

Meerut Institute of Engineering & Technology, Meerut

CO-Wise AKTU Question Bank

Course: B.Tech.

Subject Name: Engineering Mathematics-I

Subject Code: BAS-103

Semester: I

CO No.	Lect. No.	Syllabus Topic (As Per LP)	Ques. No.	Question Statement (As Per AKTU)	Session
CO-1	L-2	Complex Matrices and Problems	1.	If $N = \begin{bmatrix} 0 & 1+2i \\ -1+2i & 0 \end{bmatrix}$ is a matrix, then show that $(I-N)(I+N)^{-1}$ is unitary matrix, where I is the identity matrix.	2013-14 (short)
CO-1	L-2	Complex Matrices and Problems	2.	If $A = \begin{bmatrix} 2 & 3+2i & -4 \\ 3-2i & 5 & 6i \\ -4 & -6i & 3 \end{bmatrix}$ then show that A is Hermitian and iA is Skew-Hermitian matrix.	2013-14 (short)
CO-1	L-2	Complex Matrices and Problems	3.	Show that $A = \frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 1 & 1 \\ 1 & \omega & \omega^2 \\ 1 & \omega^2 & \omega \end{bmatrix}$ is a unitary matrix, where ω is the complex cube root of unity.	2016-17 (long)
CO-1	L-2	Complex Matrices and Problems	4.	Show that the matrix $\begin{bmatrix} \alpha + iy & -\beta + i\delta \\ \beta + i\delta & \alpha - iy \end{bmatrix}$ is unitary if $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = 1$.	2017-18 (short)
CO-1	L-2	Complex Matrices and Problems	5.	Prove that the matrix $\frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is unitary.	2020-21 (short)
CO-1	L-2	Complex Matrices and Problems	6.	If A is a Hermitian matrix, then show that iA is Skew - Hermitian matrix.	2022-23 (Short)
CO-1	L-2	Complex Matrices and Problems	7.	Prove that the matrix $A = \frac{1}{2} \begin{bmatrix} 1+i & -1+i \\ 1+i & 1-i \end{bmatrix}$ is unitary.	2022-23 (Short)
CO-1	L-3	Inverse of Matrix Using Elementary Transformations	8.	Explain the working rule to find the inverse of a matrix A by elementary row or column transformations.	2012-13 (short)

CO-1	L-3	Inverse of Matrix Using Elementary Transformations	9.	For the given matrix $A = \begin{bmatrix} -5 & -3 \\ 2 & 0 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ prove that $A^3 = 19A + 30I$	2016-17 (short)
CO-1	L-3	Inverse of Matrix Using Elementary Transformations	10.	Compute the inverse of the matrix $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ by employing elementary row transformations.	2017-2018 (long)
CO-1	L-3	Inverse of Matrix Using Elementary Transformations	11.	Find the inverse employing elementary transformation $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$	2018-19 (long)
CO-1	L-3	Inverse of Matrix Using Elementary Transformations	12.	Find the inverse of the matrix $A = \begin{bmatrix} 2 & 3 & 4 \\ 4 & 3 & 1 \\ 1 & 2 & 4 \end{bmatrix}$	2020-21 (long)
CO-1	L-4	Rank of Matrix Using Elementary Transformations (Echelon Form)	13.	Find the value of P for which the matrix $A = \begin{bmatrix} 3 & P & P \\ P & 3 & P \\ P & P & 3 \end{bmatrix}$ is be of rank 1.	2011-12 (Short)
CO-1	L-4	Rank of Matrix Using Elementary Transformations (Echelon Form)	14.	Reduce A to echelon form and then to its row canonical form where $A = \begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{bmatrix}$. Hence find the rank of A.	2014-15 (long)
CO-1	L-4	Rank of Matrix Using Elementary Transformations (Echelon Form)	15.	Using elementary transformations, find the rank of the following matrix: $A = \begin{bmatrix} 2 & -1 & 3 & -1 \\ 1 & 2 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$	2017-18 (long)
CO-1	L-4	Rank of Matrix Using Elementary Transformations (Echelon Form)	16.	Find the rank of the matrix $\begin{bmatrix} 2 & 2 & 2 \\ 2 & 2 & 2 \\ 2 & 2 & 2 \end{bmatrix}$	2018-19 (short)
CO-1	L-4	Rank of Matrix Using Elementary Transformations (Echelon Form)	17.	Find the value of 'b' so that the rank of $A = \begin{bmatrix} 2 & 4 & 2 \\ 3 & 1 & 2 \\ 1 & 0 & b \end{bmatrix}$ is 2.	2019-20 (short)

CO-1	L-5	Rank of Matrix Using Elementary Transformations (Normal Form)	18.	Determine the rank of the matrix: $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$.	2013-14 (short)
CO-1	L-5	Rank of Matrix Using Elementary Transformations (Normal Form)	19.	Reduce the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ in to the normal form and find its rank.	2017-18 (short)
CO-1	L-5	Rank of Matrix Using Elementary Transformations (Normal Form)	20.	Reduce the matrix A to its normal form when $A = \begin{bmatrix} 1 & 2 & -1 & 4 \\ 2 & 4 & 3 & 4 \\ 1 & 2 & 3 & 4 \\ -1 & -2 & 6 & -7 \end{bmatrix}$. Hence find the rank of A.	2018-19 (long)
CO-1	L-5	Rank of Matrix Using Elementary Transformations (Normal Form)	21.	Find the rank of the matrix $A = \begin{bmatrix} 1 & 3 & 4 & 2 \\ 2 & -1 & 3 & 2 \\ 3 & -5 & 2 & 2 \\ 6 & -3 & 8 & 6 \end{bmatrix}$ by reducing it to normal form.	2019-20 (long)
CO-1	L-5	Rank of Matrix Using Elementary Transformations (Normal Form)	22.	State Rank-Nullity theorem.	2020-21 (short)
CO-1	L-5	Rank of Matrix Using Elementary Transformations (Normal Form)	23.	Find non-singular matrices P and Q such that PAQ is in normal form $\begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & 1 & 1 \end{bmatrix}$.	2020-21 (long)
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	24.	Test the consistency for the following system of equations and if system is consistent, solve them: $x + y + z = 6$, $x + 2y + 3z = 14$, $x + 4y + 7z = 30$	2022-23 (Long)
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	25.	For what values of a and b ,the equations $x + 2y + 3z = 6$, $x + 3y + 5z = 9$, $2x + 5y + az = b$ have (i) no solution (ii) a unique solution (iii) more than one solution?	2022-23 (Long)
CO-1	L-6	Solution of Non-Homogeneous System of	26.	Show that the system of equations: $3x + 4y + 5z = A$,	2011-12 (Short)

		Linear Equations		$4x + 5y + 6z = B$, $5x + 6y + 7z = C$ are consistent only if A, B and C are in arithmetic progression (A.P.).	
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	27.	Investigate for what values of λ and μ the simultaneous equations : $x + y + z = 6$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ have (i) No Solution (ii) a Unique Solution and (iii) an Infinite number of Solutions	2012-13, 2015-16 (Long)
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	28.	Test the consistency and solve the following system of equations: $2x - y + 3z = 8$, $-x + 2y + z = 4$ and $3x + y - 4z = 0$.	2013-14 (Short)
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	29.	Solve by calculating the inverse by elementary row operations : $x_1 + x_2 + x_3 + x_4 = 0$, $x_1 + x_2 + x_3 - x_4 = 4$, $x_1 - x_2 + x_3 + x_4 = 2$, $x_1 + x_2 - x_3 + x_4 = -4$.	2014-15 (Long)
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	30.	Investigate for what values of λ and μ , the system of equations $x + y + z = 6$, $x + 2y + 3z = 10$ and $x + 2y + \lambda z = \mu$, has: (i) No solution (ii) Unique solution and (iii) Infinite no. of solutions	2017-18 (long)
CO-1	L-6	Solution of Non-Homogeneous System of Linear Equations	31.	For what values of λ and μ , the system of linear equations: $x + y + z = 6$, $x + 2y + 5z = 10$ and $2x + 3y + \lambda z = \mu$, has: (i) a unique solution (ii) no solution and (iii) Infinite solution. Also find the solution for $\lambda = 2$ and $\mu = 8$.	2019-20 (long)

