INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	**LINEAR ALGEBRA AND CALCULUS**
Course Code	:	**AHSB02**
Program	:	**B.Tech**
Semester	:	**I**
Branch	:	**Aeronautical engineering**
Section	:	**A, B**
Course Faculty	:	**Ms. P Rajani, Assistant Professor**

COURSE OBJECTIVES:

The course should enable the students to:	
I	Determine rank of a matrix and solve linear differential equations of second order.
II	Determine the characteristic roots and apply double integrals to evaluate area.
III	Apply mean value theorems and apply triple integrals to evaluate volume.
IV	Determine the functional dependence and extremum value of a function
V	Analyze gradient, divergence, curl and evaluate line, surface, volume integrals over a vector field.

DEFINITIONS AND TERMINOLOGY QUESTION BANK

S. No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
MODULE-I						
1	Define matrix.	A matrix is a rectangular array of numbers or other mathematical objects for which operations such as addition and multiplication are defined. For instance, this is a real matrix: The numbers, symbols or expressions in the matrix are called its entries or its elements.	Understand	CO 1	CLO 1	AHSB02.01
2	Define symmetric matrix.	A square matrix is called symmetric if it is equal to its transpose.	Remember	CO 1	CLO 1	AHSB02.01
3	Define is skew-symmetric matrix.	A square matrix is called symmetric if it is equal to negative its transpose.	Remember	CO 1	CLO 1	AHSB02.01
4	Define hermitian matrix.	In mathematics, a Hermitian matrix (or self-adjointmatrix) is a complex square matrix that is equal to its own conjugate transpose	Remember	CO 1	CLO 1	AHSB02.01

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5	Define skew Hermitian matrix	A square matrix with complex entries is said to be skew-Hermitian if its conjugate transpose is the negative of the original matrix.	Remember	CO 1	CLO 1	AHSB02.01
6	When a matrix is said to be nilpotent?	If A is a square matrix such that $A^m=0$ where m is a positive integer, then A is called nilpotent	Remember	CO 1	CLO1	AHSB02.01
7	What is differential equation?	A differential equation is an equation that contains derivatives which are either partial derivatives or ordinary derivatives. The derivatives represent a rate of change, and the differential equation describes a relationship between the quantity that is continuously varying and the speed of change.	Remember	CO 1	CLO 4	AHSB02.04
8	What are types of differential equations?	The types of differential equations are 1. An ordinary differential equation 2. partial differential equation	Remember	CO 1	CLO 4	AHSB02.04
9	Mention any two applications of differential equation.	1) Differential equations describe various exponential growths and decays. 2) They are also used to describe the change in investment return over time.	Remember	CO 1	CLO 4	AHSB02.04
10	Define order of differential equation.	The order is the highest numbered derivative in the equation,	Remember	CO 1	CLO 4	AHSB02.04
11	Define degree of differential equation.	The degree is the highest power to which a derivative is raised.	Remember	CO 1	CLO 4	AHSB02.04
12	What is general solution of higher order differential equation contains	General solution contains complementary function and particular integral.	Remember	CO 1	CLO 4	AHSB02.04
13	When a differential equation is said to be linear?	If degree of differential equation is one then it is linear.	Understand	CO 1	CLO 4	AHSB02.04
14	What is non-linear differential equation?	If degree of differential equation is greater than one it is linear.	Remember	CO 1	CLO 1	AHSB02.01
15	What is differential equation?	A differential equation is an equation that contains derivatives which are either partial derivatives or ordinary derivatives. The derivatives represent a rate of change, and the differential equation describes a relationship between the quantity that is continuously varying and the speed of change.	Remember	CO 1	CLO 1	AHSB02.01

