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

CLASS: MSc/Pre-PhD **SEMESTER : I**
BRANCH: BIOTECHNOLOGY **SESSION : MO/2025**

SUBJECT: BT404 MATHEMATICS AND STATISTICS FOR BIOLOGISTS

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.

			CO	BL
Q.1(a)	Find out the $A+B^T$, A^T-B and $A \times B^T$ product of the following matrices: $A=\begin{bmatrix}1 & 0 & 1\\ 2 & 1 & 1\\ 4 & 2 & 3\end{bmatrix}$ $B=\begin{bmatrix}1 & 1 & 2\\ 0 & 0 & 1\\ 4 & 1 & 5\end{bmatrix}$	[5]	2	4
Q.1(b)	If Vector P = -3i-2j-7k; Q = 5i-3j+3k; R = 5i-8j and S = -i+4j-10k. Compute (3S – 2R).(2P X Q) and find the angle between P and S vector.	[5]	3	4
Q.2(a)	The download time of a resource web page is normally distributed with a mean of 6.5 seconds and a standard deviation of 2.3 seconds. What proportion of page downloads take less than 5 seconds? [Z value is for (-0.65) is 0.2578]. A fitness company claim that their app can help users burn 360 calories on average per session. To test this, a researcher registers a sample of 8 participants on the app. They record the number of calories each participant burned in each workout session. Data Given calories burns per person, 330, 380, 375, 396, 315, 368, 386 and 344. Calculate the one-sample t-test value using a 95% confidence interval to see if their claim is true or not. Critical Value (95% confidence level) is 2.201.	[5]	3	5
Q.2(b)	In the experiment of pea breeding, Mendel obtained the following frequencies of seeds: Class – Observed frequency Round and yellow – 315 Wrinkled and yellow – 101 Round and green – 108 Wrinkled and green – 32 Theory predicts that the frequencies should be in the proportions of 9:3:3:1. Examine the correspondence between theory and observations. (Given 5% value of chi-square is 7.815 for 3 d.f)	[5]	4	4
Q.3(a)	Find limits for; Differentiate, $y = x^4 \cos x + 2 \ln x + 1/7\, e^x$ Integrate, $y = x^4 + \cos x + 4/x + 1/7\, e^x$	[5]	3	5
Q.3(b)	Find maxima or minima for the function, $y = 2x^3 - 3x^2 - 12x + 6$	[5]	5	4
Q.4(a)	Solve following differential equation, $dy/dx = y^2/x^2$; at x=0, y = 8	[5]	3	4
Q.4(b)	A colony of bacteria is growing exponentially. At t (time) = 0 sec, number of cells = 100; and when t = 4 secs, number of cells = 2000; Build a mathematical model for it and calculate the time when the no. of cells should be 10^6 . Also calculate the doubling time.	[5]	5	4
Q.5(a)	Write the MATLAB program for the following problem 1. Plot x vs y when, x ranges from 0 to 30 with increment of 0.5 and $y = -8x^3 + 2$; 2. Solve the linear equation, 4x+y+2z = 17; 3y+z=19; y+2z= 13;	[5]	3	5
Q.5(b)	Write mathematical expression for Monod Kinetics of Microbial Growth with First Order and Luedeking-Piret model for product formation kinetics in a batch reactor.	[5]	4	3

::::::24/11/2025::::::E