

- N.B. (1) Question No. 1 and 6 are compulsory. MVK
 (2) Attempt any **two** out of **four** questions from **Section I**.
 (3) Attempt any **two** out of **four** questions from **Section II**.
 (4) Answers to the **two** sections must be written in **separate** answer-books.
 (5) Assume any **suitable** data if **necessary**.

A.E.T.M) VIT KSV CAD/CAM & Finite Element Analysis

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1. Write notes on the following :—
 - (a) Artificial intelligence in design
 - (b) Concurrent engineering
 - (c) Adaptive control machining system.

2. (a) Calculate the three dimensional homogeneous transformation matrix to carry out a transformation involving rotation of 20° about an axis parallel to the z-axis through $x = 50, y = 50, z = 50$, followed by a rotation of 45° about an axis parallel to the x-axis through the same centre point. 8
 (b) Find the geometric transformation matrix which aligns the vector $V = I + J + K$ with the vector $N = 2I - J - K$. 8

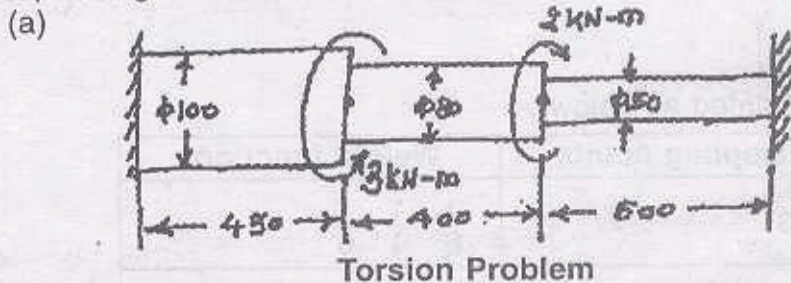
3. (a) Explain product cycle with CAD/CAM overlay. 8
 (b) Explain Ray Tracing and Radiosity. 8

4. (a) With the help of suitable job explain part programming with G-codes and M-codes. 8
 (b) Derive parametric equations for line, circle, ellipse and parabola. 8

5. Write short notes on any **four** :— 16
 - (a) FMS
 - (b) Feature based design
 - (c) Standardization in Graphics
 - (d) Rapid prototyping
 - (e) Types of statements of APT language.

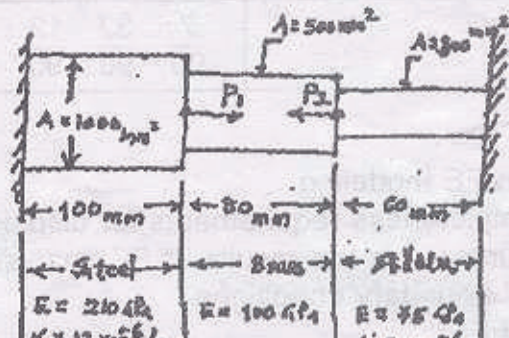
Section II

6. Analyse completely the problem given below, using directly the Element Matrix equation corresponding to that field. 18



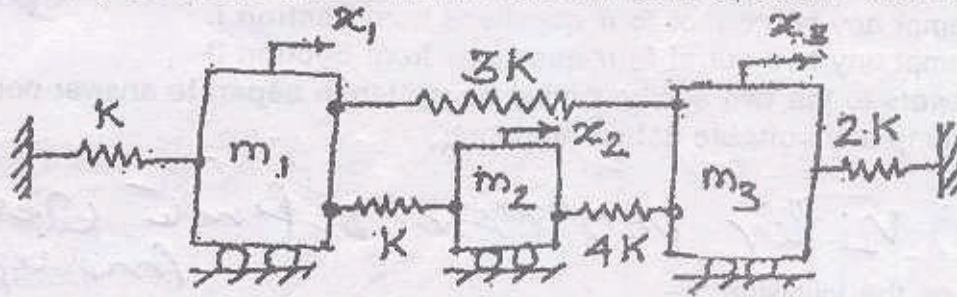
$G = 100 \text{ GPa}$
 All length and dia. are in mm.

- (b) Stepped bar, with Thermal effect

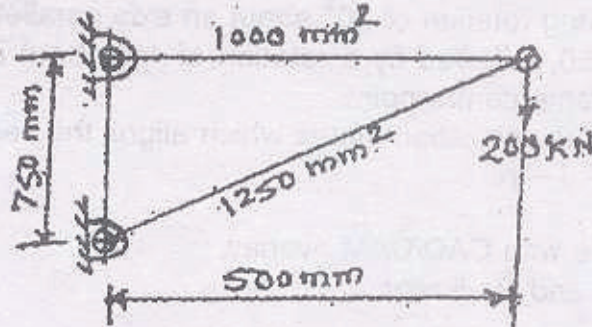


$P_1 = 49 \text{ kN}$
 $P_2 = 20 \text{ kN}$
 $\Delta T = 60^\circ\text{C rise}$

differential equations of motion. Write element mass and stiffness matrices and finally assemble all to construct Global matrix equation. Use direct approach.



8. (a) What is meant by pre-processing and post-processing with reference to FEM software package. 6
- (b) For pin jointed plane frame configuration as shown below, determine the stiffness of each member. Assembling these and form global stiffness matrix. Also work out stresses and strains in all elements. $E = 200 \text{ GPa}$. 10



9. (a) Use finite difference method to solve the following differential equation. Compare the answer with exact solution at midpoint. Use 4 subdivisions. 9

$$\frac{d^2u}{dx^2} - 16u + 5x^2 = 0, \quad 0 \leq x \leq 2$$

B.C.S. $u(0) = 0, \quad u(2) = 2$.

- (b) Use Newton Cotes Method to find out the following integral : 7

$$K_{23} = \int_0^{he} \frac{d\phi_2}{dx} \frac{d\phi_3}{dx} dx$$

Check your answer with exact value.

where $\phi_1 = \left(1 - \frac{\bar{x}}{he}\right) \left(1 - \frac{2\bar{x}}{he}\right)$

$$\phi_2 = \frac{4x}{he} \left(1 - \frac{x}{he}\right)$$

$$\phi_3 = \frac{\bar{x}}{he} \left(1 - \frac{2\bar{x}}{he}\right)$$

weight functions are tabulated as below :—

Number of sampling points	Weight functions
3	$\frac{1}{6}, \frac{1}{4}, \frac{1}{6}$
4	$\frac{1}{8}, \frac{3}{8}, \frac{3}{8}, 1$
5	$\frac{7}{90}, \frac{32}{90}, \frac{12}{90}, \frac{32}{90}, \frac{7}{90}$

10. Write short notes on any four :—

- Choice of elements in FE modeling
- Compatibility and completeness requirements for displacement functions
- Different errors encountered in the results of FE analysis
- Natural and Essential boundary conditions