# Model Question Paper-II with effect from 2022 (CBCS Scheme)

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## Second Semester B.E Degree Examination
## Mathematics-II for Computer Science Engineering-BMATS201

**TIME: 03 Hours** **Max. Marks: 100**

Note:
1. Answer any **FIVE** full questions, choosing at least **ONE** question from each **module**.
2. VTU Formula Hand Book is permitted.
3. M: Marks, L: Bloom's level, C: Course outcomes.

| | | **Module -1** | **M** | **L** | **C** |
|---|---|---|---|---|---|
| Q.01 | a | Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)\ dx\,dy\,dz$ | **7** | L2 | **CO1** |
| | b | Evaluate $\int_0^1\int_x^{\sqrt{x}} xy\ dy\,dx$ by changing the order of integration. | **7** | L3 | **CO1** |
| | c | Show that $\gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$ | **6** | L2 | **CO1** |
| | | OR | | | |
| Q.02 | a | Evaluate $\int_0^1\int_0^{\sqrt{1-y^2}}(x^2+y^2)dxdy$ by changing into polar coordinates | **7** | L3 | **CO1** |
| | b | Find by double integration, the area between the parabolas $y^2=4ax$ and $x^2=4ay$. | **7** | L2 | **CO1** |
| | c | Using Mathematical tools, write the code to find the area of an ellipse by double integration $A=4\int_0^a\int_0^{\frac{b}{a}\sqrt{a^2-x^2}} dydx$. | **6** | L3 | **CO5** |
| | | **Module-2** | | | |
| Q. 03 | a | Find the directional derivative of $\phi=x^2\,yz+4xz^2$ at (1, -2, -1) in the direction of the vector $2\hat{i}-\hat{j}-2\hat{k}$. | **7** | L2 | **CO2** |
| | b | If $\vec{F}=\nabla(xy^3z^2)$, find $div\ \vec{F}$ and $curl\ \vec{F}$ at the point $(1,-1,\ 1)$ | **7** | L2 | **CO2** |
| | c | Prove that the spherical coordinate system is orthogonal. | **6** | L2 | **CO2** |
| | | OR | | | |
| Q.04 | a | Find the angle between the surfaces $x^2+y^2-z^2=4$ and $z=x^2+y^2-13$ at $(2,1,2)$ | **7** | L3 | **CO2** |
| | b | Show that the vector $\vec{F}=\frac{x\hat{i}+y\hat{j}}{x^2+y^2}$ is both solenoidal and irrotational. | **7** | L2 | **CO2** |
| | c | Using Mathematical tools, write the code to find the curl of | **6** | L3 | **CO5** |

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| | | $\vec{F} = xy^2\hat{\imath} + 2x^2yz\,\hat{\jmath} - 3yz^2\hat{k}$ | | | |
| | | **Module-3** | | | |
| Q. 05 | a | Let $V = R^3$ be a vector space and consider the subset W of V consisting of vectors of the form $(a, a^2, b)$, where the second component is the square of the first. Is W a subspace of V? | **7** | L2 | **CO3** |
| | b | Find the basis and the dimension of the subspace spanned by the vectors {(2, 4, 2), (1, –1, 0), (1, 2, 1), (0, 3, 1)} in $V_3(R)$. | **7** | L2 | **CO3** |
| | c | Find the kernel and range of the linear operator<br>$T(x, y, z) = (x + y,\ z)$ of $R^3 \to R^2$ | **6** | L2 | **CO3** |
| | | OR | | | |
| Q. 06 | a | Let $f(x) = 2x^2 - 5$ and $g(x) = x + 1$. Show that the function $h(x) = 4x^2 + 3x - 7$ lies in the subspace Span {f, g} of $P_2$. | **7** | L2 | **CO3** |
| | b | Prove that the transformation $T; R^2 \to R^2$ defined by $T(x, y) = (3x,\ x + y)$ is linear. Find the images of the vectors (1, 3) and (–1, 2) under this transformation. | **7** | L2 | **CO3** |
| | c | Show that the functions $f(x) = 3x - 2$ and $g(x) = x$ are orthogonal in $P_n$ with inner product $\langle f, g\rangle = \int_0^1 f(x)g(x)dx$. | **6** | L2 | **CO3** |
| | | **Module-4** | | | |
| Q. 07 | a | Find an approximate value of the root of the equation $xe^x = 3$, using the Regula-Falsi method, carry out three iterations. | **7** | L2 | **CO4** |
| | b | Using Newton's divided difference formula, evaluate $f(8)$ from the following<br><table><tr><td>$x$</td><td>4</td><td>5</td><td>7</td><td>10</td><td>11</td><td>13</td></tr><tr><td>$f(x)$</td><td>48</td><td>100</td><td>294</td><td>900</td><td>1210</td><td>2028</td></tr></table> | **7** | L2 | **CO4** |
| | c | Evaluate $\int_0^1 \frac{1}{1+x^2}dx$ using the Trapezoidal rule by taking 6 divisions. | **6** | L3 | **CO4** |
| | | OR | | | |
| Q. 08 | a | Find the real root of the equation $\cos x = xe^x$, which is nearer to $x = 0.5$ by the Newton-Raphson method, correct to three decimal places. | **7** | L2 | **C04** |
| | b | Given, $\sin 45^0 = 0.7071, \sin 50^0 = 0.7660, \sin 55^0 = 0.8192,$ | **7** | L2 | **CO4** |

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| | | $\sin 60^0 = 0.8660$, find $\sin 48^0$ using Newton's forward interpolation formula. | | | |
| | c | Evaluate $\int_0^3 \frac{1}{4x+5} dx$ by using Simpson's 1/3rd rule by taking 7 ordinates. | **6** | L3 | **CO4** |
| | | **Module-5** | | | |
| Q. 09 | a | By Taylor's series method, find the value of y at $x = 0.1$ and $x = 0.2$ to 5 places of decimals from $\frac{dy}{dx} = x^2y - 1, y(0) = 1$. | **7** | L2 | **CO4** |
| | b | Using the Runge-Kutta method of fourth order, find $y(0.1)$ given that $\frac{dy}{dx} = 3e^x + 2y,\ y(0) = 0$, taking $h = 0.1$ | **7** | L2 | **CO4** |
| | c | Given that $\frac{dy}{dx} = x - y^2$ and the data $y(0) = 0,\ y(0.2) = 0.02,$ $y(0.4) = 0.0795,\ y(0.6) = 0.1762$ compute y at $x = 0.8$ by applying Milne's method. | **6** | L2 | **CO4** |
| | | OR | | | |
| Q. 10 | a | Using the modified Euler's method, find $y(0.1)$ given that $\frac{dy}{dx} = x^2 + y$ and $y(0) = 1$ take step $h = 0.05$ and perform two modifications in each stage. | **7** | L2 | **CO4** |
| | b | Using the Runge-Kutta method of fourth order, find $y(0.2)$ given that $\frac{dy}{dx} = \frac{y-x}{y+x},\ y(0.1) = 1.0912$, taking $h = 0.1$ | **7** | L2 | **CO4** |
| | c | Using Mathematical tools, write the code to find the solution of $\frac{dy}{dx} = 1 + \frac{y}{x}$ at $y(2)$ taking $h = 0.2$. Given that $y(1) = 2$ by Runge-Kutta 4th order method. | **6** | L3 | **CO5** |