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MODULE-II						
1	What is Eigen value?	Any number such that a given matrix minus that number times the identity matrix has zero determinants.	Remember	CO 2	CLO 10	AHSB02.10
2	What is Eigen vector?	a vector which when operated on by a given operator gives a scalar multiple of itself.	Remember	CO 2	CLO 10	AHSB02.10
3	Define Algebraic multiplicity of a characteristic roots.	It is number of times an Eigen value is repeated.	Understand	CO 2	CLO 10	AHSB02.10
4	Define Geometric multiplicity of a characteristic roots.	It is number of linearly independent characteristic vector corresponding to the characteristic root.	Understand	CO 2	CLO 10	AHSB02.10
5	Define Orthogonal matrix.	a matrix Q is orthogonal if its transpose is equal to its inverse	Understand	CO 2	CLO 10	AHSB02.10
6	When two matrices A and B are said to orthogonal?	If $B=P^{-1}AP$ where P is orthogonal matrix.	Remember	CO 2	CLO 11	AHSB02.11
7	State Cayley Hamilton theorem?	It states that every square matrix satisfies its own characteristic equation.	Remember	CO 2	CLO 11	AHSB02.11
8	What is integral?	Given a function f(x) that is continuous on the interval [a, b] we divide the interval into n subintervals of equal width, Δx, and from each interval choose a point, x∗i. Then the definite integral of f(x)f(x) from a to bb is $\int_a^b f(x)\,dx = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i^*)\,\Delta x$	Remember	CO 2	CLO 11	AHSB02.14
9	What are double integrals?	The multiple integral is a definite integral of a function of more than one real variable, for example, f(x, y) or f(x, y, z). Integrals of a function of two variables over a region in R^2 are called double integrals.	Remember	CO 2	CLO 11	AHSB02.14
10	What are types of integrals?	Types of integrals are 1. Definite 2. Indefinite integrals.	Remember	CO 2	CLO 14	AHSB02.14
11	What are definite integrals?	A definite integral is an integral $\int_a^b f(x)\,dx$ with upper and lower limits. If x is restricted to lie on the real line.	Remember	CO 2	CLO 14	AHSB02.14
12	What are indefinite integrals?	an integral expressed without limits, and so containing an arbitrary constant.	Remember	CO 2	CLO 10	AHSB02.10

S. No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
13	How to calculate area using double integral?	The area of a closed, bounded plane region R is defined as $A = \iint_R dA$	Remember	CO 2	CLO 10	AHSB02.10
14	What is double integral over a rectangle?	Double Integrals over Rectangles. Recognize when a function of two variables is integral over a rectangular region. ... Use a double integral to calculate the area of a region, volume under a surface, or average value of a function over a plane region	Remember	CO 2	CLO 12	AHSB02.12
15	How do you find area between two curve?	The area under a curve between two points can be found by doing a definite integral between the two points. To find the area under the curve y = f(x) between x = a and x = b, integrate y = f(x) between the limits of a and b. Areas under the x-axis will come out negative and areas above the x-axis will be positive.	Remember	CO 2	CLO 12	AHSB02.12
MODULE-III						
1	When a function is continuous?	In other words, a function f is continuous at a point x=a, when (i) the function f is defined at a, (ii) the limit of f as x approaches a from the right-hand and left-hand limits exist and are equal, and (iii) the limit of f as x approaches a is equal to f(a).	Understand	CO 3	CLO 15	AHSB02.15
2	When a function is differentiable?	A function is differentiable at a point when there's a defined derivative at that point. This means that the slope of the tangent line of the points from the left is approaching the same value as the slope of the tangent of the points from the right.	Remember	CO 3	CLO 15	AHSB02.15
3	State Rolles theorem.	If a function f is defined on the closed interval [a,b] satisfying the following conditions i) The function f is continuous on the closed interval [a, b] ii)The function f is differentiable on the open interval (a, b) Then	Remember	CO 3	CLO 15	AHSB02.15

S. No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		there exists a value x = c in such a way that $$f'(c) = \frac{f(b)-f(a)}{b-a}$$				
4	State Lagranges theorem	Lagrange's mean value theorem (MVT) states that if a function f(x) is continuous on a closed interval [a,b] and differentiable on the open interval (a,b), then there is at least one point x=c on this interval, such that $f(b) - f(a) = f'(c)(b-a)$.	Remember	CO 3	CLO 15	AHSB02.15
5	State Cauchy's mean value theorem.	Cauchy's mean-value theorem is a generalization of the usual mean-value theorem. It states that if $f(x)$ and $g(x)$ are continuous on the closed interval $[a, b]$, if $g(a) \neq g(b)$, and if both functions are differentiable on the open interval (a, b), then there exists at least one c with $a < c < b$ such that $$\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(c)}{g'(c)}$$	Remember	CO 3	CLO 15	AHSB02.15
6	What is geometric interpretation of Rolles theorem?	Geometric interpretation of Rolle's Theorem: ... Algebraically, this theorem tells us that if f (x) is representing a polynomial function in x and the two roots of the equation f(x) = 0 are x =a and x = b, then there exists at least one root of the equation f'(x) = 0 lying between the values.	Understand	CO 3	CLO 16	AHSB02.16
7	What is geometrical interpretation of Lagranges mean values?	In the given graph the curve y = *f*(x) is continuous from x = a and x = b and differentiable within the closed interval [a,b] then according to Lagrange's mean value theorem,for any function that is continuous on [*a*, *b*] and differentiable on (*a*, *b*) there exists some *c* in the interval (*a*, *b*) such that the secant joining the endpoints of the interval [*a*, *b*] is parallel to the tangent at *c*.	Remember	CO 3	CLO 16	AHSB02.16

