A Tutorial Manual for

Mathematics I
(BE01R000041)

B.E. Semester1 (All Branches)

Institute logo

Directorate of Technical Education, Gandhinagar, Gujarat

Mathematics I (BE01R000041)

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Certificate

This is to certify that Mr./Ms. ____________________________________ ________ Enrollment No. _______________ of B.E. Semester _____Branch __________ Engineering of this Institute (GTU Code: _____)has satisfactorily completed the Assignment / Tutorial work for the subject **Mathematics I** for the academic year 2025-26.

Place: __________
Date: __________

Name and Sign of Faculty member

Preface

Main objectives of assignment work of any subject is for pleasing to the eye on required skills as well as creating ability amongst students to solve real time problem by developing relevant competencies in psychomotor domain. By keeping in view, GTU has designed competency focused outcome-based curriculum for engineering degree programs where sufficient time given to Assignment or Tutorial work. It shows importance of enhancement of skills amongst the students and it pays attention to utilize every second of time allotted for Assignment or Tutorial work amongst students, faculty members to achieve relevant outcomes by solving the Assignment or Tutorial rather than having simply study type classroom learning. It is must for effective implementation of competency focused outcome-based curriculum that every Assignment or Tutorial work is keenly designed to serve as a tool to develop and enhance relevant competency required by the various branch of engineering among every student. These psychomotor skills are very difficult to develop through traditional chalk and board content delivery method in the classroom. Accordingly, this lab manual is designed to focus on the Programme and Course Outcome defined relevant programme, rather than old practice of conducting Assignment or Tutorial to prove concept and theory.

By using this Assignment or Tutorial manual students can go through the relevant theory and numerical in advance which creates an interest and students can have basic practice prior to exam. This in turn enhances pre-determined outcomes amongst students. Each Assignment or Tutorial in this manual begins with understanding, utility, modeling, analytic and creativity other relevant skills, course outcomes as well as practical outcomes (objectives).

This Assignment or Tutorial also provides guidelines to faculty members to facilitate student centric Assignment or Tutorial activities through each Assignment or Tutorial by arranging and managing necessary resources in order that the students follow the procedures with required skill to achieve the outcomes. It also gives an idea that how students will be assessed by process of continuous evaluation system.

Mathematics I is a basic science course, which focus on topics like: Indeterminate Forms and L'Hôspital's Rule, Improper Integrals, Convergence and divergence of the integrals, Beta and Gamma functions and their properties, Applications of definite integral, Volume using cross-sections, Length of plane curves, Areas of Surfaces of Revolution, Convergence and divergence of sequences, The Sandwich Theorem for Sequences, The Continuous Function Theorem for Sequences, Bounded Monotonic Sequences, Convergence and divergence of an infinite series, geometric series, telescoping series, p^{th} term test for divergent series, Combining series, Harmonic Series, Integral test, The p - series, The Comparison test, The Limit Comparison test, Ratio test, Raabe's Test, Root test, Alternating series test, Absolute and Conditional convergence, Power series, Radius of convergence of a power series, Taylor and Maclaurin series, Functions of several variables, Limits and continuity, Test for non existence of a limit, Partial differentiation, Mixed derivative theorem, differentiability, Chain rule, Implicit differentiation, Gradient, Directional derivative, tangent plane and normal line, total differentiation, Local extreme values, Method of Lagrange Multipliers, Multiple integral, Double integral over Rectangles and general regions, double integrals as volumes, Change of order of integration, double integration in polar coordinates, Area by double integration, Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals in rectangular, cylindrical and spherical coordinates, Jacobian, multiple integral by substitution.

