

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2015
CIVIL ENGINEERING
10CE6101 Advanced Numerical Methods

Max. Marks: 60

Duration: 3 Hours

Part A

(Answer any two questions : 2 x 9= 18 Marks)

1. Solve the following system by Doolittle's method.

$$3x_1 + 2x_2 + 7x_3 = 4$$

$$2x_1 + 3x_2 + x_3 = 5$$

$$3x_1 + 4x_2 + x_3 = 7$$

(9 marks)

2. Solve the following system by Gauss Elimination. Use partial pivoting if necessary

$$4x_1 + 3x_2 + 2x_3 = 2$$

$$2x_1 + 4x_2 + 9x_3 = 8$$

$$x_1 + 2x_2 + 3x_3 = 8$$

(9 marks)

3. Find all the eigen values of the system using power method.

$$\begin{bmatrix} 3.556 & -1.778 & 0 \\ -1.778 & 3.556 & -1.778 \\ 0 & -1.778 & 3.556 \end{bmatrix}$$

(9 marks)

Part B

(Answer any two questions : 2 x 9= 18 Marks)

4. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using

a). Trapezoidal rule

b). Simpsons's 1/3 rule

c). Weddie's rule

(9 marks)

5. Fit a curve $y = a+bx+cx^2$ using least squares analysis of the following data.

x	1	1.5	2	2.5	3	3.5	4
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

(9 marks)

6. Apply Milne's method to find a solution of the differential equation $y' = xy + y^2$ in the range $0 \leq x \leq 0.4$, for the boundary condition $y(0) = 1$. Starting solution required are to be obtained using 4th order Runge-Kutta method

(9 marks)

Part C

(Answer any two questions: 2 x 12 = 24 Marks)

7. Determine values of y at the pivotal points of the interval (0,1) if y satisfies the boundary value problem $\frac{d^4 y}{dx^4} + 81y = 81x^2$, $y(0) = y(1) = y''(0) = y''(1) = 0$ (take $n=3$).

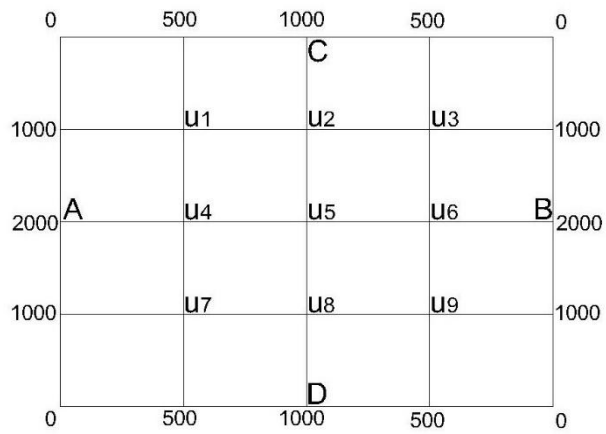
(12 marks)

8. The deflection of a beam is given by the equation $\frac{d^4 y}{dx^4} + 81y = \varphi(x)$, when $\varphi(x)$ is given by

x	0	1/3	2/3	1
$\varphi(x)$	0	81	162	243

(12 marks)

9. Solve the elliptic equation $U_{xx}+U_{yy} = 0$ for the following square mesh with boundary values as shown in figure.



(12 marks)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M. TECH DEGREE EXAMINATION, DECEMBER 2016
CIVIL ENGINEERING
10CE6101 ADVANCED NUMERICAL METHODS

Max. Marks: 60

Duration: 3 Hours

Part A

(Answer any two questions : 2 x 9 = 18 Marks)

1. Solve using Gauss Elimination method

$$4x_1 + 3x_2 + 2x_3 = 2$$

$$2x_1 + 4x_2 + 9x_3 = 8$$

$$x_1 + 2x_2 + 3x_3 = 8$$

(9 marks)

2. Apply Gauss Seidel iteration method to solve the equations

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$

$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$

$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$

$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

(9marks)

3. Find the highest eigen value and eigen vector by power method

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ -0 & -1 & 2 \end{bmatrix}$$

(9marks)

Part B

(Answer any two questions : $2 \times 9 = 18$ Marks)

