Menofia University
Faculty of Engineering Shebien El-kom
Electrical Engineering Department.
First semester Examination, 2013-2014
Date of Exam : 23 /1/ 2014

Subject:Eng. Mathematics (4)
Code: BES 311
Year : Third 3rd
Time Allowed : 3 hrs
Total Marks: 70 Marks

Answer the following questions

Question 1 (15 MARKS)

(A) Verify that the function $u(x,t) = \frac{1}{\sqrt{4\pi kt}} e^{\frac{-x^2}{4kt}}$ satisfies the heat equation $u_t = k\,u_{xx}$. (5 Marks)

(B) Solve the following PDE

$$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2} + xt, \qquad 0 < x < 1, \qquad t > 0$$

Subject to: $B.C.s\ u(0,t) = 0,\ u(1,t) = 1$ *and* $I.C.\ u(x,0) = x$

Note: the steady state occurs at t=10 (10 Marks)

Question 2 (25 MARKS)

(A) Solve the following PDE

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2} + x, \qquad 0 < x < 1, \qquad t > 0$$

Subject to: $B.C.s\ u(0,t) = 0,\ u(1,t) = 1$ *and* $I.C.\ u(x,0) = x, \frac{\partial u(x,0)}{\partial t} = 2x$

(10 Marks)

(B) (i) Discuss (ناقش) with graphs three drawbacks (عيوب) of Newton-Raphson method for solving non linear algebraic equation. (2 Marks)

(ii) Express each equation in terms of conjugate coordinates:

(i) $2x + y = 5$ ***(ii)*** $x^2 + y^2 = 36$ (3 Marks)

(C) Use the method of Secant to find the real root of the equation $x - \cos x = 0$.

Take $x^{(0)} = 0,\ x^{(1)} = 1$, make 2 iterations (5 Marks)

(D) Given the following system of algebraic equations:

$$8x_1 + 3x_2 + 2x_3 = 20$$
$$16x_1 + 6x_2 + 4x_3 = -11$$
$$4x_1 + 1.5x_2 + x_3 = 10$$

(i) If you solve this system without ordering the equations. What do you expect? Discuss the convergence of this system through Scarbora criteria.

(ii) Order your equations in an appropriate way. Use Gauss-Siedel iterative method to make two iterations. Use $x_1^{(0)} = x_2^{(0)} = x_3^{(0)} = 1$ (5 Marks)

Question 3 (15 MARKS)

(A) Determine the value of the function $f(x)$ at $x = 3$ using the direct method interpolation using first and second order polynomial.

x	0	1	2	4
$f(x)$	1	3	15	75

(5 Marks)

(B) Find the cube root of 12 using Newton-Raphson method, take $x_o = 3$.

(5 Marks)

(C) Show that $\frac{d}{dz}\left(z^2 \bar{z}\right)$ does not exist anywhere, i.e. $f(z) = z^2 \bar{z}$ is not analytic anywhere.

(5 Marks)

Question 4 (15 MARKS)

(A) If the function $f(x, y, z)$ is given by

$$f(x, y, z) = \frac{x}{z} + \cos x + \ln y - e^z$$

where: $x = 2 \pm 0.02$, $y = 4 \pm 0.04$ and $z = 6 \pm 0.06$

Find the maximum possible error in the function $f(x, y, z)$. (5 Marks)

(B) Use Euler's and Rung-Kutta 4th order method to solve the differential equation $\frac{dy}{dx} = y - x^2 + 1$ to obtain the value of y at $x = 0.4$ knowing that $y(0) = 0.5$ (take $h=0.4$).

(5 Marks)

(C) ***i)*** Prove that the function $u = 2x(1 - y)$ is harmonic.

ii) Find a function v such that $f(z) = u + iv$ is analytic.

iii) Express $f(z)$ in terms of z.

(5 Marks)

This exam measures the following ILOs												
Question Number	Q1-a	Q2-d	Q2-b		Q4-a	Q4-b	Q2-c		Q1-b	Q2-a	Q3-b	
Skills	Q4-b	d2-i	Q3-b		Q3-a	Q3-c			Q3-d	Q4-c		
	Knowledge &understanding skills				Intellectual Skills				Professional Skills			

With my best wishes

Dr. Islam M. Eldesoky