Mathematics-01 (3110014)			
CO-PO Matrices			
Table			
Sr. No.	COs	Statement	
1	1	To apply differential and integral calculus to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.	**20%**
2	2	The fallouts of Taylor's and Maclaurin's Theorem that is fundamental to application of analysis to Engineering problems.	**20%**
3	3	The tool of Sequences and Infinite series for learning advanced Engineering Mathematics.	**20%**
4	4	To deal with functions of several variables that is essential in most branches of engineering.	**20%**
5	5	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.	**20%**

Table CO – PO Matrix

Sr. No.		PO1 Engineering knowledge	PO2 Problem analysis	PO3 Design/ development of solutions	PO4 Conduct investigations of complex problems	PO5 Modern tool usage	PO6 The engineer and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning
1	CO1												
2	CO2												
3	CO3												
4	CO4												
5	CO5												

Guidelines for Faculty members

1. Teacher should provide the guideline with demonstration some problems to the students.
2. Teacher shall explain in shortly, basic concepts/theory related to the Assignment or Tutorial to the students before starting of each Assignment or Tutorial
3. Involve all the students in Assignment or Tutorial.
4. Teacher is expected to share the skills and competencies to be developed in the students and ensure that the respective skills and competencies are developed in the students after the completion of the Assignment or Tutorial.
5. Teachers should give opportunity to students for hands-on experience after the demonstration.
6. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected from the students.
7. Give assignment and assess the performance of students based on task assigned to check whether it is as per the instructions or not.
8. Teacher is expected to refer complete curriculum of the course and follow the guidelines for implementation.

Instructions for Students

1. Students are expected to carefully listen to all the theory classes delivered by the faculty members and understand the COs, content of the course, teaching and examination scheme, skill set to be developed etc.
2. Students shall organize the work in the group and make record of all work.
3. Students shall develop maintenance skill as expected by course.
4. Student shall attempt to develop related hand-on skills and build confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. apart from those included in scope of manual.
6. Student shall refer book and resources.
7. Student should develop a habit of submitting the Assignment or Tutorial work as per the schedule and s/he should be well prepared for the same.

Index
(Progressive Assessment Sheet)

Sr. No.	Objective(s) of Experiment	Page No.	Date of starting	Date of submission	Marks	Sign	Remarks
Total							

Course Outcomes	Topics
1	**Module 1: Basic Calculus:** Evaluation of improper integrals of Type-I and Type-II, Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions
2	**Module 2: Single-variable Calculus (Differentiation):** Taylor's and Maclaurin's theorem for a function of one variable, Taylor's and Maclaurin's series of a function using statement of the theorems; Extreme values of functions; Indeterminate forms and L' Hospital's rule.
3	**Module 3: Sequences and series:** Sequence of numbers and its convergence, Infinite series; Tests for convergence (Telescoping series, Geometric series test, Integral test, ptest, comparison test, D' Alembert's ratio test, Cauchy's root test), Alternating series test; Power series, Radius and interval of convergence, Conditional and Absolute convergence of a power series
4	**Module 4: Multivariable Calculus (Differentiation):** Limit, Continuity and Differentiation for function of two or more variables, total derivative, gradient, directional derivatives; Tangent plane and Normal line to the surface $f(x, y, z) = c$; Extreme values for function of two variables (Maxima, minima and saddle points); Method of Lagrange multipliers.
5	**Module 5: Multivariable Calculus (Integration):** Multiple Integration: Double integrals (Cartesian, Polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian, Cylindrical, Spherical).

Date:______________	
Assignment/Tutorial No: 01	
Topic:	Improper integrals
Sub Topics:	Improper integrals, Convergence and divergence of the integrals
Relevant CO:	1
Objectives:	find Convergence and divergence of the Improper integrals

Sr. No.	Question	CO	PI*	B.T. level
1	Define Improper integral of First kind and evaluate $\int_0^\infty \frac{dx}{x^2+1}$	1	1.1.1	R, U
2	Evaluate 1) $\int_{-\infty}^{\infty} \frac{1}{1+x^2} dx$ 2) $\int_{-\infty}^{\infty} \frac{1}{e^x+e^{-x}} dx$ 3) $\int_0^\infty \frac{dx}{(1+x^2)(1+\tan^{-1} x)}$	1	1.1.1	U
3	Define Improper integral of Second kind and evaluate $\int_0^3 \frac{1}{\sqrt{3-x}}\, dx$.	1	1.1.1	R,U
4	Check the convergence of $\int_0^3 \frac{dx}{\sqrt{9-x^2}}$.	1	1.1.1	U