4. Fit an exponential curve for $y = ae^x$ to the following data

x	1	2	3	4	5
y	1.6	4.5	13.8	40.2	125

(9marks)

5. Find x when $f(x) = 20$ using inverse interpolation for the following data

x	1	2	3	4
y	1	8	27	64

(9marks)

6. Solve $\frac{dy}{dx} = x^2 + y$ using 4th order Runge- kutta method. Find $y(0.1)$. Given $y(0) = 1$.

Use step size as 0.05

(9marks)

Part C

(Answer any two questions : $2 \times 12 = 24$ Marks)

7. Solve the Laplace equation $U_{xx} + U_{yy} = 0$. given that

0	11.1	17	19.7	18.9
0	U1	U2	U3	21.9
0	U4	U5	U6	21
0	U7	U8	U9	17
0	8.7	12.1	12.5	9

(12 marks)

8. Determine values of y at the pivotal points of the interval $(0,1)$ if y satisfies the boundary value problem $\frac{d^4 y}{dx^4} + 81 y = 81x^2$, $y(0) = y(1) = y'(0) = y'(1) = 0$ (take $n=3$).

(12marks)

9. a) Explain Galerkin's method
b) Explain collocation method for solving initial value problems.
c) Explain weighted residual methods.

(12marks)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2017
CIVIL ENGINEERING
COMPUTER AIDED STRUCTURAL ENGINEERING
10CE6101 Advanced Numerical Methods

Max. Marks: 60

Duration: 3 Hours

Part A

(Answer any two questions: 9 x 2 = 18 Marks)

1. Solve the system of linear equations using Gauss-Seidel iteration to a tolerance of $\epsilon_s < 1\%$

$$\begin{bmatrix} 2 & 1 & 0 & 0 \\ 1 & 2 & 1 & 0 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & 1 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 4 \\ 8 \\ 12 \\ 11 \end{bmatrix}$$

Use eight decimal digit rounding arithmetic.

(9Marks)

2. Solve the following system of equations by LU decomposition method

$$\begin{aligned} 2x_1 - 6x_2 - x_3 &= -38 \\ -3x_1 - x_2 + 7x_3 &= -34 \\ -8x_1 + x_2 - 2x_3 &= -20 \end{aligned}$$

(9 marks)

3. (a) Find the largest eigen values (λ) and corresponding eigen vectors of the matrix using power method. Carry at least six figures after the decimal place. Iterate until the values of λ change by less than three digits after the decimal place. Start the problem with trial

matrix $[1 \ 0 \ 1]^T$ $A = \begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 1 \\ 1 & 1 & 3 \end{bmatrix}$ (6 marks)

- (b) Explain about ill conditioned system. (3 marks)

Part B

(Answer any two questions: 9 x 2 = 18 Marks)

4. Calculate the Lagrange polynomial $P_3(x)$ for the data given in the table1. From $P_3(x)$, find $P_3(0.9)$ (9Marks)

X	0.4	0.6	0.8	1.0
F(x)	5.1600	3.6933	3.1400	3.000

5. Find $\int_0^\pi (5 + \sin x) dx$ using
- Trapezoidal rule (n=4)
 - Simpson's 1/3 rule (n=4)
 - Two point Gaussian quadrature formula for (n=2)
- (9 marks)

6. Solve the ODE by modified Euler's method over the interval from $x = 0$ to 0.5 . Use step size of 0.25 where $y(0) = 1$.

$$\frac{dy}{dx} = (1 + 2x)\sqrt{y}$$

Part C

(Answer any two questions: 12 x 2 = 24 Marks)

7. (a) Solve the differential equation $y'' + 6y' - y = 2$, $y(0)=0$ & $y(2)=1$ using Finite difference method. Take 'h' as 0.5 . (8 marks)
- (b) Explain weighted residual methods (4 marks)
8. Consider steady heat diffusion in the unit square, $0.0 < x < 1.0$ and $0.0 < y < 1.0$. Let $T(0, y) = T(x, 0) = 100.0$ and $T(1.0, y) = T(x, 1.0) = 0.0$. Solve this problem with $\Delta x = \Delta y = 0.25$ (12 marks)
9. Solve the differential equation $u'' + x = 0$ with boundary conditions $u(0) = 0$ and $u(1) = 0$ by (i) Point collocation method (ii) subdomain method (iii) least square method (12Marks)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M. TECH DEGREE EXAMINATION, DECEMBER 2018
CIVIL ENGINEERING
COMPUTER AIDED STRUCTURAL ENGINEERING
10CE6101 Advanced Numerical Methods

Max. Marks: 60

Duration: 3 Hours

Part A

(Answer any two questions: $9 \times 2 = 18$ Marks)

1. Consider a system of linear equations.

$$\begin{bmatrix} 7 & 1 & 1 & 2 \\ 1 & 8 & 0 & -2 \\ 1 & 0 & 4 & -1 \\ 2 & -2 & 1 & 6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 3 \\ -5 \\ 4 \\ -3 \end{bmatrix}$$

Solve the system using Gauss-Seidel iteration using six decimal digit rounding arithmetic. (9Marks)

2. Find all the eigen values and corresponding eigen vectors of the matrix using Jacobi method.

$$\begin{bmatrix} 5 & -2 & 0 \\ -2 & 5 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

(9 marks)

3. Solve the following system of equations by Newtons Raphsons method

$$x_1^2 + x_2^2 + x_3^2 - 1 = 0$$

$$x_1^2 + x_3^2 - \frac{1}{4} = 0$$

$$x_1^2 + x_2^2 - 4x_3 = 0$$

(9 marks)

Part B

(Answer any two questions: $9 \times 2 = 18$ Marks)

4. Construct a Lagrange polynomial and calculate the value of $\tan 33^\circ$. Given

x	:	30	32	35	38
$\tan x$:	0.57735	0.63487	0.70021	0.78129

(9Marks)

5. Solve the differential equation $y' = y - y^2$ $y(0) = 0$, using fourth order Runge- Kutta

Method up to $y = 1$. Take $h=0.1$ (9 marks)

6. Use three-point Gauss quadrature rule to approximate the distance covered by a rocket from $t=8$ to $t=30$ as given by $x = \left(\int_8^{30} 2000 \ln \left[\frac{140000}{140000-2100t} \right] - 9.8t \right) dt$

Compare the results with the results obtained from

a). Trapezoidal rule

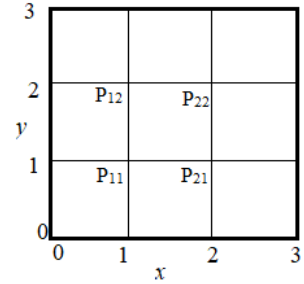
b). Simpsons's 1/3 rule

(9 marks)

Part C

(Answer any two questions: $12 \times 2 = 24$ Marks)

7. a. For the grid in Figure compute the potential at the four internal points from Laplace equation. $u = 220$ on the upper and lower edges, 110 on the left and right. (6Marks)



b. Obtain a two term Galerkin Solution for the differential equation $y''-10x^2= 5$, $0 \leq x \leq 1$ with boundary conditions $y(x=0)=0$, $\theta(x=1)=0$ (6 Marks)

8. Use the Crank-Nicolson method to solve the partial differential equation

$$\frac{\partial T}{\partial t} = 0.02 \frac{\partial^2 T}{\partial x^2} \text{ with the following initial and boundary conditions:}$$

Initial conditions: $T(x, 0) = 100x$ for $0 \leq x \leq 1$; $T(x, 0) = 100(2 - x)$ for $1 \leq x \leq 2$

Boundary conditions: $T(0, t) = 0$; $T(2, t) = 0$ (12Marks)

9. Solve the differential equation $\varphi'' - \varphi = x^2$ with boundary conditions

$\varphi(x = 0) = 0$ and $\varphi(x = 1) = 0$ by

(i) Point collocation method and (ii) Least square method.

(12Marks)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH. DEGREE EXAMINATION, JULY 2019

CIVIL ENGINEERING

10CE6101: ADVANCED NUMERICAL METHODS

Max. Marks : 60

Duration:3Hrs

Part A (Modules I - II)

(Answer any two questions :2x9 = 18 Marks)

1. Solve the following system of linear equations by Jacobis method

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$

$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$

$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$

$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

9 Marks

2. Find the largest eigen value and the corresponding eigen vector of the matrix

$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

9 Marks

3. Solve using Crout method

$$3x + 1y + 2z = 3$$

$$2x - 3y - z = -3$$

$$x + 2y + z = 4$$

9 Marks

Part B (Modules III - IV)

(Answer any two questions :2x9 = 18 Marks)

4. Evaluate the following integral using Gauss quadrature 2 point and 3 point rule,

$$\int_2^4 1 + x^4 dx$$

9 Marks

5. Find the Lagrangian polynomial for the data points and find f(3)

X	0	1	2	4	5	6
Y	1	14	15	5	6	19

9 Marks

6. Using Runge-Kutta method of order 4, find $y(0.2)$ given that $\frac{dy}{dx} = 3x + \frac{1}{2}y$, $y(0)=1$, taking $h=0.1$

9 Marks

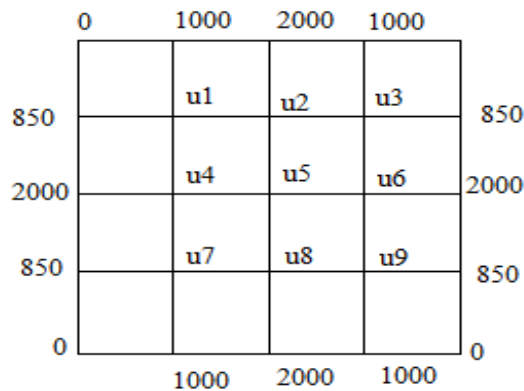
Part C (Modules V & VI)

(Answer any two questions :2 x12 = 24 Marks)

7. Solve the equation $y^{iv} - y^{iii} + y = x^2$, subjected to boundary conditions $y(0) = y'(0)=0$ and $y(1)=2$, $y'(1) = 2$, $y''(1) = 0$.

12 Marks

8. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in figure.



12 Marks

9. solve the following differential equations using least square method. Given boundary conditions are $u(0)=0$, $u(1)=0$

$$\frac{-d^2u}{dx^2} = \sin \pi x$$

12 Marks

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH. DEGREE EXAMINATION, DECEMBER 2019
COMPUTER AIDED STRUCTURAL ENGINEERING
10CE6101: ADVANCED NUMERICAL METHODS

Max. Marks: 60

Duration: 3 Hrs

Part A*(Answer any two questions: 2 x 9 = 18 Marks)*

1. Solve the equations by Gaussian Elimination

$$\begin{aligned}x + 2y - 3z - t &= 0 \\- 3y + 2z + 6t &= -8 \\- 3x - y + 3z + t &= 0 \\2x + 3y + 2z - t &= -8\end{aligned}$$

9 Marks

2. Solve the following equations by the method of Cholesky

$$\begin{aligned}8x + 4y + 2z &= 24 \\4x + 10y + 5z + 4u &= 32 \\2x + 5y + 6.5z + 4u &= 26 \\4y + 4z + 9u &= 21\end{aligned}$$

9 Marks

3. Find the eigen values of the following matrix using power method

$$A = \begin{bmatrix} 2.05 & 1.30 & 4.0 \\ 1.30 & 2.15 & 3.70 \\ 4.00 & 3.7 & 8.4 \end{bmatrix}$$

9 Marks

Part B*(Answer any two questions: 2 x 9 = 18 Marks)*

4. Produce the Lagrangian interpolation polynomial from the following data, and obtain 'x' when y=50

x	14	17	31	35
y	68.7	64	44	39.1

9 Marks

5. A function Coshx is tabulated as follows

x	1	1.2	1.4	1.6	1.8
f(x)	1.543	1.811	2.151	2.577	3.107

Compute $\int_1^{1.8} f(x) dx$ using (a) Trapezoidal rule (b) the Simpson's 1/3 rule. 9 Marks

6. If $\frac{dy}{dx} = x + y$, and initial condition $y(0) = 1$, find $y(1)$ by taking 10 intervals using Euler's methods 9 Marks

Part C

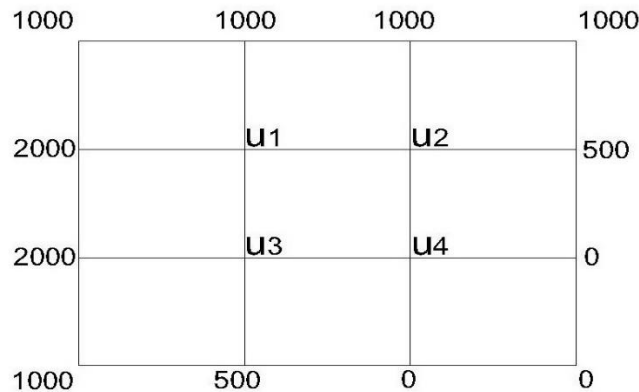
(Answer any two questions : 2 x 12 = 24 Marks)

7. Determine the value of 'y' at the pivotal points of interval 0 to 1, if y satisfies the boundary value problem $\frac{d^4y}{dx^4} + 81y = 81x^2$, $y(0) = y(1) = 0$ and $\frac{d^2y}{dx^2} = 0$ at 0 and 1 12 Marks

8. a) Given the boundary value problem $y'' = 3x + 4y$, $y(0) = 1$, $y(1) = 1$. Obtain the value of $y(0.25)$ using finite difference method
 b) Explain collocation method for solving initial value problems. 12 Marks

9. Given the values of $u(x,y)$ on the boundary of the square in the figure. Evaluate the function $u(x,y)$ satisfying the Laplace equation $\nabla^2 u = 0$ at the pivotal points of the following region

12 Marks



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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

M.Tech S1 (R,S) Exam Dec 2020

A

Reg. No.....

Name:.....

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION

COMPUTER AIDED STRUCTURAL ENGINEERING

10CE6101 : ADVANCED NUMERICAL METHODS

Max. Marks : 60

Duration: 3 Hours

PART A (Modules I & II)

Answer any TWO full questions (2 x 9=18 Marks)

- 1 Solve using Gauss Jacobi Iteration method **(9 Marks)**

$$20x + y - 2z = 17$$

$$3x + 20y - z = -18$$

$$2x - 3y + 20z = 25$$

- 2 Apply Gauss Elimination method to solve the equations **(9 Marks)**

$$x + 4y - z = -5$$

$$x + y - 6z = -12$$

$$3x - y - z = 4$$

- 3 Using Jacobis method , Find all the eigen values and eigen vectors of the matrix : **(9 Marks)**

$$A = \begin{pmatrix} 1 & 1 & 0.5 \\ 1 & 1 & 0.25 \\ 0.5 & 0.25 & 2 \end{pmatrix}$$

PART B (Modules III & IV)

Answer any TWO full questions (2 x 9=18 Marks)

- 4 Evaluate $f(9)$ using Lagrange's formula , given the values : **(9 Marks)**

$$x : \quad 5 \quad 7 \quad 11 \quad 13 \quad 17$$

$$f(x) : \quad 150 \quad 392 \quad 1452 \quad 2366 \quad 5202$$

- 5 Evaluate the $\int_0^6 \frac{dx}{1+x^2}$ by using (9 Marks)
- (a) Trapezoidal rule
 - (b) Simpson's 1/3 rule
 - (c) Simpson's 3/8 rule
 - (d) Weddle's rule and compare the results with actual value.
- 6 Solve $y' = y + e^x$, $y(0) = 0$, find $y(0.2)$ and $y(0.4)$ using Modified Euler's method. Use step size $h = 0.2$ (9 Marks)

PART C (Modules V & VI)

Answer any TWO full questions (2 x 12=24 Marks)

- 7 Solve the equation $y^{iv} + 81y = 81x^2$, over the interval 0 to 1. The boundary conditions are : $y(0)=y(1)=y''(0)=y''(1)=0$. Take $n = 3$ (12 Marks)
- 8 (a) Explain sub domain method (4 Marks)
- (b) Solve the following differential equation using least square method, given- boundary conditions are : $u(0)=0$; $u(1)=0$ (8 Marks)
- $$\frac{-d^2u}{dx^2} = \sin\pi x$$
- 9 Solve the equation $\nabla^2 u = -10(x^2+y^2+10)$ over the square with sides $x=0=y$, $x=3=y$ with $u=0$ on the boundary and mesh length = 1 (12 Marks)
