Lovely Professional University, Punjab

Course Code	Course Title	Course Planner
MTH165	MATHEMATICS FOR ENGINEERS	11033::Dr. Kulwinder Singh

Course Outcomes :Through this course students should be able to

CO1 :: recall the concepts of matrices and its application to solve the system of linear equations.

CO2 :: review the basic concept of calculus of one variable.

CO3 :: apply the concept of calculus to evaluate extreme values of functions.

CO4 :: describe calculus of multivariate functions and their applications.

CO5 :: evaluate surface and volume integral using multiple integral.

CO6 :: describe the concept of Fourier series and its application.

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	ADVANCED ENGINEERING MATHEMATICS	R.K.JAIN, S.R.K. IYENGER	NAROSA PUBLISHING HOUSE

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	HIGHER ENGINEERING MATHEMATICS	B.S. GREWAL	KHANNA PUBLISHERS
R-2	MATHEMATICS TEXT BOOK FOR CLASS XII PART I	-	NCERT
R-3	MATHEMATICS TEXT BOOK FOR CLASS XII PART II	-	NCERT

Relevant Websites (RW)		
Sr No	**(Web address) (only if relevant to the course)**	**Salient Features**
RW-1	http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx	Lecture notes on Multiple Integrals
RW-2	http://tutorial.math.lamar.edu/Classes/CalcIII/PartialDerivatives.aspx	Lecture notes on Partial Derivatives
RW-3	http://math.stackexchange.com/	A platform for students and teachers to discuss any topic

Audio Visual Aids (AV)		
Sr No	**(AV aids) (only if relevant to the course)**	**Salient Features**
AV-1	http://nptel.ac.in/courses/122107037/24#	video lectures on Fourier series
AV-2	https://www.youtube.com/watch?v=Ld9AtgPmyvM&list=UUMMt9zLt3UojrK2z52E5vng&index=41	NPTEL Video lectures on Multivariable calculus by IIT Roorkee
AV-3	https://www.khanacademy.org/math/multivariable-calculus	Video lectures on multivariable-calculus
AV-4	https://www.khanacademy.org/math/linear-algebra/	Video lecture on Type of matrices, inverse of matrices and solution of system of equations.
AV-5	http://nptel.ac.in/courses/109104124/	video lectures on calculus of one real variable

LTP week distribution: (LTP Weeks)	
Weeks before MTE	7
Weeks After MTE	7
Spill Over (Lecture)	7

Detailed Plan For Lectures

Week Number	Lecture Number	Broad Topic(Sub Topic)	Chapters/Sections of Text/reference books	Other Readings, Relevant Websites, Audio Visual Aids, software and Virtual Labs	Lecture Description	Learning Outcomes	Pedagogical Tool Demonstration/ Case Study / Images / animation / ppt etc. Planned	Live Examples

Week 1	Lecture 1	Linear Algebra(Review of matrices)	T-1 R-1	AV-4	Lecture zero will be delivered to make the students understand the importance of the course that why and how it will be taught. Review of matrices will also be done.	Student will be able to use the various types matrix and all their algebraic Properties such as Addition, Subtraction and multiplication and adjoint of a matrix for solving the real time problems .	Discussion and Brainstorming .	Situational Problem: 1.Consider each study chair of your class room as an element of a matrix. Find the order of the matrix formed by your class room. What are the other possible orders? 2. Try to find out various arrangements of things around you that can be presented as a matrix. 3. Which special kind of matrix arrangement is being followed by any wing of army while doing parade?

Week 1	Lecture 2	Linear Algebra(Elementary operations of matrices)	T-1 R-1	AV-4	Discuss Elementary operations of matrices and Rank of a matrix with the students.	Student will be able to find the rank of the matrix used in various real-time phenomenon such as distortion of an image.	Discussion and Brainstorming	Situational Problem: What is the relationship between rank of a matrix and image distortion? When there is a disturbance effect such as tampering or like photoshoping, then you can test this via rank as well. Because natural images are smooth and tampering will destroy this smooth nature. One can do this by dividing the image into sub blocks. As a result, if an image is original we expect a rank measure close to full rank and else it is less. MCQ: If A is a matrix whose rank when calculated by row operations is denoted by r(A) and when calculated by column operations is denoted by C (A), then: (a) r(A)>c(A) (b) r(A)<c(A) (c) r(A)=-c(A) (d) r(A)=c(A) An instruction