B. T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing ,E: Evaluating, C: Creating

PI*https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf

Date:	
Assignment/Tutorial No: 02	
Topic:	Beta & Gamma function,
Sub Topics:	Beta & Gamma function,
Relevant CO:	1
Objectives:	Evaluate integrals using Beta & Gamma function

Sr. No.	Question	CO	PI	B.T. level
1	Define Gamma function. Show that $i)\ \Gamma(n+1) = n\Gamma(n) \quad ii)\ \Gamma(n) = 2\int_0^\infty e^{-x^2} x^{2n-1} dx$	1	1.1.2	R, U
2	Evaluate: i) $\Gamma(7/2)$ ii) $\int_0^\infty \frac{x^5}{5^x} dx$ iii) $ii)\int_0^1 x^4 (\log x)^4 dx$	1	1.1.2	U
3	Define Beta function. Prove that $\beta(m,n) = 2\int_0^{\frac{\pi}{2}} \sin^{2m-1}\theta \cos^{2n-1}\theta d\theta$	1	1.1.2	R, U
4	Evaluate: $i)\int_{-1}^{1} (1+x)^4 (1-x)^3 dx \quad ii)\int_0^{\frac{\pi}{2}} \sin^6\theta \cos^7\theta d\theta$	1	1.1.2	U

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 03	
Topic:	Application of definite integral
Sub Topics:	Volume using cross section, Length of plane curves, Areas of surfaces of revolution
Relevant CO:	1
Objectives:	Compute area & volume as application of definite integral

1	The solid lies between planes perpendicular to the x-axis at $x = -1$ and $x = 1$. The cross-sections perpendicular to the x-axis between these planes are squares whose diagonals run from the semicircle $y = -\sqrt{1-x^2}$ to the semicircle $y = \sqrt{1-x^2}$.	1	1.1.1	A
2	Find the volumes of the solids generated by revolving the regions bounded by $y = x^2, y = 0, x = 2$ about the x-axis by the disk method.	1	1.1.1	A
3	Find the volumes of the solids generated by revolving the regions bounded by $y = x^2 + 1, y = x + 3$ about the x-axis by the washer method.	1	1.1.1	A
4	Find the length of the curve $y = \frac{1}{2}\left(e^x + e^{-x}\right); 0 \le x \le 2$	1	1.1.1	A
5	Find the length of asteroid $x^{2/3} + y^{2/3} = a^{2/3}$.	1	1.1.1	A
6	Find the area of the surface of revolution of the solid generated by revolving the ellipse $\frac{x^2}{16} + \frac{y^2}{4} = 1$ about the x-axis.	1	1.1.1	A
7	Find the surface area generated by revolving the loop of the curve $9ay^2 = x(3a - x)^2$ about the x-axis.	1	1.1.1	A
8	Find the surface area of the solid generated by revolving the asteroid $x^{2/3} + y^{2/3} = a^{2/3}$ about x- axis.	1	1.1.1	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 04	
Topic:	Taylor and Maclurin series
Sub Topics:	Taylor and Maclurin series Extreme values
Relevant CO:	2
Objectives:	Expansion of a function as a Taylor and Maclurin series

1	Express following function in power series using formula of Maclaurin series (1) e^x (2) $\sin x$ (3) $\log(1+x)$ (4) $\tan^{-1} x$	2	1.1.1	U
2	Expand following functions in powers of $(x-a)$ using Taylor's series. (1) $f(x)=x^3-2x+4,\quad a=2.$ (2) $f(x)=x^4-11x^3+43x^2-60x+14,\quad a=3.$	2	1.1.1	U
3	Expand $\sin\left(\frac{\pi}{4}+x\right)$ in power of x. Find approximate value of $\sin 46^o$ and $\sin 44^o$	2	1.1.1	U, A
4	Using Taylor's series find approximate value of $\sqrt{36.12}$ and $\sqrt{9.12}$	2	1.1.1	U, A
5	Find absolute extreme value of the function $f(x)=x+\ln x;\quad 0.5<x<4$	2	1.1.1	U,A
6	Find the extreme values (absolute & local) of the function (over its natural domain) $y=\frac{x}{x^2+1}$	2	1.1.1	U,A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 05	
Topic:	Indeterminate forms and L'Hospital's rule,
Sub Topics:	Indeterminate forms and L'Hospital's rule,
Relevant CO:	2
Objectives:	find limit of indeterminate forms using L'Hospital's Rule