CO-1	L-9	Linear Dependence and Independence of vectors	32.	Examine whether the vectors $x_1=[3, 1, 1]$, $x_2 = [2, 0, -1]$, $x_3 = [4, 2, 1]$ are linearly independent.	2015-16 (short)
CO-1	L-9	Linear Dependence and Independence of vectors	33.	Show that the vectors (1, 6, 4), (0, 2, 3) and (0, 1, 2) are linearly independent.	2019-20 (short)
CO-1	L-10	Eigen Values and Eigen Vectors	34.	If the Eigen values of the matrix A are 1, 1, 1 then find the Eigen values of $A^2+2A+3I$	2018-19 (short)
CO-1	L-10	Eigen Values and Eigen Vectors	35.	If $\alpha_1, \alpha_2, \alpha_3, \dots \dots \alpha_n$ are the characterstic roots of the n-square matrix A and k is a scalar, prove that the characteristic roots of $[A-kI]$ are $\alpha_1 - k, \alpha_2 - k, \alpha_3 - k, \dots \dots \alpha_n - k$.	2012-13 (short)
CO-1	L-10	Eigen Values and Eigen Vectors	36.	If $A = \begin{bmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & -2 \end{bmatrix}$, find the eigen values of A^2 .	2015-16 (short)
CO-1	L-10	Eigen Values and Eigen Vectors	37.	For what value of 'x', the Eigen values of the given matrix A are real $A = \begin{bmatrix} 10 & 5+i & 4 \\ x & 20 & 2 \\ 4 & 2 & -10 \end{bmatrix}$	2016-17 (short)
CO-1	L-10	Eigen Values and Eigen Vectors	38.	Find the Eigen value of the matrix $A = \begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix}$ corresponding to the eigen vector $\begin{bmatrix} 5 \\ 1 \end{bmatrix}$.	2022-23 (Short)
CO-1	L-10	Eigen Values and Eigen Vectors	39.	Find the eigen values and corresponding eigen vectors of the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$.	2022-23 (Long)
CO-1	L-10	Eigen Values and Eigen Vectors	40.	Find the eigen values and corresponding eigen vectors of the matrix A where $A = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 4 \\ -1 & -1 & -2 \end{bmatrix}$.	2022-23 (Long)

CO-1	L-10	Eigen Values and Eigen Vectors	41.	Find the Eigen value of the matrix $\begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix}$ corresponding to the eigenvector $\begin{bmatrix} 101 \\ 101 \end{bmatrix}$.	2016-17 (long)
CO-1	L-10	Eigen Values and Eigen Vectors	42.	Find the Eigen values and the corresponding Eigen vectors of the following matrix $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 3 & 0 \\ 1 & 0 & 2 \end{bmatrix}$	2020-21 (long)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	43.	State Cayley Hamilton theorem and verify it for the matrix $A = \begin{bmatrix} 4 & 0 & 1 \\ 0 & 1 & 2 \\ 1 & 0 & 1 \end{bmatrix}$. Hence find A^{-1} .	(2022-23) Long
CO-1	L-12	Cayley-Hamilton Theorem and its Application	44.	Verify Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and hence find its inverse.	(2022-23) Long
CO-1	L-12	Cayley-Hamilton Theorem and its Application	45.	The matrix $A = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$ satisfies the matrix equation $A^3 - 6A^2 + 11A - I = 0$, where I is an identity matrix of order 3. Find A^{-1} .	2011-12 (short)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	46.	Find the characteristic equation of the matrix: $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and hence find the matrix represented by $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I = 0$, where I is the identity matrix.	2012-13 (short)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	47.	If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$, find the inverse of A using Cayley Hamilton Theorem.	2013-14, 2014-15 (short)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	48.	Find the characteristic equation of the matrix $A =$	2015-16 (Long)

				$\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and verify Cayley Hamilton theorem. Also evaluate $A^6 - 6A^5 + 9A^4 - 2A^3 - 12A^2 + 23A - 9I$.	
CO-1	L-12	Cayley-Hamilton Theorem and its Application	49.	Express $2A^5 - 3A^4 + A^2 - 4I$ as a linear polynomial in A where $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$	2016-17 (short)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	50.	If $A = \begin{bmatrix} -3 & 2 \\ -1 & 0 \end{bmatrix}$ then evaluate the value of the expression $(A + 5I + 2A^{-1})$.	2016-17 (short)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	51.	Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$	2017-18 (long)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	52.	Using Cayley-Hamilton theorem, find the inverse of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$. Also express the polynomial $B = A^8 - 11A^7 - 4A^6 + A^5 + A^4 - 11A^3 - 3A^2 + 2A + I$ as a quadratic polynomial in A and hence find B.	2018-19 (long)
CO-1	L-12	Cayley-Hamilton Theorem and its Application	53.	Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 4 & 0 & 1 \\ 0 & 1 & 2 \\ 1 & 0 & 1 \end{bmatrix}$ and hence find A^{-1} .	2019-20 (long)

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CO No.	Lect. No.	Syllabus Topic (As Per LP)	Ques. No.	Question Statement (As Per AKTU)	Session
2	13	Introduction of successive differentiation, nth derivative of some elementary functions	1	If $y = \sin nx + \cos nx$ prove that $y_r = n^r [1 + (-1)^r \sin 2nx]^{1/2}$ where y_r is the r^{th} differential coefficient of y with respect to x .	2011-12 2017-18
2	13	Introduction of successive differentiation, nth derivative of some elementary functions	2	If $I_n = \frac{d^n}{dx^n} (x^n \log x)$ then show that $I_n = n I_{n-1} + (n-1)!$	2016-17
2	13	Introduction of successive differentiation, nth derivative of some elementary functions	3	Find y_n if $y = \frac{x^n - 1}{x - 1}$	2011-12
2	13	Introduction of successive differentiation, nth derivative of some elementary functions	4	If $y = \cos^{-1} x$, prove that $(1 - x^2)y_2 - xy_1 = 0$	2022-23
2	14	Leibnitz Theorem and nth derivative of product of functions	5	Find the n^{th} derivative of $x^{n-1} \log x$.	2011-12 2017-18
2	14	Leibnitz Theorem and nth derivative of product of functions	6	Find the n^{th} derivative of $y = x^2 \sin x$.	2013-14
2	14	Leibnitz Theorem and nth derivative of product of functions	7	If $y = \sin \log(x^2 + 2x + 1)$, Prove that $(1+x)^2 y_{n+2} + (2n+1)(x+1)y_{n+1} + (n^2 + 4)y_n = 0$.	2012-13 2018-19
2	14	Leibnitz Theorem and nth derivative of product of functions	8	If $y = e^{\tan^{-1} x}$, prove that $(1+x^2)y_{n+2} + [(2n+2)x - 1]y_{n+1} + n(n+1)y_n = 0$	2013-14 2017-18 2020-21
2	14	Leibnitz Theorem and nth derivative of product of functions	9	If $y^{1/m} + y^{-1/m} = 2x$, Prove that $(x^2 - 1)y_{n+2} + (2n+1)xy_{n+1} + (n^2 - m^2)y_n = 0$	2014-15