Week 1	Lecture 2	Linear Algebra(Rank of a matrix)	T-1 R-1	AV-4	Discuss Elementary operations of matrices and Rank of a matrix with the students.	Student will be able to find the rank of the matrix used in various real-time phenomenon such as distortion of an image.	Discussion and Brainstorming	Situational Problem: What is the relationship between rank of a matrix and image distortion? When there is a disturbance effect such as tampering or like photoshoping, then you can test this via rank as well. Because natural images are smooth and tampering will destroy this smooth nature. One can do this by dividing the image into sub blocks. As a result, if an image is original we expect a rank measure close to full rank and else it is less. MCQ: If A is a matrix whose rank when calculated by row operations is denoted by r(A) and when calculated by column operations is denoted by C (A), then: (a) r(A)>c(A) (b) r(A)<c(A) (c) r(A)=-c(A) (d) r(A)=c(A) An instruction
	Lecture 3	Linear Algebra(Linear	T-1	AV-4	linear dependence or	Student will be able	Discussion and	Problem:

		dependence and independence of vectors)	R-1		independence of vectors	to judge whether a particular set of vectors are linearly dependent or independent .	Brainstorming	How a geographical positioning of a person be linked with the concept of linear dependence and independence? A geographic example may help to clarify the concept of linear independence. A person describing the location of a certain place might say, "It is 3 miles north and 4 miles east of here." This is sufficient information to describe the location, because the geographic coordinate system may be considered as a 2-dimensional vector space (ignoring altitude and the curvature of the Earth's surface). The person might add, "The place is 5 milesâ€™ northeast of here.â€ MCQ: The vectors: vectors v1 = (1, 1), v2 = (âˆ’3, 2) and v3 = (2, 4) are; (a) Linearly Independent (b) Linearly Dependent

								(c) v1= 2 v3 (d) v2= 5 v1-2v3

Week 2	Lecture 4	Linear Algebra(Solution of Linear system of equations)	T-1 R-1	AV-4	Solution of Linear system of equations	Students will be able to analyze, under what standard conditions a system of Homogeneous and non-homogeneous system of equations will have a unique solution, no solution and infinitely many solutions	Discussion and Brainstorming	Situational Problem; A mixture of 12 litres of chemical A, 16 litres of chemical B, and 26 litres of chemical C is required to kill a destructive crop insect. Commercial spray X contains 1, 2, and 2 parts, respectively, of these chemicals. Commercial spray Y contains only chemical C. Commercial spray Z contains only chemicals A and B in equal amounts. How much of each type of commercial spray is needed to get the desired mixture? MCQ: If A and B are two square matrices of order n and if r (A|B)=r(A)=n, then the system of equations represented by these two matrices A and B has: (a) No solution (b) Infinitely many solutions (c) Unique solution (d) No such system exists

Week 2	Lecture 5	Linear Algebra(Inverse of matrices)	T-1 R-1	AV-4	Inverse of matrices using Gauss Jordan method	Students will be able to find the inverse of the matrix using the Gauss-Jordan method which is applicable in solving the many real-time problems in the field of science and technology	Discussion and Brainstorming	MCQ; 1. If a matrix A has inverse, then the system represented by this matrix A has: (a) No solution (b) Infinitely many solutions (c) Unique solution (d) No such matrix exists 2. A square matrix A will not have inverse, if A is a: (a) Non Singular matrix (b) Singular matrix (c) Orthogonal matrix (d) Unitary matrix
	Lecture 6	Linear Algebra(Eigen values and Eigen vectors)	T-1 R-1	AV-4	Calculation of Eigenvalues and Eigenvectors from Characteristic The equation of given matrix	The students will be able to find the Eigenvalues and Eigenvectors of a given system under the given matrix transformation.	Discussion and Brainstorming	Situational Problem: 1. How the melting of butter on bread is related with the concept of Eigen values and Eigen vectors? 2. How increase in length of a human and increase in weight related with the concept of Eigen values and Eigen vectors?