Sr. No.	Question	CO	PI	B.T. level
1	State L'Hospital's Rule and use it to evaluate following limit. 1. $\lim_{x \to 0} \frac{1-\cos x}{x^2}$ 2. $\lim_{x\to 0} \frac{xe^x - \log(1+x)}{x^2}$ 3. $\lim_{x\to 0} \frac{e^x - e^{-x} - 2\log(1+x)}{x \sin x}$	2	1.1.1	R, U
2	Determine indeterminate forms and evaluate the limit 1. $\lim_{x\to 0}\left[\frac{1}{x^2} - \frac{1}{sin^2 x}\right]$ 2. $\lim_{x\to 0}\left(\frac{1^x+2^x+3^x}{3}\right)^{\frac{1}{x}}$	2	1.1.1	A
3	**Evaluate**: $\lim_{x\to 0}\left(\frac{1}{x}\right)^{\tan x}$	2	1.1.1	A
4	Evaluate $\lim_{x\to \pi/2} \frac{\sec x}{1+\tan x}$	2	1.1.1	A
5	Evaluate $\lim_{x\to 0+} \sqrt{x} \ln x$	2	1.1.1	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

PI * https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf

Date:	
Assignment/Tutorial No: 06	
Topic:	Infinite Sequence & Series Infinite series
Sub Topics:	Converges and divergence of Sequences, The Sandwich theorem, The Continuous function theorem, bounded monotonic sequence, Convergence and divergence of infinite series, Geometric series, telescoping series Integral test,
Relevant CO:	3
Objectives:	Understand convergence and divergence of the Sequence and series Find limit of Convergent sequence Find sum of Convergent series

Sr. No.	Question	**CO**	**PI**	**B.T. level**
1	Explain Convergence and Divergence of sequence. Examine whether the following sequences are convergent or divergent. (1) $\left\{\frac{1}{n}\right\}_{n=1}^{\infty}$ (2) $\left\{(-1)^{n+1}\right\}_{n=1}^{\infty}$	3	1.1.1	R, U
2	Describe the sandwich theorem for sequences. Use it to check convergence of following sequences. (1) $\left\{\frac{\cos n}{n}\right\}_{n=1}^{\infty}$ (2) $\left\{\frac{(-1)^{n+1}}{2n-1}\right\}_{n=1}^{\infty}$	3	1.1.1	R, U
3	**Write** down continuous function theorem for sequence. **Use** it to examine convergence of following sequences. (1) $\left\{2^{\frac{1}{n}}\right\}_{n=1}^{\infty}$	3	1.1.1	R, U
4	Explain telescoping series and use it to check convergence of following series. (1) $\sum_{n=1}^{\infty}\frac{4}{(4n-3)(4n+1)}$ (2) $\sum_{n=1}^{\infty}\left(\tan^{-1}(n)-\tan^{-1}(n+1)\right)$	3	1.1.1	R, U
5	Define geometric series and explain its convergence. Examine convergence of following series and find sum of series if it is convergent. $\sum_{n=1}^{\infty}\frac{(-3)^{n}}{2^{n+2}}$	3	1.1.1	R, U
6	State n[th] term test for divergence of an infinite series. Examine that following series are divergent. (1) $\sum_{n=1}^{\infty}\frac{2n}{3n-1}$ (2) $\sum_{n=1}^{\infty} n\sin\frac{1}{n}$	3	1.1.1	R, U
7	Examine following series for their convergence using Integral test. (1) $\sum_{n=1}^{\infty}\frac{\tan^{-1}(n)}{1+n^{2}}$ (2) $\sum_{n=1}^{\infty}\frac{e^{n}}{1+e^{2n}}$	3	1.1.1	U, A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 07	
Topic:	Infinite Sequence & Series Infinite series
Sub Topics:	The p-series, The comparison test, The limit comparison test, Ratio test, Root test,
Relevant CO:	3
Objectives:	Discuss convergence of infinite series using various test Understand convergence and divergence of the series

