

Con. 5164-09.

(REVISED COURSE)

SP-6512

(4 Hours)

[Total Marks : 100]

N .B. (1) Question Nos.1 & 6 is compulsory

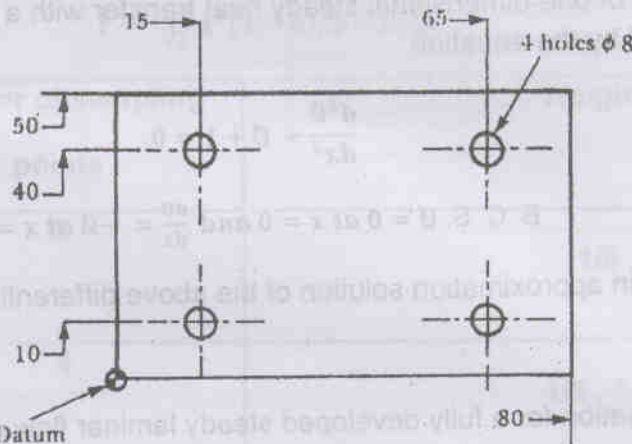
(2) Attempt any two from the remaining in each section

(3) Answers to the two sections must be written in separate answer-books

(4) Assume suitable data if necessary

Q 1.a) Select an engineering product with which you are familiar, and describe the models that you used in its development. What modeled properties were represented in these? Identify the range of engineering and other specialist that would have an input into its product development process. (10)

b) Write a part program using G codes and M codes for drilling 4 holes shown in Fig. below. The component is 10 mm thick. The HSS Drill is 8 mm dia. Assume suitable speed and feed for machining. Use Incremental programming (8)



Q.2a) Find the transformation which aligns the vector $V = I + J + K$ with the vector

$$N = 2I - J - K$$

(7)

b) Compare: -

(9)

i) NC & CNC

ii) Constructive Solid Geometry and Boundary Representation

iii) Fixed zero & Floating zero

Q.3a) A cubic Bezier curve is defined by the points (1, 1), (2, 3), (4, 4), (6, 1) (9)

Calculate the coordinates of the parametric mid-point of this curve and verify that

It's gradient $\frac{dy}{dx}$ is $\frac{1}{7}$ at this point. Use this information to sketch this curve.

b) Explain Southerland Hodgman Algorithm for Polygon Clipping (7)

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- Q.4a) What is feature recognition & design by feature? Identify a set of features for the modeling of axi-symmetric turned shaft incorporating parallel & tapered portions, chamfers, fillet bends & external threads. What parameter would you use in their definition? (9)
- b) Consider a triangle ABC having coordinates A (5, 5), B (8, 5) and C(5,10) Determine the new vertex positions if it is mirrored about the line $y = 2x + 4$. (7)
- Q.5 .Write short notes on (16)
- Sequential approach & Concurrent Engineering Approach to product development
 - Elements of APT language
 - FMS
 - Artificial Intelligence in Design

SECTION II

- Q.6 (a) A certain problem of one-dimensional steady heat transfer with a distributed heat source is governed by the equation (8)

$$\frac{d^2\theta}{dx^2} + \theta + 1 = 0$$

B. C. S. $\theta = 0$ at $x = 0$ and $\frac{d\theta}{dx} = -\theta$ at $x = 1$

Find the Galerkin approximation solution of the above differential equation.

- (b) The governing equation for a fully developed steady laminar flow of a Newtonian viscous fluid on an inclined flat surface is given by: (10)

$$\mu \frac{d^2v}{dx^2} + \rho g \cos\theta = 0$$

Where:

