

Federal University of Technology, Owerri
School Of Post Graduate Studies
Department Of Mechanical Engineering
Course: MEE. 801 Advanced Engineering Mathematics Harmattan Semester
Examination Session: 2016/2017 Time: 3hours
Instruction: Answer All Questions

(1) One end A of an insulated metal bar AB of length 2 m is kept at 0°C while the other end B is maintained at 50°C until a steady state of the temperature is achieved. At t=0. The end B is suddenly reduced to 0°C and kept at that temperature. Using the heat conduction equation $\frac{\partial^2 u}{\partial x^2} + \frac{1}{c^2} \frac{\partial^2 u}{\partial t^2}$, determine the expression for the temperature at any point in the bar distance x from A at any time t.

(2). (a). Solve $\frac{\partial^2 z}{\partial x^2} - 5 \frac{\partial^2 z}{\partial x \partial y} + 6 \frac{\partial^2 z}{\partial y^2} = 0$

(b). Solve $\frac{\partial^3 z}{\partial x^3} - 5 \frac{\partial^3 z}{\partial x^2 \partial y} + 6 \frac{\partial^3 z}{\partial y^3} = e^{(x+2y)}$

(3) Apply the Euler –Cauchy method to obtain the solution of $\frac{dy}{dx} = 3x + y^3$

Subject to the initial condition y=1, at x=1. Find the value of y for x=0.1, correct to four places of decimal.

(4). (a). Solve $6U_x + 5U_y = 0$ where $U_x = \frac{\partial u}{\partial x}$ and $U_y = \frac{\partial u}{\partial y}$

(b) Solve the Laplace's equation in plane polar coordinates.

$\frac{\partial^2 v(r,\theta)}{\partial r^2} + \frac{1}{r} \frac{\partial v(r,\theta)}{\partial r} + \frac{1}{r^2} \frac{\partial^2 v(r,\theta)}{\partial \theta^2} = 0$ in the circular region $x^2 + y^2 = a^2$ of the plane where $v(r, \theta)$ is finite for $0 \leq r \leq a$ and for all θ