



RM-7171-R

B. E. III (Sem. VI) (Mech.) Examination

May / June – 2010

Computer Aided Engg. Analysis

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दृष्टाविले निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. 3 (Sem. 6) (Mech.)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Computer Aided Engg. Analysis"/>	<input type="text"/>
Subject Code No. : <input type="text" value="7"/> <input type="text" value="1"/> <input type="text" value="7"/> <input type="text" value="1"/>	<input type="text" value="Student's Signature"/>
Section No. (1, 2,.....) : <input type="text" value="Nil"/>	

- (2) Attempt **all** questions.
- (3) Figures to the **right** indicate full marks.
- (4) Use of pocket calculator is allowed.
- (5) Assume suitable data if **necessary**.
- (6) Answer to the two sections must be written in two separate answer book

1 (a) Answer the following : 2

(i) 
$$A = \begin{bmatrix} 1 & -4 & 5 \\ 3 & 7 & -1 \\ 1 & 15 & -11 \end{bmatrix}$$

find the rank of matrix A

- (ii) Define Computer Aided Engg. Analysis. 2
- (iii) Differentiate between numerical method and Analytical Method. 2
- (iv) List four types of problems encountered in Mech. Engg. in which Computer Aided Engg. Analysis can be useful. 2
- (v) Define 2
  - Absolute error in Numerical computation.
  - Skew-Symmetric matrix.

(b) Solve the following equations by LU decomposition method. 8

$$2x + 3y + z = 9$$

$$x + 2y + 3z = 6$$

$$3x + y + 2z = 8$$

OR

- (b) Solve the following system of equation accurate to four significant digits (6 iterations required) 8

$$10x_1 + x_2 + 2x_3 = 44$$

$$2x_1 + 10x_2 + x_3 = 51$$

$$x_1 + 2x_2 + 10x_3 = 61$$

Use Gauss-Seidel method.

- 2 Attempt any two : 14

- (i) If P is the pull required to lift a load W by means of a pulley block, find a linear law of the form  $P = mW + C$  connecting P and W, using the following data.

P	12	15	21	25
W	50	70	100	120

Where P and W are taken in kg-wt. Compute P when  $W = 150$  kg.wt.

- (ii) The following table gives the value of x and y.

x :	1.2	2.1	2.8	4.1	4.9	6.2
y :	4.2	6.8	9.8	13.4	15.5	19.6

Find the value of x corresponding to  $y = 12$  using Lagrange's interpolating formula.

- (iii) From the following table, estimate the number of students who obtained marks between 40 and 45.

Marks :	30-40	40-50	50-60	60-70	70-80
No. of students :	31	42	51	35	31

- 3 Attempt the following : 18

- (i) Find the root of the equation  $x^3 - 2x - 5 = 0$  by the method of false position correct to three decimal places. 6

**OR**

- (i) Using Newton-Raphson method find the root of the equation. 6

$$x + \log_{10} x = 3.375 \text{ correct to four significant figures.}$$

- (ii) function  $f(x)$  is given as follows : 6

x:	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y:	1.001	1.008	1.027	1.064	1.125	1.216	1.343	1.512	1.729	2.0

Compute the integral of  $f(x)$  between  $x=0.1$  and  $x = 1.0$  Use Simpson's (3/8)th rule.

**OR**

- (ii) The velocity V (km/min) of a moped which starts from rest is given at a fixed interval of time t (min) as follows : 6

t :	2	4	6	8	10	12	14	16	18	20
u :	10	18	25	29	32	20	11	5	2	0

Estimate approximately the distance covered in 20 minutes.

- (iii) The distance (s) covered as a function of time (t) by an athlete during his/her run for the 50 meter race given in the following table.

Time (secs.):	0	1	2	3	4	5	6
Distance (mts.):	0	2.5	8.5	15.5	24.5	36.5	50

Find the speed of athlete at  $t = 4.5$  seconds.