Sr. No.	Question	**CO**	**PI**	**B.T. level**
1	Prove that the P- series $\sum_{n=1}^{\infty} \frac{1}{n^p}$ is convergent if $p > 1$ and divergent if $p \le 1$	3	1.1.1	U
2	Apply comparison test to find convergence of following series. (1) $\sum_{n=1}^{\infty} \frac{1}{n^2+30}$ (2) $\sum_{n=1}^{\infty} \frac{\cos^2 n}{n^{\frac{3}{2}}}$ (3) $\sum_{n=1}^{\infty} \frac{3n^2-3n}{n^2(n-1)(n^2+5)}$ (4) $\sum_{n=1}^{\infty} \frac{1}{n3^n}$ (5) $\sum_{n=1}^{\infty} \left(\frac{n}{3n+1}\right)^n$ (6) $\sum_{n=2}^{\infty} \ln\left(1+\frac{1}{n^2}\right)$	3	1.1.1	U, A
3	Examine convergence of following series by using Ratio Test (1) $\sum_{n=1}^{\infty} \frac{(n!)^2}{2^{n^2}}$ (2) $\sum_{n=1}^{\infty} \frac{4^{n}(n+1)!}{n^{n+1}}$ (3) $\sum_{n=1}^{\infty} \frac{n!}{n^n}$	3	1.1.1	U, A
4	Examine convergence of following series by using Cauchy Root Test. (1) $\sum_{n=1}^{\infty} ne^{-n^2}$ (2) $\sum_{n=1}^{\infty} \left(1+\frac{1}{n}\right)^{n^2}$ (3) $\sum_{n=2}^{\infty} \frac{n}{(\log n)^n}$	3	1.1.1	U, A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:

Assignment/Tutorial No: 08	
Topic:	Infinite series, Power series
Sub Topics:	Alternating series test, Absolute and conditionally convergent, Power series, Radius of convergence of power series,
Relevant CO:	3
Objectives:	1. Understand Alternating series and its convergence 2. Examine convergence of power series

Sr. No.	Question	CO	PI	B.T. level
1	Define Alternating series. Using Leibnitz test discuss convergence of the series. (1) $\frac{1}{1.2}-\frac{1}{3.4}+\frac{1}{5.6}-\frac{1}{7.8}+\ldots$	3	1.1.1	R, U, A
2	Define Absolutely convergent series and Conditionally convergent series. Give an example of conditionally convergent series.	3	1.1.1	R, U
3	Which of the following series is conditionally convergent? 1) $\sum_{n=1}^{\infty}\frac{(-1)^n n^2}{n^3+1}$ (2) $\sum_{n=1}^{\infty}\frac{(-1)^{n+1}}{\sqrt[3]{n}}$	3	1.1.1	R, U
4	Discuss convergence of following power series. Also find radius and interval of convergence of these power series. (1) $\sum_{n=1}^{\infty}\frac{n+1}{n}x^{n-1}$ (2) $\sum_{n=1}^{\infty}\frac{(-3)^n}{\sqrt{n+1}}x^n$ (3) $1-\frac{1}{2}(x-2)+\frac{1}{4}(x-2)^2-\frac{1}{8}(x-2)^3+\ldots$	3	1.1.1	R, U

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 09	
Topic:	Partial Derivative
Sub Topics:	Functions of several variables, Limits and continuity, Test for non existence of a limit, Partial differentiation,
Relevant CO:	4
Objectives:	1. Find Domain and range of function of several variables. 2. Evaluate Limit function of several variables. 3. Discuss continuity of function of several variables. 4. Calculate Partial derivative

