S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Near Shanku's Water Park,
Ahmedabad – Mehsana Highway,
Linch, Mehsana – 384435
Email: info@saffrony.ac.in
Web: www.saffrony.ac.in
Phone : (02762) 285721

Criterion 1: Curricular Aspects

Key Indicator- 1.1 Curricular Planning and Implementation

Metric Number: 1.1.1

ACADEMIC PRACTICES BOOKLET

Submitted to

NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

1.1.1 The Institution ensures effective curriculum planning and delivery through a well-planned and documented process including an Academic calendar and the conduct of continuous internal Assessments.

S.P.B. Patel Engineering College Linch

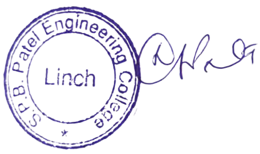
TIME TABLE:

Saffrony Institute of Technology
S.P.B.Patel Engineering College
Civil Engineering Department
Class Time Table
Winter 2021
17th June, 2021

Sem/Branch: **5CL** **Room No.:** **Online**

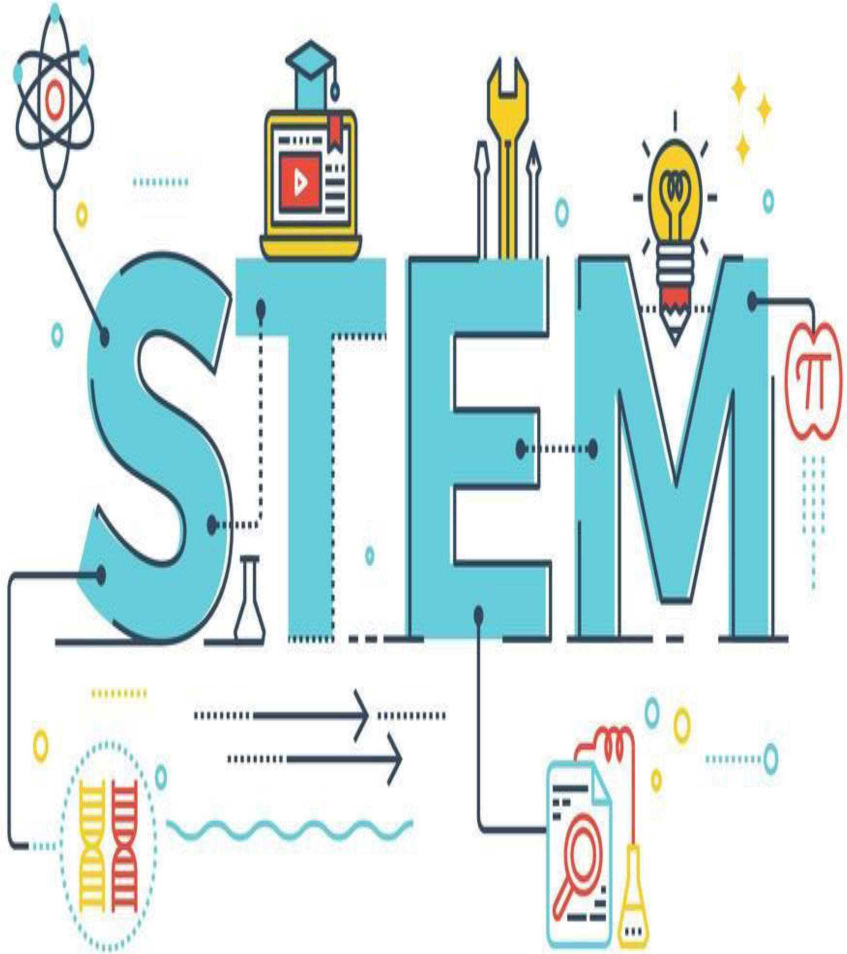
Time/Day	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
9:30 - 10:20	TE-MMJ	SM-JSS	DOS-AKD	TE-MMJ	CT-JGS
10:20 - 11:10	DOS-AKD	GIS-MMJ	IPDC	PLSD	DOS-AKD
11:10 - 12:00	DE-2A	DE-2A	IPDC	DOS-AKD	TE-MMJ
12:50 - 1:40	GIS-MMJ	CT-JGS	SM-JSS	GIS-MMJ	SM-JSS
1:40 - 2:30	CT-JGS	TE-MMJ	CT-JGS	GIS-MMJ	SM-JSS

Subject Name	Name of Teacher	Classroom Link	Recorded Lectures' Link
GIS	MMJ - Prof. Meet Jani	https://meet.google.com/nsr-hyiv-fye	https://drive.google.com/drive/folders/1RbqokaYasi2NiU76GTlShTPtBxXOdV-Q?usp=sharing
CT	JGS - Prof. Jaimin Suthar		https://drive.google.com/drive/folders/19E2cokBUXV9WcviqMnfTrME7cM0VEbUE?usp=sharing
DOS	AKD - Prof. Avani Dedhia	https://meet.google.com/zqm-yimi-akg	https://drive.google.com/drive/folders/1t9ea3tJFo0Cu02tceaKBYJ_8XxqiowVM?usp=sharing
TE	MMJ - Prof. Meet Jani	https://meet.google.com/tqy-dtji-qkz	https://drive.google.com/drive/folders/1boE1E0wvcv1t9zrzThDXM-T1XHlcgWGP?usp=sharing
SM	JSS - Prof. Joseph Sebastian Sibi	https://meet.google.com/xuv-qnfs-gvt	https://drive.google.com/folderview?id=1tHsFqZwA-wqUUJPmDX7wIbChQtcoZvq
IPDC	KRK - Prof. K R Kathia	Will be emailed	https://drive.google.com/drive/folders/1RdijOPg7A3fhIRW5FWAIPVGRNXCY_Enf
PLSD	Dr. Sumit Shah	Will be emailed	
DE-2-A	MMJ - Prof. Meet Jani	Will be emailed	



Orientation

MATHEMATICS -01 (3110014)

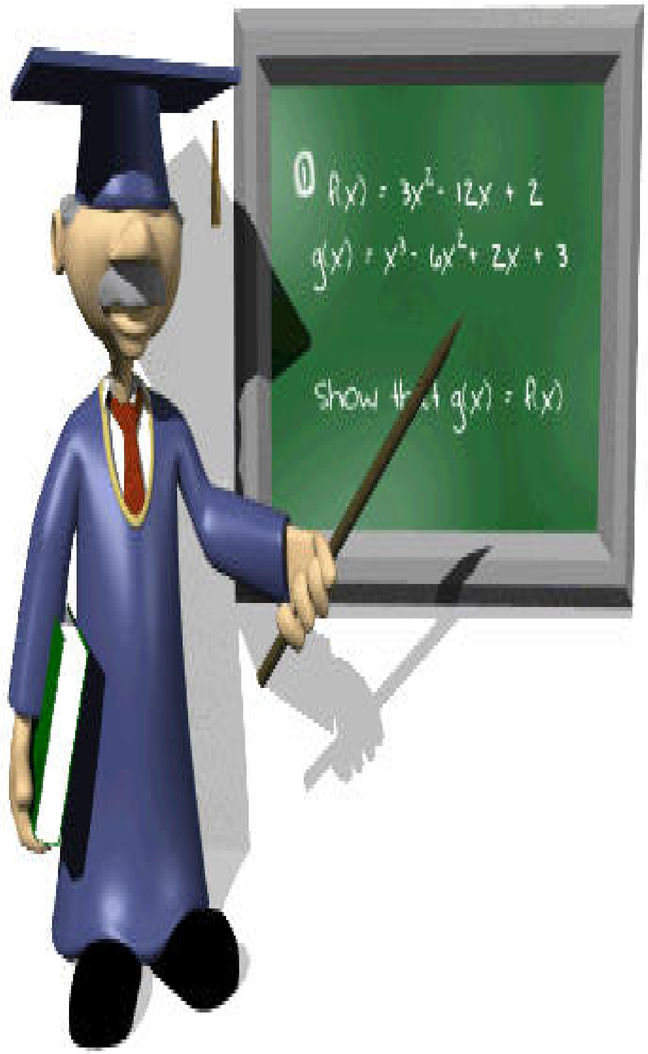


Prepared By
Dr. Rasik Patel

OUTLINE

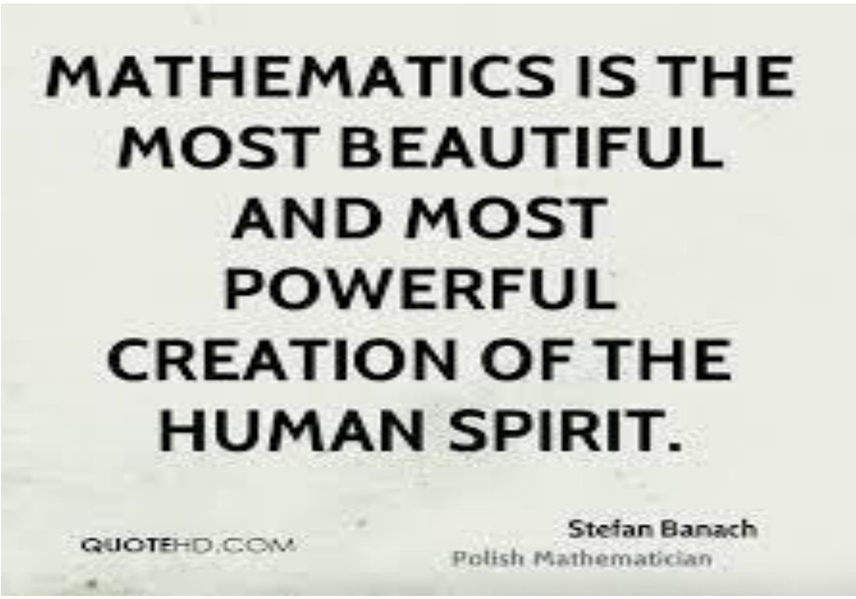
- Introduction
- Teaching Scheme
- History
- Application and Practical use
- Flow of the Subject
- Learning Materials
- Employment Opportunities
- Future Prospects
- Benefits

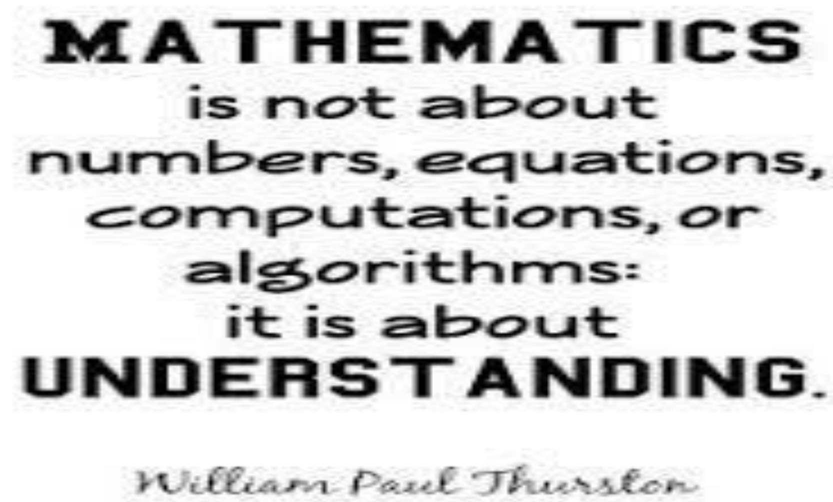
Teaching scheme

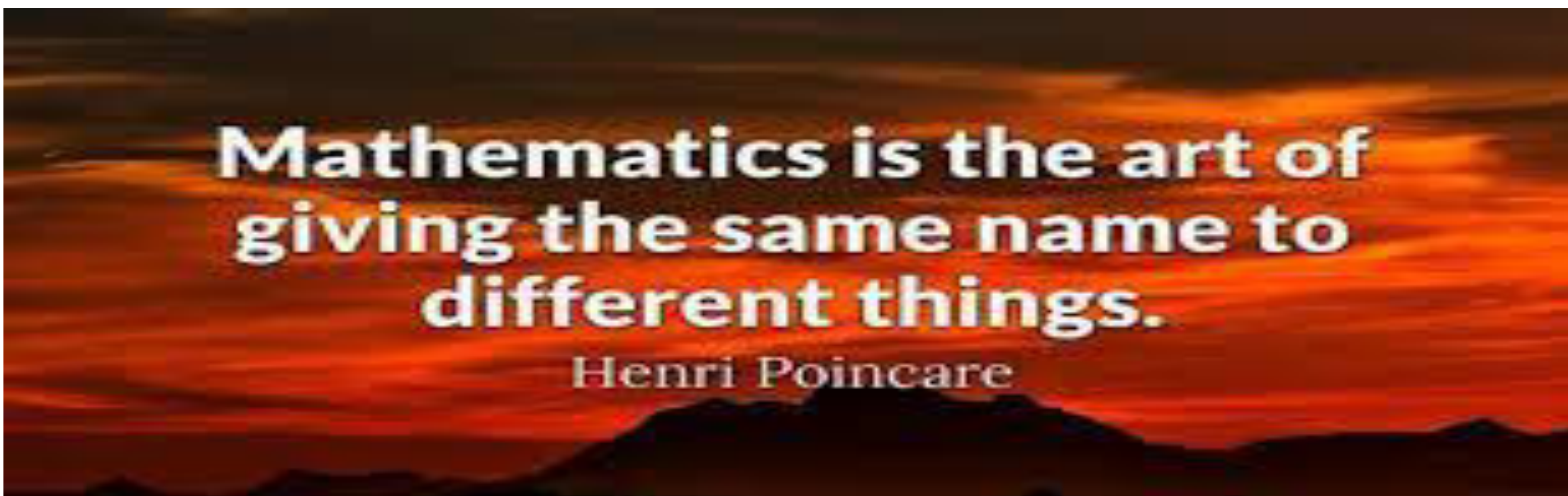


Areas	Marks Distribution
(1) Subject Credit	5
(2) Lecture	3
(3) Tutorial	2
(4) Mid semester Exam	30
(5) University Exam	70
Total	100

