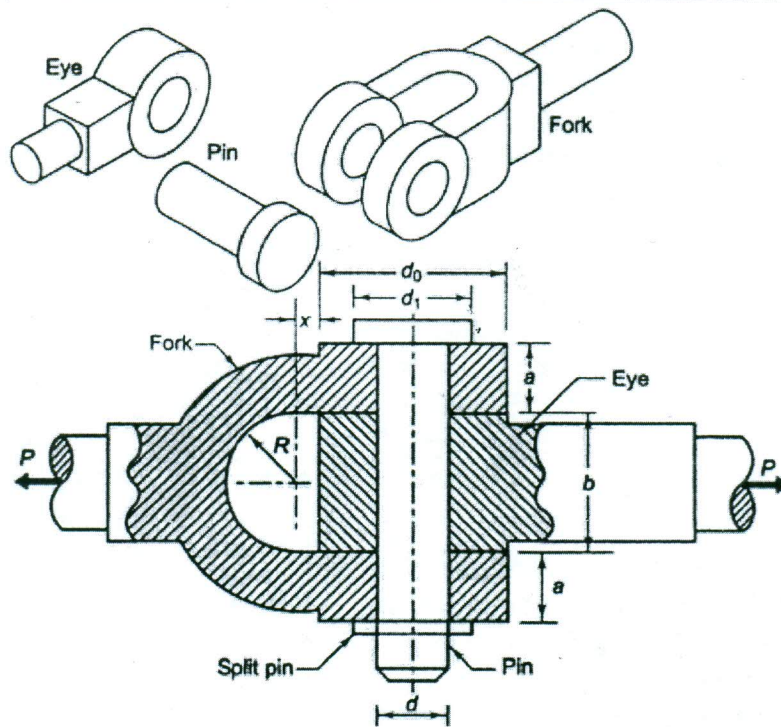


Fig. 8.21

OR

Q.8B The following data is given for a V-belt drive connecting a 25kW motor to a compressor.

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	Motor Pulley	Compressor Pulley
Pitch diameter (mm)	250	850
Speed (rpm)	1000	500
Coefficient of friction	0.2	0.2

The center distance between pulleys is 1 m and the dimensions of the cross section of the belt are given in the below Fig. 8.22 the density of the composite belt is 0.97 gm/cc and the allowable tension per belt is 850 N.

How many belts are required for this application?

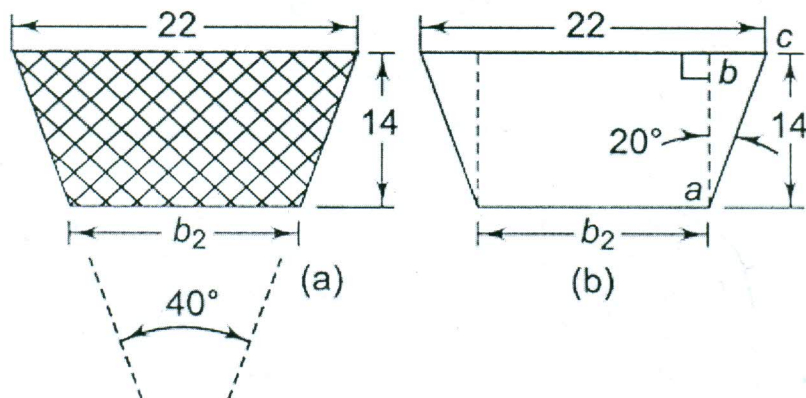


Fig. 8.22