**OR**

- (iii) Given that

**6**

x :	1.0	1.1	1.2	1.3	1.4	1.5	1.5
y :	7.989	8.403	8.781	9.129	9.451	9.750	10.031

Find  $\frac{dy}{dx}$  and  $\frac{d^2y}{dx^2}$  at  $x = 1.1$

- 4 (a) Answer the following questions : **10**
- (i) Write the general second order partial differential equation and classify it. **4**
- (ii) Differentiate between local numbering and global numbering used in FEM. **3**
- (iii) Define predictor-corrector method. **2**
- (iv) 3<sup>rd</sup> order R.K. method agrees with Taylor's series method upto \_\_\_\_\_ term. **1**

- (b) Solve the equation  $\frac{\partial y}{\partial t} = \frac{\partial^2 y}{\partial x^2}$  subject to **10**

conditions  $u(x, 0) = \sin \pi x, 0 \leq x \leq 1, u(0, t) = u(1, t) = 0$  using implicit method. Carryout the calculation for two levels

taking  $h = \frac{1}{3}, k = \frac{1}{36}$

- 5 (a) The angular displacement  $\theta$  of a simple pendulum **15**

is given by equation  $\frac{d^2\theta}{dt^2} + \frac{g}{l} \sin \theta = 0$

Where  $l = 98$  cm,  $g = 980$  cm/sec<sup>2</sup> if  $\theta = 0$  and  $\frac{d\theta}{dt} = 4.472$  at  $t = 0$ . Use 4th order R.K. method to find  $\theta$  and

$\frac{d\theta}{dt}$  when  $t = 0.2$  sec. Take  $\theta$  in radian.

**OR**

- 5 (a) The deflection of a beam is governed by equation.

$$\frac{d^4 y}{dx^4} + 81 y = \phi(x).$$

Where  $\phi(x)$  is given by the table.

x	1/3	2/3	1
$\phi(x)$	81	162	243

and boundary condition

$$y(0) = y'(0) = y''(1) = y'''(1) = 0.$$

Evaluate the deflection of beam at the pivotal points of beam using three sub-intervals.

6 Attempt any **one** :

15

(a) Consider the thin (steel) plate. The plate has a uniform thickness  $t = 1 \text{ cm}$ ,  $E = 30 \times 10^6 \frac{\text{N}}{\text{cm}^2}$ ,  $\rho = 0.2836 \frac{\text{kg}}{\text{cm}^3}$  in addition to its self weight, the plate is subjected to point load  $P = 100 \text{ N}$  at mid point.

- (i) model the plate with 2 elements
- (ii) Write equation for element stiffness matrices and element body force vector.
- (iii) Assemble the structural stiffness matrix and global load vector.
- (iv) Using elimination approach solve global displacement vector.
- (v) Evaluate stress in each element.
- (vi) Determine reaction force at support.

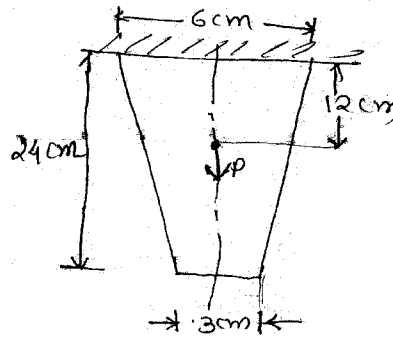


Fig. 1

(b) A composite wall consists of 3-materials the inside wall temperature is  $200^\circ\text{C}$  and outside air temperature is  $50^\circ\text{C}$  with convection co-efficient is  $10 \text{ W/m}^2\text{K}$ . Determine the interface temperature of composite wall.

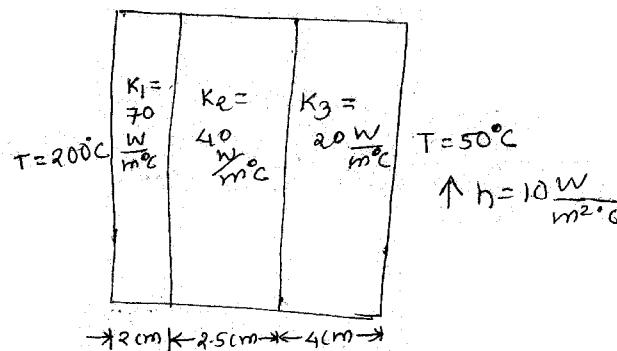


Fig. 2