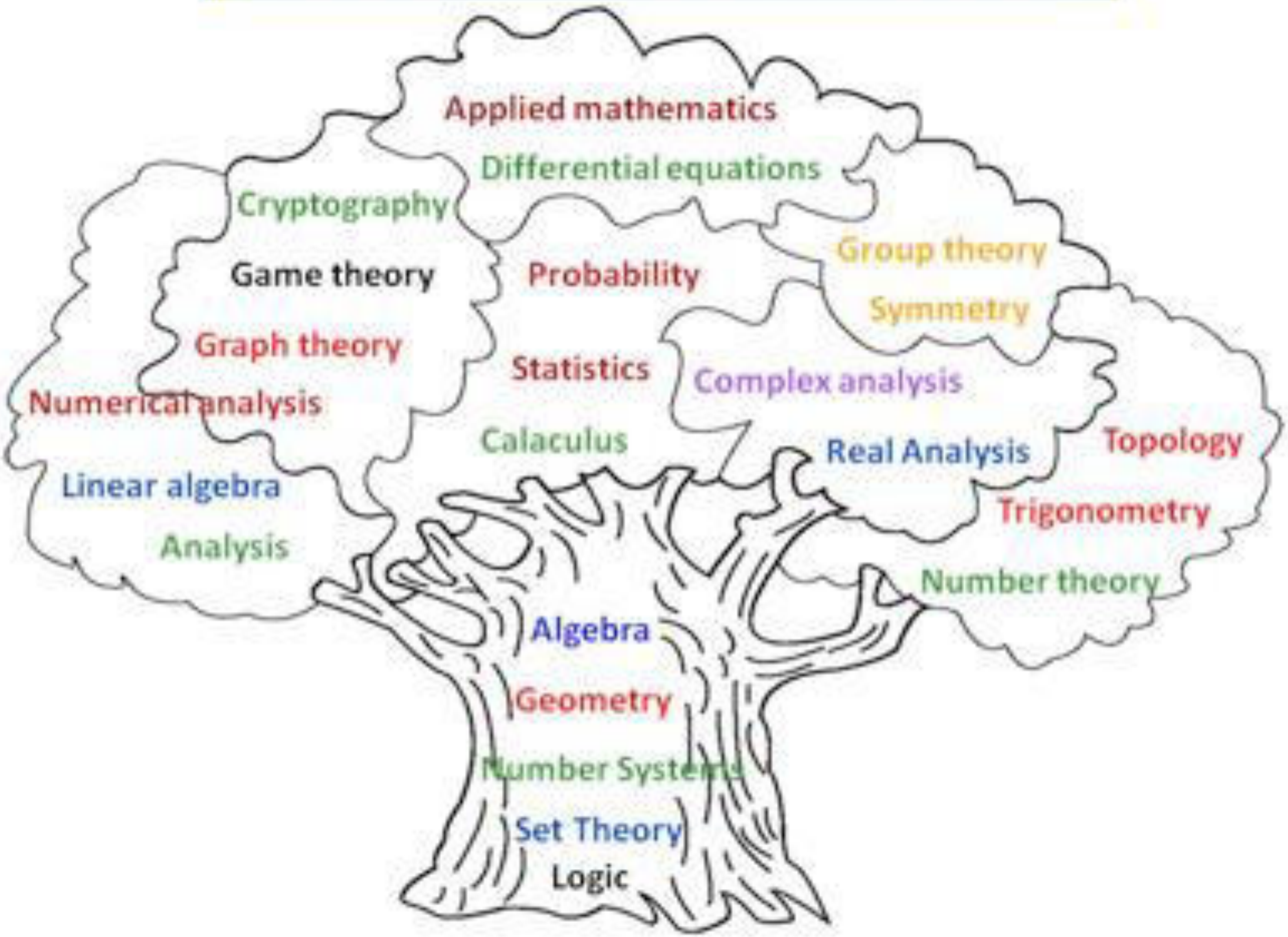
The Beauty of Mathematics



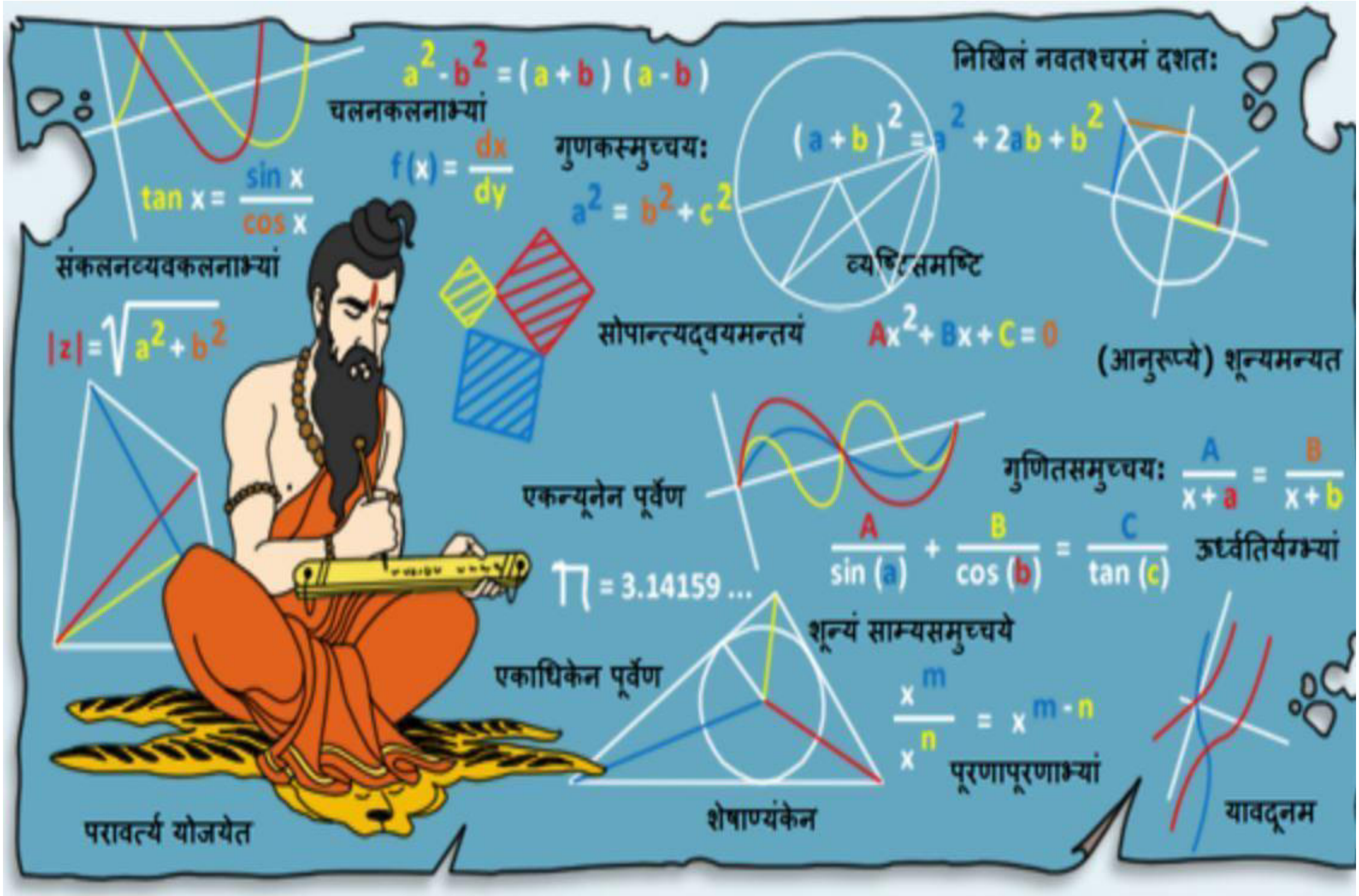




Mathematics: a tree with many branches



History of Mathematics



Fourier Series

http://www.gap-system.org/~history/PictDisplay/Fourier.html

Joseph Fourier
1768-1830

"In 1822, Joseph Fourier, a French mathematician, discovered that sinusoidal waves can be used as simple building blocks to describe and approximate any periodic waveform including square waves. Fourier used it as an analytical tool in the study of waves and heat flow. It is frequently used in signal processing and the statistical analysis of time series."

http://en.wikipedia.org/wiki/Sine_wave

The History of Differentiation

Differentiation is part of the science of Calculus, and was first developed in the 17th century by two different Mathematicians.

Gottfried Leibniz
(1646-1716)

Germany

Sir Isaac Newton
(1642-1727)

England

Differentiation, or finding the instantaneous rate of change, is an essential part of:

- Mathematics and Physics
- Chemistry
- Biology
- Computer Science
- Engineering
- Navigation and Astronomy

Application of Mathematics

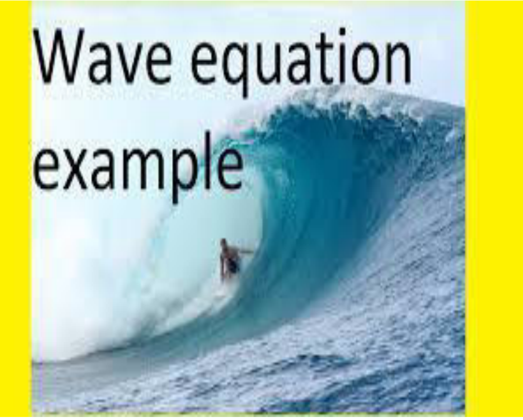
(1) Fourier series makes use of orthogonality relationships of the sine and cosine functions. It has many applications in Electrical engineering, Vibration analysis, Acoustics, Optics, Signal processing, Image Processing

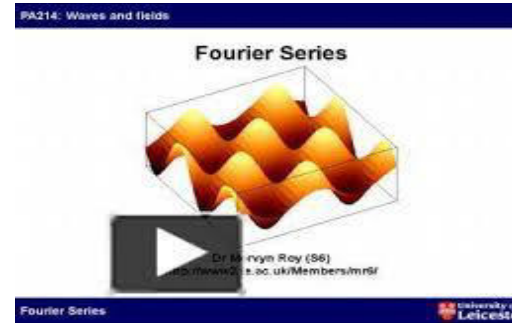
(2) Differential equations are used in Radioactive decay, Chemical reactions, Newton's law of cooling

(3) Partial differential are used in Sound ,Heat, Electrostatics, Electrodynamics, Fluid flow, Elasticity, Quantum mechanics

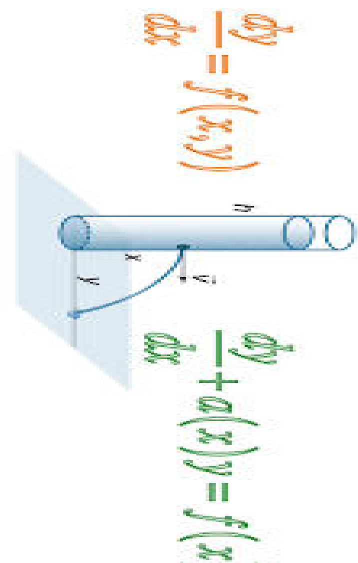
(4) Matrix in used in Graph theory, Linear combination in quantum state in physics, Computer graphics, solving linear equations, Cryptography

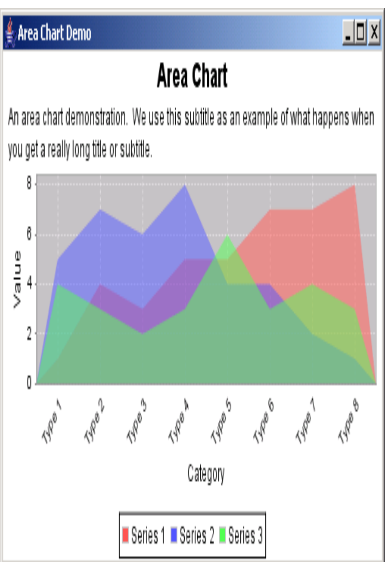
Flow of the Subject





- Matrix & System of linear eq.
- Partial differential
- Partial differential
- Infinite Series and Fourier series
- Undetermined and Multiple integrals

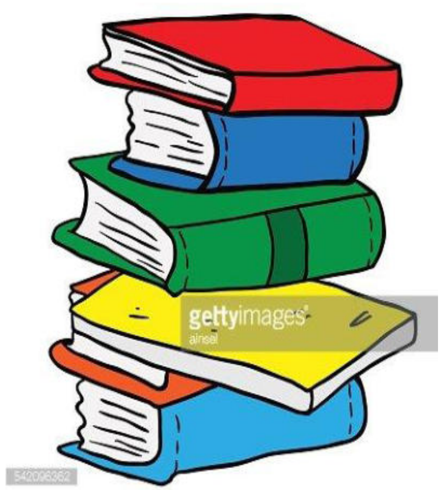


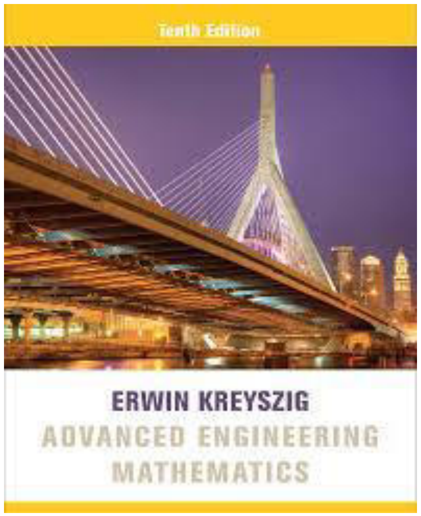


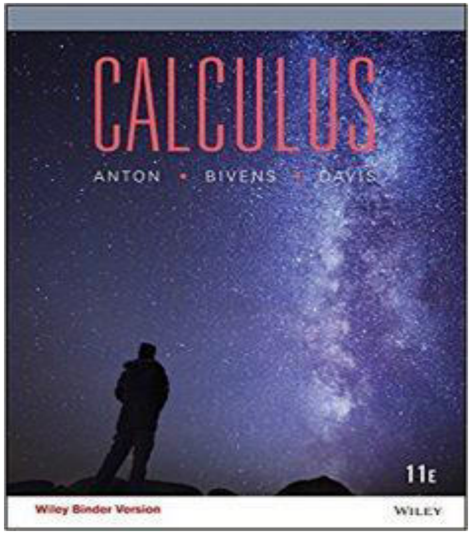
Learning materials

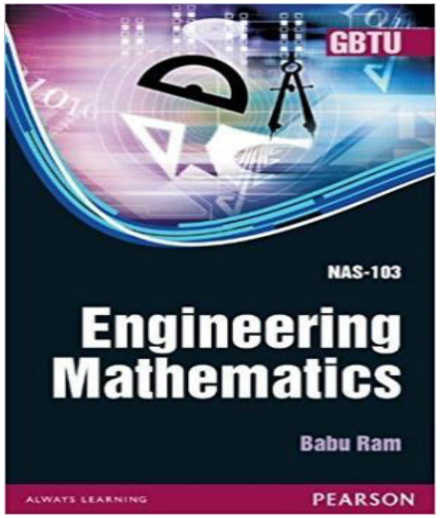
PPT
Presentations

Notes







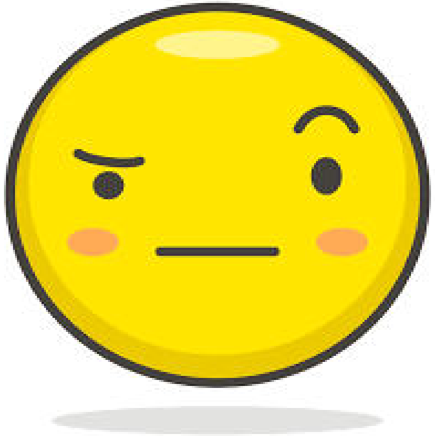


Career opportunities for mathematics

- accountant
- actuary
- computer programmer
- doctor
- engineer
- investment manager
- lawyer
- government research and laboratories
- theoretical mathematician
- mathematician
- numerical analyst
- statistician
- teacher
- market researcher
- systems analyst
- banking
- government
- space/aircraft industry

Open-Ended Problems

This is what we do
when we see Maths



Students should be able to :-

❖Find the Fourier series for a function defined on a closed interval

❖Identify and solve first order linear equations.

