School Of Engineering & Technology (SOET)

TEACHING PLAN: Engineering Mathematics-II

SCHOOL: Engineering & Technology		**ACADEMIC SESSION: 2022 – 2023**		**FOR STUDENTS' BATCH: 2022-26 B. Tech. SEM-II**	
1	**Course code**	**BSC 105**			
2	**Course Title**	**Engineering Mathematics-II**			
3	**Credits**	**04**			
4	**Learning Hours**		**Lectures**	**03**	
			Assessment OR Tutorial	**01**	
			Practical		
			Total hours	**04**	
5	**Course Objective**	After Studying this lesson, you should be able to: (1) To make the students understand the basic concepts, the history and tools of Co-ordinate Geometry of three dimension. (2) Explain importance of vector calculus and its applications. (3) Formulate and identify the characteristics of Fourier series Identify the various types of functions. (4) Understand the basics of second order linear differential equation.			
6	**Course Outcomes**	1. Conceptual knowledge of how three-dimension geometry and importance of sphere in engineering mathematics. 2. To apply the concept of Rank of matrices and Caley-Hamilton Theorem on problems of linear equations. To implement the concept of eigen values and vectors in engineering problems 3. The student has knowledge of central concepts in multivariable analysis, including space curves; directional derivative; gradient; multiple integrals; line and surface integrals; vector fields; divergence, curl and flux; the theorems of Green and Stokes, the divergence theorem and Fourier Series. 4. Students learn to solve second order linear differential equations and partial differential equations of first order.			
7					
	Unit	**Section**	**Introduction**	**Reference Number**	**Teaching Methods**
	Unit-1	(a)	**Coordinate Geometry of Three Dimensions:** Equation of a sphere, Intersection of a sphere and a plane, tangent plane, Intersection of two spheres, orthogonality of two spheres, right circular cone, right circular cylinder.	TB2 242-309	White Board & PPT

	Unit - II	(a)	**Matrices:** Rank of a matrix, Rank of matrix by reducing to normal forms,	TB3 111-131	White Board & PPT
		(b)	Consistency of systems of linear simultaneous equations and its solution,	TB3 155-183	White Board & PPT
		(c)	Eigen values and Eigen vectors, Cayley Hamilton theorem (without proof), Diagonalization of matrix.	TB3 234-270	White Board & PPT
	Unit-III	(a)	**Vector Calculus:** Scalar and vector field, differentiation & integration of vector functions, Gradient, Divergence, Curl and Differential Operator, Line, Surface and volume Integrals.	TB1 372-430	White Board & PPT
	Unit-IV	(a)	**Application of Vector Calculus:** Green's Theorem in a Plane, Gauss's and Stoke's Theorem (without proof) and their applications. **Fourier Series:** Expansion of simple functions in Fourier Series, half range Fourier sine and cosine series, change of interval. Harmonic Analysis.	TB1 430-466	White Board & PPT
	Unit-V	(a)	**Differential Equations:** Series Solutions of Second Order Linear Differential Equations with Variable Coefficients (Complementary Functions only),	TB1 174-220	White Board & PPT
		(b)	Partial Differential Equations of First Order: Lagrange's Form, Standard Forms, Charpit's Method.	TB1 671-734	White Board & PPT

8	**Course Evaluation**	
8.1	**CA: 40%**	
8.1.1	**Attendance**	5%
8.1.2	**Assignment & presentation**	20%
8.1.3	**Class test**	15%
8.1.4	**Any other**	--
8.2	**MTE**	20%
8.3	**End-term examination: 40%**	
9	**Text Books & References**	
9.1	**Text book**	**TB1:** H.K. Dass (1999). *Advanced Engineering Mathematics*, S Chand. **TB2:** A. R. Vasishth & D. C. Agrawal. *Analytical Geometry*. Krishna's. **TB3:** Advanced Engineering Mathematics, Erwin Kreyszig, Wiley 9th Edition. **TB4:** Calculus and Analytical Geometry, Thomas and Finney, Narosa Publishing