Sr. No.	**Question**	**CO**	**PI**	**B.T. level**
1	Find the domain and range and sketch the graph of domain of following function(1) $f(x,y) = \sqrt{x^2 - y}$ (2) $f(x,y) = \frac{x^2}{\sqrt{x^2+y^2-4}}$	4	1.1.1	U
2	Sketch the following surfaces by using level curves (1) $z = x^2 + y^2$ (2) $z^2 = x^2 + y^2$ (3) $z = x + y$	4	1.1.1	U
3	Evaluate following limits if exist. (1) $\lim_{(x,y) \to (0,0)} \frac{2x^2-2xy}{\sqrt{x}-\sqrt{y}}$ (2) $\lim_{(x,y) \to (0,0)} \frac{x^2-y^2}{(x^2+y^2)}$ (3) $\lim_{(x,y) \to (0,0)} \frac{4xy^2}{(x^2+y^2)}$	4	1.1.1	U
4	Discuss the continuity of f(x,y) = $\frac{xy}{\sqrt{x^2+y^2}}$ $if\ (x,y) \neq (0,0)$; $0\ if\ (x,y) = (0,0)$	4	1.1.1	A
5	If $f(x,y) = \frac{2xy(x^2+y^2)}{x^2+y^2}$ $if\ (x,y) \neq (0,0)$; 0 $if\ (x,y) = (0,0)$ find $\left(\frac{\partial^2 f}{\partial x \partial y}\right)_{(0,0)}$ and $\left(\frac{\partial^2 f}{\partial y \partial x}\right)_{(0,0)}$	4	1.1.1	A
6	For following function show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ (1) $u = tan^{-1}\left(\frac{y}{x}\right)$ (2) $u = log\sqrt{x^2+y^2}$	4	1.1.1	A
7	If $\frac{x^2}{a^2+v} + \frac{y^2}{b^2+v} + \frac{z^2}{c^2+v} = 1$ where v is function of x,y,z then prove that $\left(\frac{\partial v}{\partial x}\right)^2 + \left(\frac{\partial v}{\partial y}\right)^2 + \left(\frac{\partial v}{\partial z}\right)^2 = 2\left(x\frac{\partial v}{\partial x} + y\frac{\partial v}{\partial y} + \frac{\partial v}{\partial z}\right)$	4	1.2.1	A
8	If $x = rcos\theta\ and\ y = rsin\theta$ prove that $\frac{\partial^2 r}{\partial x^2} + \frac{\partial^2 r}{\partial y^2} = \frac{1}{r}\left(\left(\frac{\partial r}{\partial x}\right)^2 + \left(\frac{\partial r}{\partial y}\right)^2\right)$	4	1.2.1	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 10	
Topic:	Partial Derivative
Sub Topics:	Mixed derivative theorem, differentiability, Chain rule, Implicit differentiation
Relevant CO:	4
Objectives:	1. Use of chain rule 2. Using partial derivative to find total derivative 3. Understanding of partial derivative of composite function

Sr. No.	Question	CO	PI	B.T. level
1	Explain Chain Rule for composite functions.	4	1.1.1	U
2	Find $\frac{du}{dt}$ if $u = x^2 + y^2 + z^2$, $x = e^{2t}$, $y = e^{2t}cos3t, z = e^{2t}sin3t$	4	1.1.1	U
3	The height of a right circular cone is 15cm and is increasing at the rates 0.4cm/s. The radius of the base is 10cm and is decreasing at the rate of 0.6cm/s. Find the rate of change of volume.	4	1.2.1	A
4	If $u = f(x - y, y - x, z - x)$ $prove$ $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	4	1.1.1	U
5	Using partial derivative find the value of $\frac{dy}{dx}$ for $xe^y + \sin(xy) + y - \log 2 = 0$ at (0, log2)	4	1.1.1	A
6	If $y^{x^y} = sinx$ then find $\frac{dy}{dx}$.	4	1.1.1	A
7	If $\sin(xyz) + x^3y^2z^2 + \log(x^2 + y^2 + x^2) = 0$ find $\frac{\partial z}{\partial x}, \frac{\partial y}{\partial z}, \frac{\partial y}{\partial x}$	4	1.1.1	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 11	
Topic:	Partial Derivative
Sub Topics:	Gradient, Directional derivative, tangent plane and normal line, total differentiation, Local extreme values, Method of Lagrange Multipliers
Relevant CO:	4
Objectives:	1. Evaluate gradient of scalar function 2. Calculate directional derivative 3. Find error using partial derivative 4. Find maximum and minimum value