❖Determine the order of an ordinary differential equation. Classify an ordinary differential equation as linear or nonlinear.

❖Analyze the behavior of solutions.

THANK YOU

Syllabus-References

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME:All Branches
SUBJECT NAME:Mathematics 01
SUBJECT CODE:
1st Year (Semester 1)

Type of course: Basic Science Course

Prerequisite: Algebra, Trigonometry, Geometry

Rationale: The study of rate of changes, understanding to compute area, volume and express the function in terms of series, to apply matrix algebra.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	2	0	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
01	Indeterminate Forms and L'Hôspital's Rule.	01	15 %
	Improper Integrals, Convergence and divergence of the integrals, Beta and Gamma functions and their properties.	03	
	Applications of definite integral, Volume using cross-sections, Length of plane curves, Areas of Surfaces of Revolution	03	
02	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, n^{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.	08	20 %
03	Fourier Series of 2π periodic functions, Dirichlet's conditions for representation by a Fourier series, Orthogonality of the trigonometric system, Fourier Series of a function of period $2L$, Fourier Series of even and odd functions, Half range expansions.	04	10 %
04	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.	08	20 %
05	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, Triple	08	20 %

	integrals in rectangular, cylindrical and spherical coordinates, Jacobian, multiple integral by substitution.		
06	Elementary row operations in Matrix, Row echelon and Reduced row echelon forms, Rank by echelon forms, Inverse by Gauss-Jordan method, Solution of system of linear equations by Gauss elimination and Gauss-Jordan methods. Eigen values and eigen vectors, Cayley-Hamilton theorem, Diagonalization of a matrix.	07	15%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	**14**	**14**	**14**	**14**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

(**1**) Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.

(2) Howard Anton, Irl Bivens, Stephens Davis, Calculus, 10e, Wiley, 2016.

(3) James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.

(4) Elementary Linear Algebra, Applications version, Anton and Rorres, Wiley India Edition.

(5) Calculus, Volumes 1 & 2, T. M. Apostol, Wiley Eastern.

Course Outcome:

After learning the course the students should be able to:

1. identify indeterminate forms and can evaluate
2. determine the convergence/divergence of improper integral
3. use beta and gamma functions
4. evaluate volume by cross section
5. compute length of curve
6. evaluate the area of surfaces of revolution
7. determine the convergence or divergence of sequences
8. use the sandwich theorem for sequences
9. evaluate the value of geometric series
10. determine the nature of telescoping series
11. use integral test
12. apply the p - series for comparison test or Limit comparison test,
13. apply various tests for convergence or divergence of an infinite series
14. find the radius of convergence of a power series
15. find the Taylor series, Maclaurin series.
16. express the function in fourier series who satisfied Dirichlet's conditions
17. express the function in half range expansion

18. evaluate the limits of functions of two variable
19. understand the continuity of functions of two variables
20. apply the test for non existence of limit
21. find partial derivative
22. use chain rule
23. determine gradients and directional derivative
24. implicit and total differentiation
25. find local extreme values
26. use Lagrange's multipliers method to find extreme values
27. evaluate double integrals as area as well as volume
28. apply change of order of integration to simplify integral
29. compute double integration in polar coordinates
30. compute triple integrals in rectangular, cylindrical and spherical Coordinates
31. determine the Jacobian for substitution in multiple integral
32. use elementary row operations to get Row echelon form
33. use elementary row operations to get Reduced row echelon forms
34. find rank by echelon forms
35. compute inverse by Gauss-Jordan method
36. solve the system of linear equations by Gauss elimination
37. solve the system of linear equations by Gauss-Jordan methods.
38. find eigen values of matrices
39. find eigen vectors of matrices
40. use Cayley-Hamilton theorem to find inverse of a matrix
41. use Cayley-Hamilton theorem to find higher powers of a matrix
42. understand the diagonalization of a matrix.

List of Open Source Software/learning website:

Scilab, MIT Opencourseware.

Academic Calander

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ACADEMIC CALENDAR

2023-24

Submitted to

NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Academic Calendar of Semester - 1
2023 Winter - Degree Engineering

Activity	Sem 1
Orientation of 1st Sem	18.07.2023
Induction Program of 1st Sem	19.07.2023-26.07.2023
Commencement Date of 1st Sem Subject Orientation of 1st Sem	28.07.2023
List of Reference Books - Release to Students of 1st Sem 1st & 2nd Mid Sem Syllabus Release of 1st sem	31.07.2023
Independence Day	15.08.2023
Raksha Bandhan	30.08.2023
Syllabus & Attendance Review - I of 1st sem	01.09.2023
Teacher's Day Celebration	05.09.2023
Janmashtami	07.09.2023
Engineer's Day Celebration	15.09.2023
1st Mid Sem of 1st Sem	18.09.2023 - 25.09.2023
Samvatsari	19.09.2023
Mahatma Gandhi's Birthday	02.10.2023
Syllabus & Attendance Review - II of 1st sem	03.10.2023
1st Half of the Day - Result Declaration of Mid Sem - 1 of 1st Sem 2nd Half of the Day - Submision - I of 1st Sem	05.10.2023
PTM for 1st Sem	08.10.2023
Dusshera (Vijya Dashmi)	24.10.2023
GTU Term End of 1st Sem	04.11.2023
Syllabus & Attendance Review - III of 1st sem	06.11.2023
2nd Mid Sem of 1st Sem	03.11.2023 - 08.11.2023
Release of Viva Schedule of 1st Sem	21.11.2023
1st Half of the Day - Result Declaration of Mid Sem - 2 of 1st Sem 2nd Half of the Day - Submision - II of 1st Sem	22.11.2023

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S.P.B. Patel Engineering College Saffrony Institute of Technology Academic Calendar of Semester - 2 2023 Summer - Degree Engineering	
Activity	**Sem 2**
Commencement Date - 2nd Sem Academic Orientation & Offline Classes Orientation of 2nd Sem 1st & 2nd Mid Sem Syllabus of 2nd Sem	20.03.2023
List of Reference Books of 2nd Sem Subject Orientation of 2nd Sem	21.03.2023
Dr. Baba Saheb Ambedkar's Birthday	14.04.2023
Syllabus & Attendance Review - I	20.04.2023
Ramjan-Id (Id-Ul-Fitra)	22.04.2023
Syllabus & Attendance Review - II	01.05.2023
1st Mid Sem Exam	03.05.2023 - 08.05.2023
1st Half of the Day - Result Declaration of Mid Sem Exam - I of 2nd Sem 2nd Half of the Day - Submision - I of 2nd Sem	22.05.2023
PTM of 2nd Sem	27.05.2023
Syllabus & Attendance Review - III	01.06.2023
2nd Mid Sem Exam	16.06.2023 - 21.06.2023
Release of Viva Schedule	23.06.2023
GTU Term End of 2nd Sem 1st Half of the Day - Result Declaration of Mid Sem Exam - II of 2nd Sem 2nd Half of the Day - Submision - II of 2nd Sem Syllabus & Attendance Review - IV of 2nd Sem	01.07.2023
Veyg - 2023	To be announced
Fusion	To be announced
Felicitation, Farewell	To be announced
UDAAN	To be announced

S.P.B. Patel Engineering College Linch

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Academic Calendar of Semester - 3
2023 Winter - Degree Engineering

Activity	Sem 3
Commencement Date of 3rd Sem Subject Orientation of 3rd Sem	16.08.2023
List of Reference Books - Release to Students of 3rd Sem 1st & 2nd Mid Sem Syllabus of 3rd Sem	17.08.2023
Raksha Bandhan	30.08.2023
Teacher's Day Celebration	05.09.2023
Janmashtami	07.09.2023
Engineer's Day Celebration	15.09.2023
Design Engineering Review - I of 3rd Sem	26.09.2023
Samvatsari	19.09.2023
Mahatma Gandhi’s Birthday	02.10.2023
Syllabus & Attendance Review - I of 3rd Sem	03.10.2023
1st Mid Sem of 3rd Sem	09.10.2023 - 13.10.2023
Dusshera (Vijya Dashmi)	24.10.2023
1st Half of the Day - Result Declaration of Mid Sem - 1 of 3rd Sem 2nd Half of the Day - Submision - I of 3rd Sem	26.10.2023
Syllabus & Attendance Review - II of 3rd Sem	01.11.2023
PTM for 3rd Sem	05.11.2023
Diwali	12.11.2023
Vikram Samvant New Year Day	14.11.2023
Bhai Bij	15.11.2023
2nd Mid Sem of 3rd Sem	04.12.2023 - 08.12.2023
Syllabus & Attendance Review - III of 3rd Sem	01.12.2023
1st Half of the Day - Result Declaration of Mid Sem - 2 of 3rd Sem 2nd Half of the Day - Submision - II of 3rd Sem	11.12.2023
Christmas	25.12.2023
Release of Viva Schedule of 3rd Sem	29.12.2023
GTU Term End of 3rd Sem	30.12.2023
Design Engineering Review - II of 3rd Sem	08.01.2024

S.P.B. Patel Engineering College Saffrony Institute of Technology Academic Calendar of Semester - 4 2023 Summer - Degree Engineering	
Activity	**Sem 4**
Commencement Date - 4th Sem Academic Orientation & Offline Classes Orientation of 4th Sem 1st & 2nd Mid Sem Syllabus of 4th Sem	14.03.2023
List of Reference Books of 4th Sem Subject Orientation of 4th Sem	15.03.2023
Syllabus & Attendance Review - I Design Engineering Review - I	13.04.2023
Dr. Baba Saheb Ambedkar's Birthday	14.04.2023
Ramjan-Id (Id-Ul-Fitra)	22.04.2023
Syllabus & Attendance Review - II	01.05.2023
1st Mid Sem Exam	03.05.2023 - 08.05.2023
Design Engineering Review -II	19.05.2023
1st Half of the Day - Result Declaration of Mid Sem Exam - I 2nd Half of the Day - Submision - I	22.05.2023
PTM of 4th Sem	27.05.2023
Syllabus & Attendance Review - III	01.06.2023
2nd Mid Sem Exam	16.06.2023 - 21.06.2023
Release of Viva Schedule of 4th Sem	23.06.2023
GTU Term End of 4th Sem Syllabus & Attendance Review - IV of 4th Sem	24.06.2023
1st Half of the Day - Result Declaration of Mid Sem Exam - II of 4th Sem 2nd Half of the Day - Submision - II of 4th Sem	30.06.2023
Veyg - 2023	To be announced
Fusion	To be announced
Felicitation, Farewell	To be announced
UDAAN	To be announced

S.P.B. Patel Engineering College Linch

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Academic Calendar of Semester - 5
2023 Winter - Degree Engineering

Activity	Sem 5
Commencement Date of 5th Sem Subject Orientation of 5th Sem	03.08.2023
List of Reference Books - Release to Students of 5th Sem 1st & 2nd Mid Sem Syllabus of 5th Sem	04.08.2023
Independence Day	15.08.2023
Raksha Bandhan	30.08.2023
Teacher's Day Celebration	05.09.2023
Janmashtami	07.09.2023
Engineer's Day Celebration	15.09.2023
Syllabus & Attendance Review - I of 5th Sem	18.09.2023
Samvatsari	19.09.2023
Mahatma Gandhi’s Birthday	02.10.2023
Design Engineering Review - I of 5th Sem	03.10.2023
Dusshera (Vijya Dashmi)	24.10.2023
PTM for 5th Sem	29.10.2023
Design Engineering Review - II of 5th Sem	31.10.2023
Syllabus & Attendance Review - II of 5th Sem	01.11.2023
1st Mid Sem of 5th Sem	03.11.2023 - 09.11.2023
GTU Term End of 5th Sem	09.11.2023
Diwali	12.11.2023

S.P.B. Patel Engineering College
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Vikram Samvant New Year Day	14.11.2023
Bhai Bij	15.11.2023
1st Half of the Day - Result Declaration of Mid Sem - 1 of 5th Sem 2nd Half of the Day - Submision - I of 5th Sem	22.11.2023

S.P.B. Patel Engineering College Linch

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Academic Calendar of Semester - 6
2023 Summer - Degree Engineering

Activity	Sem 6
Commencement Date	31.01.2023
Academic Orientation & Offline Classes Orientation 1st & 2nd Mid Sem Syllabus List of Reference Books Subject Orientation	06.02.2023
Maha Shivratri	18.02.2023
Design Engineering Review - I	28.02.2023
Syllabus & Attendance Review - I	01.03.2023
Holi 2nd Day - Dhuleti	08.03.2023
1st Mid Sem Exam	27.03.2023 - 01.04.2023
Syllabus & Attendance Review - II	01.04.2023
Design Engineering Review -II	07.04.2023
1st Half of the Day - Result Declaration of Mid Sem Exam - I 2nd Half of the Day - Submision - I	13.04.2023
Dr. Baba Saheb Ambedkar's Birthday	14.04.2023
PTM	15.04.2023
Ramjan-Id (Id-Ul-Fitra)	22.04.2023
Syllabus & Attendance Review - III	01.05.2023
Design Engineering Review -III	12.05.2023
2nd Mid Sem Exam	15.05.2023 - 20.05.2023
Release of Viva Schedule	22.05.2023
GTU Term End of 6th Sem 1st Half of the Day - Result Declaration of Mid Sem Exam - II Syllabus & Attendance Review - IV	27.05.2023
Veyg - 2023	To be announced
Fusion	To be announced
Felicitation, Farewell	To be announced
UDAAN	To be announced

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Academic Calendar of Semester - 7
2023 Winter - Degree Engineering

Activity	Sem 7
Commencement Date of 7th Sem Subject Orientation of 7th Sem	16.08.2023
List of Reference Books - Release to Students of 7th Sem 1st & 2nd Mid Sem Syllabus of 7th sem	17.08.2023
Raksha Bandhan	30.08.2023
Teacher's Day Celebration	05.09.2023
Janmashtami	07.09.2023
Engineer's Day Celebration	15.09.2023
Samvatsari	19.09.2023
Mahatma Gandhi’s Birthday	02.10.2023
Syllabus & Attendance Review - I of 7th Sem	03.10.2023
Dusshera (Vijya Dashmi)	24.10.2023
Syllabus & Attendance Review - II of 7th Sem	01.11.2023
1st Mid Sem of 7th Sem	03.11.2023 - 09.11.2023
PTM for 7th Sem	05.11.2023
GTU Term End of 7th Sem	09.11.2023
Diwali	12.11.2023
Vikram Samvant New Year Day	14.11.2023
Bhai Bij	15.11.2023
1st Half of the Day - Result Declaration of Mid Sem - 1 of 5th Sem GTU Fighters Session of 5th Sem	22.11.2023

