MTE1201
EEE2201

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

NOV 2024

DEPARTMENT OF STATISTICS AND MATHEMATICS

EEE2201/MTE1201: ENGINEERING MATHEMATICS 2
ENGINEERING MATHEMATICS 2B

DURATION: 3 HOURS **TOTAL MARKS: 100**

INSTRUCTIONS TO CANDIDATES

Answer ALL questions in Section A and any TWO questions from Section B
The number of marks is indicated in brackets at the end of each question
Each question should start on a fresh page correctly numbered

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SECTION A [40 MARKS]

A1. Define the following terms

a) Idempotent Matrix [2]
b) Orthogonal Matrix [2]

A2. State the difference between scalar and vector quantities. [2]

A3. Show that $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ is orthogonal [5]

A4. Find the rank of the matrix $A = \begin{bmatrix} 2 & 3 & 7 \\ 3 & -2 & 4 \\ 1 & -3 & -1 \end{bmatrix}$ by reducing it to Echelon form [8]

A5. Solve the following exact differential equation

$$(x + y - 1)dy - (x - y + 2)dx = 0$$ [5]

A6. If $x^x y^y z^z = e$ show that at $x = y = z$, $\frac{\partial^2 z}{\partial x \partial y} = -(xlogex)^{-1}$ [7]

A7. A bacterial culture, growing exponentially, increases from 100 to 400 gms in 10 hrs. How much was present after 3 hrs, from the initial instant? [5]

A8. Find the differential equation of all spheres of fixed radius having their centre on the xy −plane. [4]

SECTION B [60 MARKS]

B9.

a) Find whether the following equations are consistent, if so solve them.
$x + y + 2z = 4, 2x - y + 3z = 9, 3x - y - z = 2$ [12]

b) Find the eigen values and eigen vectors of the matrix A and its inverse, where
$A = \begin{bmatrix} 1 & 3 & 4 \\ 0 & 2 & 5 \\ 0 & 0 & 3 \end{bmatrix}$ [18]

B10.

(a) Solve the differential equation $y(y^2 - 2x^2)dx + x(2y^2 - x^2)dy = 0$ using the integrating factor $\frac{1}{Mx+Ny}$ [12]

(b) Show that the system of confocal conics $\frac{x^2}{a^2+\lambda} + \frac{y^2}{b^2+\lambda}$ where λ is a parameter, is self orthogonal. [10]

(c) Solve the differential equation
$(D^2 - 4)y = 2cos^2 x$ [8]

B11.

(a) Use the method of grouping to find the general solution of $y^2zp + x^2zp = y^2x$ using Lagrange's linear equation $Pp + Qq = R$ [6]

(b) Use the method of multipliers to find the general solution of
$x^2(y - z)p + y^2(z - x)q = z^2(x - y)$ using Lagrange's linear equation
$Pp + Qq = R$ [7]

(c) Find the integral surface of $x(y^2 + z)p - y(x^2 + z)q = (x^2 - y^2)$ which contains the straight line $x + y = 0, z = 1$ [9]

(d) Solve the equation by the method of separation of variables $\frac{\partial^2 U}{\partial x^2} = \frac{\partial U}{\partial y} + 2U$ [8]

END OF PAPER