Sr. No.	Question	CO	PI	B.T. level
1	"The flow of the heat in a temperature field take place in the direction of maximum decrease of temperature." If T is a temperature field then find the direction of maximum change of temperature at given point. (1)$T(x,y,z) = \frac{x}{x^2+y^2}$ *at point* $(1,-1,2)$ (2)$T(x,y) = e^{x^2+y^2}\sin(2xy)$ *at point* $P\left(\frac{\pi}{2},0\right)$	4	1.1.2	A
2	If $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ and $\lvert\vec{r}\rvert = \sqrt{x^2+y^2+z^2}$ then find grad(($\lvert\vec{r}\rvert^n$).	4	1.1.2	A
3	If $f(x,y,z) = e^{xyz} + tan^{-1}\left(\frac{x}{y}\right)$ then find grad(f) at point (1,1,1)	4	1.1.1	U
4	Explain directional derivative and find the directional derivative of f(x,y,z) = $3e^x\cos(yz)$ at point p(0,0,0) in the direction of $\vec{a} = 2 + 2\hat{\jmath} - 2\hat{k}$.	4	1.2.1	A
5	Find the angle between the surface $x^2 + y^2 + z^2 = 9$ and $x^2 + y^2 - z = 3$ at point (2, - 1 , 2).	4	1.1.1	A
6	Find the equation of tangent plane and normal line to the surface $2xz^2 - 3xy - 4x = 7$ at point (1, - 1, 2)	4	1.1.1	A
7	For simple pendulum $T = 2\pi\sqrt{\frac{l}{g}}$. Find the maximum error in T due to possible error 2.4% in l and 1% in g.	4	1.1.1	A
8	Find the local maximum and minimum values of $2(x^2 - y^2) - x^4 + y^4$.	4	1.1.1	A
9	Find the shortest distance from origin to the surface $xyz^2 = 2$.	4	1.2.1	A
10	Prove that the rectangular solid of maximum volume that can be inscribe in a sphere is a cube	4	1.2.1	A
11	Find the numbers x,y and z such that xyz = 8 and xy + yz +zx is maximum using Langrage Multipliers method	4	1.2.1	A

Date:	
Assignment/Tutorial No: 12	
Topic:	Multiple Integration
Sub Topics:	Multiple integral, Double integral over Rectangles and general regions, double integrals as volumes,
Relevant CO:	5
Objectives:	1. Evaluate multiple Integral 2. compute area and volume by using Multiple integral

Sr. No.	Question	CO	PI	B.T. level
1	Explain double integration with its geometric meaning.	5	1.1.2	U
2	Evaluate following double integrals (1) $\int_0^1 \int_0^1 \frac{dxdy}{\sqrt{(1-x^2)(1-y^2)}}$ (2) $\int_1^4 \int_{2x^2}^{3x^2} xe^{x^2+y} dydx$ (3) $\int_0^1 \int_0^{\sqrt{1-y^2}} x^2 + y^2 dxdy$ (4) $\int_o^{\pi} \int_{y=0}^{x} \frac{sinx}{x} dydx$	5	1.1.1	U
3	Evaluate $\int \int_R (x+y)^2$dxdy where R is a region enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	5	1.1.1	U
4	Evaluate $\iint_R x^2 \, dA$ where R is a region in the first quadrant bounded by the hyperbola xy = 16 and lines y = x , x = 4 and x = 8.	5	1.1.1	U
5	Evaluate $\iint_R r\sqrt{a^2 - r^2} drd\theta$ over the upper half of the circle r = a cosθ	5	1.1.1	U
6	Find the volume of prism where base is triangle in XY plane bounded by y axis y= x and y = 1 and whose top lies in the plane z = 2- x – y .	5	1.1.1	A
7	A thin plate covers the triangular region bounded by x axix and line x = 1 and y = 2x in the first octant. The plate density at point (x,y) is $\rho(x, y) = 6x + 6y + 6.$ Find the plate mass, first moments and center of mass about the coordinate axis.	5	1.1.1	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 13	
Topic:	Multiple Integration
Sub Topics:	Change of order of integration, double integration in polar coordinates, Area by double integration,
Relevant CO:	5
Objectives:	1. To change order of integration 2. To convert Cartesian coordinate to another coordinate for integral using Jacobian.

