Question Paper Code13251B.E. / B. Tech DEGREE EXAMINATIONS, NOV / DEC 2024Fifth SemesterMechanical Engineering20MEPC504 - DESIGN OF MACHINE FLEMENTSRegulations - 2020(Use of design data book is permitted)Duration: 3 HoursMax. Marks: 100PART - A (MCQ) (20 × 1 = 20 Marks)Marks $\frac{K}{Level}$ colspan="2">Colspan="2" <th cols<="" th=""><th></th><th></th><th>Reg. No</th><th>•</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></th>	<th></th> <th></th> <th>Reg. No</th> <th>•</th> <th></th>			Reg. No	•											
B.E. / B. Tech DEGRE EXAMINATIONS, NOV / DEC 2024         Fifth Semester         Mechanical Engineering         20MEPC504 - DESIGN OF MACHINE ELEMENTS         Regulations - 2020         (Use of design data book is permitted)         Duration: 3 Hours       Max. Marks: 100         PART - A (MCQ) (20 × 1 = 20 Marks)       Mark $\frac{K}{Lord}$ Answer ALL Questions       Mark $\frac{K}{Lord}$ 1. Which design consideration deals with the appearance of the product?       I       KI         (a) Ergonnics       (b) Aesthetics       (c) System design       (d) Creative design         2. Which of the following is not the cause of stress concentration?       I       KI       COI         (a) Ergonnics       (b) Mild stel       (c) alloping stress in a curved beam is       I       KI       COI         3. Which of the following materials has maximum ductility       (a) agrey cast iron       (b) mild stel       (c) alloy steel       (d) high carbon steel         3. Which of the toilouing stress in a curved beam is       (c) atcoing the materials has a result of which of the following       I       KI       COI         (a) agrey cast iron       (b) mild steel       (c) alloy the consider the controidal axis       I       KI       COI         (c) Tacture       (d) by $-0.57$ og       (d) $y - 0.4$ og <th></th> <th>Question Paper</th> <th>Code</th> <th></th> <th>13</th> <th>325</th> <th>1</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>		Question Paper	Code		13	325	1									
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<ul> <li>6. A mechanical component may fail as a result of which of the following <ol> <li>KI CO2</li> <li>(a) elastic deflection</li> <li>(b) general yielding</li> <li>(c) fracture</li> <li>(d) each of the mentioned</li> </ol> </li> <li>7. When using cast iron components, which of the following strength are considered to <ol> <li>KI CO2</li> <li>(a) Yield Strength (b) Endurance limit (c) Ultimate tensile strength (d) None of the above</li> </ol> </li> <li>8. The phenomenon of decreased resistance of the materials to fluctuating stresses is the <ol> <li>KI CO2</li> <li>(a) Fracture</li> <li>(b) Fatigue</li> <li>(c) Yielding</li> <li>(d) None of the above</li> </ol> </li> <li>9. Shafts are subjected to <ol> <li>forces.</li> <li>forces.</li> <li>(a) Compressive</li> <li>(b) Tensile</li> <li>(c) Shear</li> <li>(d) None of the listed</li> </ol> </li> <li>10. The shafts will have same strength on the basis of torsional rigidity, if <ol> <li>KI CO3</li> <li>(a) diameter and length of both shafts is same</li> <li>(c) angle of twist for both shafts is same</li> <li>(d) all of above conditions are satisfied</li> </ol> </li> <li>11. KI CO3</li> <li>(a) Axial</li> <li>(b) Radial</li> <li>(c) Eccentric</li> <li>(d) None of the listed</li> <li>(c) Tensile failure of the plate <ol> <li>(b) Shear failure of rivet</li> <li>(c) Tensile failure of the plate between rivets</li> <li>(d) Shear failure of plate</li> </ol> </li> <li>12. What is the requirement to weld a butt joint?</li> <li>(a) Crushing failure of the plate between rivets</li> <li>(d) Shear failure of plate</li> <li>(a) The components may not necessarily lie in the same plane <ol> <li>(c) Bevelling is not required for components with a thickness less than 5 mm</li> </ol> </li> </ul>		(a) $\tau_v = 0.5 \sigma_v$ (b) $\tau_v = 0.577 \sigma_v$ (c	$\tau_{\rm v} = 0.$	75 (	$\sigma_{\rm v}$		(d)	$\tau_v =$	0.4	$\sigma_{\rm v}$						
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<ul> <li>(a) Axial</li> <li>(b) Radial</li> <li>(c) Eccentric</li> <li>(d) None of the listed</li> <li>1 K1 CO4</li> <li>(a) Crushing failure of the plate</li> <li>(b) Shear failure of rivet</li> <li>(c) Tensile failure of the plate between rivets</li> <li>(d) Shear failure of rivet</li> <li>(e) Shear failure of plate</li> <li>(f) Shear failure of plate</li> <li>(f) Shear failure of plate</li> <li>(g) Shear failure of plate</li> <li>(h) Shear failure of plat</li></ul>	11.	Woodruff key permits movement betw	ween sha	ıft a	nd t	he	hub.	Ŧ	<b>C</b> .	1		1	1	Kl	COS	
<ul> <li>(a) Crushing failure of the plate</li> <li>(b) Shear failure of rivet</li> <li>(c) Tensile failure of the plate between rivets</li> <li>(d) Shear failure of plate</li> <li>1 K1 CO4</li> <li>(a) The components must lie in the same plane</li> <li>(b) The components may not necessarily lie in the same plane</li> <li>(c) Bevelling is not required for components with a thickness less than 5 mm</li> </ul>	10	(a) Axial (b) Radial Which is not a possible type of failure in a riv	(c) Ecc	entr	10		(d) N	lone	of t	he	lıst	ed	1	K1	$CO_4$	
<ul> <li>(a) Frashing failure of the plate between rivets</li> <li>(b) Shear failure of first</li> <li>(c) Tensile failure of the plate between rivets</li> <li>(d) Shear failure of plate</li> <li>1 K1 CO4</li> <li>(a) The components must lie in the same plane</li> <li>(b) The components may not necessarily lie in the same plane</li> <li>(c) Bevelling is not required for components with a thickness less than 5 mm</li> </ul>	12.	(a) Crushing failure of the plate	(b) S	int: ieai	· fail	ure	ofri	vet					1	m	004	
<ul> <li>13. What is the requirement to weld a butt joint?</li> <li>(a) The components must lie in the same plane</li> <li>(b) The components may not necessarily lie in the same plane</li> <li>(c) Bevelling is not required for components with a thickness less than 5 mm</li> </ul>		(c) Tensile failure of the plate between rivets	(d)	She	ar fa	ilu	re of	plate	•							
<ul><li>(a) The components must lie in the same plane</li><li>(b) The components may not necessarily lie in the same plane</li><li>(c) Bevelling is not required for components with a thickness less than 5 mm</li></ul>	13.	What is the requirement to weld a butt joint?						•					1	K1	CO4	
<ul><li>(b) The components may not necessarily lie in the same plane</li><li>(c) Bevelling is not required for components with a thickness less than 5 mm</li></ul>		(a) The components must lie in the same plan	ne													
(c) Bevening is not required for components with a thickness less than 5 mm		(b) The components may not necessarily lie i	in the sa	me	plan	ne	~~ 4 <sup>1</sup>	-								
(d) There is no requirement to weld a buff joint		(c) Bevening is not required for components (d) There is no requirement to weld a buttion	with a t	nici	cnes	s ie	ss tha	an 5	mm							