2	14	Leibnitz Theorem and nth derivative of product of functions	10	If $y = e^{m \cos^{-1} x}$ then find the relation between y_n, y_{n+1} and y_{n+2} .	2015-16 2019-20
2	14	Leibnitz Theorem and nth derivative of product of functions	11	If $y = \left(\frac{1+x}{1-x}\right)^{1/2}$, prove that $(1-x^2)y_n - [2(n-1)x+1]y_{n-1} - (n-1)(n-2)y_{n-2} = 0$	2013-14
2	14	Leibnitz Theorem and nth derivative of product of functions	12	If $y = e^{a \sin^{-1} x}$ then find $(1-x^2)y_2 - x y_1 - a^2 y$.	2015-16
2	14	Leibnitz Theorem and nth derivative of product of functions	13	If $y\sqrt{x^2-1} = \log_e(x + \sqrt{x^2-1})$, prove that $(x^2-1)y_{n+1} + (2n+1)xy_n + n^2y_{n-1} = 0$.	2022-23
2	15	To find nth derivative at x=0	14	If $y = x^2 \exp(2x)$ determine $(y_n)_0$.	2012-13
2	15	To find nth derivative at x=0	15	If $y = \sin(\sin^{-1} x)$, find $(y_n)_0$	2015-16 2018-19 2020-21
2	15	To find nth derivative at x=0	16	If $y = (x + \sqrt{1+x^2})^m$, find $y_n(0)$.	2021-22
2	15	To find nth derivative at x=0	17	If $y = \sin(m \sin^{-1} x)$, then prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2-m^2)y_n = 0$ and hence evaluate the value of $(y_n)_0$.	2022-23
2	16	Introduction to the partial differentiation and partial derivative	18	If $f(x, y, z, w) = 0$, then find $\frac{\partial x}{\partial y} \times \frac{\partial y}{\partial z} \times \frac{\partial z}{\partial w} \times \frac{\partial w}{\partial x}$. (Very Short question)	2015-16
2	16	Introduction to the partial differentiation and partial derivative	19	If $x^2 = au + bv, y^2 = au - bv$ Evaluate $\left(\frac{\partial u}{\partial x}\right)_y \left(\frac{\partial x}{\partial u}\right)_v$. (Very Short)	2017-18

2	16	Introduction to the partial differentiation and partial derivative	20	If $u = x^2 \tan^{-1}\left(\frac{y}{x}\right) - y^2 \tan^{-1}\left(\frac{x}{y}\right); xy \neq 0$ prove that $\frac{\partial^2 u}{\partial x \partial y} = \frac{x^2 - y^2}{x^2 + y^2}$. (Long question)	2017-18
2	17	Chain rule on partial derivatives	21	If $w = \sqrt{x^2 + y^2 + z^2}$ & $x = \cos v, y = u \sin v, z = uv$, then prove that $\left[u \frac{\partial w}{\partial u} - v \frac{\partial w}{\partial v}\right] = \frac{u}{\sqrt{1+v^2}}$. (Long question)	2016-17
2	17	Chain rule on partial derivatives	22	If $u = f(r)$ where $r^2 = x^2 + y^2$, show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r)$. (Long question)	2015-16
2	17	Chain rule on partial derivatives	23	If $V = f(2x - 3y, 3y - 4z, 4z - 2x)$, prove that $6 \frac{\partial V}{\partial x} + 4 \frac{\partial V}{\partial y} + 3 \frac{\partial V}{\partial z} = 0$. (Short question)	2014-15
2	17	Chain rule on partial derivatives	24	If $u = f(r, s, t)$, where $r = \frac{x}{y}, s = \frac{y}{z}, t = \frac{z}{x}$, show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$. (Short question)	2017-18
2	17	Chain rule on partial derivatives	25	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, then find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$.	2022-23
2	17	Chain rule on partial derivatives	26	If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$, prove that $\frac{1}{2} \frac{\partial u}{\partial x} + \frac{1}{3} \frac{\partial u}{\partial y} + \frac{1}{4} \frac{\partial u}{\partial z} = 0$. (Long question)	2019-20
2	17	Chain rule on partial derivatives	27	If $u = f(y - z, z - x, x - y)$, prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. (Very Short)	2017-18
2	18	Total derivatives	28	Find $\frac{du}{dt}$ if $u = x^3 + y^3, x = a \cos t, y = b \sin t$.	2022-23
2	18	Total derivatives	29	Find $\frac{du}{dt}$ as a total derivative and verify the result by direct substitution if $u = x^2 + y^2 + z^2$ and $x = e^{2t}, y = e^{2t} \cos 3t, z = e^{2t} \sin 3t$. (Short question)	2014-15
2	18	Total derivatives	30	Find $\frac{du}{dt}$ if $u = x^3 + y^3, x = a \cos t, y = b \sin t$. (Very Short)	2019-20
2	19	Euler's theorem for Homogeneous functions	31	If $u = x^2 y z - 4 y^2 z^2 + 2 x z^3$, then find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$. (Very Short question)	2011-12

2	19	Euler's theorem for Homogeneous functions	32	If $u(x, y) = (\sqrt{x} + \sqrt{y})^5$, find the value of $\left(x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}\right)$. (Very Short question)	2012-13
2	19	Euler's theorem for Homogeneous functions	33	Verify Euler's theorem for the function $z = \frac{x^{1/3} + y^{1/3}}{x^{1/2} + y^{1/2}}$. (Long question)	2015-16
2	19	Euler's theorem for Homogeneous functions	34	If $V = (x^2 + y^2 + z^2)^{-\frac{1}{2}}$, then find $x \frac{\partial V}{\partial x} + y \frac{\partial V}{\partial y} + z \frac{\partial V}{\partial z}$. (Very Short question)	2015-16
2	19	Euler's theorem for Homogeneous functions	35	If $u = x^3 y^2 \sin^{-1}\left(\frac{y}{x}\right)$, then find then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$. (Very Short)	2017-18
2	19	Euler's theorem for Homogeneous functions	36	If $u = \frac{x^2 y^2}{x^2 + y^2} + \cos\left(\frac{xy}{x^2 + y^2}\right)$, prove that $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = 2 \frac{x^2 y^2}{x^2 + y^2}$	2022-23
2	20	Deductions from Euler's Theorem	37	Show that: $xU_x + yU_y + zU_z = -2 \cot u$. where $u = \cos^{-1}\left(\frac{x^3 + y^3 + z^3}{ax + by + cz}\right)$ (Short question)	2013-14
2	20	Deductions from Euler's Theorem	38	Prove that $xu_x + yu_y = \frac{5}{2} \tan u$ if $u = \sin^{-1}\left(\frac{x^3 + y^3}{\sqrt{x} + \sqrt{y}}\right)$. (Short question)	2014-15
2	20	Deductions from Euler's Theorem	39	If $u = \sin^{-1}\left(\frac{x^3 + y^3 + z^3}{ax + by + cz}\right)$, prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 2 \tan u$. (Long question)	2017-18
2	20	Deductions from Euler's Theorem	40	If $u = \sin^{-1}\left(\frac{\frac{1}{x^3} + \frac{1}{y^3}}{\frac{1}{x^2} - \frac{1}{y^2}}\right)^{\frac{1}{2}}$, Show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = -\frac{1}{12} \tan u$. Evaluate $\left(x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}\right)$	2011-12
2	20	Deductions from Euler's Theorem	41	If $u = \sin^{-1}\left(\frac{x^{1/4} + y^{1/4}}{x^{1/6} + y^{1/6}}\right)$, then evaluate the value of $\left(x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}\right)$. (Short question)	2016-17

2	20	Deductions from Euler's Theorem	42	If $u = \cos^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + \frac{1}{2} \cot u = 0$. (Long question)	2018-19
2	20	Deductions from Euler's Theorem	43	If $u = \cos^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, then find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$. (Very Short)	2019-20
2	20	Deductions from Euler's Theorem	44	If $u = \sec^{-1}\left(\frac{x^3-y^3}{x+y}\right)$, prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2 \cot u$. Also evaluate $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$. (Long question)	2020-21
2	19	Euler's theorem for Homogeneous functions	45	If $u = \sin^{-1}\left(\frac{x^3+y^3}{\sqrt{x}+\sqrt{y}}\right)$, then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{5}{2} \tan u$.	2022-23
2	20	Deductions from Euler's Theorems	46	If $u = \sin^{-1}\left(\frac{\frac{1}{x^4+y^4}}{\frac{1}{x^6+y^6}}\right)$, then evaluate values of i) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ ii) $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$	2022-23
2	44	Curve tracing	47	Trace the curve $x^2 y^2 = (a^2 + y^2)(a^2 - y^2)$ in xy -plane, where a is constant.	2022-23
2	44	Curve tracing	48	Trace the curve $y^2(2a - x) = x^3$.	2011-12 2014-15
2	44	Curve tracing	49	Trace the curve $y = x(x^2 - 1)$.	2012-13
2	44	Curve tracing	50	Trace the curve $r^2 = a^2 \cos 2\theta$.	2014-15 2019-20
2	44	Curve tracing	51	Find all symmetries in the curve $x^2 y^2 = x^2 - a^2$	2022-23

CO-Wise AKTU Question Bank

Course: B. Tech.

