PANDIAN SARASWATHI YADAV ENGINEERING COLLEGE

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Department of Mechanical Engineering,

Academic Year 2022-23

Model Exam

Sub Code: **ME8593** Sub Name: **Design of Machine Elements**

Year /SEM: **III / V** Date: 24.11.2022

Max. Marks: 50 Marks Duration: 01.00 pm- 04.00 pm (3 Hours)

Part-A **Answer all the questions** **(10×2=20)**

Q. No	Question	M	CO	BTL
1	Describe the material properties of Hardness, Stiffness and Resilience	2	1	1
2	What are the unilateral and bilateral tolerances?1.220-25	2	1	1
3	Differentiate between rigid coupling and flexible coupling	2	2	2
4	Define the term critical speed of a shaft?	2	2	3
5	State the disadvantages of welding	2	3	3
6	List out three conditions where tap bolts are used	2	3	2
7	Define the term of fluctuation speed and Energy	2	4	2
8	Distinguish between close coiled and open coiled springs.	2	4	4
9	What is meant by hydrodynamic lubrication and advantages of hydrodynamic bearings?	2	5	4
10	List are four advantages to rolling contact bearings over sliding contact bearings	2	5	2

Part-B **Answer all the questions** **(5×13=65)**

Q. No	Question	M	CO	BTL
11.(a)	A C clamp is subjected to a maximum load of W, as shown in fig. If the maximum tensile stress in the clamp is limited to 130 MPa. Find value of W	**13**	**1**	**4**

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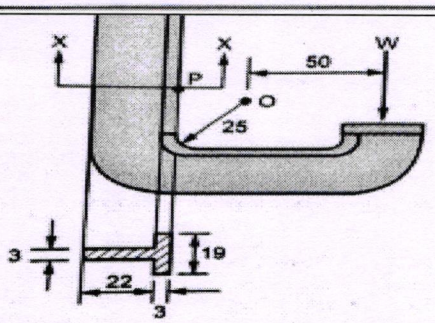
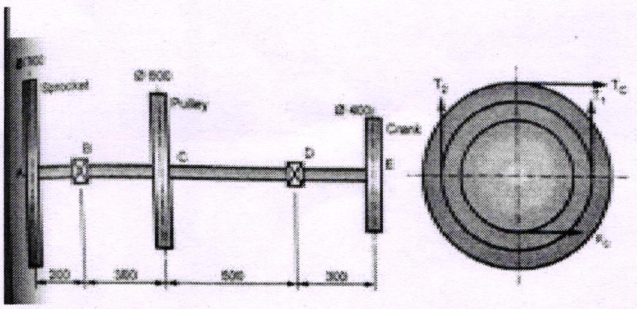
				
	OR			
11.(b)	A transmission shaft made of C45 steel is subjected to a fluctuating torque varying from 100N-m to 500N-m. Also a fluctuating bending moment acts on the shafts which varies from 500N-m to -50 N-m. let the stress concentration factor to be2. The shaft is machined , for a factor of safety of 1.5.Determine the required diameter of the shaft	**13**	**1**	**3**
12.(a)	A power of 20 kW is supplied to the sprocket of diameter 700 mm with the help of chain drive as shown in fig. out of 20 kW, 14 kW is taken off at pulley of 600 mm diameter which weighs 3 KN and remaining power at the crank. The force in the chain is represented by Tc. Ratio of belt tensions in the pulley is 4:1. The shaft is rotating at 280 rpm. Take K_b= 2 and K_t= 1.5. Design the shat if Sys= 60 N/mm^2 by assuming that the sprocket and pulley are keyed to the shaft 	**13**	**2**	**4**
	OR			
12.(b)	Design rigid flange couplings to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges are of cast iron and bolts are of steel.	**13**	**2**	**3**

