Paper Id: 140518 Roll No:

B. TECH
(SEM-V) THEORY EXAMINATION 2019-20
MACHINE DESIGN-I

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If required any missing data, then choose suitably.
Use of Design data handbook is allowed.

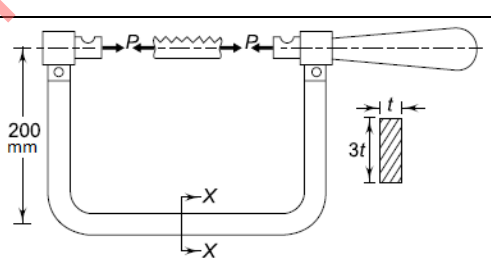
SECTION A

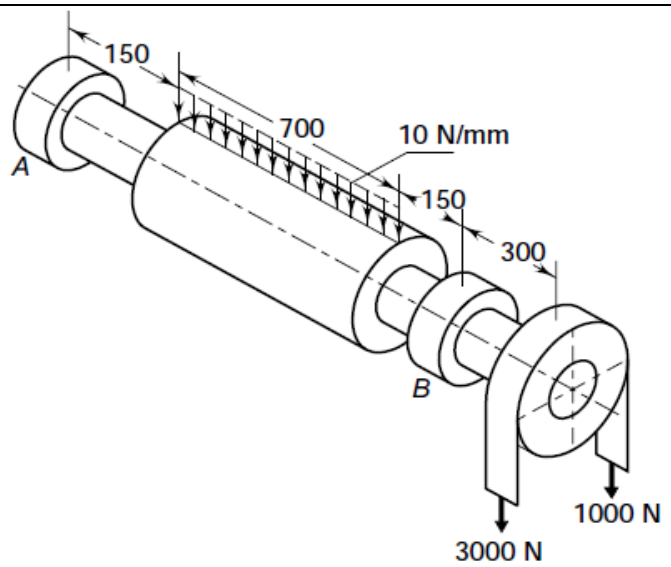
1. Attempt all questions in brief. **2 x 10 = 20**

a.	What is preferred number? State the advantage of preferred number.
b.	It is required to standardize eleven shafts from 100 to 1000 mm diameter. Specify their diameters.
c.	How will you select appropriate material for designing a component?
d.	Why stress concentration occurs? How its effect can be reduced?
e.	Define endurance strength & endurance limit.
f.	What are the different types of spring?
g.	What are the different types of rivet heads?
h.	Which theories of failure are applicable for the design of shafts? Why?
i.	What is feather key? Give its applications.
j.	What is lock nut? What is the principle of lock nut?

SECTION B

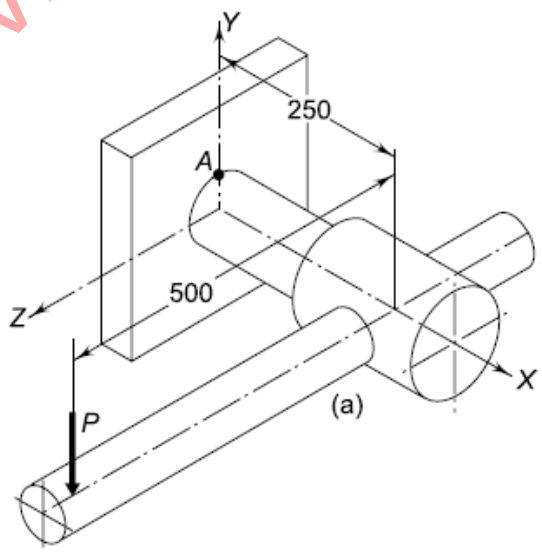
2. Attempt any *three* of the following: **10x3=30**

a.	Frame of a hacksaw is shownin Fig. The initial tension P in the bladeshould be 300 N. The frame is made of plain carbonsteel 30C8 with a tensile yield strength of 400N/mm^2 and the factor of safety is 2.5. The cross-sectionof the frame is rectangular with a ratio of depth to width as 3. Determine the dimensions of the cross-section.	
b.	A rod of a linkage mechanism madeof steel 40Cr1 (Sut = 550 N/mm^2) is subjected to a completely reversed axial load of 100 kN. The rodis machined on a lathe and the expected reliabilityis 95%. There is no stress concentration. Determinethe diameter of the rod using a factor of safety of 2for an infinite life condition.	
c.	The armature shaft of a 40 kW, 720rpm electric motor, mounted on two bearings A andB, is shown in Fig. The total magnetic pullon the armature is 7 kN and it can be assumed tobeuniformly distributed over a length of 700 mmmidway between the bearings. The shaft is made ofsteel with an ultimate tensile strength of 770 N/mm^{2}and yield strength of 580 N/mm^2. Determine theshaft diameter using the ASME code if,k_b = 1.5 and k_t = 1.0. All dimensions mentioned in figure are in mm.	