Subject Name: Engg. Mathematics-I

Subject Code: BAS-103

Semester: First

CO No.	Lect. No.	Syllabus Topic (As Per LP)	Ques. No.	Question Statement (As Per AKTU)	Session
3	21	Taylor's and Maclaurin's Theorems for a function of two variables	1	Expand $f(x, y) = y^x$ about $(1, 1)$ upto second degree terms and hence evaluate $(1.02)^{1.03}$. (Long question)	2012-13, 2022-23
3	21	Taylor's and Maclaurin's Theorems for a function of two variables	2	Expand $e^x \log(1 + y)$ in the powers of x and y upto terms of third degree. (Long question)	2014-15
3	21	Taylor's and Maclaurin's Theorems for a function of two variables	3	Express the function $f(xy) = x^2 + 3y^2 - 9x - 9y + 26$ as Taylor's Series expansion about the point $(1, 2)$. (Long question)	2017-18, 2016-17
3	21	Taylor's and Maclaurin's Theorems for a function of two variables	4	State the Taylor's Theorem for two variables. (Very Short)	2018-19
3	21	Taylor's and Maclaurin's Theorems for a function of two variables	5	Expand x^y in powers of $(x - 1)$ and $(y - 1)$ up to the third-degree terms and hence evaluate $(1.1)^{1.02}$	2021-22
3	22	Maxima and Minima of functions of several variables	6	Locate the stationary point of: $x^4 + y^4 - 2x^2 + 4xy - 2y^2$ and determine their nature. (Short question)	2012-13
3	22	Maxima and Minima of functions of several variables	7	Find the stationary point of: $f(x, y) = 5x^2 + 10y^2 + 12xy - 4x - 6y + 1$. (Very Short question)	2013-14
3	22	Maxima and Minima of functions of several variables	8	Find the maximum value of the function $f(xyz) = (z - 2x^2 - 2y^2)$ where $3xy - z + 7 = 0$. (Very Short question)	2016-17
3	22	Maxima and Minima of functions of several variables	9	Find the stationary point of $f(x, y) = x^3 + y^3 + 3axy, a > 0$. (Very Short)	2018-19
3	22	Maxima and Minima of functions of several variables	10	Find the maximum and minimum distance of the point $(1, 2, -1)$ from the sphere $x^2 + y^2 + z^2 = 24$. (Long question)	2017-18, 2018-19

3	22	Maxima and Minima of functions of several variables	11	Find the critical points of the function $f(x, y) = x^3 + y^3 - 3axy$. (Very short)	2021-22
3	23	Lagrange's method of multiplier	12	Divide 24 into three parts such that the continued product of the first, square of the second and the cube of the third may be maximum. (Long question)	2013-14
3	23	Lagrange's method of multiplier	13	Using the Lagrange's method, find the maximum and Minimum distances from the origin to the curve $3x^2 + 4xy + 6y^2 = 140$. (Short question)	2011-12
3	23	Lagrange's method of multiplier	14	Find the volume contained in the solid region in the first Octant of the ellipsoid: $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$. (Long question)	2013-14
3	23	Lagrange's method of multiplier	15	A rectangular box open at the top is to have 32 cubic ft. Find the dimensions of the box requiring least material for its construction. (Long question)	2014-15, 2021-22, 2022-23
3	23	Lagrange's method of multiplier	16	Using the Lagrange's method to find the dimension of rectangular box of maximum capacity whose surface area is given when (a) Box is open at the top (b) Box is closed. (Long question)	2015-16
3	23	Lagrange's method of multiplier	17	Using Lagrange's method of Maxima and Minima, find the shortest distance from the point (1, 2, -1) to sphere $x^2 + y^2 + z^2 = 24$. (Long question)	2017-18
3	24	Introduction to Jacobian, properties of Jacobian	18	If $x + y + z = u, y + z = uv, z = uvw$ then find $\frac{\partial(x,y,z)}{\partial(u,v,w)}$. (Long question)	2015-16
3	24	Introduction to Jacobian, properties of Jacobian	19	If $u_1 = \frac{x_2 x_3}{x_1}, u_2 = \frac{x_1 x_3}{x_2}, u_3 = \frac{x_2 x_1}{x_3}$, find the value of $\frac{\partial(u_1, u_2, u_3)}{\partial(x_1, x_2, x_3)}$. (Short question)	2017-18
3	24	Introduction to Jacobian, properties of Jacobian	20	If $u = x(1 - y), v = xy$, find $\frac{\partial(u,v)}{\partial(x,y)}$. (Very Short)	2019-20
3	24	Introduction to Jacobian, properties of Jacobian	21	If $x = e^v \sec u, y = e^v \tan u$, then evaluate $\frac{\partial(x,y)}{\partial(u,v)}$. (Very Short)	2020-21

3	24	Introduction to Jacobian, properties of Jacobian	22	Calculate $\frac{\partial(u,v)}{\partial(x,y)}$ for $x = e^u \cos v$ and $y = e^u \sin v$. (Very Short question)	2011-12
3	24	Introduction to Jacobian, properties of Jacobian	23	If $J = \frac{\partial(u,v)}{\partial(x,y)}$ and $J^* = \frac{\partial(x,y)}{\partial(u,v)}$ then show that $JJ^* = 1$. (Short question)	2013-14
3	25	Jacobian of implicit function	24	Find $\frac{\partial(x,y,z)}{\partial(r,\theta,\phi)}$ if $x = \sqrt{vw}$, $y = \sqrt{uw}$, $z = \sqrt{uv}$ and $u = r \sin \theta \cos \phi$, $v = r \sin \theta \sin \phi$, $w = r \cos \theta$. (Long question)	2014-15
3	25	Jacobian of implicit function	25	If $x = v^2 + w^2$, $y = w^2 + u^2$, $z = u^2 + v^2$ then show that $\frac{\partial(x,y,z)}{\partial(u,v,w)} \cdot \frac{\partial(u,v,w)}{\partial(x,y,z)} = 1$ (Long question)	2016-17
3	25	Jacobian of implicit function	26	If $x = r \cos \theta$, $y = r \sin \theta$, $z = z$ then find $\frac{\partial(r,\theta,z)}{\partial(x,y,z)}$. (Very Short)	2018-19
3	25	Jacobian of implicit function	27	Find the Jacobian of the functions $y_1 = (x_1 - x_2)(x_2 + x_3)$, $y_2 = (x_1 + x_2)(x_2 - x_3)$, $y_3 = x_2(x_1 - x_3)$, hence show that the functions are not independent. Find the relation between them.	2022-23
3	25	Jacobian of implicit function	28	Are the functions: $u = \frac{x-y}{x+z}$, $v = \frac{x+z}{y+z}$ functionally dependent? If so, find the relation between them. (Short question)	2011-12
3	25	Jacobian of implicit function	29	If u, v, w are the roots of the equation $(\lambda - x)^3 + (\lambda - y)^3 + (\lambda - z)^3 = 0$, in λ then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. (Long question)	2015-16, 2021-22
3	25	Jacobian of implicit function	30	Find the relation between u, v, w for the values $u = x + 2y + z$; $v = x - 2y + 3z$; $w = 2xy - zx + 4yz - 2z^2$. (Short question)	2016-17
3	25	Jacobian of implicit function	31	If u, v, w are the roots of the equation $(x - a)^3 + (x - b)^2 + (x - c)^2 = 0$, then find $\frac{\partial(u,v,w)}{\partial(a,b,c)}$. (Long question)	2018-19
3	25	Jacobian of implicit function	32	If $u^3 + v^3 + w^3 = x + y + z$, $u^2 + v^2 + w^2 = x^3 + y^3 + z^3$ and $u + v + w = x^2 + y^2 + z^2$, then show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{(x-y)(y-z)(z-x)}{(u-v)(v-w)(w-u)}$. (Long question)	2019-20