μ = coefficient of viscosity

v = fluid velocity

ρ = density

g = acceleration due to gravity

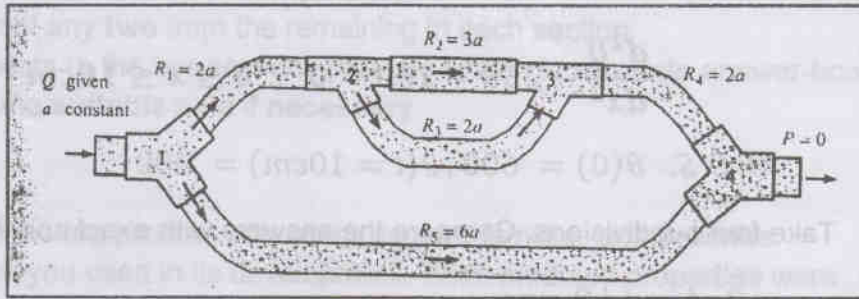
θ = angle between the inclined surface and the vertical.

The boundary conditions are given by

$\frac{dv}{dx} = 0$ at $x = 0$ (zero shear stress), $v(L) = 0$ (no slip)

Determine the elementary matrix equation using Rayleigh Ritz Method over general element.

Q.7 (a) For the Fluid Flow network shown below, determine pressure at nodes. (8)



$$\text{EME} : \begin{pmatrix} 1 \\ R^e \end{pmatrix} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{Bmatrix} P_1^e \\ P_2^e \end{Bmatrix} = \begin{Bmatrix} Q_1^e \\ Q_2^e \end{Bmatrix}$$

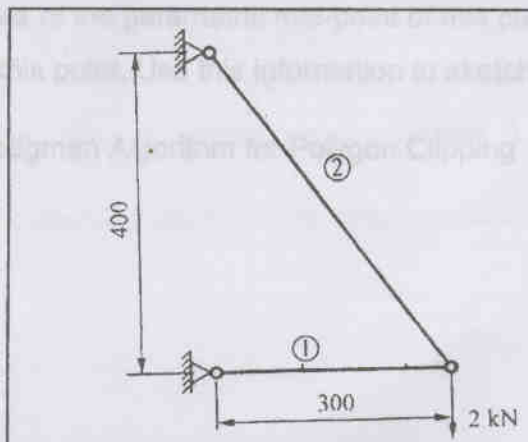
(b) Use Newton- Cotes Integration formula to evaluate (8)

$$I = \int_2^5 x^2(1-x)(3-x)dx$$

Number of sampling points	Weight functions
3	1/6 , 4/6 , 1/6
4	1/8 , 3/8 , 3/8 , 1/8
5	7/90, 32/90, 12/90, 32/90, 7/90

Q.8 (a) With the help of example discuss the effect of node numbering on the assembled stiffness matrix. (4)

(b) Analyze the Truss completely. The cross sectional area of each member of truss is 100 mm² . The modulus of Elasticity is 200 GPa (12)



Q9 (a) Use Finite difference method to solve:

(8)

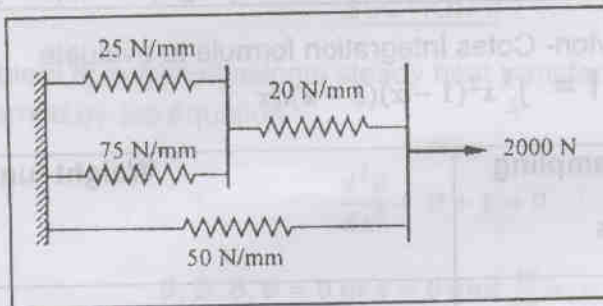
$$\frac{d^2\theta}{dx^2} - 25\theta + 100 = 0, \quad 0 \leq x \leq 10\text{cm}$$

B.C.S. $\theta(0) = 600, \theta(l = 10\text{cm}) = 300$

Take four subdivisions. Compare the answers with exact solutions at $x = 2, 4, \text{ and } 8 \text{ cms.}$

b) The figure below shows a cluster of four springs. Calculate deflections of each spring when a force of 2000N is applied. Model the springs as 1D spar element.

(8)



Q10. Explain:

(16)

- (a) Explain what you understand by h and p methods of Finite Element Analysis?
- (b) What are the sources of errors in FEM solution? Write in brief.
- (c) Advantages of weak form method
- (d) Discuss the applications of FEM