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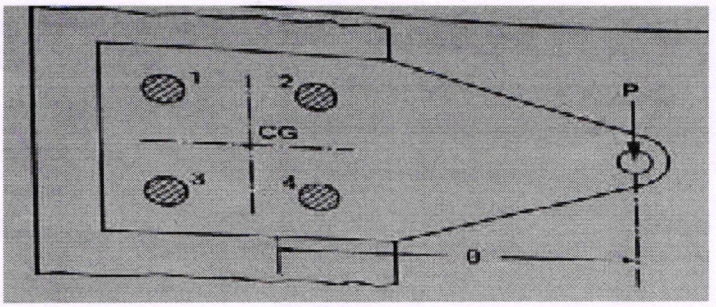
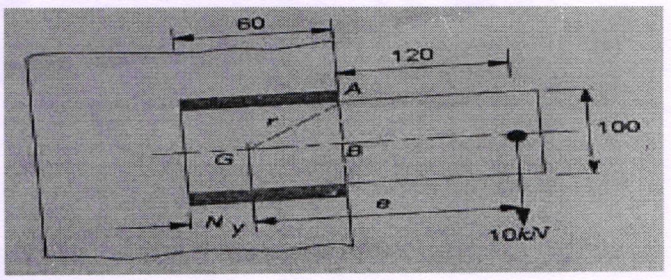
	Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below (a) Shear stress on shaft = 100 MPa (b)Bearing or crushing stress on shaft = 250MPa (c) Shear stress on keys = 100 MPa (d)Bearing stress on keys =250MPa (e)Shearing stress on cast iron =200MPa (f) Shear stress on bolts =100MPa After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. Check stresses developed in the various members, if thumb rules are used for fixing the dimensions			
13.(a)	A structural connection shown in figure is subjected to an eccentric force P of 10kN wit an eccentricity of 500 mm. The centre distance between bolts 1 and 2 is 200 mm and 1 and 3 is 150 mm. all the bolts are identical, Assume shear stress 80 N/mm^2 for the bolt material 	**13**	**3**	**4**
	OR			
13.(b)	A bracket shown figure carries a load of 10kN. Find the size of the weld if the allowable shear stress is not exceed 75 N/mm^2 	**13**	**3**	**4**
	OR			

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14.(a)	It is required to design a helical compression spring of circular wire, subjected to an axial load, which varies from 2.5 kN to 3.5 kN . For this range of load, the deflection of the spring should be limited to 5mm.The spring index is 5. The spring has square and ground ends. For spring wire material ultimate strength 1050 MPa and G=81370 MPa. The permissible shear stress for the spring wire should be taken as 50% of the ultimate strength. Calculates (i)Wire diameter and mean coil diameter (ii) Number of active coils and total number of coils (iii) Solid length of spring (iv) Free length of spring (v) Required spring rate and Actual spring rate	**13**	**4**	**4**
	OR			
14.(b)	A punching machine, with a capacity to punch 30 holes of 20 mm diameter per minute in a steel plate of 15 mm thickness and having ultimate shear stress of 250 N/mm2 is powered by a flywheel through a gear reducer having reduction ratio of 10:1. The actual punching operation last for 1/5 of the angular rotation of the punching machine crank shaft. Design a rimmed flywheel made of grey cast iron with a following data: (i) Mechanical efficiency of punching machine = 85% (ii) Maximum permissible fluctuation of flywheel speed = 10 % of mean speed (iii) Maximum permissible diameter of the flywheel =1.0 m (iv) Contribution of the rim to the flywheel effect =90% (v) Flywheel rim width to thickness ratio=2.0 (vi) Number of arms =6 (vii) Permissible tensile stress for the flywheel=7 N/mm^2 (viii) Mass density of the flywheel material = 7200 kg/m^3	**13**	**4**	**3**

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	(ix) Also find the required power of electric motor to drive the punching machine if the mechanical efficiency of transmission system is 90%			
	OR			
15.(a)	The following data is given for a 360° hydrodynamic bearing: Radical load =3.2 kN, journal speed =1490 rpm. Journal diameter=50 mm, Bearing length =50 mm, Radial clearance=0.05 mm, Viscosity of lubricant=25cP Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, Calculate (i) Co efficient of friction (ii) Power lost in friction (iii) Minimum oil film thickness (iv) flow requirements in litres /min and (v) Temperature rise	**13**	**5**	**4**
	OR			
15.(b)	A shaft of length 1.2 m is supported on two identical deep groove ball bearings. The shaft is fixed with a gear at its centre which is rotating at 720 rpm. The tangential and radial force components for the gear are 1kN and 0.8 kN respectively. Expected life of the bearings is 15000 hours with a reliability of 80%. Neglecting the effect of axial force (if any) calculate the dynamic load rating for the bearings so that they can directly be selected from manufacturer's catalogue. Use following data: Load factor 1.25, $L=6.8441\ L10[\log_e(1/R)]^{0.8547}$	**13**	**5**	**3**

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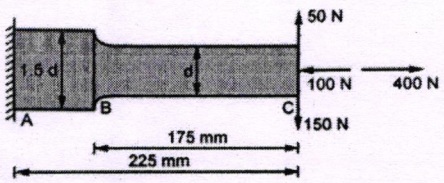
Part C Answer all the questions **(1×15=15 marks)**