3	25	Jacobian of implicit function	33	If $u^3 + v + w = x + y^2 + z^2$ $u + v^3 + w = x^2 + y + z^2$ $u + v + w^3 = x^2 + y^2 + z$,Show that: $\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{1-4xy(xy+yz+zx)+16xyz}{2-3(u^2+v^2+w^2)+27u^2v^2w^2}$ (Long question)	2020-21
3	26	Approximations of errors	34	Find approximate value of: $[(3.82)^2 + 2(2.1)^3]^{\frac{1}{5}}$. (Short question)	2011-12, 2013-14
3	26	Approximations of errors	35	The formula, $V = kr^4$, says that the volume V of the fluid flowing through a small pipe or tube in a unit of time at a fixed pressure is a constant times the fourth power of the tube's radius r. How will a 10% increase in r affect V? (Very Short question)	2012-13
3	26	Approximations of errors	36	If $pv^2 = k$ and the relative errors in p and v are respectively 0.05 and 0.025, show that the error in k is 10%. (Very Short question)	2015-16
3	26	Approximations of errors	37	Find the percentage error in measuring the volume of a rectangular box when the error of 1% is made in measuring the each side. (Long question)	2016-17, 2022-23
3	26	Approximations of errors	38	A balloon in the form of right circular of radius 1.5m and length 4m is surmounted by hemispherical ends. If the radius is increased by 0.01m find the percentage change in the volume of the balloon. (Long question)	2017-18
3	26	Approximations of errors	39	What error in the logarithm of a number will be produced by an error of 1% in the number? (Very Short)	2017-18
3	26	Approximations of errors	40	If $RI = E$ and possible error in E and I are 20% and 10% respectively, then find the error in R. (Very Short)	2018-19

CO-Wise AKTU Question Bank

Course: Btech

Subject Name: Engg. Mathematics-I

Subject Code: BAS103

Semester: First

CO No.	Lect. No.	Syllabus Topic (As Per LP)	Ques. No.	Question Statement (As Per AKTU)	Session
CO4	30	Area by Double integral	1	Evaluate $\int y \, dx \, dy$ over the part of the plane bounded by the line $y = x$ and the parabola $y=4x-x^2$.	2022- 23
CO4	29	Change of order of integration.	2	Evaluate the double integral $\int_0^a \int_{ay^2}^{4-ay^2} dy \, dx$ by changing the order of integration.	2022- 23
CO4	31	Introduction to triple integral , volume by triple integral	3	Evaluate $\int_0^1 \int_0^{x^2} \int_0^{x+y} dz \, dy \, dx$ on R ,where R is the region determined by $0 \leq x \leq 1, 0 \leq y \leq x^2, 0 \leq z \leq x+y$.	2022- 23
CO4	35	Dirichlet integral and its application to area and volume.	4	Use Dirichlet's integral to evaluate $\int_0^1 \int_0^1 \int_0^1 xyz \, dx \, dy \, dz$ throughout the volume bounded by $x=0, y=0, z=0$ and $x+y+z=1$.	2022- 23
CO4	34	Properties and Problems of beta and gamma functions	5	Find the value of $\Gamma(-3/2)$ where symbol has their usual meaning.	2022-23
CO4	30	Area by double integral	6	Find the area in the positive quadrant bounded by the curves $y^2=4ax, y^2=4bx, xy=c^2$ and $xy=d^2$, given that $d > c, b > a$.	2022-23
CO4	29	Change of order of integration	7	By changing order of integration, evaluate the $\int_0^\infty \int_0^y e^{-y^2x} dx \, dy$.	2022-23
CO4	35	Dirichlet integral and its application to area and volume.	8	Using Dirichlet's integral, find the volume of the solid $x^2+y^2+z^2=1, x>0, y>0, z>0$.	2022-23
CO4	30	Area bounded by double integral	9	Find the area bounded by the curve $y^2=x$ and $x^2=y$.	2021- 22

CO4	31	Introduction to triple integral, Volume by triple integral	10	Find the value of $\int_0^1 \int_0^{1-x} \int_0^{1-x-y} dz dy dx$.	2021- 22
CO4	31	Introduction to triple integral , volume by triple integral	11	Find the volume bounded by cylinder $x^2 + y^2 = 4$ and the plane $y + z = 4$ and $z = 0$.	2021 - 22
CO4	29	Change of order of integral	12	Change the order of integration in $I = \int_0^1 \int_{2x}^{2-x} x^2 y dy dx$ and hence evaluate the integral.	2021 - 22
CO4	27	Introduction to double integral	13	Evaluate $\int_0^1 \int_{1-x}^{1-x^2} (1-x^2-y^2) dx dy$.	2011-12 (short)
CO4	27	Introduction to double integral	14	Prove that $\int_0^a \int_0^b \int_0^c (x^2 + y^2 + z^2) dz dy dx = \frac{4}{3} \pi abc$, where S is the ellipsoid $ax^2 + by^2 + cz^2 = 1$	2011-12 (short)
CO4	30	Area by double integral	15	Evaluate $\int_0^1 \int_0^{1-x} (x-y)^4 e^{x+y} dy dx$ where R is the square in the xy-plane with vertices at (1,0), (2,1), (1,2) and (0,1).	2012-13 (short)
CO4	29	Change in order of integration	16	Evaluate $\int_0^\infty \int_0^\infty x e^{-x^2-y^2} dy dx$	2012-13 (long)
CO4	27	Introduction to double integral	17	Evaluate $\int_0^a \int_0^x x y dy dx$	2013-14 (short)
CO4	27	Introduction to double integral	18	Evaluate $\int_0^1 \int_0^{1-x} (1-x^2-y^2) dx dy$	2015-16 (short)
CO4	27	Introduction to double integral	19	Evaluate $\int_0^1 \int_0^{1-x} x e^{y^2} dy dx$	2017-18 (short)
CO4	27	Introduction to double integral	20	Evaluate $\int_0^1 \int_0^{1-x} x e^{y^2} dy dx$	2018-19 (short)

CO4					
CO4	27	Introduction to double integral	21	Evaluate $\int_0^1 \int_0^{2-2x} (x^2+3y^2) dy dx$	2019-20 (short)
CO4	30	Area by double integral	22	Compute the area bounded by lemniscate $r^2 = a^2 \cos 2\theta$.	2013-14 (long)
CO4	28	Double integral by polar coordinates	23	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing to polar coordinates. Hence show that $\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$	2018-19 (short)
CO4	29	Change of order of integration	24	Changing the order of integration in the double integral: $I = \int_0^1 \int_{2x}^4 f(x,y) dy dx$ leads to $I = \int_p^q \int_r^s f(x,y) dx dy$ say, what is p?	2012-13 (short)
CO4	29	Change of order of integration	25	Change the order of integration and evaluate $\int_0^1 \int_{2x}^4 (x^2 - xy) dy dx$	2014-15 (short) 2015-16 (short) 2016-17 (short) 2017-18 (short) 2019-20 (short)

CO4	29	Change of order of integration	26	Changing the order of integration in the double integral: $I = \int_0^8 \int_{\frac{x}{2}}^4 xy \, dy \, dx$ leads to $I = \int_{\frac{1}{2}}^2 \int_{xy}^{4x} xy \, dx \, dy$ say, what is q ?	2016-17 (long)
CO4	29	Change of order of integration	27	Change the order of integration and evaluate $\int_0^2 \int_{2x}^4 xy \, dy \, dx$.	2018-19 (long)
CO4	29	Change of order of integration	28	Evaluate the following integral by changing the order of integration $\int_0^\infty \int_{xy}^\infty e^{-yy} \, dy \, dx$	2020-21 (long)
CO4	30	Area by double integral	29	Find the value of the integral $\int_R xy \, dx \, dy$ where R is the region bounded by the x -axis, the line $y=2x$ and the parabola $x^2=4ay$	2011-12 (short)
CO4	30	Area by double integral	30	Determine the area bounded by the curves $xy=2$, $4y=x^2$, $y=4$	2014-15 (short)
CO4	31	Introduction of triple integral, volume by triple integral	31	Find the volume of the tetrahedron bounded by the plane $xa+yb+zc=1$ and the coordinate planes.	2011-12 (long)
CO4	31	Introduction of triple integral, volume by triple integral	32	Find the volume of the solid which is bounded by the surfaces $2z=x^2+y^2$ and $z=x$	2011-12 (long)
CO4	31	Introduction of triple integral, volume by triple integral	33	Find the volume contained in the solid region in the first octant of the ellipsoid $x^2a^2+y^2b^2+z^2c^2=1$	2013-14 (short)
CO4	31	Introduction of triple integral, volume by triple integral	34	Find the volume and the mass contained in the solid region in the first octant of the ellipsoid $x^2a^2+y^2b^2+z^2c^2=1$ if the density at any point $p(x,y,z)=kxyz$	2014-15 (long)
CO4	31	Introduction of triple integral, volume by triple integral	35	Prove that $\int_0^1 \int_0^1 \int_0^1 \frac{1}{1-x^2-y^2-z^2} \, dx \, dy \, dz = \frac{\pi^2}{8}$, the integral being extended to all positive values of the variables for which the expression is real.	2015-16 (short)

CO4	31	Introduction of triple integral, volume by triple integral	36	Evaluate $(x+y+z)dxdydz$ where $R: 0 \leq x \leq 1; 1 \leq y \leq 2; 2 \leq z \leq 3$	2015-16 (long) 2017-18 (long)
CO4	31	Introduction of triple integral, volume by triple integral	37	If the volume of an object expressed in the spherical coordinates as following: $V = \int_0^1 \int_0^{\pi} \int_0^{2\pi} r^2 \sin \phi dr d\phi d\theta$ Evaluate the value of V.	2016-17 (short)
CO4	31	Introduction of triple integral, volume by triple integral	38	Evaluate the triple integral $\int_0^1 \int_0^1 \int_0^1 x^2 y z dx dy dz$	2016-17 (short)
CO4	31	Introduction of triple integral, volume by triple integral	39	Evaluate $x^2 y z dx dy dz$ throughout the volume bonded by planes $x=0, y=0, z=0$ and $x+a+y+b+z=1$	2016-17 (long)
CO4	31	Introduction of triple integral, volume by triple integral	40	Calculate the volume of the solid bounded by the surface $x=0, y=0, z=0$ and $x+y+z=1$	2018-19 (short) 2020-21 (short)
CO4	31	Introduction of triple integral, volume by triple integral	41	Find the volume of the largest rectangular parallelopiped that can be inscribed in the ellipsoid $x^2/a^2 + y^2/b^2 + z^2/c^2 = 1$	2019-20 (short)
CO4	31	Introduction of triple integral, volume by triple integral	42	Find the volume of the region bounded by the surface $y=x^2, x=y^2$ and the plane $z=0, z=3$.	2019-20

					(long)
CO4	29	Change of order of integral	43	Evaluate by changing the variables $(x+y)^2 dx dy$ where R is the region bounded by the parallelogram $x+y=0, x+y=2, 3x-2y=0, 3x-2y=3$	2013-14 (long) 2020-21 (long)
CO4	30	Area by double integral	44	Evaluate $(x+y)^2 dx dy$ where R is the region bounded by the parallelogram in the xy-plane with vertices (1,0), (3,1), (2,2), (0,1) using the transformation $u=x+y, v=x-2y$.	2019-20 (long)
CO4	28	Double integral in Polar coordinates	45	$I = \int_0^{2\pi} \int_0^2 x^2 f(x,y) dx dy$ Change into polar coordinates.	
CO4	31	Introduction to triple integral.	46	Evaluate $\int_{-1}^1 \int_{-2}^2 \int_{-3}^3 dx dy dz$	
CO4	30	Area by double integral	47	Evaluate $xy(1-x-y)^{1/2} dx dy$ where R is the region in first quadrant bounded by $x=0, y=0, x+y=1$ using the transformation $u=x+y, y=uv$.	
CO4	34	Properties and problems of beta and gamma function	48	Evaluate $\frac{\Gamma(8/3)}{\Gamma(2/3)}$	[2015-16]
CO4	34	Properties and problems of beta and gamma function	49	Evaluate $\Gamma\left(\frac{-5}{2}\right)$	[2013-14]
CO4	34	Properties and problems of beta and gamma function	50	Find the value of integral $\int_0^\infty e^{-ax} x^{n-1} dx$	[2015-16]

CO4	34	Properties and problems of beta and gamma function	51	Evaluate $\Gamma(3/4)\Gamma(1/4)$	[2012-13]
CO4	34	Properties and problems of beta and gamma function	52	Prove that $\sqrt{\pi}\Gamma(2n) = 2^{2n-1}\Gamma(n)\Gamma\left(n+\frac{1}{2}\right)$.	[2011-12]
CO4	34	Properties and problems of beta and gamma function	53	(a) For the Gamma function, show that $\frac{\Gamma\left(\frac{1}{3}\right)\Gamma\left(\frac{5}{6}\right)}{\Gamma\left(\frac{2}{3}\right)} = (2)^{1/3} \sqrt{\pi}.$	[2016-17]
				(b) Show that $\int_0^{\pi/2} \tan \theta \, d\theta = \int_0^{\pi/2} \cot \theta \, d\theta = \pi/2$	
CO4	34	Properties and problems of beta and gamma function	54	Prove that $\int_0^1 x^4(1-x)^4 dx = \frac{1}{142}$	[2015-16]
CO4	34	Properties and problems of beta and gamma function	55	Evaluate $\int_0^{\infty} \frac{x^4}{1+x^4} dx$	[2012-13]
CO4	34	Properties and problems of beta and gamma function	56	Prove that $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$, $m > 0$, $n > 0$, where Γ is Gamma function.	[2017-18]
CO4	34	Properties and problems of beta and gamma function	57	Use Beta function to evaluate: $\int_0^1 \frac{x^8(1-x^6)}{(1+x)^{24}} dx.$	[2011-12]

CO4	34	Properties and problems of beta and gamma function	58	Show that $\int_0^1 x^5(1-x^3)^{10} dx = 1396$	
CO4	34	Properties and problems of beta and gamma function	59	(a) For a β function, show that $\beta_{p,q} = \beta_{p+1,q} + \beta_{p,q+1}$	
				(b) Show that $\beta_p, q+1 = \beta_{p+1,q} + \beta_{p,q+1}$ where $p > 0, q > 0$	[2015-16]
CO4	34	Properties and problems of beta and gamma function	60	Using Beta and Gamma functions, evaluate $\int_0^1 x^{31}(1-x^3)^{1/2} dx$	[2017-18]
CO4	34	Properties and problems of beta and gamma function	61	Evaluate $I = \int_0^1 \left(\frac{x}{1-x^3} \right)^{1/2} dx$	[2013-14]
CO4	35	Dirichlet integral and its application to find volume.	62	Apply Dirichlet integral to find the volume of an octant of the sphere $x^2 + y^2 + z^2 = 25$	[2018-19]
CO4	35	Dirichlet integral and its application to find volume	63	Find the volume and mass of a tetrahedron which is formed by the co-ordinate planes and the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ the density is given by $\rho = kxyz$	[2017-18]
CO4	31	Introduction to triple integral	64	Evaluate $\int \int \int x^2 y z \, dx \, dy \, dz$ through out the volume bounded by the planes $x=0, y=0, z=0$ and $ax+by+cz=1$	[2016-17]
CO4	35	Dirichlet integral and its application to find volume	65	Find the volume and the mass contained in the solid region in the first octant of the ellipsoid:	[2019-20] [2014-15]

				$x^2a^2+y^2b^2+z^2c^2=1$ if the density at any point $\rho(x,y,z)=kxyz$	
CO4	35	Dirichlet integral and its application to find volume	66	Find the mass of the solid $xap+ybq+zcr=1$, where x,y,z are all positive and the density at any point being $\rho=kx^{l-1}y^{m-1}z^{n-1}$.	[2013-14] [2012-13]
CO4	35	Dirichlet integral and its application to find volume	67	Show that $dx dy dz \sqrt{1-x^2-y^2-z^2} = \pi/8$, the integral being extended to all positive values of the variables for which the expression is real.	[2015-16] [2012-13]
CO4	35	Dirichlet integral and its application to find volume	68	Evaluate $dx dy dz \sqrt{a^2-x^2-y^2-z^2}$, the integral being extended to all positive values of the variables for which the expression is real.	[2012-13]
CO4	36	Liouville's extension of Dirichlet's integral.	69	Show that $dx dy dz (x+y+z+1)^2 = 34 \log 2$ the integral being taken throughout the volume bounded by the planes $x=0, y=0, z=0$ and $x+y+z=1$	
CO4	35	Dirichlet integral and its application to find volume	70	Find the volume and the mass of the ellipsoid: $x^2a^2+y^2b^2+z^2c^2=1$ if the density at any point $\rho(x,y,z)=kxyz$	

Meerut Institute of Engineering & Technology, Meerut

CO-Wise AKTU Question Bank

Course: B.Tech

Subject Name: Engg. Mathematics-I

Subject Code: BAS103

Semester: I

CO No.	Lect. No.	Syllabus Topic (As Per LP)	Ques. No.	Question Statement (As Per AKTU)	Session
5	37	Gradient, Directional Derivatives	1	Find a unit vector normal to the surface $x^3 + y^3 + 3xyz = 3$ at the point (1,2,-1).	2013-14 (Very short)
5	37	Gradient, Directional Derivatives	2	If $u = x + y + z$, $v = x^2 + y^2 + z^2$, $w = yz + zx + xy$ Prove that $\text{grad } u$, $\text{grad } v$ and $\text{grad } w$ are coplanar.	2014-15 (Long)
5	37	Gradient, Directional Derivatives	3	For the scalar field $u = \frac{x^2}{2} + \frac{y^2}{3}$, find the magnitude of gradient at the point (1,3).	2016-17 (Very short)
5	37	Gradient, Directional Derivatives	4	Define Del ∇ operator and gradient.	2018-19 (Very short)
5	37	Gradient, Directional Derivatives	5	If $\phi = 3x^2y - y^3z^2$, find $\text{grad } \phi$ at point (2, 0, -2).	2018-19 (Very short)
5	37	Gradient, Directional Derivatives	6	Find $\text{grad } \phi$ at the point (2,1,3) where $\phi = x^2 + yz$	2019-20 (Very short)
5	37	Gradient, Directional Derivatives	7	Find the directional derivative of v^2 , where $\vec{v} = xy^2\hat{i} + zy^2\hat{j} + xz^2\hat{k}$ at the point (2,0,3) in the direction of the outward normal to the sphere $x^2 + y^2 + z^2 = 14$ at the point (3,2,1).	2012-13 (Short)

5	37	Gradient, Directional Derivatives	8	Find the directional derivative of: $(x^2 + y^2 + z^2)^{-1/2}$ at the point (3,1,2) in the direction of the vector $yz\hat{i} + zx\hat{j} + xy\hat{k}$.	2013-14 (Short)
5	37	Gradient, Directional Derivatives	9	Find the directional derivative of $\left(\frac{1}{r^2}\right)$ in the direction of $\vec{r}$, where $\vec{r} = \hat{i}x + \hat{j}y + \hat{k}z$.	2016-17 (Short)
5	37	Gradient, Directional Derivatives	10	Find the directional derivative of $\phi = 5x^2y - 5y^2z + \frac{5}{2}z^2x$ at the point P(1,1,1) in the direction of the line $\frac{x-1}{2} = \frac{y-3}{-2} = \frac{z}{1}$.	2018-19 (Long)
5	37	Gradient, Directional Derivatives	11	Find the directional derivative of $\phi(x, y, z) = x^2yz + 4xz^2$ at (1,-2,1) in the direction of $2\hat{i} - \hat{j} - 2\hat{k}$. Find also the greatest rate of increase of ϕ .	2019-20 (Long)
5	38	Divergence of a vector and its physical interpretations	12	Show that the vector: $\vec{V} = 3y^4z^2\hat{i} + 4x^3z^2\hat{j} - 3x^2y^2\hat{k}$ is solenoidal.	2011-12 (Very short)
5	38	Divergence of a vector and its physical interpretations	13	Find the value of m if $\vec{F} = mx\hat{i} - 5y\hat{j} + 2z\hat{k}$ is a solenoidal vector.	2017-18 (Very short)
5	38	Divergence of a vector and its physical interpretations	14	Show that vector $\vec{V} = (x + 3y)\hat{i} + (y - 3z)\hat{j} + (x - 2z)\hat{k}$ is solenoidal.	2019-20, 2020-21 (Very short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	15	If $\vec{F} = (\vec{a} \cdot \vec{r})\vec{r}$, where $\vec{a}$ is a constant vector, find $\text{curl } \vec{F}$ and prove that it is perpendicular to $\vec{a}$.	2011-12 (Short)

5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	16	If $\vec{F} = \frac{\vec{r}}{r^3}$, find $\text{curl } \vec{F}$.	2012-13 (Very short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	17	Prove that $\vec{A} = (6xy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (3xz^2 - y)\hat{k}$ is irrotational.	2013-14 (Very short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	18	Find the curl of $\vec{F} = xy\hat{i} + y^2\hat{j} + xz\hat{k}$ at (-2,4,1).	2015-16 (Very short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	19	Prove that, for every field $\vec{V}$; $\text{div curl } \vec{V} = 0$.	2015-16 (Short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	20	A fluid motion is given by $\vec{v} = (y + z)\hat{i} + (z + x)\hat{j} + (x + y)\hat{k}$. Show that the motion is irrotational and hence find the velocity potential.	2015-16 (Short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	21	If $\vec{A} = (xz^2\hat{i} + 2y\hat{j} - 3xz\hat{k})$ and $\vec{B} = (3xz\hat{i} + 2yz\hat{j} - z^2\hat{k})$. Find the value of $[\vec{A} \times (\nabla \times \vec{B})]_{\&}$ & $[(\vec{A} \times \nabla) \times \vec{B}]$.	2016-17 (Short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	22	Determine the value of constants a, b, c if $\vec{F} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$ is irrotational.	2017-18 (Short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	23	If all second order derivatives of ϕ and $\vec{v}$ are continuous, then show that (i) $\text{Curl}(\text{grad } \phi) = 0$ (ii) $\text{div}(\text{curl } \vec{v}) = 0$	2017-18 (Long)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	24	Prove that $(y^2 - z^2 + 3yz - 2x)\hat{i} + (3xz + 2xy)\hat{j} + (3xy - 2xz + 2z)\hat{k}$ is both solenoidal and irrotational.	2018-19 (Long)

5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	25	A fluid motion is given by $\vec{v} = (y \sin z - \sin x)\hat{i} + (x \sin z + 2yz)\hat{j} + (xy \cos z + y^2 \sin z)\hat{k}$ Is the motion irrotational? If so, find the velocity potential.	2020-21 (Long)
5	40	Line, Surface and Volume integral	26	Evaluate: $\iint_S \vec{F} \cdot \hat{n} \, dS$ where $\vec{F} = 18z\hat{i} - 12\hat{j} + 3y\hat{k}$ and S is the part of the plane $2x + 3y + 6z = 12$ in the first octant.	2011-12 (Long)
5	40	Line, Surface and Volume integral	27	Find the work done in moving a particle in the force field: $\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$ along the curve $x^2 = 4y$ and $3x^3 = 8z$ from $x = 0$ to $x = 2$.	2011-12 (Short)
5	40	Line, Surface and Volume integral	28	Evaluate $\int_C \vec{F} \cdot d\vec{r}$ along the curve $x^2 + y^2 = 1, z = 1$ in the positive direction from $(0,1,1)$ to $(1,0,1)$, where: $\vec{F} = (yz + 2x)\hat{i} + xz\hat{j} + (xy + 2z)\hat{k}.$	2012-13 (Short)
5	40	Line, Surface and Volume integral	29	If $\vec{A} = (x - y)\hat{i} + (x + y)\hat{j}$, evaluate $\oint_C \vec{A} \cdot d\vec{r}$ around the curve C consisting of $y = x^2$ and $y^2 = x$.	2013-14 (Short)
5	40	Line, Surface and Volume integral	30	Evaluate $\int_S (yz\hat{i} + zx\hat{j} + xy\hat{k}) \cdot d\vec{S}$, where S is the surface $x^2 + y^2 + z^2 = a^2$ of the sphere in the first octant.	2014-15 (Long)