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8	When a function f(x, y) is said to be homogeneous?	Let $f(x, y)$ be a homogeneous function of order n so that $f(tx, ty) = t^n f(x, y)$.	Understand	CO 3	CLO 16	AHSB02.16
9	What are triple integrals?	Integrals of a function of three variables over a region of R^3 are called triple integrals.	Remember	CO 3	CLO 16	AHSB02.16
10	How to calculate volume using triple integral?	volume using triple integral $\iiint_E f(x, y, z)\, dV$	Remember	CO 3	CLO 16	AHSB02.16
11	What is difference between double and triple integrals?	A double integral is used for integrating over a two-dimensional region, while a triple integral is used for integrating over a three-dimensional region.	Remember	CO 3	CLO 16	AHSB02.16
12	What is R in polar coordinates?	In polar coordinates, a point in the plane is determined by its distance r from the origin and the angle theta (in radians) between the line from the origin to the point and the x-axis (see the figure below). It is common to represent the point by an ordered pair (r, theta).	Remember	CO 3	CLO 17	AHSB02.17
13	What is Z in cylindrical coordinates?	In the cylindrical coordinate system, a point P in space is represented by the ordered triple (r, θ, z), where r and θ are polar coordinates of the projection of P onto the x y-plane and z is the directed distance from the x y-plane to P.	Remember	CO 3	CLO 17	AHSB02.17
14	What is relationship between Cartesian and polar coordinates?	to convert from Polar Coordinates (r, θ) to Cartesian Coordinates (x, y) : $x = r \times \cos(\theta)$ $y = r \times \sin(\theta)$	Remember	CO 3	CLO 16	AHSB02.16
15	What is Cartesian coordinate?	The *x* and *y* coordinates of a point measure the respective distances from the point to a pair of perpendicular lines in the plane called the coordinate axes, which meet at the origin.	Remember	CO 3	CLO 16	AHSB02.16
MODULE-IV						
1	What is partial derivate?	A derivative of a function of two or more variables with respect to one variable, the	Remember	CO 4	CLO 18	AHSB02.18

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		other(s) being treated as constant.				
2	When the functions u and v are said to be functionally dependent?	When Jacobian transformation of u and v with respect to dependent variables x and y is zero.	Remember	CO 4	CLO 18	AHSB02.18
3	What is stationary value?	A stationary point of a differentiable function of one variable is a point on the graph of the function where the function's derivative is zero.	Remember	CO 4	CLO 18	AHSB02.18
4	What are critical points?	Critical point of a single variable function. A critical point of a function of a single real variable, f(x), is a value x_0 in the domain of f where it is not differentiable or its derivative is 0 ($f'(x_0) = 0$).	Remember	CO 4	CLO	AHSB02.18
5	What are saddle points?	Saddle points are points where the function is neither maxima nor minima.	Remember	CO 4	CLO	AHSB02.18
6	What are inflection points?	A point of a curve at which a change in the direction of curvature occurs	Remember	CO 4	CLO	AHSB02.18
7	When the function is maximum?	$f^1(x)$ and equate it to zero Solve the above equation we get x_0, x_1 as roots. Then find $f^{11}(x)$. If $f^{11}(x)_{(x = x0)} > 0$, If $f^{11}(x)_{(x = x0)}$, < 0, f(x) is maximum at x_0	Remember	CO 4	CLO	AHSB02.18
8	When the function is minimum?	$f^1(x)$ and equate it to zero Solve the above equation we get x_0, x_1 as roots. Then find $f^{11}(x)$. If $f^{11}(x)_{(x = x0)} > 0$, then f(x) is minimum at x_0	Remember	CO 4	CLO	AHSB02.18
9	Write the first order partial derivatives?	f is a function x and y variable then $\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}$	Remember	CO 4	CLO	AHSB02.18
10	Write the higher order partial derivatives?	f is a function x and y variable then $\frac{\partial^2 f}{\partial x^2}, \frac{\partial^2 f}{\partial y^2}, \frac{\partial^2 f}{\partial x \partial y}$	Remember	CO 4	CLO	AHSB02.18
11	Explain the jacobian of two variables?	If u and v are continuous and differentiable functions of two independent variables x and y then the determinant $\begin{vmatrix} \frac{\partial u}{\partial x} & \frac{\partial u}{\partial y} \\ \frac{\partial v}{\partial x} & \frac{\partial v}{\partial x} \end{vmatrix}$	Remember	CO 4	CLO	AHSB02.18