Week 3	Lecture 7	Linear Algebra(Properties of Eigen values)	T-1 R-1	AV-4	Properties of Eigen values	The students will be able to use the properties of Eigen values in various scientific fields.	Discussion and Brainstorming	Situational Problem: 1. The eigenvalues are used to determine the natural frequencies (or Eigen frequencies) of vibration, and the eigenvectors determine the shapes of these vibrational modes. 2. The eigenvalues can also be used to determine if a structure has deformed under the application of a particular force. Eigenvalues for the structure are measured before and after the application of force. If a change in the eigenvalues is observed, it means the structure has undergone deformation.
	Lecture 8	Linear Algebra(Cayley-Hamilton theorem)	T-1 R-1	AV-4	Cayley Hamilton theorem	Student will be able to use Cayley Hamilton theorem in finding the inverse of matrix in an easy way.	Discussion and Brainstorming	Cayley Hamilton theorem is applicable to which of the following matrices: (a) Row matrix (b) Column matrix (c) Rectangular matrix (d) Square

Week 3	Lecture 9				Online Assignment			
Week 4	Lecture 10	Differentiatial and integral calculus(General rules of differentiation)	R-2	AV-5	General rules of differentiation andDerivatives of standard functions	Student will be able to apply general rules of differentiation and derivatives of standard functions in various field of science and tecnology	Discussion and Brainstorming	Situation Problem: Isaac Newton is jumping on a very springy trampoline with a membrane 1 meter off the ground. If it flings Isaac upwards at an initial velocity of 100 meters per second, then his height S above the ground (vertical position, with upward being the positive direction), measured in meters, is given by S(t)=1+100t-4.9 t^2 How fast is he moving after 10 seconds? In what direction? MCQ: The geometrical meaning of derivative dy/dx is: (a) Slope of a normal (b) Slope of a tangent (c) Rotation of a liquid (d) Motion of an engine An instruction

Week 4	Lecture 10	Differentiatial and integral calculus(Derivatives of standard functions)	R-2	AV-5	General rules of differentiation andDerivatives of standard functions	Student will be able to apply general rules of differentiation and derivatives of standard functions in various field of science and tecnology	Discussion and Brainstorming	Situation Problem: Isaac Newton is jumping on a very springy trampoline with a membrane 1 meter off the ground. If it flings Isaac upwards at an initial velocity of 100 meters per second, then his height S above the ground (vertical position, with upward being the positive direction), measured in meters, is given by S(t)=1+100t-4.9 t^2 How fast is he moving after 10 seconds? In what direction? MCQ: The geometrical meaning of derivative dy/dx is: (a) Slope of a normal (b) Slope of a tangent (c) Rotation of a liquid (d) Motion of an engine An instruction

Week 4	Lecture 11	Differentiatial and integral calculus(Derivatives of Parametric forms)	R-2	AV-5	Derivatives of Parametric forms and implicit functions	Students will be able to find the derivatives of Parametric forms and implicit functions.	Discussion and Brainstorming	Situational Problem: An airplane travelling at a constant altitude of 3 Km is being tracked by a ground based radar station. At a certain time t0, the radar crew measures the plane to be 5 Km distant and this distance is falling at a rate of 320 Km/Hr. How fast is the plane flying at time t0 ? and A petroleum storage tank on the shoreline leaks oil into the water at a steady rate of 2 barrels per minute. A clean-up crew, intending to contain the spill with a string of floats, asks how fast the oil slicks circumference is growing?

Week 4	Lecture 11	Differentiatial and integral calculus(Derivatives of implicit functions)	R-2	AV-5	Derivatives of Parametric forms and implicit functions,Logarithmic differentiation	Students will be able to find the derivatives of Parametric forms, implicit functions, and Logarithmic functions .	Discussion and Brainstorming	Situational Problem: An airplane travelling at a constant altitude of 3 Km is being tracked by a ground based radar station. At a certain time t0, the radar crew measures the plane to be 5 Km distant and this distance is falling at a rate of 320 Km/Hr. How fast is the plane flying at time t0 ? and A petroleum storage tank on the shoreline leaks oil into the water at a steady rate of 2 barrels per minute. A clean-up crew, intending to contain the spill with a string of floats, asks how fast the oil slicks circumference is growing?

