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 $\begin{bmatrix} \alpha+i\gamma & -\beta+i\delta \\ \beta+i\delta & \alpha-i\gamma \end{bmatrix}$ 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 thatiA 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 $\lambda and \mu$ the simultaneous equations : x + y+ z =6, x + 2y +3z =10, x + 2 y +$\lambda z =\ \mu$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 + λ z = μ, 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 + λ z = μ, has: (i) a unique solution (ii) no solution and (iii) Infinite solution. Also find the solution for λ = 2 and μ = 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 α_1,α_2,α_3, … … … α_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 $\alpha_1 - k$,$\alpha_2 - k$,$\alpha_3 - k$, … … … $\alpha_n - k$.	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 $\begin{bmatrix} 51 \\ 51 \end{bmatrix}$.	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 + cosnx 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 relationbetween $y_n, y_{n+1} and y_{n+2}$.	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 $y\sqrt{x^2-1} = \log_e\left(x + \sqrt{x^2-1}\right)$, prove that $(x^2-1)y_{n+1} + (2n+1)xy_n + n^2 y_{n-1} = 0$.	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 $y = \sin(a\sin^{-1}x)$, find $(y_n)_0$	2015-16 2018-19 2020-21
2	**15**	To find nth derivative at x=0	**16**	If $y = \left(x + \sqrt{1+x^2}\right)^m$, 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 $u = x^2yz - 4y^2z^2 + 2xz^3$, 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 $u(x,y) = \left(\sqrt{x} + \sqrt{y}\right)^5$, 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 $u = x^3 y^2 \sin^{-1}(\frac{y}{x})$, 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 $u = \frac{x^2y^2}{x^2+y^2} + \cos\left(\frac{xy}{x^2+y^2}\right)$, prove that $$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x\, \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = 2\frac{x^2y^2}{x^2+y^2}$$	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 $u = \sin^{-1}\left(\frac{x^{\frac{1}{3}}+y^{\frac{1}{3}}}{x^{\frac{1}{2}}-y^{\frac{1}{2}}}\right)^{\frac{1}{2}}$, 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 $u=\sin^{-1}\left(\frac{x^{\frac{1}{4}}+y^{\frac{1}{4}}}{x^{\frac{1}{6}}+y^{\frac{1}{6}}}\right)$, 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 $x^2y^2=(a^2+y^2)(a^2-y^2)$ 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$x^2y^2=x^2-a^2$	2022-23

Meerut Institute of Engineering & Technology, Meerut

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 $u_1 = \frac{x_2x_3}{x_1}, u_2 = \frac{x_1x_3}{x_2}, u_3 = \frac{x_2x_1}{x_3}$, 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$= r\cos\theta, y = r\sin\theta, z = z$ 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

Meerut Institute of Engineering & Technology, Meerut

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 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 0aaxay^2(y4-a2x2) dx dy by changing the order of integration.	2022- 23
CO4	**31**	Introduction to triple integral , volume by triple integral	**3**	Evaluate x-2y+zdz dy dx on R ,where R is the region determined by 0≤x≤1, 0≤y≤x2,0≤z ≤x+y.	2022- 23
CO4	**35**	Dirichlet integral and its application to area and volume.	**4**	Use Dirichlet's integral to evaluate 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 y2=4ax, y24bx , xy=c2and 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 0∞0yy e-y2xdx 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 xa23+yb23+zc23=1, x>0, y>0, z>0.	2022-23
CO4	**30**	Area bounded by double integral	**9**	Find the area bounded by the curve y2=x and x2=y.	2021- 22

CO4	**31**	Introduction to triple integral, Volume by triple integral	**10**	Find the value of 010x0x+ydx dy dz.	2021- 22
CO4	**31**	Introduction to triple integral , volume by triple integral	**11**	Find the volume bounded by cylinder x2+ y2=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 = 01x^22-xxy dy dx and hence evaluate the integral.	2021 - 22
CO4	**27**	Introduction to double integral	**13**	Evaluate 0101-x2ey(ey+1)1-x2-y2dxdy.	2011-12 (short)
CO4	**27**	Introduction to double integral	**14**	Prove that 1a2x2+b2y2+c2z2ds=4πabc, where S is the ellipsoid ax2+by2+cz2=1	2011-12 (short)
CO4	**30**	Area by double integral	**15**	Evaluate (x-y)4expx+ydxdy 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 0∞0xx.exp-x2ydxdy	2012-13 (long)
CO4	**27**	Introduction to double integral	**17**	Evaluate 0a0xxydydx	2013-14 (short)
CO4	**27**	Introduction to double integral	**18**	Evaluate 0101dxdy1-x21-y2	2015-16 (short)
CO4	**27**	Introduction to double integral	**19**	Evaluate 010x2xeydxdy	2017-18 (short)
CO4	**27**	Introduction to double integral	**20**	Evaluate 010x2eyxdxdy	2018-19 (short)

CO4					
CO4	**27**	Introduction to double integral	**21**	Evaluate 0201x2+3y2dydx	2019-20 (short
CO4	**30**	Area by double integral	**22**	Compute the area bounded by lemniscater2=a2cos2θ.	2013-14 (long)
CO4	**28**	Double integral by polar coordinates	**23**	Evaluate 0∞0∞e-(x2+y2)dxdyby changing to polar coordinates. Hence show that 0∞e-x2dx=π2	2018-19 (short)
CO4	**29**	Change of order of integration	**24**	Changing the order of integration in the double integral: I=08π42fx,ydxdy leads to I=rspqfx,ydxdy say, what is p?	2012-13 (short)
CO4	**29**	Change of order of integration	**25**	Change the order of integration and evaluate 01x22-xxydydx	2014-15 (short) 201516 (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=08x42fxydydx leads to I=rspqfxydxdy say, what is q?	2016-17 (long
CO4	**29**	Change of order of integration	**27**	Change the order of integration and evaluate 02x243-xxydydx.	2018-19 (long)
CO4	**29**	Change of order of integration	**28**	Evaluate the following integral by changing the order of integration 0∞x∞e-yydydx	2020-21 (long)
CO4	**30**	Area by double integral	**29**	Find the value of the integral xydxdy where R is the region bounded by the x-axis, the line y=2x and the parabola x2=4ay	2011-12 (short)
CO4	**30**	Area by double integral	**30**	Determine the area bounded by the curves xy=2, 4y=x2, 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=1and 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=x2+y2 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 x2a2+y2b2+z2c2=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 ellipsoidx2a2+y2b2+z2c2=1 if the density at any point ρx,y,z=kxyz	2014-15 (long)
CO4	**31**	Introduction of triple integral, volume by triple integral	**35**	Prove that dxdydz1-x2-y2-z2=π28, 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≤x≤1;1≤y≤2;2≤z≤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=02π0π01r2sinØdrdØdθ Evaluate the value of V.	2016-17 (short)
CO4	**31**	Introduction of triple integral, volume by triple integral	**38**	Evaluate the triple integral0101-x201-x2-y2xyzdxdydz	2016-17 (short)
CO4	**31**	Introduction of triple integral, volume by triple integral	**39**	Evaluate x2yzdxdydz throughout the volume bonded by planes x=0,y=0,z=0 and xa+yb+zc=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 x2a2+y2b2+z2c2=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=x2, x=y2and the plane z=0, z=3.	2019-20

					(long)
CO4	**29**	Change of order of integral	**43**	Evaluate by changing the variables (x+y)2dxdy 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)2dxdy 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=0202x-x2f(x,y)dxdy Change into polar coordinates.	
CO4	**31**	Introduction to triple integral.	**46**	Evaluate -11-22-33dx dy dz	
CO4	**30**	Area by double integral	**47**	Evaluate xy(1-x-y)1/2dxdy 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 0π/2tanθ dθ=0π/2cotθ dθ=π2	
CO4	**34**	Properties and problems of beta and gamma function	**54**	Prove that 0111+x4dx=142β14,12	[2015-16]
CO4	**34**	Properties and problems of beta and gamma function	**55**	Evaluate 0∞11+x4 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: $\int_0^\infty \frac{x^8(1-x^6)}{(1+x)^{24}}\,dx.$	[2011-12]

