Registration No. | | | | | | | | | | |

Total number of pages : 04 **B.Tech.**
PCE6I101

6^{th} Semester Regular Examination 2017-18
NUMERICAL METHODS & MATLAB
BRANCH : CHEM
Time : 3 Hours
Max Marks : 100
Q.CODE : C141
Answer Part-A which is compulsory and any four from Part-B.
The figures in the right-hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

Part – A (Answer all the questions)

Q1. Answer the following questions : **(2 x 10)**

(a) _____ is used to denote the process of finding the valuesinside the interval(X0, Xn).
- i. Interpolation
- ii. Extrapolation
- iii. Iterative
- iv. Polynomial equation

(b) Lagrange's interpolation formula is used to compute the values for _____ intervals.
- i. Equal
- ii. Unequal
- iii. Open
- iv. Closed

(c) Romberg's method is also known as _____.
- i. Trapezoidal rule
- ii. Simpson's (1/3)rd Rule
- iii. Simpson's (3/8)th Rule
- iv. Rombergs Integration

(d) In Simpson's 1/3rd rule the number of intervals must be _____.
- i. A multiple of 3
- ii. A multiple of 6
- iii. Odd
- iv. Even

(e) The Eigenvalues of $\begin{bmatrix} 5 & 6 & 17 \\ 0 & -19 & 23 \\ 0 & 0 & 37 \end{bmatrix}$ are
- i. 37,5,-19
- ii. -37,-5,19
- iii. 7,-3,2
- iv. 37,-5,3

(f) The Eigen values of a 4×4 matrix [A] are given as 2,-3, 13, and 7. The det(A) is _____.
- i. 546
- ii. 19
- iii. 25
- iv. Cannot be determined

(g) y(x+h) = y(x) + h f(x,y) is referred as _____ method.
- i. Euler
- ii. Modified Euler
- iii. Taylor's Series
- iv. Runge-Kutta

(h) The power method for approximating Eigen value is _____ method.
- i. Iterative
- ii. Point-wise
- iii. Direct
- iv. Indirect

(i) The partial differential equation $5\frac{\partial^2 z}{\partial x^2}+6\frac{\partial^2 z}{\partial y^2}=xy$ is classified as
- i. Elliptic
- ii. Parabolic
- iii. Hyperbolic
- iv. None of these

(j) A partial differential equation requires
- i. Exactly one independent variable
- ii. Two or more independent variables
- iii. More than one dependent variable
- iv. Equal number of dependent and independent variables

Q2. Answer the following questions : **(2 x 10)**

(a) If $Y(X_i) = Y_i$, i=0, 1,2, …., n write down the formula for the cubic spline polynomial Y(X) valid in $X_{i-1} \leq X \leq X_i$.

(b) What is interpolation? What is the difference between interpolation and extrapolation?

(c) State Forward divided difference formula for finding F'(x) and f''(x).

(d) The table given below reveals the velocity v of a body during the time t specified. Find its acceleration at t=1.1.

T(in sec)	1.0	1.1	1.2	1.3	1.4
V(in m/s)	43.1	47.7	52.1	56.4	60.8

(e) Define Discrete Fourier Transform and algebraic form of FFT.

(f) Find a QR factorization of a matrix $\begin{bmatrix} 3 & 7 \\ 4 & 4 \end{bmatrix}$.

(g) What is the need of numerical solution for differential equations?

(h) "Multistep methods are not self-starting". Justify.

(i) State the condition of the equation $Au_{xx} + Bu_{yy} + Cu_{yy} + Du_x + Eu_y + Fu = G$ where A, B, C, D, E, F, G are functions of x and y to be (i) elliptic (ii) parabolic (iii) hyperbolic.

(j) Write down Adam-Bashforth predictor formula.

Part – B (Answer any four questions)

Q3. (a) The following table gives some relationship between steam pressure and temperature. Find the pressure at temperature 372 using piecewise linear interpolation. **(04)**

T(K)	361	367	378	387	399
P(kPa)	154.9	167.9	191.0	212.5	244.2

(b) Find the second derivative at x=4, using the following data: **(03)**

x	0	2	4	6
y	2	5	8	14

(c) Find the values of f''(0.2), f''(0.6), f''(1.0) from the following data using appropriate initial values based on finite difference and Richardson's extrapolation method. **(08)**

x	0.2	0.4	0.6	0.8	1.0
F(x)	0.12	0.49	1.12	2.02	3.20

Q4. (a) Compute I= $\int_0^{\frac{\pi}{3}} \tan x dx$, using Simpson's rule with h=π/6, π/12, π/24 and then by Romberg's method. **(05)**

(b) Using Hermite's interpolation formula estimate the value of ln3.2 from the following data **(10)**

x	**F(x)=lnx**	**F'(x)=1/x**
3.0	1.09861	0.33333
3.5	1.25276	0.28571
4.0	1.38629	0.25

Q5. (a) Find the dominant Eigen value of the following matrix by power method and compare with Rayleigh's quotient method. **(10)**

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

(b) The differential equation $\frac{dy}{dx} = y - x^2$ satisfied by y(0)=1, y(0.2)=1.1218, y(0.4)=1.4282,y(0.6)=1.7379.Compute y(0.8) by Milne's predictor-corrector method. **(05)**

Q6. (a) Find the QR factorization of the matrix $\begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ using Gram Schmidt process. **(10)**

(b) Compute 4-point DFT of the following sequence using DIT and DIF algorithms. **(05)**

X(n)={0,1,2,3}

Q7. Find the numerically smallest Eigen value of the matrix A by finding A^{-1} and without finding A^{-1} given that one of the Eigen values of A is -20. **(15)**

$$A=\begin{bmatrix} -15 & 4 & 3 \\ 10 & -12 & 6 \\ 20 & -4 & 2 \end{bmatrix}$$

Q8. Solve $25u_{xx}-u_{tt}=0$ for u with the boundary conditions u(0,t)=0, u(5,t)=0 and the initial conditions $u_t(x,o)=0$ and u(x,0)=2x for $0\le x\le 2.5$ u(x,0)=10-2x for $2.5\le x\le 5$, taking h=1.(for four time steps) **(15)**

Q9. **(a)** Given $\frac{\partial^2 f}{\partial x^2}=\frac{\partial f}{\partial t}$, **(05)**

Subject to f(0,t)=f(5,t)=0, $f(x,0)=x^2(25-x^2)$.

Find f in the range taking h=1 and up to 5 seconds.

(b) Solve $\nabla^2 u= -10(x^2+y^2+10)$ over the square mesh with sides x=0, y=0, x=3, y=3 with u=0 on the boundary and mesh length is 1 unit. **(10)**