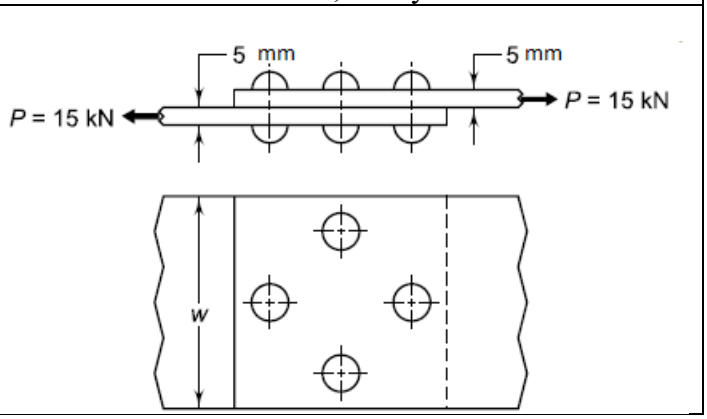
	
d.	The standard cross-section for a flat key, which is fitted on a 50 mm diametershaft, is 16x10 mm. The key is transmitting 475N-m torque from the shaft to the hub. The key ismade of commercial steel (Syt = Syc = 230 N/mm ^{2}).Determine the length of the key, if the factor ofsafety is 3.
e.	What is Alloy steel? Explain the effect of different alloying elements added to get certain beneficial effects.

SECTION C

3. Attempt any *one* part of the following: 10x1=10

a.	The shaft of an overhang crank subjected to a force P of 1 kN is shown in Fig. The shaft is made of plain carbon steel 45C8 and the tensile yield strength is 380 N/mm^2. The factor of safety is 2. Determine the diameter of the shaft using the maximum shear stress theory. Dimensions mentioned in the figure are in mm.	
b.	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 (Syt = 400 N/mm^2) and the factor of safety is 4. The width of the cotter is five times of thickness.Calculate: (i) width and thickness of the cotter based on shear failure; and (ii) width and thickness of the cotter based on bending failure.	

4. Attempt any *one* part of the following: 10x1=10

a.	A rotating bar made of steel 45C8(Sut = 630 N/mm^2) is subjected to a completelyreversed bending stress. The corrected endurancelimit of the bar is 315 N/mm^2. Calculate the fatiguestrength of the bar for a life of 90,000 cycles.	
b.	Two plates, each 5 mm thick, are connectedby means of four rivets as shown inFig. Thepermissible stresses for rivets and plates in tension, shear and compressionare 80, 60 and 120 N/mm2 respectively. Calculate: (i) diameter of the rivets; (ii) width of the plate; and (iii) efficiency of the joint.	

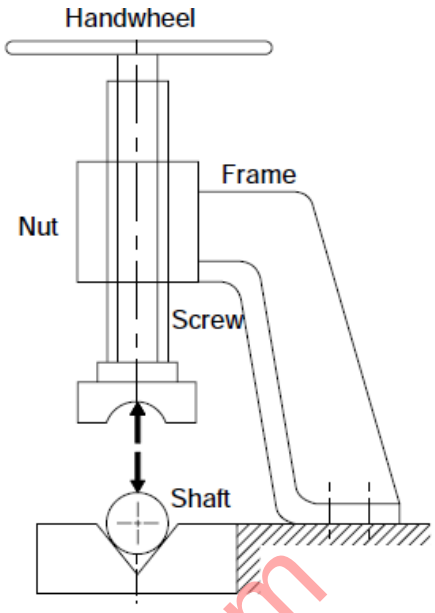
5. Attempt any *one* part of the following: 10x1=10

a.	A shaft supported at the ends in ball bearings carries a straight tooth spur gearat its mid-span and is to transmit 7.5 kW at 300 r.p.m. The pitch circle diameter of the gear is 150 mm.The distances between the centerline of bearings and gear are 100 mm each. If the shaft is made ofsteel and the allowable shear stress is 45 MPa, determine the diameter of the shaft. The pressure angle of the gear may be taken as 20°.
b.	Design a muff coupling which is used toconnect twosteel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plaincarbonsteel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MParespectively. The material for the muff is cast iron for which the allowable shear stress may beassumed as 15 MPa.

6. Attempt any *one* part of the following: 10x1=10

a.	Design a helical compression spring for a maximum load of 1000 N for adeflection of 25 mm using the value of the spring index as 5.The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is84 kN/mm^2.
b.	A helical compression spring,made of circular wire, is subjected to an axialforce, which varies from 2.5 kN to 3.5 kN. Over thisrange of force, the deflection of the spring shouldbe approximately 5 mm. The spring index can betaken as 5. The spring has square and ground ends.The spring is made of patented and cold-drawnsteel wire with ultimate tensile strength of 1050N/mm^2 and modulus of rigidity of 81370 N/mm^2. Thepermissible shear stress for thespring wire shouldbe taken as 50% of the ultimate tensile strength. Design the spring and calculate (i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) total number of coils; (v) solid length of the spring; (vi) free length of the spring;

7. Attempt any *one* part of the following: 10x1=10

a.	The construction of a shaftstraightener used on the shop floor is shown in. The screw has single-start square threadsof 80 mm nominal diameter and 10 mm pitch. Thescrew is required to exert a maximum axial force of 10 kN. The mean radius of the friction collar is30 mm. The axial length of the nut is 40 mm. Thecoefficient of friction at the threads and the. collaris 0.12. The mean diameter of the rim of the handwheel is 500 mm. Calculate (i) the force exerted at therim to drive thescrew (ii) the efficiency of the straightener.	
b.	Two flat plates subjected to atensile force P are connected together by meansof double-strap butt joint as shown in Fig. The force P is 250 kN and the width of the plate wis 200 mm. The rivets and plates are made of thesame steel and the permissible stresses in tension,compression and shear are 70, 100 and 60 N/mm^2 respectively. Calculate: (i) the diameter of the rivets; (ii) the thickness of the plates; (iii) the dimensions of the seam, viz., p, p_t and m; (iv) the efficiency of the joint.