CO4	**34**	Properties and problems of beta and gamma function	**58**	Show that 01x5(1-x3)10dx=1396	
CO4	**34**	Properties and problems of beta and gamma function	**59**	(a) For a β function, show that βp,q=βp+1,q+ βp,q+1	
				(b)Show that βp, q+1q=βp+1,qp= βp,qp+q where p > 0, q > 0	[2015-16]
CO4	**34**	Properties and problems of beta and gamma function	**60**	Using Beta and Gamma functions, evaluate 01x31-x31/2dx	[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 x2yz dxdydz through out the volume bounded by the planes x=0,y=0,z=0 and xa+yb+zc=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]

				x2a2+y2b2+z2c2=1 if the density at any point ρ(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 ρ=kxl-1ym-1zn-1.	[2013-14] [2012-13]
CO4	**35**	Dirichlet integral and its application to find volume	**67**	Show that dxdydz1-x2-y2-z2=π28, 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 dxdydza2-x2-y2-z2, 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 dxdydz(x+y+z+1)2.=34-log2 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: x2a2+y2b2+z2c2=1 if the density at any point ρ(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 $grad\ u,\ grad\ v$ and $grad\ w$ 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 $grad\phi$ at point (2, 0, -2).	2018-19 (Very short)
5	37	Gradient, Directional Derivatives	6	Find $grad\ \phi$ 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 $\phi.$	2019-20 (Long)
5	38	Divergence of a vector and its physical interpretations	12	Show that the vector: $\vec{V}=3y^4z^2\hat{i}+4x^3z^2\hat{j}-3x^2y^2\hat{k}$ issolenoidal.	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 $curl\,\vec{F}$ 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 $curl\ \vec{F}$.	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 $\vec{V}$; $div\ curl\ \vec{V} = 0$.	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 $B = (3xz\hat{i} + 2yz\hat{j} - z^2\hat{k})$. 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) $Curl(grad\ \phi) = 0$ (ii) $div(curl\ \vec{v}) = 0$	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 $\vec{v} = (y\sin z - \sin x)\hat{i} + (x\sin z + 2yz)\hat{j} + (xy\cos z + y^2)\hat{k}$. 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 $\int_S (yzI + zxJ + xyK)\cdot dS$, where S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$ 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: $\oint_C (x^2-2xy)dx+(x^2y+3)dy$, 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 $\int_C (2y^2dx+3xdy)$, 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 $\oint \vec{F}\cdot dr$.	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 $x=\pm1,\ y=\pm1$.	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 $\vec{F} = (x^2 + y^2)I - 2xyJ$ 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 $0 \le x \le a,\ 0 \le y \le b,\ 0 \le z \le c.$	2012-13 (Long)
5	43	Applications of Gauss Divergence Theorem	47	Verify Gauss Divergence theorem for $\int_C [(x^3 - yz)\hat{i} - 2x^2 y\hat{j} + 2\hat{k}]\hat{n}\, dS$, 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 $0 \le x \le 1,\ 0 \le y \le 1,\ 0 \le z \le 1.$	2019-20 (Long)
5	43	Applications of Gauss Divergence Theorem	50	Use divergence theorem to evaluate the surface integral $\iint_S (xdydz + ydzdx + zdxdy)$ 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 $\vec{V} = (px + 4y^2 z)\hat{i} + (x^3 \sin z - 3y)\hat{j} - (e^x + 4 \cos x^2 y)\hat{k}$ is solenoidal.	2022-23 (Very Short)
5	41	Applications of Green's Theorem	52	Verify Green's theorem for $\oint (2y^2 dx + 3xdy)$, 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 $\iint \vec{F}.\hat{n}dS$, where $\vec{F} = (x^2 - yz)\hat{\imath} + (y^2 - zx)\hat{\jmath} + (z^2 - xy)\hat{k}$ and S is the surface of the rectangular parallelopiped $0 \le x \le a$, $0 \le y \le b$, $0 \le z \le c$.	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 $2i + j - k$. 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 dxdy 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 $\vec{F} = (x^2 + xy^2)\hat{\imath} + (y^2 + x^2y)\hat{\jmath}$	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 spherex^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 $\iint_S \vec{F}.\hat{n}$ dS, where $\vec{F}$= 4x $\hat{\imath}$-2$y^2\hat{\jmath}$+$z^2\hat{k}$ 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 $\oint \vec{F} \cdot dr.$ by Stoke's theorem, where $\vec{F}$=$y^2\hat{\imath}$+$x^2\hat{\jmath}$-(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)