Q. No	Question	M	CO	BTL
16.(a)	A cantilever beam made of cold draw steel 35C8 (Sut = 550 MPa and Syt=320 MPa) is subjected to transverse loading at its end. It varies from 50N (up) to 150 N (down) and an axial load varies from 100N (Compressive) to 400N (tensile). The surface finish factor and size factor are 0.9 and 0.85 respectively. The load factor is 0.923 and modifying factor for stress concentration is 0.68. If FOS = 2, Determine the required diameter of the section for infinite life of the beam 	15	1	4
	OR			
16.(b)	An engine runs at a constant load at a speed of 480 rpm. The crank effort diagram is drawn to a scale 1mm= 200 N-m torque and 1mm=3.60 crank angle. The areas of the diagram above and below the mean torque line in sq.mm are in the following order: +110,- 132, +153,-166,+197,-162. Design the flywheel if the total fluctuation of speed is not to exceed 5 MPa. Assume that the rim breadth is approximately 2.5 times the rim thickness and 90% of the moment of inertia is due to rim. The density of the material of the flywheel is 7250 kg/m3	15	2	4

Prepared by **HOD** **Principal**

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Department of Mechanical Engineering,

Academic Year 2022-23

Model Exam

Sub Code: **ME 8692** Sub Name: **Finite Element Analysis**

Year /SEM: **III / VI** Date:18.05.2023

Max. Marks: 100 Marks Duration: 90 Minutes

Part-A (10×2=20)

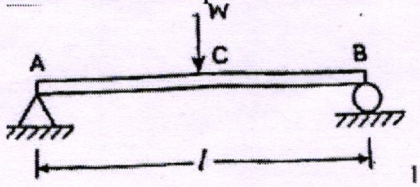
Answer all the questions

Q. No	Question	M	CO	BTL
1	Why polynomial type of interpolation functions is mostly used in FEM?	2	1	1
2	Define the discretization and Assemblage?	2	1	1
3	List down the expression of longitudinal vibration of bar element?	2	2	2
4	What is natural and Global Coordinates?	2	2	3
5	State the assumptions in the theory of pure torsion?	2	3	3
6	Define CST and LST	2	3	2
7	Mention conditions for a problem to be axisymmetric?	2	4	2
8	Write the assumptions used in thin plate and thick plate element?	2	4	3
9	Distinguish the Jacobian Matrix for Four Noded quadrilateral Element	2	5	3
10	Explain Dynamic analysis and Resonance	2	5	2

Part-B (5×13=65)

Answer all the questions

Q. No	Question	M	CO	BTL
11.(a)	The following differential equation is available for a physical phenomenon $d^2y/dx^2 + 500\,x^2 = 0$ $0 \le x \le 10$, Trial function is $y = a_1x(x-x^4)$, Boundary condition are , $y(o) = 0$ $Y(1)=0$ Find the value of the parameter a1 by the following methods,(i) Point collocation (ii) sub domain Collocation (iii) Least squares (iv) Galerkins Method	**13**	**1**	**4**
	OR			
11.(b)	A beam AB of span l simply supported at ends and carrying a concentrated load W at the centre Load W at the centre C as shown in fig. Determine the deflection at midspan by using Rayleigh Ritz method and compare with Exact Solutions	**13**	**1**	**3**



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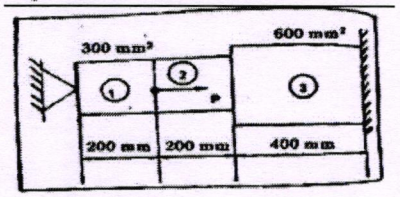
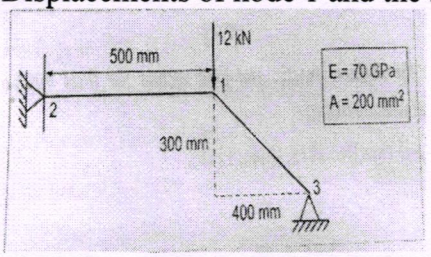
12.(a)	Consider the bar as shown in Fig Calculate the following: Assume $E=2\times10^5 N/mm^2$,P=400N .Determine (i) Nodal displacements (ii) Element Stresses (iii) Support Reactions(	**13**	**2**	**4**

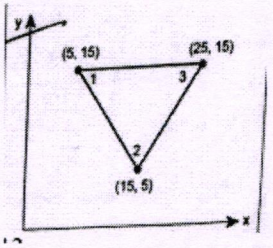


OR

12.(b)	For the two-bar truss shown in Fig. Determine the Displacements of node 1 and the stress element 1-3	**13**	**2**	**3**

