Code: BSM_110

Roll No. 2 0

B. Tech.
Year: I Semester: I
Minor Test Examination (2025-26)
Title of Subject: Engineering Mathematics-I

Time: 2 Hr. Max Marks: 30

Note: Attempt ALL questions.

| | | Marks | CO | BL | PO | PI Code |
|---|---|---|---|---|---|---|
| Q1 | **Attempt any three parts of the following.** | | | | | |
| a) | If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$, then prove that $\frac{1}{2}\frac{\partial u}{\partial x} + \frac{1}{3}\frac{\partial u}{\partial y} + \frac{1}{4}\frac{\partial u}{\partial z} = 0$. | 4 | 1 | 3 | 1 | 1.1.1 |
| b) | If $u, v, w$ are the roots of the cubic equation $(\lambda - x)^3 + (\lambda - y)^3 + (\lambda - z)^3 = 0$ in $\lambda$, find Jacobian of $u, v, w$ with respect to $x, y$ and $z$. | 4 | 2 | 3 | 1 | 1.1.1 |
| c) | Find the rank of the matrix $\begin{bmatrix} 2 & 3 & -2 & 4 \\ 3 & -2 & 1 & 2 \\ 3 & 2 & 3 & 4 \\ -2 & 4 & 0 & 5 \end{bmatrix}$. | 4 | 3 | 3 | 1 | 1.1.1 |
| d) | Using elementary transformations, find the inverse of the matrix $A = \begin{bmatrix} 9 & 7 & 3 \\ 5 & -1 & 4 \\ 3 & 4 & 1 \end{bmatrix}$. | 4 | 3 | 3 | 1 | 1.1.1 |
| Q2 | **Attempt any three parts of the following.** | | | | | |
| a) | Expand $\sin(m \sin^{-1} x)$ in ascending power of $x$ up to nth degree term by evaluating $(y_n)_0$. | 3 | 1 | 3 | 1 | 1.1.1 |
| b) | If $u = \sin^{-1}\left[\frac{x^{1/4}+y^{1/4}}{x^{1/6}+y^{1/6}}\right]$, then find $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2}$. | 3 | 2 | 3 | 1 | 1.1.1 |
| c) | Show that the equations $3x + 4y + 5z = a$, $4x + 5y + 6z = b$, $5x + 6y + 7z = c$ do not have solution unless $a + b = 2c$. | 3 | 3 | 2/3 | 1 | 1.1.1 |
| d) | Determine $\lambda$ and $\mu$ such that the equations $x + y + z = 6$, $x + 2y + 3z = 10$ and $x + 2y + \lambda z = \mu$ have (i) no solution (ii) a unique solution (iii) infinite number of solutions. | 3 | 3 | 2/3 | 1 | 1.1.1 |
| Q3 | **Attempt any three parts of the following.** | | | | | |
| a) | Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & -1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ and hence deduce the value of $A^5 - 6A^4 + 6A^3 - 11A^2 + 2A + 3I$. | 3 | 3 | 3 | 1 | 1.1.1 |
| b) | Expand $f(x, y) = tan^{-1}(xy)$ in Taylor's series about the (1, -1) up to the second-degree terms and hence evaluate $f(1, 0.9)$. | 3 | 2 | 3 | 1 | 1.1.1 |
| c) | Examine for minimum and maximum values of the function $u = \sin x + \sin y + \sin(x + y)$. | 3 | 2 | 2/3 | 1 | 1.1.1 |
| d) | Find the eigen values and corresponding eigen vectors of the following matrix $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$. | 3 | 3 | 2/3 | 1 | 1.1.1 |

Sub Code: BSM_110

Roll No. 2 0

B. Tech.

Year: I Semester: I

Major Examination (205-2026)

Engineering Mathematics-I

Time: 3 Hr. Max Marks: 50

Note: Attempt All questions.