14.	The pin in knuckle joint is subjected to stress.	1	K1	<i>CO</i> 4				
	(a) torsional shear (b) double shear (c) axial compressive (d) axial tensile							
15.	Find the shear stress in the spring wire used to design a helical compression sprig if a	1	K1	<i>CO5</i>				
	load of 1200N is applied on the spring. Spring index is 6, and wire diameter 7mm.							
	(a) $452.2$ N/mm <sup>2</sup> (b) $468.6$ N/mm <sup>2</sup> (c) $512.2$ N/mm <sup>2</sup> (d) None of the listed							
16.	What will happen if stresses induced due to surge in the spring exceeds the endurance	1	K2	CO5				
	limit stress of the spring.							
	(a) Fatigue Failure (b) Fracture (c) None of the listed (d) Nipping							
17.	Which of the following are functions of flywheel?	1	K1	<i>CO5</i>				
	(a) Store and release energy during work cycle							
	(b) Reduce power capacity of the electric motor							
	(c) Reduce amplitude of speed fluctuations							
	(d) All of the listed							
18.	A journal bearing is a contact bearing working on the hydrodynamic	1	K2	CO6				
	lubrication and which supports load in direction.							
	(a) Sliding, Axial (b) Rolling, Radial (c) Sliding, Radial (d) Rolling, Axial							
19.	The bearing is subjected to a radial load of 4000N. Expected life for 90% bearings is	1	K1	<i>CO6</i>				
	9000h and shaft is rotating at 1500rpm. Calculate the dynamic load capacity.							
	(a) 42.21kN (b) 37.29kN (c) 26.33kN (d) 35.22kN							
20.	There is problem of alignment in deep groove ball bearings.	1	K2	<i>CO6</i>				
	(a) Yes (b) It aligns itself only in some particular cases							
	(c) No, it is self-aligning (d) Can't be determined							
PART - B (10 × 2 = 20 Marks)								
Answer ALL Questions								
21.	Define fits and tolerances.	2	K1	<i>CO1</i>				
22.	Define fluctuating stresses.	2	K1	<i>CO2</i>				
23.	List some advantages of hollow shafts over solid shafts.	2	K2	CO3				
24.	State the difference between rigid and flexible coupling.	2	K1	СО3				
25.	Discuss the need for preloading of bolts.	2	K2	<i>CO</i> 4				
26.	List the various modes of failure of fork end in knuckle joint.	2	K1	<i>CO</i> 4				
27.	State the various functions of a spring. In which type of spring the behaviour is	2	K1	<i>CO5</i>				
	non-linear?							
28.	Name the stresses set up in an IC engine connecting rod.	2	K1	<i>CO5</i>				
29.	. List any four advantages of rolling contact bearings over sliding contact bearings.			<i>CO6</i>				
30.	Give two applications where the inner race is rotating and outer race is stationary in	2	K2	<i>CO6</i>				
	rolling contact bearings.							

