Registration no:

Total Number of Pages: 2

B.TECH
FESM6302

5th Semester Regular / Back Examination 2016-17
ADVANCED NUMERICAL METHODS
BRANCH(S): CIVIL, MECH
Time: 3 Hours
Max Marks: 70
Q. CODE: Y377

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

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

a) What do you mean by piecewise cubic interpolation?.
b) What do you mean by Spline interpolation?
c) Find the value of $f'(3)$ by central difference and central difference formulas of the following data

x	0	1	2	3	4	5
f(x)	3	5	8	10	13	16

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d) Explain basic power method to find eigen values of a matrix?
e) What is accelerating convergence?
f) Write the formula for Milne-explicit to solve ODE.
g) Define Discrete Fourier transform.
h) Name some of the predictor corrector methods to solve ODE.
i) Write the implicit formula to solve the wave equation.
j) Write down the explicit formula to solve the heat equation.

Q2 **a)** Using Piecewise Quadratic Interpolation find the interpolating polynomial of the function $y = f(x)$ defined by the data: **(5)**

$x = [-3 \quad -2 \quad -1 \quad 1 \quad 3 \quad 6 \quad 7]$
$y = [369 \quad 222 \quad 171 \quad 165 \quad 207 \quad 990 \quad 1779]$.
Hence estimate the values of $f(-2.5)$ and $f(2.5)$.

(5)

b) Fit a cubic spline function for the data

x	0	1	2	3
y	1	2	33	244

Assume $M(0) = f''(0) = 0$. Hence find $f(2.5)$.

Q3 **a)** For the following data estimate the first derivatives at 3 employing step sizes of 1 and 0.5 by Central Difference Formula. Then compute an improved estimate with Richardson's extrapolation **(5)**

x	1	1.5	2	2.5	3	3.5	4	4.5	5
y=f(x)	2	2.82843	4	5.65685	8	11.31371	16	22.62742	32

b) Using Romberg integration evaluate $\int_0^1 \frac{1+x}{1+x^3} dx$ taking h = 1 **(5)**

Q4 Using inverse power method, find the smallest eigen value of the following matrix after five iterations. Also find the corresponding eigen vectors. **(10)**

$$\begin{bmatrix} 1 & 2 & 6 \\ 2 & 5 & 15 \\ 6 & 15 & 46 \end{bmatrix}$$

Q5 Find QR factorization of the following matrix. **(10)**

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

Q6 Given $\frac{dy}{dx} = \frac{1}{x+y}$, $y(0) = 1$ on [0, 1], taking step size h = 0.25 using Adam – Bashforth – Moulton predictor-corrector method. **(5)**

Q7 Using Crank - Nicolson method solve the heat equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, for $0 < x < 1$, $0 \leq t \leq 0.5$ with the initial condition $u(x,0) = sin\pi x$, for $0 < x < 1$ and boundary conditions are $u(0,t) = 0, u(1,t) = 1$ for $0 \leq t \leq 0.5$ with $h = 0.25$, $k = 0.25$ **(10)**

Q8 **(a)** Using FFT, find the interpolation function for the data $z = \langle 0,1,2,3 \rangle$. **(5)**

(b) Using Milne's method find $y(0.6)$ of the initial value problem $\frac{dy}{dx} = \frac{1}{2}(1 + x^2)y^2$, $y(0) = 1$, y(0.1) = 0.99587, y(0.2) = 0.98548, y(0.2) = 0.97131 on [0, 0.5] with h=0.1. **(5)**

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