

Course:

Branch: Common to all branch

Semester: I

Subject Code & Name: BTBS101 & Engineering Mathematics-I

Max Marks: 60

Date: 13.01.2026

Duration: 3 Hr.

Instructions to the Students:

1. Each question carries 12 marks.
2. Question No. 1 will be compulsory and include objective-type questions.
3. Candidates are required to attempt any four questions from Question No. 2 to Question No. 6.
4. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question.
5. Use of non-programmable scientific calculators is allowed.
6. Assume suitable data wherever necessary and mention it clearly.

		CO(Level)	Marks
Q.1	Objective type questions. (Compulsory Question)		12
1	The rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{bmatrix}$ is equal to a. 1 b. 2 c. 3 d. None	CO1	1
2	Every homogeneous system of linear equations is a. Always consistent b. no solution c. at least one solution d. None	CO1	1
3	The eigen values of an idempotent matrix are either a. (0, 1) b. (1, 1) c. (0, 0) d. None	CO1	1
4	If $u = x^y$, then $\frac{\partial u}{\partial x}$ is equal to a. yx^{y-1} b. 0 c. $x^y \log x$ d. None	CO2	1
5	If $u = 3x^2y + 5y$ then $\frac{\partial^2 u}{\partial x \partial y}$ is a. 6y b. 6x c. xy d. None	CO2	1
6	Euler's Theorem on Homogeneous Functions $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nu$. Here n indicates a. order of n b. constant of n c. variable of n d. None	CO2	1
7	If $x = uv, y = \frac{u}{v}$, then $\frac{\partial(x,y)}{\partial(u,v)}$ is equal to a. $-\frac{2u}{v}$ b. $-\frac{2v}{u}$ c. 0 d. None	CO3	1
8	If $J_1 = \frac{\partial(u,v)}{\partial(x,y)}$ and $J_2 = \frac{\partial(x,y)}{\partial(u,v)}$, then $J_1 J_2$ is equal to a. 1 b. -1 c. 0 d. None	CO3	1
9	The value of $\int_0^{\frac{\pi}{2}} \cos^3 x \, dx$ is equal to a. $\frac{3}{2}$ b. $\frac{1}{4}$ c. $\frac{5}{6}$ d. None	CO4	1
10	The number of loops in polar curve $r = a \sin 3\theta$ a. 1 b. 3 c. 2 d. None	CO4	1

11	$\text{The value of } \int_1^2 \int_0^{3y} y \, dx \, dy \text{ is}$	CO5	1
	a. 3 b. 5 c. 7 d. None		
12	$\text{The value of the integral } \int_0^1 \int_0^2 \int_0^1 x^2 \, dx \, dy \, dz \text{ is}$	CO5	1
	a. $\frac{2}{3}$ b. $\frac{4}{3}$ c. $\frac{3}{2}$ d. None		
Q.2	Solve the following.		12
A)	Find the rank of a matrix A by reducing it to normal form, where $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$.	CO1	6
B)	Find the eigen values and the eigen vectors of the matrix $A = \begin{bmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$.	CO1	6
Q.3	Solve the following.		12
A)	If $r^2 = x^2 + y^2 + z^2$ and $V = r^m$, prove that $V_{xx} + V_{yy} + V_{zz} = m(m+1)r^{m-2}$.	CO2	6
B)	If $u = \sin^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right)$, Prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$.	CO2	6
Q.4	Solve Any Two of the following.		12
A)	If $x = r \sin \theta \cos \phi$, $y = r \sin \theta \sin \phi$, $z = r \cos \theta$, show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\phi)} = r^2 \sin \theta$.	CO3	6
B)	Find the first six terms of the expansion of the function $f(x, y) = e^x \log(1 + y)$ in the powers of x and y .	CO3	6
C)	Find the points on the surface $z^2 = xy + 1$ nearest to the origin.	CO3	6
Q.5	Solve Any Two of the following.		12
A)	Evaluate $\int_0^a \frac{x^7 dx}{\sqrt{a^2 - x^2}}$	CO4	6
B)	Trace the curve $x = a \cos t + \frac{a}{2} \log_e \tan^2\left(\frac{t}{2}\right)$; $y = a \sin t$ (Tractix).	CO4	6
C)	Trace the curve $r = a \sin 3\theta$ (3 Leaved Rose)	CO4	6

Q.6	Solve Any Two of the following.		12
A)	Evaluate $\int_0^1 \int_y^{y^2+1} x^2 y \, dx \, dy$	CO5	6
B)	Evaluate $\int_0^1 \int_0^y \int_0^{xy} xy^2 z^3 \, dx \, dy \, dz.$	CO5	6
C)	Change the order of integration & evaluate $\int_0^3 \int_{x^2}^9 x^3 e^{y^3} \, dx \, dy.$	CO5	6