5	40	Line, Surface and Volume integral	31	If $\vec{A} = (x - y)\hat{i} + (x + y)\hat{j}$, evaluate $\oint_C \vec{A} \cdot d\vec{r}$ around the curve C consisting of $y = x^2$ and $y^2 = x$.	2017-18 (Short)
5	41	Applications of Green's Theorem	32	State Green's theorem for a plane region.	2011-12 (Very short)
5	41	Applications of Green's Theorem	33	Using Green's theorem, evaluate the integral $\oint_C (xy dy - y^2 dx)$, where C is the square cut-from the first quadrant by the lines $x = 1, y = 1$.	2012-13 (Very short)
5	41	Applications of Green's Theorem	34	Verify Green's theorem in plane for: $\oint_C (x^2 - 2xy)dx + (x^2 y + 3)dy$, where C is the boundary of the region defined by $y^2 = 8x$ and $x = 2$.	2013-14 (Long)
5	41	Applications of Green's Theorem	35	Verify the Green's theorem to evaluate the line integral $\int_C (2y^2 dx + 3x dy)$, where C is the boundary of the closed region bounded by $y = x$ and $y = x^2$.	2015-16 (Long)
5	40	Line, Surface and Volume Integrals	36	If $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$, then evaluate the value of $\oint \vec{F} \cdot d\vec{r}$.	2016-17 (Short)
5	41	Applications of Green's Theorem	37	Verify Green's theorem, evaluate $\int_C (x^2 + xy)dx + (x^2 + y^2)dy$ where C square formed by lines $x = \pm 1, y = \pm 1$.	2017-18 (Long)
5	41	Applications of Green's Theorem	38	State Green's theorem.	2020-21 (Very short)

5	42	Applications of Stoke's Theorem	39	Evaluate $\oint_C \vec{F} \cdot d\vec{r}$ by Stoke's Theorem, where: $\vec{F} = y^2\hat{i} + x^2\hat{j} - (x+z)\hat{k}$ and C is the boundary of triangle with vertices at (0,0,0), (1,0,0) and (1,1,0).	2013-14 (Short)
5	42	Applications of Stoke's Theorem	40	Verify Stokes theorem for $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken around the rectangle bounded by the lines $x = \pm a, y = 0$ and $y = b$.	2014-15 (Long)
5	42	Applications of Stoke's Theorem	41	State Stoke's theorem.	2015-16 (Very short)
5	42	Applications of Stoke's Theorem	42	Verify Stokes theorem $\vec{F} = (2y + z, x - z, y - x)$ taken over the triangle ABC cut from the plane $x + y + z = 1$ by the coordinate planes.	2016-17 (Short)
5	42	Applications of Stoke's Theorem	43	Verify Stoke's theorem for $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken round the rectangle bounded by the lines $x = \pm a, y = 0, y = b$.	2017-18 (Long)
5	42	Applications of Stoke's Theorem	44	Verify Stoke's theorem for the vector field $\vec{F} = (x^2 - y^2)\hat{i} + 2xy\hat{j}$ integrated round the rectangle in the plane $z = 0$ and bounded by the lines $x = 0, y = 0, x = a, y = b$.	2019-20 (Short)
5	42	Applications of Stoke's Theorem	45	Verify Stoke's theorem for the function $\vec{F} = x^2\hat{i} + xy\hat{j}$ integrated round the square whose sides are $x = 0, y = 0, x = a, y = a$ in the plane $z = 0$.	2020-21 (Long)

5	43	Applications of Gauss Divergence Theorem	46	Verify the Gauss divergence theorem for: $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - xz)\hat{j} + (z^2 - xy)\hat{k}$ Taken over the rectangular parallelepiped $0 \leq x \leq a, 0 \leq y \leq b, 0 \leq z \leq c.$	2012-13 (Long)
5	43	Applications of Gauss Divergence Theorem	47	Verify Gauss Divergence theorem for $\int_C [(x^3 - yz)\hat{i} - 2x^2y\hat{j} + 2z\hat{k}] \cdot \hat{n} \, dS$, where S denotes the surface of cube bounded by the planes $x = 0, x = a; y = 0, y = a; z = 0, z = a.$	2016-17 (Short)
5	43	Applications of Gauss Divergence Theorem	48	Verify the divergence theorem for $\vec{F} = (x^3 - yz)\hat{i} + (y^3 - zx)\hat{j} + (z^3 - xy)\hat{k}$, taken over the cube bounded by planes $x = 0, y = 0, z = 0, x = 1, y = 1, z = 1.$	2018-19 (Very short)
5	43	Applications of Gauss Divergence Theorem	49	Verify the divergence theorem for $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ taken over the rectangular parallelepiped $0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq z \leq 1.$	2019-20 (Long)
5	43	Applications of Gauss Divergence Theorem	50	Use divergence theorem to evaluate the surface integral $\iint_S (x \, dy \, dz + y \, dz \, dx + z \, dx \, dy)$ where S is the portion of the plane $x + 2y + 3z = 6$ which lies in the first octant.	2020-21 (Long)
5	38	Divergence of a vector and its physical interpretations	51	Find p such that $\vec{V} = (px + 4y^2z)\hat{i} + (x^3 \sin z - 3y)\hat{j} - (e^x + 4 \cos x^2y)\hat{k}$ is solenoidal.	2022-23 (Very Short)
5	41	Applications of Green's Theorem	52	Verify Green's theorem for $\oint (2y^2 \, dx + 3x \, dy)$, where C is the boundary of the closed region bounded by $y = x$ and $y = x^2$.	2022-23 (Long)

5	40	Line, Surface and Volume integral	53	Evaluate $\iint_S \vec{F} \cdot \hat{n} dS$, where $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - zx)\hat{j} + (z^2 - xy)\hat{k}$ and S is the surface of the rectangular parallelopiped $0 \leq x \leq a, 0 \leq y \leq b, 0 \leq z \leq c$.	2022-23 (Long)
5	37	Gradient, Directional Derivatives	54	Find the directional derivative of $f(x, y, z) = x^2 - 2y^2 + 4z^2$ at the point (1, 1, -1) in the direction of $2\hat{i} + \hat{j} - \hat{k}$. In what direction will the directional derivative be maximum and what is the magnitude?	2022-23 (Long)
5	40	Line, Surface and Volume integral	55	Evaluate $\iint y \, dx dy$ over the part of the plane bounded by the line $y = x$ and the parabola $y = 4x - x^2$.	2022-23 (Very Short)
5	39	Curl of a vector and its physical interpretations and vector identities(without proof)	56	Find curl of a vector field given by $\vec{F} = (x^2 + xy^2)\hat{i} + (y^2 + x^2y)\hat{j}$	2022-23 (Very Short)
5	37	Gradient, Directional Derivatives	57	Find the directional derivative of scalar function $f(x, y, z) = xyz$ at point P(1,1,3) in the direction of the outward drawn normal to the sphere $x^2 + y^2 + z^2 = 11$ through the point P.	2022-23 (Long)
5	43	Applications of Gauss Divergence Theorem	58	Apply Gauss divergence theorem to evaluate $\iint_S \vec{F} \cdot \hat{n} \, dS$, where $\vec{F} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ and S is the surface of the region bounded by the cylinder $x^2 + y^2 = 4, z = 0, z = 3$.	2022-23 (Long)
5	42	Applications of Stoke's Theorem	59	Evaluate $\oint_C \vec{F} \cdot d\vec{r}$ by Stoke's theorem, where $\vec{F} = y^2\hat{i} + x^2\hat{j} - (x+z)\hat{k}$ and C is the boundary of the triangle with vertices at (0,0,0), (1,0,0) and (1,1,0).	2022-23 (Long)