		House N. Delhi. **TB5:** A Text Book of Differential Equations, M.Ray and Chaturvedi, Students Friends & Co. Publisher, Agra. **TB6:** Higher Engineering Mathematics, B.V.Ramana, Tata Mcgraw Hill.
9.2	**References**	**RB1:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiqo4Srnrv3AhWP6mEKHQYgD0cQFnoECBMQAQ&url=http%3A%2F%2Fwww.numbertheory.org%2Fbook%2Fcha8.pdf&usg=AOvVaw39xJwVU3SD7ZCEID-VQDAM **RB2:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi19o7Gnrv3AhUHZ94KHRZZDhQQFnoECAMQAQ&url=https%3A%2F%2Fwww.vmi.edu%2Fmedia%2Fcontent-assets%2Fdocuments%2Facademics%2Fappliedmath%2FFundamentals-of-Matrix-Algebra-3rd-Edition.pdf&usg=AOvVaw1rz_afO9v4wCcZ_9fd-WkG **RB3:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi19o7Gnrv3AhUHZ94KHRZZDhQQFnoECCsQAQ&url=https%3A%2F%2Fwww.maths.ed.ac.uk%2F~v1ranick%2Fpapers%2Fgantmacher1.pdf&usg=AOvVaw0e9OaZTvCra6imUznCPQlf **RB4:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjxkoLdnrv3AhVVdXAKHR2KAOYQFnoECAYQAQ&url=https%3A%2F%2Fwww.robots.ox.ac.uk%2F~sjrob%2FTeaching%2FVectors%2Fcourse.pdf&usg=AOvVaw37VCFwUexnHTnSB-GUk4Cv **RB5:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjxkoLdnrv3AhVVdXAKHR2KAOYQFnoECDAQAQ&url=https%3A%2F%2Fwww.math.hkust.edu.hk%2F~machas%2Fvector-calculus-for-engineers.pdf&usg=AOvVaw1Pah4khXOUAhJbxuz09kK6 **RB6:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjv3sX3nrv3AhWVEYgKHfpnBekQFnoECAIQAQ&url=http%3A%2F%2Fmdudde.net%2Fpdf%2Fstudy_material_DDE%2FM.Sc.MAthematics%2FDIFFERENTIAL%2520EQUATIONS.pdf&usg=AOvVaw2tNjEhWUEDFGGWzKJ72LEI
9.3	**Video References**	[1] https://www.youtube.com/watch?v=VAiNh-5i6yA&list=PLCvpYrhOPdiWKKx7cUFjwO9_mH6wxnKiv [2] https://www.youtube.com/watch?v=KaLA1cWhQlA&list=PLLy_2iUCG87BLKl8eISe4fHKdE2_j2B_T [3] https://www.youtube.com/watch?v=aMlu6SakJW0&list=PLbRMhDVUMngdcugfQl36Rnf50ki_8grvh [4] https://www.youtube.com/watch?v=ksS_yOK1vtk&list=PLbRMhDVUMngfIrZCNOyPZwHUU1pP66vQW [5] https://www.youtube.com/watch?v=XzaeYnZdK5o&list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy [6] https://www.youtube.com/watch?v=NBcGLLU90fM&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6glD [7] https://www.youtube.com/watch?v=U51lQtlzvA0&list=PLgMDNELGJ1CZpu0rJvVh-bUHGFINS7xIk

CO-PO Mapping

Course Outcome	Program Outcome												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	3	3	3	1	2	1	1	2	2	1	2	3	1	2	2
CO 2	2	3	3	3	2	2	2	1	2	1	2	2	3	2	2	2
CO 3	2	3	3	3	2	2	1	1	2	1	2	3	3	2	2	2
CO 4	3	3	3	3	3	2	2	2	2	2	1	2	3	2	2	3

Question Bank

1) Find characteristic equation, eigen values and eigen vector of matrix B, where $B=\begin{bmatrix}5 & 0 & 0\\ 2 & 0 & 0\\ 1 & 3 & 5\end{bmatrix}$.
2) Find the equation to the sphere through the circle $x^2+y^2+z^2=9,\ 2x+3y+4z=5$ and the point (1, 2, 3).
3) Find the equation to the sphere through the circle $x^2+y^2+z^2=1,\ 2x+4y+5z-6=0$ and touching the plane $z=0$.
4) Find rank of the following matrices.

I. $\begin{bmatrix}1 & 2 & 3\\ 2 & 3 & 4\\ 0 & 2 & 2\end{bmatrix}$ II. $\begin{bmatrix}3 & -1 & 2\\ -6 & 2 & 4\\ -3 & 1 & 2\end{bmatrix}$

5) Reduce the matrix A to its normal form and find the rank of A.

$A=\begin{bmatrix}0 & 1 & -3 & -1\\ 1 & 0 & 1 & 1\\ 3 & 1 & 0 & 2\\ 1 & 1 & -2 & 0\end{bmatrix}$

6) Find characteristic equation, eigen values and eigen vector of matrix B, where $B=\begin{bmatrix}5 & 0 & 0\\ 2 & 0 & 0\\ 1 & 3 & 5\end{bmatrix}$.

7) Find the equation to the sphere through the circle $x^2+y^2+z^2=9,\ 2x+3y+4z=5$ and the point (1, 2, 3).
8) Find the equation to the sphere through the circle $x^2+y^2+z^2=1,\ 2x+4y+5z-6=0$ and touching the plane $z=0$.
9) Find equation of sphere for which the circle $x^2+y^2+z^2+7y-2z+2=0,\ 2x+3y+4z=8$ is great circle.
10) Find equation of sphere for which the circle $x^2+y^2+z^2+7y-2z+2=0,\ 2x+3y+4z=8$ is great circle.
11) If A and B are two square matrices. Then $(AB)^t$ = ____

B^tA^t A^tB^t AB $-B^tA^t$

12) For a matrix B, $(B^t)^t$ is equal to _____

-B B B^t $-B^t$

13) If A is a singular matrix then |A| = _____
14) Find $\begin{vmatrix} 3 & 0 & 5 \\ 0 & 1 & 3 \\ 0 & 0 & 7 \end{vmatrix}$ = ____
15) A square matrix $A=[a_{ij}]_{n\times n}$ is said to be symmetric if
    a) $a_{ij}=a_{ji}$ for $i,j\in\{1,2,\dots,n\}$
    b) $a_{ij}=-a_{ji}$ for $i,j\in\{1,2,\dots,n\}$
    c) $a_{ij}=0$ for $i=j,\ i\in\{1,2,\dots,n\}$
    d) None of the above

16) If $A = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{vmatrix}$ then 9A is _____

17) A square matrix A= $[a_{ij}]_{n\times n}$ is said to be skew-symmetric if

a) $a_{ij} = a_{ji}$ for $i, j \in \{1,2, \dots, n\}$

b) $a_{ij} = -a_{ji}$ for $i, j \in \{1,2, \dots, n\}$

c) $a_{ij} \neq 0$ for $i = j$, $i \in \{1,2, \dots, n\}$

d) None of the above

18) Which of the matrix is a scalar matrix?

a) $\begin{bmatrix} 2 & 0 \\ 1 & 2 \end{bmatrix}$

b) $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$

c) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

d) $\begin{bmatrix} 0 & 1 \\ 4 & 0 \end{bmatrix}$

19) If A and B are square matrices then (AB)'=_____

a) B'A'

b) A'B'

c) AB

d) BA

20) Q.11 If $\begin{bmatrix} 1-x & 2 \\ 18 & 6 \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ 18 & 6 \end{bmatrix}$ then x=

21) If $\begin{vmatrix} x & 5 \\ 3 & 3 \end{vmatrix} = 0$, then value of x is_____

22) If A= $\begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$ and B= $\begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix}$ then AB=_____

$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ $\begin{bmatrix} 3 & 1 \\ 1 & 0 \end{bmatrix}$ $\begin{bmatrix} 3 & 1 \\ -1 & -1 \end{bmatrix}$ $\begin{bmatrix} 3 & 0 \\ -1 & -1 \end{bmatrix}$

23) If $\begin{bmatrix} 1 & 0 & 0 \\ 0 & b-4 & 7 \\ a-7 & 6 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 7 \\ 4 & 6 & -1 \end{bmatrix}$ then the value of a and b respectively are a=11, b=5

24) If A= $\begin{bmatrix} 1 & 2 & -1 \\ 4 & 3 & 2 \\ 1 & 2 & -1 \end{bmatrix}$ then

|A|=0 |A|≠0 A^{-1} exists none of the above

25) If A= $\begin{bmatrix} 1 & 2 \\ 4 & 8 \end{bmatrix}$ then |2A|=

26) For matrix A, A^3=I, A^{-1} is equal to _____

A^2 A^{-2} A A^{-1}

27) If A is an invertible matrix then |A| is always _____

$\neq 0$ =0 =3 none of these

28) Consider the statements

(a) 2x+3y=0

4x+5y=0 is a homogeneous system of equations

3x+10y=9

(b) 3x+y=0

4x+10y=0 is a non-homogeneous system of equations

3x+7y=0

29) The value of $\left(\frac{\partial z}{\partial x}\right)_{(1,-1,2)}$ =_____ , if $x^2 + y^2 + z^2 = a^2$.

(a) 2 (b) 1 (c) 4 (d)$-\frac{1}{2}$

30) If $z = f(x, y)$ is homogeneous function of x, y of degree 6, then

$x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2}$ =_____

(a) $6z$ (b) $30z$ (c) 30 (d)6

31) $\lim_{h \to 0} \frac{f(x+h,y)-f(x,y)}{h}$, exists if:

(a) x at (x, y) (b) x at (a, b) (c) y at (x, y) (d) y at (a, b)

32) If $(x, y) = x^3 + y^3 - 2x^2y^2$, then $(f_{xx})_{x=y=1}$ =

(a) 1 (b) -1 (c) 0 (d) None of these

33) Find the total differential coefficient of x^2y with respect to x when x, y connected by $x^2 + xy + y^2$.

34) Find $\frac{d^2y}{dx^2}$ for $x^5 + y^5 = 5a^3x^2$.

35) Use Taylor's theorem to expand $f(x,y) = x^2 + xy + y^2$ in the powers of $(x-1)$ and $(x-2)$.

Use the method of separation of variables to find the general solution to the following differential equation. $u' = \dfrac{1}{5-2u}$

36) Using the existence and uniqueness theorem for second order linear ordinary differential equations, find the largest interval in which the solution to the initial value is certain to exist.
t(t2-4) y''-ty'+3t2y=0, y (1) =1, y'(1) =3.

37) Find the solution to the given initial value problem.
4y''-12y'+9y=0, y (0) =0, y'(0) =1

38) Evaluate $\iint_R y^2\,dydx$; where R is the region bounded by the curves $y^2 = x$ and $y = x^3$.

39) Evaluate $\iint_R y^2\,dxdy$; where R is the region bounded by the curves $y^2 = x$ and $y = x^3$

40) Integrate $f(x,y) = x/y$ over the region in the first quadrant bounded by the lines $y = x,\ y = 2x,$ $x = 1, , x = 2.$

41) Integrate $f(x,y) = x^2 + y^2$ over the triangular region with vertices (0, 0), (1, 0) and (0,1).

42) Evaluate $\iint_R (x+y)\,dydx$; where R is the region bounded by the curves $x = 2$, $y = x$, $y = x + 2$ and $x = 0$.

43) Evaluate $\iint_R (x+y)\,dxdy$; where R is the region bounded by the curves $x = 2$, $y = x$, $y = x + 2$ and $x = 0$.

44) Evaluate $\iint_R \sqrt{xy - y^2}\,dA$; where R is the region bounded by the triangle with vertices $(0,0)$, $(10,1)$ and $(1,1)$.

45) Evaluate $\iint_R r^3\,drd\theta$; where R is the region bounded by the curves $r = 2\sin\theta$ and $r = 4\sin\theta$.

46) Evaluate $\iint_R r^3\,drd\theta$; where R is the region bounded by the curves $r = 2\cos\theta$ and $r = 4\cos\theta$.

47) If $A = \begin{bmatrix} 6 & -5 & 2 \\ 0 & 5 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 0 \\ -4 & -2 \\ 1 & -4 \end{bmatrix}$, then find AB and BA. Show that $AB \neq BA$.

48) Find X and Y, if $X + Y = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix}$ and $X - Y = \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$

49) Find rank of the following matrices

a) $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 0 & 2 & 2 \end{bmatrix}$

b) $\begin{bmatrix} 3 & -1 & 2 \\ -6 & 2 & 4 \\ -3 & 1 & 2 \end{bmatrix}$

50) Find characteristic equation, eigen values and eigen vector of matrix B, where $B = \begin{bmatrix} 6 & 0 & 8 \\ 0 & 1 & 0 \\ 0 & 0 & 5 \end{bmatrix}$

51) Reduce the matrix A to its normal form and find the rank of matric $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$.