Sr. No.	Question	CO	PI	B.T. level
1	Describe change of order of multiple integration with figures.	5	2.1.3	U
2	Establish relation between Cartesian coordinate and polar coordinate. Also explain role of Jacobian in multiple integral	5	2.1.3	U
3	Evaluate following double integrals (1) $\int_0^\infty \int_x^\infty e^{-y^2} dydx$ (2) $\int_0^1 \int_x^{\sqrt{2-x^2}} \frac{x}{\sqrt{x^2+y^2}} dydx$ (3) $\int_0^2 \int_0^{4-x^2} \frac{xe^{2y}}{4-y} dydx$ (4) $\int_0^1 \int_0^{\sqrt{1-x^2}} \frac{e^y}{(e^y+1)\sqrt{1-x^2-y^2}} dydx$	5	1.1.1	A
4	Evaluate $\iint_R x^2+y^2\, dA$ by change of variables where R is the region lying in the first quadrant and bounded by the hyperbolas $x^2 - y^2 = 1, xy = 2, x^2 - y^2 = 9, xy = 4$.	5	1.1.2	A
5	Evaluate following by using polar coordinate (1) $\int_0^a \int_o^{\sqrt{a^2-y^2}} y^2\sqrt{x^2+y^2} dxdy$ (2) $\int_0^{2a} \int_0^{\sqrt{2ax-x^2}} x^2+y^2 dydx$	5	1.1.2	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment/Tutorial No: 14	
Topic:	Multiple Integration
Sub Topics:	Triple integrals in rectangular, cylindrical and spherical coordinates, Jacobian, multiple integral by substitution.
Relevant CO:	5
Objectives:	1. Evaluate multiple Integral 2. compute area and volume by using Multiple integral

Sr. No.	Question	CO	PI	B.T. level
1	Derive relation between Cartesian coordinate and spherical coordinate and cylindrical coordinate.	5	2.1.3	U
2	Evaluate following triple integrals (1) $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dzdydx}{\sqrt{1-x^2-y^2-z^2}}$ (2) $\int_{\theta=0}^{\frac{\pi}{2}} \int_{r=0}^{asin\theta} \int_{z=0}^{\frac{a^2-r^2}{a}} rdzdrd\theta$	5	1.1.1	A
3	Evaluate $\iiint_D \frac{dv}{(x^2+y^2+z^2)^{\frac{3}{2}}}$ where D is the region bounded by the sphere $x^2+y^2+z^2=a^2$ and $x^2+y^2+z^2=b^2$	5	1.1.1	A
4	Find the volume of the region B bounded by paraboloid $z = 4 - x^2 - y^2$ and XY plane.	5	1.1.2	A
5	Evaluate $\iiint_B \sqrt{x^2+y^2+z^2}dv$ where B is the region bounded by the plane z = 3 and the cone $z = \sqrt{x^2+y^2}$	5	1.1.2	A
6	Find the volume of "ice cream cone" cut from the solid sphere $\rho \leq 1$by the cone $\emptyset = \frac{\pi}{3}$	5	2.1.3	A
7	Show that the volume of sphere of radius r is $\frac{4}{3}\pi r^3$ by using (i) single integral (ii) double integral (iii) triple integral	5	1.1.2	A

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating