

**University of Mumbai**  
**Examinations Summer 2022**

Time: 2 hour 30 minutes

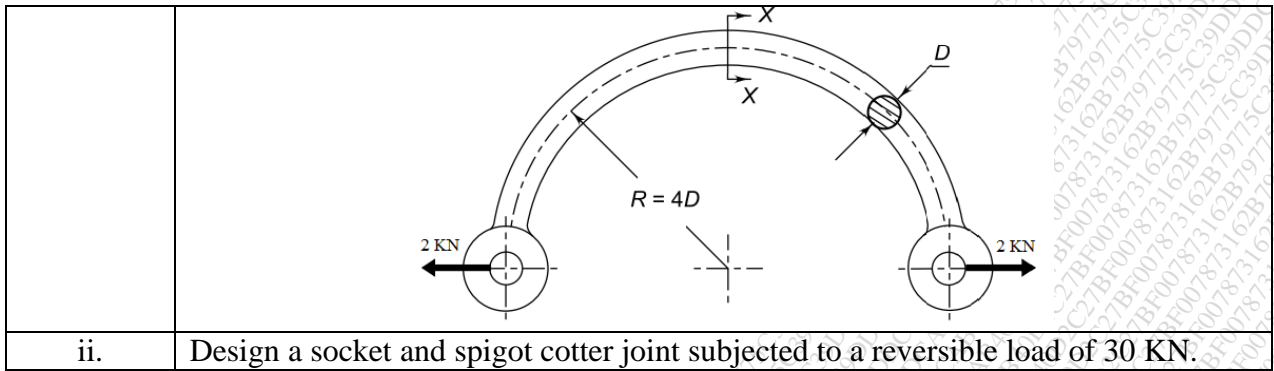
Max. Marks: 80

<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks</b>
1.	According to the following theory of failure, the shape of the safe region when plotted on stress axes is an ellipse.
Option A:	Distortion energy theory
Option B:	Maximum shear stress theory
Option C:	Maximum principal stress theory
Option D:	Maximum principal strain theory
2.	Which of the following in power screws is the correct equation for torque if the load is lowered while designing a machine? ( W: Weight in N, $\theta$ : Angle of inclination, $\phi$ : Friction angle)
Option A:	$W \tan (\theta / \phi)$
Option B:	$W \tan (\theta * \phi)$
Option C:	$W \tan (\theta + \phi)$
Option D:	$W \tan (\theta - \phi)$
3.	When a knuckle joint is subjected to a tensile pull, the knuckle pin is subjected to the following stresses
Option A:	Crushing, direct shear and bending
Option B:	Tensile, direct shear and crushing
Option C:	Tensile, torsional shear and bending
Option D:	Crushing, torsional shear and bending
4.	In a power screw, which thread has more capability to transmit power in both directions?
Option A:	Acme thread
Option B:	Square thread
Option C:	Buttress thread
Option D:	Knuckle thread
5.	A steel plate, 100 mm wide and 10 mm thick, is welded to another steel plate of larger dimensions by means of double parallel fillet welds. The plates are subjected to a static tensile force of 50 kN. Determine the required length of the welds if the permissible shear stress in the weld is $94 \text{ N/mm}^2$ .
Option A:	37.62
Option B:	19.45
Option C:	29.19
Option D:	82.06
6.	When a component is subjected to variable loading, the mean stress is zero in the following case.
Option A:	Completely reversed stress
Option B:	Fluctuating stress
Option C:	Repeated stress
Option D:	Alternating stress

7.	The standard cross-section of flat sunk key for a 45 mm diameter shaft is 14 x 9 mm. The length of key in each shaft is 80 mm. If the torque transmitted by key is 665150 Nmm, then the induced shear stress in the key material will be
Option A:	26 N/mm <sup>2</sup>
Option B:	62 N/mm <sup>2</sup>
Option C:	41 N/mm <sup>2</sup>
Option D:	26 N/mm <sup>2</sup>
8.	Following coupling can tolerate lateral and angular misalignment.
Option A:	Bush pin coupling
Option B:	Oldham's coupling
Option C:	Flange coupling
Option D:	Muff coupling
9.	The initial gap between extra full-length leaf and the graduated-leaf before the assembly is called as
Option A:	Nip
Option B:	Clearance
Option C:	Void
Option D:	Spacing
10.	In leaf springs, the longest leaf is known as
Option A:	Master leaf
Option B:	Upper leaf
Option C:	Graduated leaf
Option D:	Lower leaf