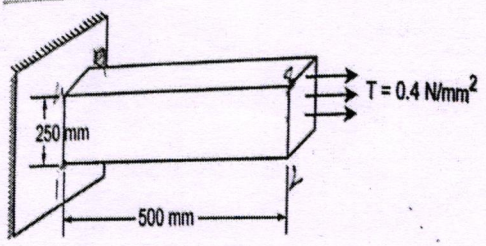


13.(a)	For the plane statin element shown in fig. the nodal displacements are: $u_1=0.005mm$, $u_2=0.0mm$, $u_3=0.005mm$, $v_1=0.002mm$, $v_2=0.0mm$, $v_3=0.0mm$. determine the element stresses σx, σy, τxy, σ1, and σ2 and the pricipal angle θp, Let E=70Gpa and Poisson ratio (v)=0.3 and use unit thickness for a plane strain. All coordinates are in mm	**13**	**3**	**4**



OR

13.(b)	A thin Plate is subjected to surface traction as shown in fig.14. calculate the global stiffness matrix. Take t=25mm , E=2Gpa and Poisson ratio (v)=0.3	**13**	**3**	**4**



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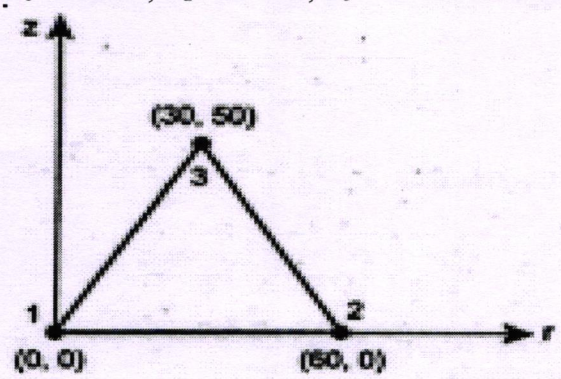
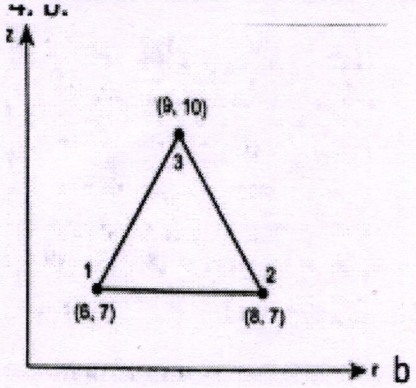
14.(a)	For the axisymmetric element shown in fig. Determine the element stress and stiffness Matrix. Take E=2Gpa and Poisson ratio (v)=0.25. the nodal displacements are: u_1=0.05mm, u_2=0.02mm, u_3=0.0mm, w_1=0.03mm, w_2=0.02mm, w_3=0.0mm. All coordinates are in mm	**13**	**4**	**4**



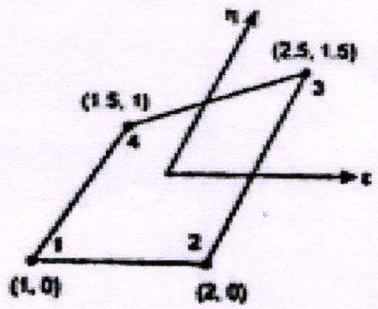
OR

14.(b)	Calculate the element stiffness matrix and the thermal force vector for the axisymmetric triangular element shown in fig. 14.b the element experiences a 15°C increase the temperature. The coordinates are in mm. Take α=10×10-6 /°C ,v=0.25	**13**	**4**	**3**



OR

15.(a)	Evaluate the Jacobian matrix isoperimetric quadrilateral element shown in figure	**13**	**5**	**4**



OR

15.(b)	Evaluate the Intergral I=$\iint_{-1}^{1}(2x^2+3xy+4y^2)$ dx dy using Gauss integration	**13**	**5**	**3**

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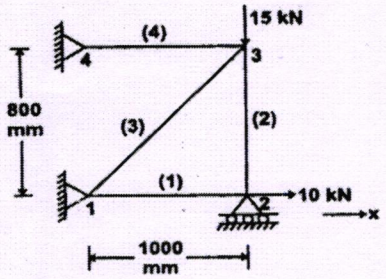
Part C — Answer all the questions — **(1×15=15 marks)**

Q. No	Question	M	CO	BTL
16.(a)	Solve following system of equations using Gauss elimination method. $2x_1 + 3x_2 + x_3 = 9;\ x_1 + 2x_2 + 3x_3 = 6;\ 3x_1 + x_2 + 2x_3 = 0$	15	1	4
	OR			
16.(b)	Consider a 4-bar truss as shown in figure It is given that E = 200 GPa and A= 625 mm^2 for all the elements. Determine (a) Element stiffness marix for each element (b)Structural stiffness matrix (c)Solve for the Nodal displacement	15	2	4



Faculty Incharge **HOD7MECH** **Principal**

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