Week 4	Lecture 11	Differentiatial and integral calculus(Logarithmic differentiation,)	R-2	AV-5	Derivatives of Parametric forms and implicit functions,Logarithmic differentiation	Students will be able to find the derivatives of Parametric forms, implicit functions, and Logarithmic functions .	Discussion and Brainstorming	Situational Problem: An airplane travelling at a constant altitude of 3 Km is being tracked by a ground based radar station. At a certain time t0, the radar crew measures the plane to be 5 Km distant and this distance is falling at a rate of 320 Km/Hr. How fast is the plane flying at time t0 ? and A petroleum storage tank on the shoreline leaks oil into the water at a steady rate of 2 barrels per minute. A clean-up crew, intending to contain the spill with a string of floats, asks how fast the oil slicks circumference is growing?

Week 4	Lecture 12	Differentiatial and integral calculus(properties of indefinite integral)	R-3	RW-3	Properties of indefinite integral and methods of integration by parts	student will be able to find the integral of different functions	Discussion and Brainstorming	Situational Problem: A snake eating its own tail, forms a perfect circle. If the snake's length falls at a rate of c centimetres per hour, how fat does the enclosed area shrink? and The anti derivative of the function y= sin x is: (a) cos x (b) -cos x (c) Sin x. cos x (d) - Sin x. cos x
		Differentiatial and integral calculus(Methods of integration-By Parts)	R-3	RW-3	Properties of indefinite integral and methods of integration by parts	student will be able to find the integral of different functions	Discussion and Brainstorming	Situational Problem: A snake eating its own tail, forms a perfect circle. If the snake's length falls at a rate of c centimetres per hour, how fat does the enclosed area shrink? and The anti derivative of the function y= sin x is: (a) cos x (b) -cos x (c) Sin x. cos x (d) - Sin x. cos x

Week 5	Lecture 13	Differentiatial and integral calculus(Methods of integration-By Partial fractions)	R-3		Methods of integration-By Partial fractions	The students will be able to calculate an integral involving linear and quadratic factors in denominator by forming partial fractions.	Discussion and Brainstorming	
	Lecture 14	Differentiatial and integral calculus(Properties of definite integral)	T-1 R-1		Properties of definite integral	The students will be able to use various properties of definite integrals to convert the calculations easier and lighter	Discussion and Brainstorming	Find the area enclosed by a circle of radius 4 units in the first quadrant.
	Lecture 15				Online Assignment			
Week 6	Lecture 16	Application of derivatives (Rolle’s theorem)	T-1 R-1		Rolle’s theorem ,Mean value theorems	students will be able to use Rolle’s theorem ,Mean value theorems in solving the problems of advance mathematics	Discussion and Brainstorming	
		Application of derivatives (Mean value theorems)	T-1 R-1		Rolle’s theorem ,Mean value theorems	students will be able to use Rolle’s theorem ,Mean value theorems in solving the problems of advance mathematics	Discussion and Brainstorming	
	Lecture 17	Application of derivatives (Taylor’s theorems with remainders)	T-1 R-1		Taylor’s and Maclaurin 's series with remainder	Students will be able to produce the Taylor’s and Maclaurin 's series for different functions	Discussion and Brainstorming	
		Application of derivatives (Maclaurin theorems with remainders)	T-1 R-1		Taylor’s and Maclaurin 's series with remainder	Students will be able to produce the Taylor’s and Maclaurin 's series for different functions	Discussion and Brainstorming	
	Lecture 18	Application of derivatives (indeterminate forms)	T-1 R-1		indeterminate forms using L' Hospital's rule	Students will be able to evaluate the values of indeterminate forms using L' Hospital's rule	Discussion and Brainstorming	
		Application of derivatives(L' Hospital's rule)	T-1 R-1		indeterminate forms using L' Hospital's rule	Students will be able to evaluate the values of indeterminate forms using L' Hospital's rule	Discussion and Brainstorming	

Week 7	Lecture 19	Application of derivatives (maxima and minima.)	T-1 R-1		maxima and minima for on variable	students will be able to find the maximum and minimum value of function of one variable .	Discussion and Brainstorming	
		SPILL OVER						
Week 7	Lecture 20				Spill Over			
	Lecture 21				Spill Over			
		MID-TERM						
Week 8	Lecture 22	Multivariate functions (Functions of two variables)	T-1 R-1	AV-2 AV-3	Functions of two variables, Limits and Continuity	The students will learn the extension of the concept of limit and continuity of single variable to multiple variables	Discussion and Brainstorming .	
		Multivariate functions (Limits and Continuity)	T-1 R-1	AV-2 AV-3	Functions of two variables, Limits and Continuity	The students will learn the extension of the concept of limit and continuity of single variable to multiple variables	Discussion and Brainstorming .	
	Lecture 23	Multivariate functions (Partial derivatives)	T-1 R-1	RW-2	Partial derivatives	The students will learn the difference between rate of change of a single variable and multiple variable functions	Discussion and Brainstorming	
	Lecture 24	Multivariate functions(Total derivative and differentiability)	T-1 R-1	RW-2	Total derivative and differentiability	The students will learn to calculate the total derivative of a function involving more than one independent variables.	Discussion and Brainstorming .	
Week 9	Lecture 25	Multivariate functions(Chain rule)	T-1 R-1	RW-2	Chain rule	The students will learn the implicit differentiation of functions involving more than one independent variables	Discussion and Brainstorming .	

Week 9	Lecture 26	Multivariate functions (Euler's theorem for Homogeneous functions)	T-1 R-1	RW-2	Euler's theorem for Homogeneous functions	The students will first learn the concept of Homogeneous functions and then the application of Euler's theorem to these homogeneous functions.	Discussion and Brainstormig	
	Lecture 27	Multivariate functions (Maxima and Minima)	T-1 R-1	RW-2	Maxima and Minima	The students will learn the extension of maxima and minima in single variable to multiple variables.	Discussion and Brainstorming .	
Week 10	Lecture 28	Multivariate functions (Lagrange method of multiplier)	T-1 R-1	RW-2	Lagrange method of multiplier	The students will learn about this particular method of optimization.	Discussion and Brainstorming	
	Lecture 29	Multiple Integrals(Double integrals)	T-1 R-1	RW-1	Double integrals	The students will learn the extension of idea of single integral to double integral over two-dimensional region.	Discussion and Brainstorming .	
	Lecture 30	Multiple Integrals(change of order of integration)	T-1 R-1	RW-1	Change of order of integration	The students will learn how the value of integral remains same even on flipping of limits of x and y.	Discussion and Brainstorming .	
Week 11	Lecture 31	Multiple Integrals(Triple integrals)	T-1 R-1	RW-1	Triple integrals	The students will learn the extension of idea of single integral to triple integral over three-dimensional space.	Discussion and Brainstorming .	
	Lecture 32	Multiple Integrals(change of variables)	T-1 R-1	RW-1	Change of variables	The students will learn how the value of integral remains same even on changing the system of coordinates axes to polar, spherical or cylindrical system	Discussion and Brainstorming .	
	Lecture 33				Online Assignment			

Week 12	Lecture 34	Multiple Integrals (Application of double integrals to calculate area and volume)	T-1 R-1	RW-1	Application of double and triple integrals to calculate area and volume	The students will learn to use concept of double and triple integrals to volume	Discussion and Brainstorming .	
	Lecture 35	Multiple Integrals (Application of triple integrals to calculate volume.)	T-1 R-1	RW-1	Application of double and triple integrals to calculate area and volume	The students will learn to use concept of double and triple integrals to volume.	Discussion and Brainstorming .	
	Lecture 36	Fourier series(Introduction and Euler's formulae)	T-1 R-1	AV-1	Introduction of Fourier series Euler's formula. Conditions for a Fourier Expansion and Functions having points of discontinuity.	Student will learn methods to solve Fourier series and will be able to understand the conditions for a Fourier expansion and the series for Functions having points of discontinuity.	Discussion and Brainstorming.	
		Fourier series(Conditions for a Fourier Expansion and Functions having points of discontinuity)	T-1 R-1	AV-1	Introduction of Fourier series Euler's formula. Conditions for a Fourier Expansion and Functions having points of discontinuity.	Student will learn methods to solve Fourier series and will be able to understand the conditions for a Fourier expansion and the series for Functions having points of discontinuity.	Discussion and Brainstorming.	
Week 13	Lecture 37	Fourier series(Change of interval)	T-1 R-1	AV-1	Change of interval,	Student will learn method to find the series for Change of interval,	Discussion and Brainstorming	
	Lecture 38	Fourier series(Even and odd functions)	T-1 R-1	AV-1	Even and odd function	Student will learn method to find the series for even and odd function	Discussion and Brainstorming .	
	Lecture 39	Fourier series(Half Range series)	T-1 R-1	AV-1	Fourier series for half range series.	Student will learn methods to find the series for half range.	Discussion and Brainstorming .	
Week 14	Lecture 40	Fourier series(Perseval's Formula)	T-1 R-1	AV-1	Fourier series for half range series Perseval's Formula and Complex form of Fourier Series	Student will learn methods to find the series for half range, Perseval's Formula and Complex form.	Discussion and Brainstorming.	