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Lesson-Plan

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Humanities and Sciences Department
Lesson Plan & Session Plan

Name of Faculty Member:Dr. Rasik Patel		Semester 1IT			
Subject Name: Mathematics-I		Winter 2021			
Subject Code: 3110014		Teaching Scheme: 3L+2T			
Unit No.	Name of Unit	Planned - Session Plan Contents	Actual Delivered - Session Plan Contents	"Assignment Number (For example A1.1 means Assignment 1, Question 1 A2.1 means Assignment 2, Questio 1 & so on)"	Date of conduction
1	Indetermined and Improper integrals	1. [5 min] Introduction to the subject 2. [15 min] Explain about Indeterminates forms 3. [10 min] Explain about L' Hospital rules 4. [20 min] Different types of Examples	1. [6 min] Introduction to the subject 2. [16 min] Explain about Indeterminates forms 3. [12 min] Explain about L' Hospital rules 4. [14 min] Different types of Examples	Unit 1 - Assignment	28/12/2021
		1. [9 min] Explain about Improper integrals 2. [10 min] Explain about Improper of first and second kind 3. [26 min] Different types of Examples	1. [12 min] Explain about Improper integrals 2. [15 min] Explain about Improper of first and second kind 3. [23 min] Different types of Examples	Unit 1 - Assignment	30/12/2021, 31/12/2021
		1. [5 min] Revision above topics 2. [13 min] Explain about Gamma function 3. [14 min] Explain about its properties 4. [18 min] Different types of Examples	1. [7 min] Revision above topics 2. [14 min] Explain about Gamma function 3. [16 min] Explain about its properties 4. [13 min] Different types of Examples	Unit 1 - Assignment	07-01-2022
		1. [5 min] Revision above topics 2. [13 min] Explain about Beta function 3. [14 min] Explain about its properties 4. [18 min] Different types of Examples	1. [7 min] Revision above topics 2. [15 min] Explain about Beta function 3. [18 min] Explain about its properties 4. [10 min] Different types of Examples	Unit 1 - Assignment	10/01/2022, 11/01/2022
		1. [5 min] Revision of above topics 2. [12 min] Explain about Taylor's sreies 3. [8 min] Explain about Maclaurian series 4. [25 min] Different types of Examples	1. [5 min] Revision of above topics 2. [15 min] Explain about Taylor's sreies 3. [10 min] Explain about Maclaurian series 4. [20 min] Different types of Examples	Unit 1 - Assignment	01-03-2022
		1. [16 min] Revision about all topics 2. [17 min] Solve-MCQs about Indeterminate, Improper integrals, Gamma and Beta functions 3. [17 min] Solve -MCQ- Fourier series and Infinite series	1. [16 min] Revision about all topics 2. [17 min] Solve-MCQs about Indeterminate, Improper integrals, Gamma and Beta functions 3. [17 min] Solve -MCQ- Fourier series and Infinite series	Unit 1 - Assignment	02-04-2022
2	Infinite series	1. [6 min] Introduction to the subject 2. [10 min] explain about Sequence and types of sequence 3. [12 min] Explain about convergence and divergence and its sum 4. [22 min] Different types of Examples	1. [7 min] Introduction to the subject 2. [12 min] explain about Sequence and types of sequence 3. [15 min] Explain about convergence and divergence and its sum 4. [16 min] Different types of Examples	Unit 2 - Assignment	20/12/2021
		1. [5 min] Revision of above topics 2. [8 min] Explain about Series 3. [10 min] Explain about convergence and divergence series 4. [27 min] Explain about Geometric series and examples	1. [6 min] Revision of above topics 2. [10 min] Explain about Series 3. [15 min] Explain about convergence and divergence series 4. [19 min] Explain about Geometric series and examples	Unit 2 - Assignment	21/12/2021
		1. [5 min] Revision of above topics 2. [6 min] Explain about P-te	1. [6 min] Revision of above topics 2. [8 min] Explain about P-test Series 3. [20 min] Explain about Co		22/12/2021
		1. [5 min] Revision of above topics 2. [12 min] Explain about Ratio test 3. [12 min] Explain about Root test 4. [21 min] Different types of examples	1. [6 min] Revision of above topics 2. [14 min] Explain about Ratio test 3. [14 min] Explain about Root test 4. [16 min] Different types of examples	Unit 2 - Assignment	22/12/2021
		1. [5 min] Revision of above topics 2. [6 min] Explain Alternate series 3. [10 min] Explain about Libnitz's test 4. [29 min] Explain about Absolute and conditional convergent and examples	1. [7 min] Revision of above topics 2. [8 min] Explain Alternate series 3. [12 min] Explain about Libnitz's test 4. [23 min] Explain about Absolute and conditional convergent and examples	Unit 2 - Assignment	27/12/2021
		1. [5 min] Revision of above topics 2. [8 min] Explain about Power series 3. [10 min] Explain about radius of convergence 4. [27 min] Different types of examples	1. [8 min] Revision of above topics 2. [12 min] Explain about Power series 3. [14 min] Explain about radius of convergence 4. [16 min] Different types of examples	Unit 2 - Assignment	27/12/2021
3	Fourier Series	1. [5 min] Introduction to the subject 2. [5 min] Applications of the subject 3. [12 min] Explain about Fourier series 4. [28 min] Different types of Examples	1. [6 min] Introduction to the subject 2. [7 min] Applications of the subject 3. [18 min] Explain about Fourier series 4. [19 min] Different types of Examples	Unit 3 - Assignment	25/11/2021
		1. [5 min] Revision of above topics 2. [20 min] Explain about different types of fourier series 3. [25 min] Examples	1. [7 min] Revision of above topics 2. [24 min] Explain about different types of fourier series 3. [19 min] Examples	Unit 3 - Assignment	30/11/2021
		1. [5 min] Revision of above topics 2. [10 min] Explain about fourier series of even function 3. [10 min] Explain about fourier series of odd function 4. [25 min] Different types of Examples	1. [7 min] Revision of above topics 2. [12 min] Explain about fourier series of even function 3. [12 min] Explain about fourier series of odd function 4. [19 min] Different types of Examples	Unit 3 - Assignment	30/11/2021
		1. [5 min] Revision of above topics 2. [10 min] Explain about fourier sine series 3. [10 min] Explain about fourier cosine series 4. [25 min] Different types of Examples	1. [7 min] Revision of above topics 2. [11 min] Explain about fourier sine series 3. [11 min] Explain about fourier cosine series 4. [21 min] Different types of Examples	Unit 3 - Assignment	12-01-2021
		1. [5 min] Introduction to the subject 2. [8 min] Application of this topic 3. [19 min] Difference between ordinary and partial derivatives 4. [18 min] Different types of Examples	1. [6 min] Introduction to the subject 2. [9 min] Application of this topic 3. [20 min] Difference between ordinary and partial derivatives 4. [15 min] Different types of Examples		11-10-2021
		1. [5 min] Revision above topics 2. [12 min] Explain about limit in one and two variables 3. [12 min] Explain about continuity of the function 4. [21 min] Different types of Examples	1. [6 min] Revision above topics 2. [15 min] Explain about limit in one and two variables 3. [14 min] Explain about continuity of the function 4. [15 min] Different types of Examples	Unit 4 - Assignment	10/11/2021, 11/11/2021
		1. [8 min] Revision above topics 2. [8 min] Explain about Homogeneous function 3. [18 min] Explain about Eiuler's theorem and proof 4. [16 min] Different types of Examples	1. [7 min] Revision above topics 2. [12 min] Explain about Homogeneous function 3. [20 min] Explain about Eiuler's theorem and proof 4. [11 min] Different types of Examples	Unit 4 - Assignment	11-12-2021
		1. [6 min] Revision above topics 2. [18 min] Explain about Modified euler's theorem 3. [10 min] Explain properties of modified euler's thm. 4. [16 min] Different types of Examples	1. [7 min] Revision above topics 2. [19 min] Explain about Modified euler's theorem 3. [12 min] Explain properties of modified euler's thm. 4. [12 min] Different types of Examples	Unit 4 - Assignment	15/11/2021
		1. [6 min] Revision above topics 2. [08 min] Explain about chain rules 3. [20 min] Explain composite function of one and two variable. 4. [16 min] Different types of Examples	1. [5 min] Revision above topics 2. [10 min] Explain about chain rules 3. [21 min] Explain composite function of one and two variable. 4. [14 min] Different types of Examples	Unit 4 - Assignment	16/11/2021, 17/11/2021

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4	Partial Derivatives and Its Application	1. [7 min] Revision above topics 2. [10 min] Explain about implicit function 3. [15 min] Explain tangent plane and normal line 4. [18 min] Different types of Examples	1. [8 min] Revision above topics 2. [12 min] Explain about implicit function 3. [14 min] Explain tangent plane and normal line 4. [16 min] Different types of Examples	Unit 4 - Assignment	17/11/2021
		1. [5 min] Explain diff. between Vector and Scalar. 2. [12 min] Explain about Grediant of scalar function 3. [15 min] Explain about Directional derivatives 4. [18 min] Unit normal vector	1. [5 min] Explain diff. between Vector and Scalar. 2. [12 min] Explain about Grediant of scalar function 3. [15 min] Explain about Directional derivatives 4. [18 min] Unit normal vector		18/11/2021
		1. [15 min] Explain about Maximum and minimum for one variable 2. [20 min] Explain about Maximum and minimum for two variable 3. [15 min] Different types of Examples	1. [18 min] Explain about Maximum and minimum for one variable 2. [22 min] Explain about Maximum and minimum for two variable 3. [10 min] Different types of Examples	Unit 4 - Assignment	19/11/2021
		1. [5 min] Revision above topics 2. [8 min] Explain about Jacobian transformation 3. [20 min] Explain Lagrange's method 4. [17 min] Different types of Examples	1. [7 min] Revision above topics 2. [10 min] Explain about Jacobian transformation 3. [22 min] Explain Lagrange's method 4. [11 min] Different types of Examples	Unit 4 - Assignment	22/11/2021
		1. [5 min] Revision above topics 2. [10 min] Explain about taylor's series one variable	1. [6 min] Revision above topics 2. [12 min] Explain about taylor's series one variable		23/11/2021
		1. [10 min] Revision about all topics 2. [20 min] Solve MCQ- Partial derivatives 3. [20 min] Solve MCQ- Matrices and system of linear equations, eigen values and eigen vectors	1. [12 min] Revision about all topics 2. [21 min] Solve MCQ- Partial derivatives 3. [17 min] Solve MCQ- Matrices and system of linear equations, eigen values and eigen vectors		24/11/2021
5	Multiple integrals	1. [8 min] Introduction to Multiple integrals 2. [10 min] Application of this topic 3. [12 min] Explain about Double integration 4. [20 min] Different types of double integration Examples	1. [10 min] Introduction to Multiple integrals 2. [12 min] Application of this topic 3. [14 min] Explain about Double integration 4. [14 min] Different types of double integration Examples	Unit 5 - Assignment	18/01/2022, 19/01/2022
		1. [8 min] Introduction to graphs 2. [10 min] Discuss with differents graphs line, triangles, parabola 3. [12 min] Explain about Double integration over the region 4. [20 min] Different types of double integration Examples	1. [10 min] Introduction to graphs 2. [12 min] Discuss with differents graphs line, triangles, parabola 3. [14 min] Explain about Double integration over the region 4. [14 min] Different types of double integration Examples	Unit 5 - Assignment	20/01/2022, 21/01/2022
		1. [8 min] Revision above topics 2. [10 min] Changing order of integration over the region in xy plane 3. [12 min] Explain about Changing order of integration over different curves 4. [20 min] Different types of Examples and questions answering	1. [8 min] Revision above topics 2. [10 min] Changing order of integration over the region in xy plane 3. [12 min] Explain about Changing order of integration over different curves 4. [20 min] Different types of Examples and questions answering	Unit 5 - Assignment	24/01/2022
		1. [6 min] Explain about polar region 2. [12 min] Double integration over the polar region and examples 3. [14 min] Changing cartesian into polar form 4. [18 min] Different types of Examples and questions answering	1. [7 min] Explain about polar region 2. [14min] Double integration over the polar region and examples 3. [12 min] Changing cartesian into polar form 4. [17 min] Different types of Examples and questions answering	Unit 5 - Assignment	25/01/2022, 27/01/2022
		1. [6 min] Explain about Jacobian 2. [12 min] Explain about Jacobian transformation 3. [14 min] Explain about different curves and transformation 4. [18 min] Different types of Examples and questions answering	1. [8 min] Explain about Jacobian 2. [14 min] Explain about Jacobian transformation 3. [10 min] Explain about different curves and transformation 4. [18 min] Different types of Examples and questions answering	Unit 5 - Assignment	28/01/2022
		1. [6 min] Introduction of triple integration 2. [10 min] Triple integration examples 3. [14 min] Explain about different integration w.r.t x, y, z 4. [20 min] Different types of Examples and questions answering	1. [9 min] Introduction of triple integration 2. [12 min] Triple integration examples 3. [16 min] Explain about different integration w.r.t x, y, z 4. [13 min] Different types of Examples and questions answering	Unit 5 - Assignment	31/01/2022
6	Matrices and System of Linear Equations	1. [10 min] Introduction to the subject 2. [10 min] Application of this topic 3. [15 min] Definition of Matrices and Types of Matrices 4. [15 min] Different types of Examples	1. [08 min] Introduction to the subject 2. [13 min] Application of this topic 3. [16 min] Definition of Matrices and Types of Matrices 4. [13 min] Different types of Examples	Unit 6 - Assignment	11-12-2021
		1. [5 min] Revision about previous lecture(topics) 2. [16 min] Row echelon form Method 3. [14 min] Reduced row echelon form method 4. [15 min] Examples of REF and RREF	1. [6 min] Revision about previous lecture(topics) 2. [18 min] Row echelon form Method 3. [15 min] Reduced row echelon form method 4. [11 min] Examples of REF and RREF	Unit 6 - Assignment	13/10/2021
		1. [5 min] Explain Rank of the Matrix 2. [12 min] Explain Rank of the Matrix by row echelon form 3. [15 min] Explain Rank of the Matrix by Reduced -row echelon form and determinants 4. [18 min] Examples	1. [6 min] Explain Rank of the Matrix 2. [13 min] Explain Rank of the Matrix by row echelon form 3. [17 min] Explain Rank of the Matrix by Reduced -row echelon form and determinants 4. [14 min] Examples	Unit 6 - Assignment	13/10/2021
		1.[20] Explain Inverse of the matrix by Adjoint method 2. [30] Explain Inverse of the matrix by Gauss method	1.[25] Explain Inverse of the matrix by Adjoint method 2. [25] Explain Inverse of the matrix by Gauss method	Unit 6 - Assignment	14/10/2021
		1.[15] Explain Gauss elimination Method for Non-Homogeneous 2. [15]Explain Gauss -Jordan elimination Method for Non-Homogeneous 3. [20] Explain Solution of Non-Homogeneou linear equations	1.[14] Explain Gauss elimination Method for Non-Homogeneous 2. [17]Explain Gauss -Jordan elimination Method for Non-Homogeneous 3. [19] Explain Solution of Non-Homogeneou linear equations	Unit 6 - Assignment	19/10/2021
		1.[15] Explain Gauss elimination Method for Homogeneous 2. [15]Explain Gauss -Jordan elimination Method for Homogeneous 3. [20] Explain Solution of Homogeneou linear equations	1.[16] Explain Gauss elimination Method for Homogeneous 2. [16]Explain Gauss -Jordan elimination Method for Homogeneous 3. [18] Explain Solution of Homogeneou linear equations	Unit 6 - Assignment	20/10/2021
		1. [10 min] Revision about all topics 2. [20 min] Solve Extra examples- Orthogonal, Unitary, Symmetric , Skew Symmetric Matrix 3. [20 min] Solve Extra examples- Rank of the Matrix, Inverse, Gauss elimination, Gauss jordan method,	1. [12 min] Revision about all topics 2. [19 min] Solve Extra examples- Orthogonal, Unitary, Symmetric , Skew Symmetric Matrix 3. [19 min] Solve Extra examples- Rank of the Matrix, Inverse, Gauss elimination, Gauss jordan method,	Unit 6 - Assignment	20/10/2021