## PART - C ( $6 \times 10 = 60$ Marks)

Answer ALL Questions

31. a) A punch press, used for stamping sheet metal, has a punching capacity of 50 <sup>10</sup> <sup>K3</sup> <sup>CO1</sup> kN. The section of the frame is as shown in Figure. Find the resultant stress at the inner and outer fibers of the section.



b) Figure shows a C-clamp, which carries a load P of 25 kN. The cross-section of <sup>10</sup> K<sup>3</sup> CO1 the clamp is rectangular and the ratio of width to thickness (b/t) is 2:1. The clamp is made of cast steel of Grade 20-40 ( $S_{ut}$ = 400 N/mm<sup>2</sup>) and the factor of safety is 4. Determine the dimensions of the cross-section of the clamp.



- 32. a) A machine component is subjected to a flexural stress which fluctuates <sup>10</sup> K<sup>3</sup> CO<sup>2</sup> between +300 MN/m<sup>2</sup> and -150 MN/m<sup>2</sup>. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength= 0.5 Ultimate strength and factor of safety = 2. OR
  - b) A mild steel shaft of 50 mm diameter is subjected to a bending moment of <sup>10</sup> K3 CO2 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. The maximum principal stress theory and 2. The maximum shear stress theory.
- 33. a) The shaft, as shown in Figure, is driven by pulley B from an electric motor. <sup>10</sup> K3 CO3 Another belt drive from pulley A is running a compressor. The belt tensions for pulley A is 1500 N and 600 N. The ratio of belt tensions for pulley B is 3.5. The diameter of pulley A is 150 mm and the diameter of pulley B is 480 mm. The allowable shear stress is 85 MPa. Taking torsion and bending factors as 1.25 and 1.75 respectively, find the shaft diameter.



b) Design a muff coupling to connect two shafts transmitting 40kW at 120 rpm. 10 K3 CO3 The permissible shear and crushing stress for the shaft and key material (mild steel) are 30 MPa and 80MPa respectively. The material of muff is cast iron with permissible shear stress of 15 MPa. Assume that the maximum torque transmitted is 25 per cent greater than mean torque.

OR

34. a) Determine the length of the weld run for a plate size 120mm wide and 15mm <sup>10</sup> <sup>K3</sup> <sup>CO4</sup> thick to be welded to another plate by means of a) a single transverse weld and b) double fillet welds when the joint is subjected to variable load.

## OR

- b) Design a cotter joint to connect piston rod to the crosshead of a double acting <sup>10</sup> K3 CO4 steam engine. The diameter of the cylinder is 300mm and the steam pressure is 1N/mm<sup>2</sup>. The allowable stresses for the material of cotter and piston rod are as follows. Tensile stress50MPa, Shear Stress 40 MPa and Compressive stress 84MPa.
- 35. a) A semi-elliptical laminated spring 900 mm long and 55 mm wide is held <sup>10</sup> K<sup>3</sup> CO<sup>5</sup> together at the centre by a band 50mm wide. If thickness of each leaf is 5mm, find the number of leaves required to carry a load of 4500 N. Assume a maximum working stress of 490 MPa. If the two of these leaves extend the full length of the spring, find the deflection of spring. The young's modulus for the spring material may be taken as 210 kN/mm<sup>2</sup>.

## OR

- b) Evaluate the dimensions of an I-section connecting rod for a petrol engine 10 K3 CO5 from the following data: Diameter of the piston = 110 mm; Mass of the reciprocating parts = 2kg; Length of the connecting rod from the centre to centre = 325mm; Stroke length = 150mm RPM = 1500 with possible over speed of 2500; Compression ratio = 4:1; Maximum explosion pressure = 2.5 N/mm<sup>2</sup>.
- 36. a) A full journal bearing of 50 mm diameter and 100 mm long has a bearing 10 K3 C06 pressure of 1.4 MPa. The speed of the journal is 900 rpm and the ratio of journal diameter to the diametrical clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Calculate (i) The amount of artificial cooling required and (ii) The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J/kg/°C.

## OR

b) Select a single row deep groove ball bearing for a radial load of 4000N and an <sup>10</sup> <sup>K3</sup> <sup>CO6</sup> axial load of 5000N, operating at a speed of 1600 rpm for an average life of 5 year at 10 hours per day. Assume uniform and steady load.