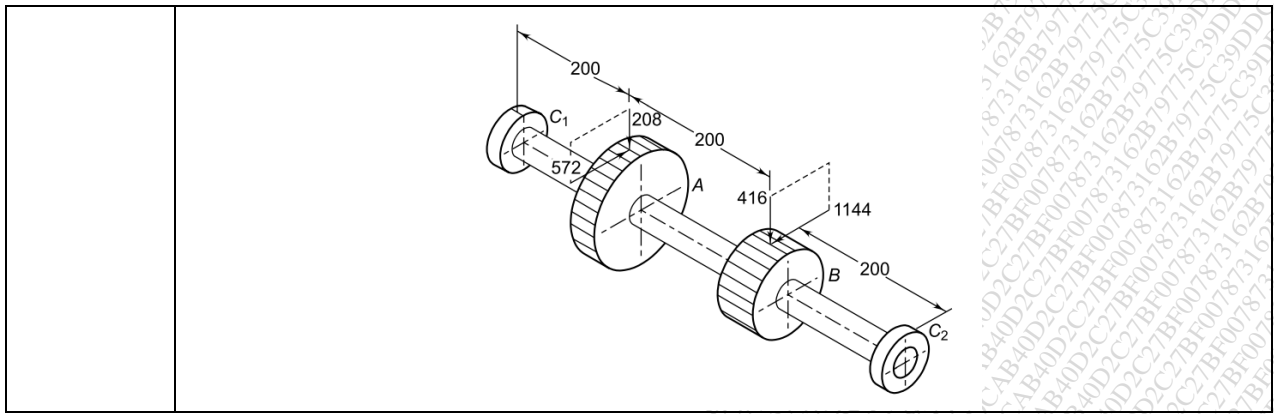
<b>Q2</b>	<b>Attempt the following questions</b>	<b>[20]</b>
<b>A</b>	<b>Solve any Two of the following</b>	<b>[5*2]</b>
i.	Describe the various design considerations for casting with suitable sketches wherever possible.	
ii.	The nominal diameter of a triple-threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having an outer diameter of 100 mm and inner diameter as 65 mm. The coefficient of friction at the thread surface as well as at the collar surface can be taken as 0.15. The screw is used to raise a load of 15 KN. (a) Calculate torque required to raise the load, if uniform wear theory is applicable at collar. (b) How much force should be applied at the end of a 0.5 m long lever in order to raise the load?	
iii.	What are the reasons for misalignment in shaft?	
<b>B</b>	<b>Solve any one of the following</b>	<b>[10]</b>
i.	A semi-circular link of the mechanism is subjected to a load of 2 KN as shown in figure. The link has a circular cross section and is made from 30C8. Determine the dimensions of the link if the factor of safety is 2.5.	





ii. Design a socket and spigot cotter joint subjected to a reversible load of 30 kN.

<b>Q3</b>	<b>Attempt the following questions</b>	<b>[20]</b>
<b>A</b>	<b>Solve any Two of the following</b>	<b>[5*2]</b>
i.	List any four theories of failure. Explain any one theory of failure with a suitable sketch to show boundary of safe region under biaxial stress system.	
ii.	A rectangular plate 150 mm x 100 mm with a central hole of diameter 20 mm, is subjected to a completely reversed axial load of 20 kN. The notch sensitivity can be assumed as 0.8. Determine the plate thickness for infinite life, if F.S. is 2. Assume ultimate tensile strength as 500 MPa, surface factor as 0.8, size factor as 0.85 and calculations are expected at 90% reliability, for which the reliability factor is 0.897.	
iii.	The internal diameter of a hollow shaft is 2/3 rd of its external diameter. Compare the strength and stiffness of the shaft with that of a solid shaft of the same material.	
<b>B</b>	<b>Solve any one of the following</b>	<b>[10]</b>
i.	Two plates are joined by using a combination of single parallel and double transverse fillet weld. An eccentric load of 40 kN acts on the plates as shown in figure. Calculate the size of weld if the allowable shear stress in the weld material is limited to 65 MPa.	
ii.	An intermediate shaft of a gearbox, supporting two spur gears A and B and mounted between two bearings C <sub>1</sub> and C <sub>2</sub> , as shown in figure. The pitch circle diameters of gears A and B are 500 and 250 mm respectively. The yield strength for shaft material is 480 N/mm <sup>2</sup> . The factors k <sub>b</sub> and k <sub>t</sub> can be taken as 2 and 1.5 respectively. Assume suitable factor of safety and determine the shaft diameter.	



<b>Q4</b>	<b>Attempt the following questions</b>	<b>[20]</b>
<b>A</b>	<b>Solve any Two of the following</b>	<b>[10]</b>
i.	Enlist the different assumptions made in the design of curved beam.	
ii.	Explain the concept of nipping in leaf spring.	
iii.	What are the various stresses acting on a key? Explain with suitable sketches.	
<b>B</b>	<b>Solve any one of the following</b>	<b>[10]</b>
i.	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 figure. The notch sensitivity factor at the fillet can be taken as 0.85 and the expected reliability is 90%, for which the reliability factor is 0.897. Determine the diameter of the beam for a life of 10000 cycles.	
ii.	A helical valve spring is to be designed for an operating load range of approximately 90 to 135 N. The deflection of the spring for the load range is 7.5 mm. Assume a spring index of 10. Permissible shear stress for the material of the spring = 480 MPa and its modulus of rigidity = 80 KN/mm <sup>2</sup> . Design the spring considering the effect of curvature.	