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	1. [5 min] Revision about previous lecture(topics) 2. [12 min] Eigen values 3. [12 min] Properties of Eigen values 4. [21 min] Examples of Eigen values	1. [7 min] Revision about previous lecture(topics) 2. [10 min] Eigen values 3. [20 min] Properties of Eigen values 4. [13 min] Examples of Eigen values		22/10/2021, 25/10/2021
	1. [5 min] Revision about previous lecture(topics) 2. [20 min] Explain about Eigen vectors by cramer's rule or Gauss elimination 3. [25 min] Examples of Eigen vectors	1. [08 min] Revision about previous lecture(topics) 2. [21 min] Explain about Eigen vectors by cramer's rule or Gauss elimination 3. [21 min] Examples of Eigen vectors		26/10/2021
	1. [5 min] Revision about previous lecture(topics) 2. [20 min] Caley-Hamilton Theorem 3. [25 min] Examples	1. [6 min] Revision about previous lecture(topics) 2. [22 min] Caley-Hamilton Theorem 3. [22 min] Examples		27/10/2021
	1. [5 min] Revision about previous lecture(topics) 2. [20 min] Diagonalization Matrix 3. [25 min] Examples	1. [6 min] Revision about previous lecture(topics) 2. [25 min] Diagonalization Matrix 3. [19 min] Examples		27/10/2021

Unit-2-Test-13-In
Unit-3-Test-14-F
Doubts solving se
Unit-6-Matrices-I
Lecture-Unit-5-P
Unit-5-Test-15-M
Power point prese
Power point prese
Mid sem-2 syllab

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Tutorial-List

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Humanities and Sciences Department
Lab Conduction Plan / Tutorial Conduction Plan
Winter 2021

Name of Faculty Member: Dr. Rasik Patel	Semester: 1IT
Subject Name: Mathematics-I	Winter 2021
Subject Code: 3110014	Teaching Scheme: 3L + 2T

Sr. No.	Name of Tutorial
1	Indeterminate forms and Improper Integrals
2	Infinite Series
3	Fourier Series
4	Partial Derivatives and its Appliaction
5	Multiple Integrals
6	Matrices and System of Linear Equations

Tutorial-Plan

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Humanities and Sciences Department
Lab Conduction Plan / Tutorial Conduction Plan
Winter 2021

Name of Faculty Member: Dr. Rasik Patel	Semester: 1IT
Subject Name: Mathematics-I	Winter 2021
Subject Code: 3110014	Teaching Scheme: 3L + 2T

Sr. No.	Name of Practical	Date of conduction					
		Batch A		Batch B		Batch C	
		Planned Date	Actual Date	Planned Date	Actual Date	Planned Date	Actual Date
1	Indeterminate forms and Improper Integrals						
2	Infinite Series	28/12/2021, 4/01/2022	28/12/2021, 4/01/2022	31/12/2021, 4/01/2022	23/12/2021, 4/01/2022	01-03-2022	01-03-2022
3	Fourier Series	27/12/2021, 11/01/2022	27/12/2021, 11/01/2022	23/12/2021	23/12/2021	27/12/2021, 10/01/2022	27/12/2021, 10/01/2022
4	Partial Derivatives and its Appliaction	02-08-2022	02-08-2022	02-10-2022	02-10-2022	02-07-2022	02-07-2022
5	Multiple Integrals	25/01/2022, 1/02/2022	25/01/2022, 1/02/2022	20/01/2022, 27/01/2022	20/01/2022, 27/01/2022	24/01/2022, 31/01/2022	24/01/2022, 31/01/2022
6	Matrices and System of Linear Equations	18/01/2022	18/01/2022	02-03-2022	02-03-2022	17/01/2022	17/01/2022

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Continuous-Evaluation-Sheet

S.P.B.Patel Engineering College
Saffrony Institute of Technology
Continuous Evaluation Sheet

1. Branch: Information Technology — 2. Sem & Div: 1IT — 3. Term: Winter 2021

4. Subject Code: 3110014 — 5. Subject Name: Mathematics-I — 6. Faculty Name: Dr. Rasik Patel

Last Name	First Name	Unit -6-Assignment-6-Matrices and System of Linear	Unit 4-Assignment-Partial-Derivatives-and-its application	Quiz-4-Assignment-4-Partial-Derivatives	Unit -Quiz-Assignment-6-Matrices and System of Linear	Unit 2-Assignment-2 Infinite Series	Unit 3-Assignment-3-Fourier-Series	Mid Sem-I-Paper	T1	T2	T3	T4	T5	T6		T7		T9	T11	T12	T13	T14
Points		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	12	10
PATEL	ANKITKUMAR	10	0	10	10	8	9	8	7	7	9	9	9	9	9	10	9	10	1	9	10	0
NANRA	KAMALPREETSINGH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GHANCHI	MOHAMMADHUJEFA F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PATEL	NIMISHABEN	0	10	10	10	10	9	10	0	0	0	9	8	9	9	5	0	10	0	9	10	7
SHARMA	SANJEET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAGHELA	VISHWARAJSINH	0	0	0	0	0	0	10	0	0	0	0	0	0	9	10	0	0	0	0	0	0
PANDYA	05-IT-DINKAR	10	10	10	10	10	10	10	10	10	10	10	10	9	10	10	10	9	8	9	10	8
	06-IT-MANN SHAH	0	10	10	10	10	8	8	9	10	10	10	10	8	10	10	10	8	4	6	9	9
PRAJAPATI	10-IT-MITKUMAR	9	10	10	10	10	10	10	10	10	10	10	10	10	5	6	8	10	7	9	9	10
GUPTA	12-IT-ADITYA	9	10	10	10	10	10	10	10	10	10	10	10	9	10	8	9	10	4	10	10	10
Patel	13-IT-Drashti	10	10	10	10	10	10	10	6	6	10	10	10	10	9	5	8	10	3	7	7	0
Vansh patel	16-it-	9	0	10	10	9	8	8	7	8	10	9	9	9	10	10	0	10	6	9	7	0
SATHVARA	19-IT-ARYAN	10	10	10	10	8	8	8	7	9	0	0	0	0	0	0	0	0	8	7	6	9
Riyaben prajapati	21-IT	0	0	10	10	10	10	10	6	9	9	10	10	10	9	10	8	10	3	10	10	6
	21-IT- krupa patel	10	10	10	10	10	10	10	8	9	10	10	10	10	10	10	10	10	8	10	9	6
KUNVARIYA	21-IT-RIYA	0	0	10	10	10	10	10	8	9	9	10	10	9	9	5	9	10	3	6	0	0
BASAR	36-IT- SAFAK	10	10	10	10	0	0	10	10	10	10	10	10	10	9	5	9	10	0	0	0	0
PATEL	38 - it Meet	0	0	10	10	9	9	8	6	5	0	10	10	8	2	3	0	5	4	8	9	0
	40- IT - Rahi Mehta	8	10	10	10	10	10	10	10	10	10	10	10	10	9	6	9	10	9	8	10	10
Tandel	50-IT-Jeet	0	0	9	10	9	9	10	10	10	6	9	9	9	10	0	10	10	0	9	9	0
Shlok Brahmaniya	52-IT-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patel	55-IT-Harsh	10	10	9	10	10	9	10	5	9	10	9	9	9	10	10	5	10	7	9	12	7
CHAUDHARI	57-IT-SACHIN	0	10	10	10	10	10	8	6	10	7	10	10	10	8	5	10	10	2	6	5	9
GAJJAR	65-IT-RIYA	10	10	10	10	10	10	10	10	10	10	10	10	9	9	10	9	10	4	7	10	10
PATEL	73-IT-NIKITABEN	9	10	9	10	10	10	10	5	6	10	9	9	9	5	10	8	10	0	3	10	7
PATEL	76-IT-SNEH	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10
SANANDWALA	AASIM	0	0	9	10	8	6	8	0	0	0	0	0	0	5	6	0	0	8	10	8	0

CHAUDHARY	ANIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KHANPARA	CHARVIN	10	10	10	10	9	10	9	10	10	5	10	10	9	9	9	9	10	2	7	10	7
PAREKH	DARSHAN	0	0	10	10	10	10	10	7	8	10	9	9	9	10	9	10	10	5	10	9	10
PATANI	DHAVAL KUMAR	0	0	0	0	6	6	8	0	0	0	0	0	0	0	0	0	0	0	0	9	0
PATEL	DIPKUMAR	0	0	0	10	0	0	0	10	10	10	9	9	8	8	9	8	10	0	0	0	0
PATEL	GARV	10	10	10	10	10	0	10	6	6	7	9	9	5	8	7	8	0	0	6	6	10
SAVANI	HARSH	0	0	10	9	9	8	10	10	10	7	10	10	9	10	10	10	10	8	8	9	10
PATEL	HIR	9	10	10	10	9	8	9	10	10	10	9	8	8	9	10	9	9	8	7	8	6
LIMBASIYA	IT- TIRTH	9	10	10	10	9	8	10	5	6	9	9	8	9	5	10	7	9	8	8	6	9
PATEL	JAYKUMAR	10	8	10	10	10	10	10	10	10	10	10	10	10	0	8	9	9	8	9	11	10
REDDY	KRISH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARAVADIYA	MADHAV	9	10	10	10	10	10	10	6	10	6	10	10	10	5	10	10	10	8	7	7	10
PADHYAY	MANAN	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	8	0	0	0	0	0
MAKRANI	Mo.REHSHAT	0	0	9	10	8	5	8	7	7	0	9	9	8	10	9	10	0	8	6	8	0
Lodha	Mohammadali	9	10	0	0	9	9	9	9	7	8	8	7	8	8	8	7	8	9	10	7	10
BHATT	NEEL	0	0	9	0	6	5	5	6	6	10	0	8	9	0	0	0	0	8	0	8	0
Mulani	Neel	10	10	10	10	8	9	10	5	7	10	9	8	0	0	10	8	9	2	5	3	9
MEHTA	PARV	9	0	9	9	6	7	9	6	8	10	10	9	9	9	10	9	10	8	8	7	0
YADAV	SIDDHARTH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHOUDHARY	UMESH	9	10	10	10	9	10	10	10	10	10	10	9	9	5	10	10	10	8	10	11	10
RATHORE	YUDHVEERSINGH	9	0	10	10	10	10	10	6	9	9	9	9	9	9	10	8	5	0	8	9	9
solanki	krunalsinh	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
patel	meet	0	10	0	0	9	7	10	0	0	0	0	0	0	10	7	10	10	0	0	8	0

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Assignments

Saffrony Institute of Technology
B.E. Sem. I – Information Technology
Subject Name & Subject Code: Mathematics-01 (3110014)
Assignment –1
Unit 1 – Indetermined & Improper Integrals, Gamma & Beta functions

Name: ______________________________________ Date of Submission: ______________________

Serial Number: _____Enrolment Number ___________________ Email ID: ___________________