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12	Explain the jacobian of three variables?	If u , v,w are continuous and differentiable functions of two independent variables x and y,z then the determinant $\begin{vmatrix} \frac{\partial u}{\partial x} & \frac{\partial u}{\partial y} & \frac{\partial u}{\partial z} \\ \frac{\partial v}{\partial x} & \frac{\partial v}{\partial y} & \frac{\partial v}{\partial z} \\ \frac{\partial w}{\partial x} & \frac{\partial w}{\partial y} & \frac{\partial w}{\partial z} \end{vmatrix}$	Remember	CO 4	CLO	AHSB02.18
13	When the functions u and v are said to be functionally independent?	When Jacobian transformation of u and v with respect to dependent variables x and y is not equals to zero.	Remember	CO 4	CLO	AHSB02.18
14	When the function is maximum point ?	The stationary point (a,b) satisfying maximum condition ,that point of the function is called the maximum point.	Remember	CO 4	CLO	AHSB02.18
15	When the function is minimum point ?	The stationary point (a,b) satisfying minimum condition ,that point of the function is called the minimum point.	Remember	CO 4	CLO	AHSB02.18
MODULE-V						
1	What is vector algebra?	An algebra for which the elements involved may represent vectors and the assumptions and rules are based on the behavior of vectors.	Remember	CO 5	CLO 22	AHSB02.22
2	Define unit vector?	A unit vector is a vector of unit length.	Remember	CO 5	CLO 22	AHSB02.22
3	What is difference between scalar and vector?	A vector quantity has a direction and a magnitude, while a scalar has only a magnitude.	Remember	CO 5	CLO 21	AHSB02.21
4	What is difference between dot and cross product?	If the product of two vectors is a scalar quantity, the product is called scalar product or dot product. If the product of two vectors is a vector quantity then the product is called vector product or cross product. If two vectors are perpendicular to each other than their scalar product is zero.	Remember	CO 5	CLO 21	AHSB02.21
5	What is vector calculus?	Vector calculus, or vector analysis, is a branch of mathematics concerned with differentiation and integration of vector fields.	Understand	CO 5	CLO 22	AHSB02.22
6	What is line integral?	Any integral that is evaluated along a curve is called a line integral.	Understand	CO 5	CLO 23	AHSB02.23
7	Define unit normal.	Let S be a two-sided surface . Let one side of S be considered arbitrarily as the positive side (if S is a closed surface this is taken as the outer side). A unit normal n to any point of the	Understand	CO 5	CLO 22	AHSB02.22

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		positive side of S is called a positive or outward drawn normal.				
8	What does Greens theorem mean?	Green's theorem gives a relationship between the line integral of a two-dimensional vector field over a closed path in the plane and the double integral over the region it encloses.	Understand	CO 5	CLO 24	AHSB02.24
9	What does Stokes theorem mean?	a theorem proposing that the surface integral of the curl of a function over any surface bounded by a closed path is equal to the line integral of a particular vector function round that path.	Understand	CO 5	CLO 24	AHSB02.24
10	What does Gauss divergence theorem mean?	The divergence theorem is a mathematical statement of the physical fact that, in the absence of the creation or destruction of matter, the density within a region of space can change only by having it flow into or away from the region through its boundary.	Understand	CO 5	CLO 24	AHSB02.24
11	What is Gradient?	Gradient of a scalar field, gives the change per unit "distance" in the value of the field.	Remember	CO 5	CLO 21	AHSB02.21
12	What is divergence?	the scalar product of the operator del and a given vector, which gives a measure of the quantity of flux emanating from any point of the vector field or the rate of loss of mass, heat, etc., from it.	Remember	CO 5	CLO 21	AHSB02.21
13	What is difference between gradient and directional derivative?	In sum, the gradient is a vector with the slope of the function along each of the coordinate axes whereas the directional derivative is the slope in an arbitrary specified direction.	Remember	CO 5	CLO 21	AHSB02.21
14	What is directional derivative?	The directional derivative is the rate at which the function changes at a point in the direction. It is a vector form of the usual derivative	Remember	CO 5	CLO 21	AHSB02.21
15	What is difference between gradient and directional derivative?	In sum, the gradient is a vector with the slope of the function along each of the coordinate axes whereas the directional derivative is the slope in an arbitrary specified direction.	Remember	CO 5	CLO 21	AHSB02.21

Signature of the Faculty **HOD, AE**