**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: B.Sc.** **SEMESTER : II**
**BRANCH: Chemistry** **SESSION : SP/2025**

**SUBJECT: MA108R1 MATHEMATICS - III**

**TIME: 3 Hours** **FULL MARKS: 50**

**INSTRUCTIONS:**
**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

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|---|---|---|---|---|
| Q.1(a) | Test for convergence the series $\sum_{n=1}^{\infty} \frac{2n^2+3n}{5+n^5}$. | [5] | 1 | 2 |
| Q.1(b) | Test the convergence of alternating series $1 - \frac{1}{3!} + \frac{1}{5!} - \frac{1}{7!} + \cdots$. | [5] | 1 | 2 |
| Q.2(a) | Find the rank of the matrix A = $\begin{bmatrix} 3 & 6 & -3 & 3 \\ 0 & 1 & 1 & 4 \\ -2 & -3 & 3 & 10 \end{bmatrix}$ by reducing it to echelon form. | [5] | 2 | 2 |
| Q.2(b) | Solve the system: $2x_1 + 5x_2 + 7x_3 = 52$, $x_1 + x_2 + x_3 = 9$, $2x_1 + x_2 - x_3 = 0$ | [5] | 2 | 2 |
| Q.3(a) | If $u = \log[(x^2 + y^2)/(x + y)]$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial x} = 3$. | [5] | 3 | 2 |
| Q.3(b) | A rectangular box open at the top is to have volume of 32 cubic ft. Find the dimensions of the box requiring least material for its construction. | [5] | 3 | 2 |
| Q.4(a) | Change the order of integration in the following integral and evaluate: $\int_0^{4a} \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} dydx$ | [5] | 4 | 2 |
| Q.4(b) | Evaluate $\iint xy(x+y)dxdy$ over the area between $y = x^2$ and $y = x$. | [5] | 4 | 2 |
| Q.5(a) | Find the directional derivative of $\frac{1}{\vec{r}}$ in the direction $\vec{r}$ where $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$. | [5] | 5 | 2 |
| Q.5(b) | If $\vec{F} = xy^2\hat{\imath} + 2x^2yz\hat{\jmath} - 3yz^2\hat{k}$ then find $div\ \vec{F}$ and $curl\ \vec{F}$ at the point (1, -1,1). | [5] | 5 | 2 |

**:::::26/04/2025 E:::::**