A	$\frac{0}{0}$ *form*	B	$\frac{\infty}{\infty}$ *form*	C	$\infty - \infty$ *form*
1	$\lim_{x\to 0}\frac{e^x - e^{sinx}}{sinx}$	1	$\lim_{x\to\infty}\frac{x(\log x)^3}{1+x+x^2}$	1	$\lim_{x\to 1}\left[\frac{1}{\log x}-\frac{x}{x-1}\right]$
2	$\lim_{x\to 0}\frac{e^x+e^{-x}-x^2-2}{sin^2x-x^2}$	2	$\lim_{x\to a}\frac{\log(x-a)}{\log(e^x-e^a)}$	2	$\lim_{x\to 0}\left[\frac{1}{x}-\frac{1}{e^x-1}\right]$
3	$\lim_{x\to 1}\frac{x^x-x}{x-1-\log x}$	3	$\lim_{n\to\infty}\frac{1^3+2^3+\cdots+n^3}{n^3}$	3	$\lim_{x\to 0}\left[\frac{1}{x^2}-\frac{1}{sin^2x}\right]$
4	$\lim_{x\to\frac{\pi}{2}}\frac{\log\sin x}{(\pi-2x)^2}$	4	$\lim_{x\to 0}\frac{\log(\sin x)}{\log(\tan x)}$	4	$\lim_{x\to 0}\left[\frac{1}{x}(1-x\,cotx)\right]$
5	$\lim_{x\to 0}\frac{2-x^2-2\cos x}{x^4}$	5	$\lim_{x\to\infty}\frac{x\log x}{x+\log x}$	5	$\lim_{x\to\frac{\pi}{2}}[\sec x-\tan x]$
6	$\lim_{x\to 0}\frac{xe^x-\log(1+x)}{x^2}$	6	$\lim_{x\to\frac{\pi}{2}}\frac{\log\left(x-\frac{\pi}{2}\right)}{tanx}$	6	$\lim_{x\to\frac{\pi}{2}}\left[\tan x-\frac{2x\,secx}{\pi}\right]$
D	$0\times\infty$ *form*	E	$0^0, \infty^0, 1^\infty$ *form*		
1	$\lim_{x\to 1}(x^2-1)\tan\left(\frac{\pi x}{2}\right)$	1	$\lim_{x\to\frac{\pi}{2}}(\cos x)^{\frac{\pi}{2}-x}$	6	$\lim_{x\to 0}(e^{3x}-5x)^{\frac{1}{x}}$
2	$\lim_{x\to\frac{\pi}{2}}\cos x\log(\tan x)$	2	$\lim_{x\to 1}(x-1)^{x-1}$	7	$\lim_{x\to a}\left(2-\frac{x}{a}\right)^{tan\left(\frac{\pi x}{2a}\right)}$
3	$\lim_{x\to 0}\ x\ \tan\left(\frac{\pi}{2}-x\right)$	3	$\lim_{x\to\frac{\pi}{2}}(1-cosx)^{\tan x}$	8	$\lim_{x\to 0}(a^x+x)^{\frac{1}{x}}$
4	$\lim_{x\to\frac{\pi}{4}}\ (1-\tan x)\sec 2x$	4	$\lim_{x\to 0}\left(\frac{1}{x}\right)^{1-cosx}$	9	$\lim_{x\to 0}\left(\frac{e^x+e^{2x}+e^{3x}}{3}\right)^{\frac{1}{x}}$
5	$\lim_{x\to\frac{\pi}{2}}(1-sinx)tanx$	5	$\lim_{x\to 0}\left(\frac{a^x+b^x+c^x}{3}\right)^{\frac{1}{x}}$	10	$\lim_{x\to 1}(1-x^2)^{\frac{1}{\log(1-x)}}$
		Improper integrals			
1	Evaluate $\int_0^1\frac{1}{e^x-e^{-x}}\,dx$	2	Evaluate $\int_5^\infty\frac{5x}{(1+x^2)^3}dx$	3	Evaluate $\int_{-\infty}^2 e^{4x}\,dx$
4	Evaluate $\int_{-\infty}^\infty\ \frac{1}{x^2+1}\,dx$	5	Evaluate $\int_0^\infty\ \frac{1}{x^2+1}\,dx$	6	Evaluate $\int_0^\infty\frac{x}{x^2+1}\,dx$
7	Evaluate $\int_2^\infty\frac{(x+3)}{(x-1)(x^2+1)}\,dx$	8	Show that $\int_{-\infty}^\infty f(x)\,dx\neq\lim_{b\to\infty}\int_{-b}^b f(x)dx$	9	Discuss the convergence $\int_{-2}^2\frac{1}{x^3}\,dx$

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10	Discuss the convergence $\int_1^8 \frac{x}{(x+1)^3}\,dx$	11	Discuss the convergence $\int_1^\infty \frac{\cos^2 x}{\sqrt[3]{x}}\,dx.$	12	Discuss the convergence $\int_0^\infty \frac{x^2+3}{x^4+3x^2+7}\,dx$
13	Discuss the convergence $\int_5^\infty \frac{7x+4}{x^2+9}\,dx$	14	Discuss the convergence $\int_4^\infty \frac{\sin^2 x}{\sqrt{x}\,(x-1)}\,dx$	15	Evaluate $\int_{-1}^{1} \log\lvert x\rvert\,dx$
16	Evaluate $\int_0^\infty \frac{1}{(x^2+1)(1+\tan^{-1}x)}\,dx$	17	Discuss the convergence $\int_1^\infty e^{-x^2}\,dx$	18	Discuss the convergence $\int_0^4 \frac{1}{\sqrt{16-x^2}}\,dx.$

Gamma and Beta functions

1	Prove that $\Gamma(n+1)=n\Gamma(n)$..	1	Prove that $\beta(m,n)=2\int_0^{\frac{\pi}{2}} \sin^{2m-1}(\theta)\cos^{2n-1}(\theta)\,d\theta.$
2	Prove that $\Gamma(n)=2\int_0^\infty e^{-x^2}x^{2n-1}dx.$	2	Prove that $\beta(m,n)=\int_0^\infty \frac{x^{n-1}}{(1+x)^{m+n}}\,dx.$
3	Prove that $\frac{\Gamma(n)}{k^n}=2\int_0^\infty e^{-kx}x^{n-1}\,dx.$	3	Find (i) $\int_0^\infty \frac{x^9\left(1+x^6\right)}{(1+x)^{24}}\,dx.$ (ii) $\int_0^{\frac{\pi}{2}} \cos^9\theta\sin^6\theta\,d\theta.$
4	Evaluate $\int_0^\infty e^{-x^2}x^4\,dx.$	4	Evaluate $\int_0^1 x^3\left(1-\sqrt{x}\right)^5 dx.$
5	Evaluate $\int_0^1 x^5\log\left(\frac{1}{x}\right)^6 dx.$	5	Evaluate $\int_0^1 \frac{x^2}{\sqrt{\left(1-x^4\right)}}\,dx.$
6	Evaluate $\int_0^\infty \frac{e^{-x^2}}{\sqrt{x}}\,dx.$	6	Evaluate $\int_0^2 y^4\left(8-y^3\right)^{-1/3}dx.$
7	Evaluate $\int_0^\infty \frac{x^4}{4^x}\,dx.$	7	Evaluate $\int_0^3 \frac{x^{3/2}}{\sqrt{3-x}}\,dx.$

1	Expand $\ln(\cos x)$ in power of x.
2	Expand $f(x)=x^5-x^4+x^3-x^2+x-1$ in power of $(x-1)$ and find $f(1.1)$.
3	Expand $e^x\sec x$ in power of x.
4	Find the Taylor's series of $f(x)=x^4-11x^3+43x^2-60x+14,\ a=3.$
5	Expand $\sin\left(\frac{\pi}{4}+x\right)$ in powers of x and find $\sin 43^0$ & $\sin 47^0$ correct up to four decimal places.
6	Expand $\tan\left(\frac{\pi}{4}+x\right)$ in powers of x and find $\sin 43^0$ & $\sin 44^0$ correct up to four decimal places.

7	Express $(x-1)^4+2(x-1)^3+6(x-1)+3$ in ascending power of x.
8	Using taylor's series , find $(i)\sqrt{36.12}$ $(ii)\sqrt{25.15}$ correct up to four decimal spaces.
9	Find the Taylor's series of $f(x)=\tan x$ in power of $\left(x-\frac{\pi}{4}\right)$ up to three degree terms. Also find $\tan 46^0$.

Saffrony Institute of Technology
B.E. Sem. I – Information Technology
Subject Name & Subject Code: Mathematics-I (3110014)
Assignment –2
Unit 2 – Sequence & Series

Name: ______________________________ Date of Submission: ______________________

Serial Number: _____Enrollment Number __________________ Email ID: ____________________

A	Check the given sequence is decreasing or increasing. $(i)\left\{\frac{n}{n+3}\right\}$ $(ii)\left\{\frac{n}{n^2+1}\right\}$ $(iii)\left\{\frac{n^3}{n^2+1}\right\}$
B	Check the convergence of the given series, if it is convergent, and then find its sum. $(i)\sum_{n=1}^{\infty}\left(\frac{4}{(4n-3)(4n+1)}\right)$ $(ii)\sum_{n=1}^{\infty}\left(\frac{1}{2^n}+\frac{1}{3^n}\right)$ $(iii)\ 1-\frac{4}{7}+\frac{16}{49}-\frac{64}{343}+.......$
C	Test the convergence of the following series(Comparison test) $(i)\sum_{n=1}^{\infty}\left(\sqrt{n^4+1}-\sqrt{n^4-1}\right)$ $(ii)\sum_{n=1}^{\infty}\frac{5n^3-3n}{n^2(n-2)(n^2+5)}$ $(iii)\sum_{n=1}^{\infty}\frac{n+1}{n^2\sqrt{n}}$ $(iv)\sum_{n=1}^{\infty}\frac{n+2}{(1+n)^p}$ $(v)\ \frac{1.2}{3.4.5}+\frac{2.3}{4.5.6}+\frac{3.4}{5.6.7}+....$
D	Test the convergence of the following series(Ratio test) $(i)\sum_{n=1}^{\infty}\frac{n.2^n.(n+1)!}{3^n.n!}$ $(ii)\sum_{n=1}^{\infty}\frac{(n+3)!}{3!\,n!\,3^n}$ $(iii)\sum_{n=1}^{\infty}\frac{(n+3)(n+2)}{n!}$ $(iv)\sum_{n=1}^{\infty}\frac{n!}{(10)^n}$
E	Discuss the convergence of the following series(Root test) $(i)\sum_{n=1}^{\infty}\left(1-\frac{2}{n}\right)^{n^2}$ $(ii)\sum_{n=2}^{\infty}\left(\frac{\log n}{1000}\right)^n$ $(iii)\sum_{n=2}^{\infty}\frac{n^n}{\left(2^n\right)^2}$ $(iv)\sum_{n=1}^{\infty}\left(\frac{n}{2n+5}\right)^n$
F	Discuss the convergence of the following series(Integral test) $(i)\sum_{n=1}^{\infty}\frac{1}{n(1+\log^2 n)}$ $(ii)\sum_{n=1}^{\infty}n.e^n$ $(iii)\sum_{n=2}^{\infty}\frac{\log n}{\sqrt{n}}$
G	Discuss the convergence of the following series(Absolutely/ Conditionally) $(i)\sum_{n=1}^{\infty}\frac{(-1)^{n+1}}{\log(n+1)}$ $(ii)\sum_{n=1}^{\infty}\frac{(-1)^n n}{n^3+1}$ $(iii)\sum_{n=1}^{\infty}\frac{(-1)^{n-1}}{n^2.\sqrt{n}}$ $(iv)\sum_{n=1}^{\infty}(-1)^{n+1}\left(\frac{1}{10}\right)^n$

H	Find the Radius of convergence and interval of convergence of the following series $(i) \sum_{n=1}^{\infty} \frac{(-2)^n x^n}{\sqrt{n+1}}$ $(ii) \sqrt{\frac{1}{2}}x + \sqrt{\frac{2}{5}}x^2 + \sqrt{\frac{3}{10}}x^3 + ..., x > 0$ $(iii) \frac{x}{1.2} + \frac{x^2}{3.4} + \frac{x^3}{5.6} + ..., x > 0$ $(iv) \frac{x}{1} - \frac{x^2}{4} + \frac{x^3}{9} - \frac{x^4}{16} + ... , x > 0$ $(v) \frac{x}{1.2.3} + \frac{x^2}{4.5.6} + \frac{x^3}{7.8.9} + ..., x > 0$

Saffrony Institute of Technology

B.E. Sem. I – Information Technology

Subject Name & Subject Code: Mathematics-I (3110014)

Assignment –3

Unit 3 – Fourier series

Name: ______________________________________ Date of Submission:______________________

Serial Number: _____Enrollment Number ____________________ Email ID: _____________________

(A) Find the Fourier series of the given function.

(1) $f(x) = e^{-x},\ 0 < x < 2\pi.$ (June.2016)	(5) $f(x) = \frac{(\pi - x)^2}{4},\ \ 0 \le x \le 2\pi$
(2) $f(x) = x,\quad 0 \le x \le 2$ (Dec.2015) $= 4 - x,\ 2 \le x \le 4.$ Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \ldots. = \frac{\pi^2}{8}$	(6) $f(x) = x^2,\ 0 < x < 3.$ (June.2016) (7) $f(x) = x^2,\ 0 < x < \pi$ $= 0,\ \ \pi < x < 2\pi.$ (Jan.2013)
(3) $f(x) = 2x - x^2,\ 0 < x < 3.$ (June.2016)	(8) $f(x) = x + \lvert x \rvert,\ -\pi < x < \pi.$ (Mar.2010, Dec.2015)
(4) $f(x) = x^2 + x,\ -2 < x < 2.$ (Jan.2013)	

(B) Find the Fourier series of the given function (Discontinuous fun.)

(1) $f(x) = 1 + \frac{2x}{\pi},\ \ -\pi \le x \le 0$

$= 1 - \frac{2x}{\pi},\ \ 0 \le x \le \pi.$ Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \ldots \ldots. = \frac{\pi^2}{8}$ (June.2016)

(2) $f(x) = -\pi,\quad -\pi < x < 0$

$= x,\quad 0 < x < \pi.$ Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \ldots \ldots. = \frac{\pi^2}{8}$, (June.2016)

(3) $f(x) = x,\quad -1 \le x \le 0$

$= 2,\quad 0 \le x \le 1.$ (Jan.2013)

(C) Find the Fourier series of the given function (Even/Odd function).

(1) $f(x) = x^2,\ -\pi < x < \pi.$ Deduce that $\frac{1}{1^2} + \frac{1}{2^2} + \cdots. = \frac{\pi^2}{6}$ (June.2016)	(3) $f(x) = 2x,\ -1 < x < 1.$ (June.2015) (4) $f(x) = x^3,\ \ -1 < x < 1.$ (May.2017)
(2) $f(x) = x^2 - 2,\ -2 \le x \le 2.$ (Jan.2015)	(5) $f(x) = \lvert x \rvert, -\pi < x < \pi.$
(D) Find the Half range Sine series	**Find the Half range Cosine series**
(1) $f(x) = x,\ 0 < x < 3.$ (Jan.2013)	(4) $f(x) = (x-1)^2,\ 0 < x < 1.$ (June.2015)
(2) $f(x) = \pi x - x^2,\ 0 < x < \pi$.(June.2015)	(5) $f(x) = x^2,\ 0 < x < \pi.$ (June.2015)
(3) $f(x) = e^x,\ 0 < x < l. (Jan. 2015)$	(6) $f(x) = x^2,\ -1 < x < 1.$

Saffrony Institute of Technology
B.E. Sem. I – Information Technology
Subject Name & Subject Code: Mathematics-I (3110014)
Assignment –4
Unit 6 – Partial derivatives & its Applications-I

Name: ______________________________________ Date of Submission: _________________________

Serial Number: _____Enrollment Number ____________________ Email ID: _____________________

A

Find the limit of the following functions: (1) $\lim\limits_{(x,y)\to(0,0)} \dfrac{3x^2 y}{x^2+y^2}$ (2) $\lim\limits_{(x,y)\to(0,0)} \dfrac{x^2 y^2}{x^4+3y^4}$

B

Discuss the continuity of the following functions

(1) $f(x,y)=\begin{cases} \dfrac{xy}{\sqrt{x+y}}, & (x,y)\neq(0,0) \\ 0, & (x,y)=(0,0) \end{cases}$ (2) $f(x,y)=\begin{cases} \dfrac{x^{400}-y^{400}}{x^{400}+y^{400}}, & (x,y)\neq(0,0) \\ 0, & (x,y)=(0,0) \end{cases}$.

C

(1) If $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$. Find the value of $\frac{\partial R}{\partial R_2}$ where $R_1=30, R_2=45, R_3=90\ ohms$.

(2) If $W=f(x+ct)+g(x-ct)$, prove that $W_{tt}=c^2W_{xx}$.