| | | Marks | CO | BL | PO | PI Code |
|---|---|---|---|---|---|---|
| Q1 | Attempt any five parts of the following. | | | | | |
| a) | Determine $\lambda$ and $\mu$ such that the equations $x+y+z=6$, $x+2y+3z=10$ and $x+2y+\lambda z=\mu$ have a unique solution. | 2 | 3,6 | 3 | 1 | 1.1.1 |
| b) | Using elementary operation, reduce the following matrix into unit matrix $\begin{bmatrix}1 & 3 & 3\\ 2 & 4 & 10\\ 3 & 8 & 4\end{bmatrix}$. | 2 | 3.6 | 3 | 1 | 1.1.1 |
| c) | Show that the equations $3x+4y+5z=a$, $4x+5y+6z=b$, $5x+6y+7z=c$ do not have solution unless $a+b=2c$ and solve it in each case. | 2 | 3,6 | 2/3 | 1 | 1.1.1 |
| d) | If $u=\sin nx+\cos nx$, then show that $u_r=n^r[1+(-1)^r\sin 2nx]^{1/2}$, where $u_r$ is the $r^{th}$ differential coefficient of $u$ w.r.t. $x$. | 2 | 3.6 | 3 | 1 | 1.1.1 |
| e) | If $u=\sin^{-1}\left[\frac{x^{1/4}+y^{1/4}}{x^{1/6}+y^{1/6}}\right]$, then find $x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}$. | 2 | 1.6 | 3 | 1 | 1.1.1 |
| f) | Examine $f(x,y)=x^3+y^3-12x-3y+20$ for its extreme points. Hence find its extreme value. | 2 | 1.6 | 3 | 1 | 1.1.1 |
| g) | If $u=\frac{yz}{x}$, $v=\frac{zx}{y}$, $w=\frac{xy}{z}$, then find $J(u,v,w)$. | 2 | 1.6 | 3 | 1 | 1.1.1 |
| Q2. | **Attempt any two parts of the following.** | | | | | |
| a) i. | Evaluate $\int_0^\infty\int_0^x xe^{-x^2/y}dxdy$ by changing the order of integration. | 5 | 5.6 | 3 | 1 | 1.1.1 |
| ii. | Find the area enclosed between the parabola $y=4x-x^2$ and the line $y=x$. | | | | | |
| iii. | Evaluate $\iint_R (x+y)^2dxdy$, where $R$ is the parallelogram in the $x-y$ plane with vertices $(1,0)$, $(3,1)$, $(2,2)$, $(0,1)$ using the transformation $u=x+y$ and $v=x-2y$. | 5 | 5.6 | 3 | 1 | 1.1.1 |
| iv. | Find the volume and mass contained in the solid region of the positive octant of the surface $\left(\frac{x}{a}\right)^p+\left(\frac{y}{b}\right)^q+\left(\frac{z}{c}\right)^r=1$, where $p,q$ & $r>0$, given that density at any point $\rho(x,y,z)=k\sqrt{xyz}$. | 5 | 5.6 | 3 | 1 | 1.1.1 |
| Q3. | **Attempt any two parts of the following.** | | | | | |
| a) i. | Evaluate the integral $\int_0^\infty \frac{x^c}{c^x}dx$, $(c>1)$. | 5 | 5.6 | 3 | 1 | 1.1.1 |
| ii. | Evaluate by changing it in polar coordinates: $\int_0^a\int_0^{\sqrt{a^2-y^2}} y^2\sqrt{x^2+y^2}\,dxdy$. | | | | | |
| b) | Evaluate (i) $\int_0^1 \log\Gamma x\,dx$ (ii) $\int_{-\infty}^{\infty}\cos\frac{\pi}{2}x^2\,dx$. | 5 | 5.6 | 3 | 1 | 1.1.1 |
| c) | Change the order of integration in $\int_0^a\int_{\frac{x^2}{a}}^{2a-x} f(x,y)dxdy$. | 5 | 5.6 | 2,3 | 1 | 1.1.1 |
| Q4. | **Attempt any two parts of the following.** | | | | | |
| a) i. | Find a and b if the surfaces $ax^2-byz=(a+2)x$ and $4x^3y+z^3=4$ cut orthogonally at the point $(1,-1,2)$. | 5 | 4.6 | 3 | 1 | 1.1.1 |