Week 14	Lecture 40	Fourier series(Complex form of Fourier Series)	T-1 R-1	AV-1	Fourier series for half range series Perseval's Formula and Complex form of Fourier Series	Student will learn methods to find the series for half range, Perseval's Formula and Complex form.	Discussion and Brainstorming.	
		SPILL OVER						
Week 14	Lecture 41				Spill Over			
	Lecture 42				Spill Over			
Week 15	Lecture 43				Spill Over			
	Lecture 44				Spill Over			
	Lecture 45				Spill Over			

Plan for Tutorial: (Please do not use these time slots for syllabus coverage)

Tutorial No.	Lecture Topic	Type of pedagogical tool(s) planned (case analysis,problem solving test,role play,business game etc)
Tutorial1	Review of matrices, Elementary operations of matrices, Rank of a matrix, Linear dependence and independence of vectors	Problem solving and discussion on MCQ questions
Tutorial2	Solution of Linear system of equations, Inverse of matrices, Eigen values and Eigen vectors	Problem solving and discussion on MCQ questions
Tutorial3	Cayley-Hamilton theorem,Differential coefficient, General rules of differentiation, Derivatives of standard functions.	Problem solving and discussion on MCQ questions
Tutorial4	Derivatives of Parametric forms,Derivatives of implicit functions, Logarithmic differentiation,Methods of integration-By Substitution	Problem solving and discussion on MCQ questions
Tutorial5	Methods of integration-By Partial fractions,Methods of integration- By Parts,Properties of definite integral.	Problem solving and discussion on MCQ questions
Tutorial6	Rolle’s Theorem, Mean value theorems, Taylor’s and Maclaurin theorems with remainders	Problem solving and discussion on MCQ questions
Tutorial7	indeterminate forms and L'Hospital's rule, Maxima and minima.	Problem solving and discussion on MCQ questions
	After Mid-Term	
Tutorial8	Functions of two variables, Limits and Continuity, Partial derivatives, Total derivative and differentiability	Problem solving and discussion on MCQ questions
Tutorial9	Chain rule, Euler's theorem for Homogeneous functions, Maxima and Minima, Lagrange method of multiplier.	Problem solving and discussion on MCQ questions
Tutorial10	Double integrals, change of order of integration, Triple integrals	Problem solving and discussion on MCQ questions
Tutorial11	Change of variable	Problem solving and discussion on MCQ questions

An instruction plan is only a tentative plan. The teacher may make some changes in his/her teaching plan. The students are advised to use syllabus for preparation of all examinations. The students are expected to keep themselves updated on the contemporary issues related to the course. Upto 20% of the questions in any examination/Academic tasks can be asked from such issues even if not explicitly mentioned in the instruction plan.

Tutorial12	Application of double integrals to calculate area and volume, Application of triple integrals to calculate volume.	Problem solving and discussion on MCQ questions
Tutorial13	Euler's formulae, Conditions for a Fourier Expansion and Functions having points of discontinuity, Change of interval.	Problem solving and discussion on MCQ questions
Tutorial14	Even and odd functions, Half Range series, Perseval's Formula, Complex form of Fourier Series.	Problem solving and discussion on MCQ questions