(3) If $u=f(r)\ and\ \ r^2=x^2+y^2,\ Prove\ that\ \frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=f''(r)+\frac{1}{r}f'(r)$.

(4) If $\theta=t^n e^{\left(\frac{-r^2}{4t}\right)}$, then find the value of n so that $\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\theta}{\partial r}\right)=\frac{\partial\theta}{\partial t}$.

(5) If $r^2=x^2+y^2+z^2\ \ and\ v=r^m$, prove that $\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}+\frac{\partial^2 v}{\partial z^2}=m(m+1)r^{m-2}$.

(6) The Kinetic energy k of a body with mass m and velocity v is given by $k=\frac{1}{2}mv^2$.
Show that $\frac{\partial k}{\partial m}.\frac{\partial^2 k}{\partial v^2}=k$.

D

(1) If $w=x^3y+4xy^3$, where $x=sint\ , y=cost$, find $\frac{dw}{dt}\ at\ t=0$.

(2) If $u=2x^3y+y^3z^2\ ,\ x=rs\,e^t\ ,\ y=rs^2e^{-t},\ z=r^2$ then find $\frac{\partial u}{\partial s}\ at\ \ r=s=1, t=0$.

(3) If $z=f(x,y)$, where $x=e^u+e^{-v},\ y=e^{-u}-e^v$, prove that $\frac{\partial z}{\partial u}-\frac{\partial z}{\partial v}=x\frac{\partial z}{\partial x}-y\frac{\partial z}{\partial y}=0$.

(4) If $u=f\left(\frac{x}{y},\frac{y}{z},\frac{z}{x}\right)$, then prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}+z\frac{\partial u}{\partial z}=0$.

(5) If $u=f\left(\frac{y-x}{xy},\ \frac{z-x}{xz}\right)$ show that $x^2\frac{\partial u}{\partial x}+y^2\frac{\partial u}{\partial y}+z^2\frac{\partial u}{\partial z}=0$.

(6) If $w=f(e^{y-z}, e^{z-x}, e^{x-y})$, then prove that $\frac{\partial w}{\partial x}+\frac{\partial w}{\partial y}+\frac{\partial w}{\partial z}=0$.

Prepared by: Dr.Rasik Patel

	(7) Using partial derivatives, find the value of $\frac{dy}{dx}$ for $(i)\ \sin(xy) + x^2 - y^2 = 0 \quad (ii)\ x^2 + y^3 = 7xy$
E	(1) Verify Euler's theorem for $(i)\ u = 2e^{y/x} \quad (ii)\ u = x^3 + y^3$. (2) If $u = \left(x^{1/5} + y^{1/5}\right)\left(x^{1/3} + y^{1/3}\right)$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} - \frac{8}{15}u = 0.$ (3) If $u = \frac{\left(x^{1/8} + y^{1/8}\right)}{\sqrt{x} - \sqrt{y}}$, find the $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$. (4) If $u = \cos^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$ then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = -\frac{1}{2}\cot u.$ (5) If $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$ then prove that $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{-\operatorname{Sin} u\,.\operatorname{Cos} 2u}{4\ Cos^3 u}$ (6) If $u = \operatorname{cosec}^{-1}\sqrt{\left(x^{\frac{1}{2}} + y^{\frac{1}{2}}\right)/\left(x^{\frac{1}{3}} + y^{\frac{1}{3}}\right)}$, show that $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{1}{144}tanu(13 + tan^2 u).$ (7) If $u = \sin^{-1}(x^3 + y^3)^{2/5}$ then prove that $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{6}{5}tanu(\frac{6}{5}sec^2 u - 1).$

Saffrony Institute of Technology
B.E. Sem. I – Information Technology
Subject Name & Subject Code: Mathematics-I (3110014)
Assignment –4
Unit 6 – Partial derivatives & its Applications-II

Name: ______________________________________ Date of Submission: ________________________

Serial Number: _____Enrolment Number ___________________ Email ID: ____________________

F	**Find the gradient of scalar functions.** (1) $f(x, y, z) = (x^2 + y^2 + z^2)^{-1/2}$,P($\sqrt{2}$,$\sqrt{2}$,0) (2) $\emptyset(x, y, z) = 3x^2y - y^3z^2$, P(1 ,-2 ,-1)
G	**Find the directional derivatives.** (1) $f(x, y) = x^2 sin2y$ at P(1, $\frac{\pi}{2}$) , $\bar{a} = 3\hat{\imath} - 4\hat{\jmath}$ (2) $\emptyset(x, y, z) = 3e^x \cos(yz)$ at P(1 ,-2 ,-1), $\bar{a} = 2\hat{\imath} + \hat{\jmath} - 2\hat{k}$ (3) $\emptyset(x, y, z) = x^2y^2z^2$, P (1 , 1 ,-1) along a direction equally inclined with coordinate axes.
H	**Find the unit normal vector for the following surfaces** (1) $z^2 = 4(x^2 + y^2)$ at P(1 , 0 , 2) (2) $x^2 + 2y^2 + z^2 = 7$ at P(1 , -1 , 2)
I	**Find the equations of tangent plane and normal line to the given surface** (1) $\sqrt{x} + \sqrt{y} + \sqrt{z} = 4$ at (4 ,1 ,1) (2) $x^3 + 2xy^2 - 7yz^2 + 3xy + 1 = 0$ at (1 ,1 ,1).
J	**Find the Extreme values/ Stationary points/Maximum & minimum values of the functions** (1) $f(x , y) = x^2 - 6x + 4xy + y^2$ (2) $f(x , y) = x^2y - xy^2 + 4xy - 4y^2 - 4x^2$. (3) $f(x , y) = x^2 - 2xy + 2y^2 - 2x + 2y + 1$
K	(1) Find the largest values of $f(x , y) = 49 - x^2 - y^2$ subject to the constraint $x + 3y = 10$. (2) Find the largest and smallest values of $f(x , y) = xy$ takes on the ellipse $\frac{x^2}{8} + \frac{y^2}{2} = 1$. (3) Find the point on the plane $ax + by + cz = p$ at which the function $f = x^2 + y^2 + z^2$ has a minimum value and find this minimum f by Lagrange's method. (4) Find the maximum and minimum distances of the point (3 ,4, 12) from the sphere $x^2 + y^2 + z^2 = 1$, using the Lagrange's method.

S.P.B. Patel Engineering College Linch

Prepared by: Dr.Rasik Patel

Saffrony Institute of Technology
B.E. Sem. I – Information Technology
Subject Name & Subject Code: Mathematics-I (3110014)
Assignment –5
Unit 5 – Multiple integrals

Name: ______________________________________ Date of Submission: _________________________

Serial Number: _____Enrollment Number ___________________ Email ID: _____________________

1. Evaluate the following integrals.

(a) $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{1}{1+x^2+y^2} dydx$ (b) $\int_0^{\pi} \int_0^{\sin x} ydydx$ (c) $\int_0^1 \int_0^{y^2} 3y^3 e^{xy} dxdy$

(d) $\int_0^4 \int_0^{x^2} e^{\frac{y}{x}} dydx$ (e) $\int_0^1 \int_0^{\sqrt{1-y^2}} (x^2+y^2) dydx$ (f) $\int_0^1 \int_0^1 \frac{dx\, dy}{\sqrt{(1-x^2)(1-y^2)}} dxdy$

(g) $\int_1^4 \int_0^{\sqrt{x}} \frac{3}{2} e^{\frac{y}{\sqrt{x}}} dydx$ (h) $\int_1^4 \int_{2x^2}^{3x^2} xe^{x^2+y} dydx$ (i) $\int_0^1 \int_y^1 x^2 \cdot e^{xy} dxdy$ (j) $\int_1^a \int_1^b \frac{1}{xy} dxdy$

(k) $\int_0^{\pi/2} \int_0^{a\cos\theta} r \sin\theta \, drd\theta$ (l) $\int_0^{\pi/2} \int_0^{1-\sin\theta} r^2 \cos\theta \, drd\theta$

2. Evaluate $\iint_R xy \, dA$, where R is the region bounded by x-axis, ordinate x = 2a and the curve $x^2 = 4ay$.
3. Evaluate $\iint_R xy(x+y) \, dA$, where R is the region between $x^2 = y$ and $x = y$.
4. Evaluate $\iint_R dA$, where R is the region bounded by the circle $x^2+y^2 = 4$ and the line $x + y = 2$.
5. Evaluate $\iint_R (y - 2x^2) \, dA$, where R is the region bounded by $the\ square$ $|x| + |y| = 1$.
6. Evaluate $\iint_R (x + y) \, dydx$, where R is the region bounded by $x = 0, x = 2, y = x, y = x + 2$.
7. Evaluate $\iint_R dydx$, where R is the region bounded by $x = 0, x = 1, y = x^2, y = 2 - x$.
8. Evaluate $\iint_R y^2 dydx$, where R is the region bounded by $y^2 = x \ and \ y = x^3$.
9. Evaluate $\iint_R dA$, where R is the region bounded by the circle $x^2+y^2 = 4$, $x = 1, x = 0, y = 0$.
10. Evaluate $\iint_R e^{2x+3y} \, dA$, where R is the triangle bounded by $x = 0, y = 0 \ and \ x + y = 1$.
11. Evaluate $\iint_R y \, dA$, where R is the region bounded by the parabola $y^2 = 4x \ and \ x^2 = 4y$.
12. Evaluate $\iint_R x^2 \, dA$, where R is the region in the first quadrant bounded by the hyperbola $xy = 16$ and the lines $x = y$, $y = 0$ and $x = 8$.
13. Evaluate $\iint_R r^3 \sin 2\theta \; drd\theta$, where R is the region between the circles $r = 2, r = 4$.

14. Evaluate $\iint_R r^3 \, dr d\theta$, where R is the region between the circles $r = 2\sin\theta, r = 4\sin\theta$.

15. Evaluate $\iint_R r\sin\theta \; dr d\theta$, where R is the region bounded by cardioid $r = a(1+\cos\theta), a > 0$ & the initial line.

16. Evaluate $\iint_R r^2 \sin\theta \; dr d\theta$, where R is the region bounded by circle $r = 2a cos\theta$ lying above initial line.

17. Evaluate $\iint_R \frac{r}{\sqrt{r^2+a^2}} \, dr d\theta$, where R is a loop $r^2 = a^2 cos 2\theta$.

18. Evaluate $\int_0^2 \int_{y^2}^{2y} dx dy$ by changing the order of integration

19. Evaluate $\int_0^1 \int_{x^2}^{2-x} dy dx$ by changing the order of integration.

20. Evaluate $\int_0^{2a} \int_0^{x^2/4a} xy \, dy dx$ by changing the order of integration.

21. Evaluate $\int_0^{4a} \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} dy dx$ by changing the order of integration.

22. Evaluate $\int_0^a \int_y^a \frac{x}{x^2+y^2} dx dy$ by changing the order of integration.

23. Evaluate $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2\sqrt{x^2+y^2} dy dx$ by changing the polar co-ordinates.

24. Evaluate $\int_0^1 \int_0^x y^2\sqrt{x^2+y^2} dy dx$ by changing the polar co-ordinates.

25. Evaluate $\iint_R (x+y)^2 \, dx dy$, where R is the region bounded by $x+y=0, x+y=1,$ $2x-y=0, 2x-y=3$ using transformations $u = x+y, v = 2x-y$.

26. Evaluate $\iint_R (x^2+y^2) dx dy$ by changing the variables, where R is the region bounded by $x^2-y^2=1, \; x^2-y^2=9, xy=2, xy=4$.

27. Evaluate $\iint_R (y-x) dx dy$ by changing the variables, where R is the region bounded by $y = x-3, \; y = x+1, 3y+x=5, 3y+x=7$.

28. Evaluate $\iint_R (x^2-y^2)^2 dx dy$ by changing the variables, where R is the region bounded by $lines \; |x|+|y| = 1, using \; transformations \; x+y = u, x-y = v$.

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29. Evaluate the following integrals

$(a)\int_0^1\int_0^{\sqrt{z}}\int_0^{2\pi}((r\cos\theta)^2+z^2)r\,d\theta\,drdz$

$(a)\int_0^1\int_0^{2-x}\int_0^{2-x-y}dzdydx$ $(a)\int_0^1\int_0^{\sqrt{1-x^2}}\int_0^{\sqrt{1-x^2-y^2}}xyz\,dz\,dydx.$

$(a)\int_0^1\int_0^1\int_0^1 e^{x+y+z}dxdydz$ $(a)\int_0^1\int_0^{1-y}\int_0^{1-y-z}z\,dxdzdy$

30. By using the triple integration find the volume of the region between the cylinder $z=y^2$ and xy-plane that is bounded by the planes $x=0, x=1, y=-1\ y=1.$

Find the volume of the region that lies under the paraboloid $z=x^2+y^2$ and above the triangle enclosed by the lines $y=x, x=0, and\ x+y=2$ in the xy-plane

Saffrony Institute of Technology

B.E. Sem. I – Information Technology

Subject Name & Subject Code: Mathematics-I (3110014)

Assignment –6

Unit 6 – Matrices and System of Linear equations

Name: ____ Date of Submission: __________________________

Serial Number: _____Enrolment Number ____________________ Email ID: _____________________

A Defines:

(1) Matrix (2) Upper & Lower triangular matrix (3) Symmetric-skew symmetric matrix (4) Unitary (5) Hermitian-skew- Hermitian matrix (6) Orthogonal matrix (7) Rank of the matrix (8)Transpose (9) Trace (10) Eigen value & Eigen vectors (11) Cayley-Hamilton theorem(12) Diagonalization of a matrix

B (i) Find a rank of the following matrices (Row-echelon form).

(1) $A=\begin{bmatrix} 4 & 2 & 3 \\ 8 & 4 & 6 \\ -2 & -1 & -\frac{3}{2} \end{bmatrix}$ (2) $A=\begin{bmatrix} 3 & -2 & 0 & -1 \\ 0 & 2 & 2 & 1 \\ 1 & -2 & -3 & 2 \\ 0 & 1 & 2 & 1 \end{bmatrix}$ (3) $A=\begin{bmatrix} 1 & 1 & -1 & 1 \\ 1 & -1 & 2 & -1 \\ 3 & 1 & 0 & 1 \end{bmatrix}$ (4) $A=\begin{bmatrix} 3 & 4 & 5 & 6 & 7 \\ 4 & 5 & 6 & 7 & 8 \\ 5 & 6 & 7 & 8 & 9 \\ 10 & 11 & 12 & 13 & 14 \\ 15 & 16 & 17 & 18 & 19 \end{bmatrix}$

(ii) Find a rank of the following matrices (Reduced row-echelon form).

(1) $A=\begin{bmatrix} 1 & -1 & 2 & -1 \\ 2 & 1 & -2 & -2 \\ -1 & 2 & -4 & 1 \\ 3 & 0 & 0 & -3 \end{bmatrix}$ (2) $A=\begin{bmatrix} 1 & -1 & 0 & 2 \\ 0 & 1 & 1 & -1 \\ 2 & 1 & 2 & 1 \\ 3 & -2 & 1 & 6 \end{bmatrix}$ (3) $A=\begin{bmatrix} 1 & 2 & 2 \\ -1 & 1 & 1 \\ 3 & -2 & 1 \end{bmatrix}$

C Find the inverse of the matrix by elementary row operations or Gauss-Jordan method:

(1) $A=\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 4 & 5 & 1 \end{bmatrix}$ (2) $A=\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ (3) $A=\begin{bmatrix} 1 & 2 & 1 \\ 0 & 2 & 2 \\ 2 & 1 & 1 \end{bmatrix}$

D Solve the following system by Gauss-Elimination method.

(1) $x+y+z=6,\quad x+2y+3z=14,\quad 2x+4y+7z=30.$

(2) $4x-2y+6z=8,\quad x+y-3z=-1,\quad 15x-3y+9z=21.$

(3) $2x-y+z=9,\quad 3x-y+z=6,\quad 4x-y+2z=7,\quad -x+y-z=4$

(4) $2x+y+2z+w=6,\quad 4x+3y+3z-3w=1,\quad 6x-y+6z+12w=36,\quad 2x+2y-z+w=10.$

(5) $3x-yz=0,\quad x+2y+z=0,\quad 2x+y+3z=0.$

(6) $2x-2y+5z+3w=0,\quad 4x-y+z+w=0,\quad 3x-2y+3z+4w=0,\quad x-3y+7z+6w=0.$

E For which values of k and μ the following system have (1) no solution (2) unique solution (3) infinite number of solutions (1) $x + y + z = 6,\ x + 2y + 3z = 10,\ x + 2y + kz = \mu$.

(2) $2x + 3y + 5z = 9,\ 7x + 3y - 2z = 8,\ 2x + 3y + kz = \mu$.

F Investigate for what values of k the equations $x + y + z = 1,\ 2x + y + 4z = k,\ 4x + y + 10z = k^2$ have infinite number of solutions.

G Express the given matrix as the sum of a symmetric and a skew-symmetric matrix:

(1) $A = \begin{bmatrix} 1 & 5 & 7 \\ -1 & -2 & -4 \\ 8 & 2 & 13 \end{bmatrix}$ (2) $A = \begin{bmatrix} 0 & 5 & -3 \\ 1 & 1 & 1 \\ 4 & 5 & 9 \end{bmatrix}$

H Express the given matrix as the sum of a Hermitian and a skew-Hermitian matrix:

(1) $A = \begin{bmatrix} 2 & 4+i & 6i \\ 6 & 5-i & 4 \\ 0 & 1-i & 8i \end{bmatrix}$ (2) $A = \begin{bmatrix} 4+2i & 7 & 3-i \\ 0 & 3i & -2 \\ 5+3i & -7+i & 9+6i \end{bmatrix}$

I Show that the following matrices are unitary and find their inverse.

(1) $A = \begin{bmatrix} \frac{2+i}{3} & \frac{2i}{3} \\ \frac{2i}{3} & \frac{2-i}{3} \end{bmatrix}$ (2) $A = \begin{bmatrix} \frac{i}{2} & \frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{i}{2} \end{bmatrix}$

J Verify the following matrices are orthogonal and find their inverse.

(1) $A = \frac{1}{9}\begin{bmatrix} 8 & -4 & 1 \\ 1 & 4 & -8 \\ 4 & 7 & 4 \end{bmatrix}$ (2) $A = \begin{bmatrix} \cos\phi.\cos\theta & \sin\phi & \cos\phi.\sin\theta \\ -\sin\phi.\cos\theta & \cos\phi & -\sin\theta.\sin\phi \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$

K Solve the equations by determinant method or Cramer rule.

(1) $x + y + z = 1,\ 2x + 3y + z = 4,\ 4x + 9y + z = 16$.

(2) $x + 2y + z = 5,\ 3x - y + z = 6,\ x + y + 4z = 7$.

L Find the Eigen value of (1)A^{-1} (2) A^T (3) $5A$(4) A^3 (5) AdjA (6) $A^2 + 2A - I$ of the following matrices:

(1) $\begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$ (2) $\begin{bmatrix} 2 & 0 \\ 3 & 3 \end{bmatrix}$ (3) $\begin{bmatrix} 1 & 2 & -3 \\ 0 & 2 & 3 \\ 0 & 0 & 2 \end{bmatrix}$ (4) $\begin{bmatrix} 2 & -1 & 5 \\ 0 & 5 & -2 \\ 0 & 0 & -3 \end{bmatrix}$ (5) $\begin{bmatrix} 1 & 0 & 0 \\ 5 & 2 & 0 \\ 12 & 15 & 3 \end{bmatrix}$

M Find the Eigen values and Eigen vectors or Eigen space of the following matrices.

(1) $A=\begin{bmatrix}2 & 1 & 1\\ 2 & 3 & 2\\ 3 & 3 & 4\end{bmatrix}$ (2) $A=\begin{bmatrix}8 & -6 & 2\\ -6 & 7 & -4\\ 2 & -4 & 3\end{bmatrix}$ (3) $A=\begin{bmatrix}2 & 2 & 1\\ 1 & 3 & 1\\ 1 & 2 & 2\end{bmatrix}$

N Verify Caley-Hamilton theorem for the given matrices.

(1) $A=\begin{bmatrix}3 & 2\\ 4 & -1\end{bmatrix}$ find A^2 & A^{-2} (2) $A=\begin{bmatrix}1 & 3 & 7\\ 4 & 2 & 3\\ 1 & 2 & 1\end{bmatrix}$ find A^{-1} (3) $A=\begin{bmatrix}1 & 1 & 2\\ 3 & 1 & 1\\ 2 & 3 & 1\end{bmatrix}$ find A^{-1}.

(4) $A=\begin{bmatrix}2 & 1 & 1\\ 0 & 1 & 0\\ 1 & 1 & 2\end{bmatrix}$ find $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I_3$.

O (1)Find a matrix P that Diagonalizes A and hence find A^{10}. find the Eigen value of A^2, where $A=\begin{bmatrix}1 & 4\\ 2 & 3\end{bmatrix}$

(2) Find a matrix P that Diagonalizes A and hence find A^{13}, where $A=\begin{bmatrix}1 & 0\\ -1 & 2\end{bmatrix}$

(3) Find the modal matrix P which Diagonalizes A, where $A=\begin{bmatrix}1 & 1 & 3\\ 1 & 5 & 1\\ 3 & 1 & 1\end{bmatrix}$, find A^4.

(4) Find the modal matrix P which Diagonalizes A, where $(i)\ A=\begin{bmatrix}-9 & 4 & 4\\ -8 & 3 & 4\\ -16 & 8 & 7\end{bmatrix}$ $(ii)\ A=\begin{bmatrix}4 & 2 & -2\\ -5 & 3 & 2\\ -2 & 4 & 1\end{bmatrix}$

and hence determine $P^{-1}AP$.

GTU-MidSem-Papers

Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE –SEMESTER 1&2(NEW SYLLABUS)EXAMINATION- WINTER 2018

Subject Code: 3110014 **Date: 07-01-2019**

Subject Name: Mathematics - I

Time: 10:30 am to 01:30 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	State Cayley– Hamilton theorem. Find eigen values of A and A^{-1}, where $A=\begin{bmatrix}1 & 2\\ 0 & 4\end{bmatrix}$	**03**
	(b)	State L' Hospital's Rule. Use it to evaluate $\lim_{x\to 0}\left[\frac{1}{x^2}-\frac{1}{\sin^2 x}\right]$	**04**
	(c)	Investigate convergence of the following integrals: (i) $\int_5^{\infty}\frac{5x}{\left(1+x^2\right)^3}dx$ (ii) $\int_0^{\infty}\frac{x^{10}\left(1+x^5\right)}{\left(1+x\right)^{27}}dx$	**07**
Q.2	**(a)**	Test the convergence of series $\sum_{n=1}^{\infty}\frac{4^n+5^n}{6^n}$	**03**
	(b)	State the p-series test. Discuss the convergence of the series $\sum_{n=2}^{\infty}\frac{n+1}{n^3-3n+2}$	**04**
	(c)	State D'Alembert's ratio test and Cauchy's root test. Discuss the convergence of the following series: (i) $\sum_{n=1}^{\infty}\frac{4^n\left(n+1\right)!}{n^{n+1}}$ (ii) $\sum_{n=2}^{\infty}\frac{n}{\left(\log n\right)^n}$	**07**
		OR	
	(c)	Test the convergence of the series $\frac{1}{1\cdot 2\cdot 3}+\frac{x}{4\cdot 5\cdot 6}+\frac{x^2}{7\cdot 8\cdot 9}+\frac{x^3}{10\cdot 11\cdot 12}+\cdots;$ $x\ge 0$	**07**
Q.3	**(a)**	Reduce matrix $A=\begin{bmatrix}1 & 5 & 3 & -2\\ 2 & 0 & 4 & 1\\ 4 & 8 & 9 & -1\end{bmatrix}$ to row echelon form and find its rank.	**03**
	(b)	Derive half range sine series of $f\left(x\right)=\pi-x,\ 0\le x\le \pi$	**04**
	(c)	Find the eigen values and corresponding eigen vectors for the matrix A where $A=\begin{bmatrix}1 & 2 & 2\\ 0 & 2 & 1\\ -1 & 2 & 2\end{bmatrix}$	**07**

OR

Q.3 **(a)** Expand $e^{x\sin(x)}$ in power of x up to the terms containing x^6. **03**

(b) Solve system of linear equation by Gauss Elimination method, if solution exists. **04**

$x + y + 2z = 9;\ 2x + 4y - 3z = 1;\ 3x + 6y - 5z = 0$

(c) Find Fourier series of $f(x) = \begin{cases} x, & -1 < x < 0 \\ 2, & 0 < x < 1 \end{cases}$ **07**

Q.4 **(a)** Discuss the continuity of the function f defined as **03**

$$f(x,y) = \begin{cases} \dfrac{x^3 - y^3}{x^2 + y^2}; & (x,y) \neq (0,0) \\ 0 & (x,y) = (0,0) \end{cases}$$

(b) Define gradient of a function. Use it to find directional derivative of $f(x,y,z) = x^3 - xy^2 - z$ at $P(1,1,0)$ in the direction of $\bar{a} = 2\hat{i} - 3\hat{j} + 6\hat{k}$. **04**

(c) Find the shortest and largest distance from the point $(1,2,-1)$ to the sphere $x^2 + y^2 + z^2 = 24$. **07**

OR

Q.4 **(a)** Find the extreme values of $x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$ **03**

(b) Evaluate $\int_0^2 \int_0^{\sqrt{4-x^2}} (x^2 + y^2)\,dydx$ by changing into polar coordinates. **04**

(c) (i) If $u = x^2y + y^2z + z^2x$ then find out $\dfrac{\partial u}{\partial x} + \dfrac{\partial u}{\partial y} + \dfrac{\partial u}{\partial z}$ **07**

(ii) If $x^3 + y^3 = 6xy$ then find $\dfrac{dy}{dx}$ and $\dfrac{d^2y}{dx^2}$

Q.5 **(a)** Evaluate $\iint_R y\sin(xy)\,dA$, where R is the region bounded by $x = 1$, $x = 2$, $y = 0$ and $y = \dfrac{\pi}{2}$. **03**

(b) By changing the order of integration, evaluate $\int_0^3 \int_y^3 \dfrac{x\,dxdy}{x^2 + y^2}$ **04**

(c) Find the volume below the surface $z = x^2 + y^2$, above the plane $z = 0$, and inside the cylinder $x^2 + y^2 = 2y$. **07**

OR

Q.5 **(a)** Evaluate integral $\iint_R \dfrac{r\,dr\,d\theta}{\sqrt{a^2 + r^2}}$ over the region R which is one loop of $r^2 = a^2\cos 2\theta$ **03**

(b) Evaluate the integral $\int_1^e \int_1^{\log y} \int_1^{e^x} (x^2 + y^2)\,dzdxdy$. **04**

(c) Find the volume of the solid obtained by rotating the region R enclosed by the curves $y = x$ and $y = x^2$ about the line $y = 2$. **07**

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GTU-Question-Bank

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MCQ - Matrices and System of Linear equations.

2018

(1) A square Matrix whose determinant is non zero is called ______

(A) singular (B) non-singular (C) invertibe (D) both B & C

(2) If A and B are non-singular Matrices then $(AB)^{-1} =$ ______

(a) $A^{-1}B^{-1}$ (b) AB (c) $B^{-1}A^{-1}$ (d) none of these

(3) If $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ then A is in

(a) Row-echelon (b) Reduced Row-echelon (c) both a & b (d) none-of these

(4) For what values of K does the system $x + y = 2$, $3x + 3y = k$ has infinitely many solutions

(a) $k = 5$ (b) $k = 4$ (c) $k = 6$ (d) $k = 1$

(5) If A is a $n \times n$ size invertible Matrix then rank of A is ______

(a) $n-1$ (b) n (c) $2n$ (d) $n+1$

(6) What is the value of P the given Matrix $\begin{bmatrix} 1 & 2 \\ 2 & P \end{bmatrix}$ has rank one?

(a) $P = 0$ (b) $P = 2$ (c) $P = 3$ (d) $P = 4$

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(7) Let A be a skew-symmetric Matrix then

(a) $a_{ij} = a_{ji}$ (b) $a_{ij} = -a_{ji}$ (c) $a_{ii} = 0$ (d) both (b) & (c)

2019

(8) For a square Matrix A, if $A \cdot A^T = I$, then A is ____

(a) symmetric (b) skew-symmetric (c) orthogonal (d) singular

(9) Which of the following is in reduced row echelon form?

(a) $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 3 \\ 0 & 0 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & 0 \\ 0 & 6 & 0 \end{bmatrix}$ (d) none of these

(10) For Homogeneous system of equations $Ax = 0$, if $|A| \neq 0$, then the system has

(a) trivial solution (b) non-trivial (c) Infinite no. of sol^n (d) no solutions

(11) For Homogeneous system of equations $Ax = 0$, if A is a singular Matrix then the system has

(a) trivial solution (b) non-trivial (c) Infinite no. of sol^n (d) no solution

Hand-Notes

Fourier series & Fourier integrals

* Fourier series is used in the analysis of Periodic functions. It has many applications in electrical engineering, Vibration analysis, Digital signal processing, Image processing, optics, computer assisted Tomography etc...

* Periodic function: A function $f(x)$ is called periodic function if $f(x+P) = f(x), \forall x$ where P is period.

Ex. $\sin x$, $\cos x$, $\sec x$, $\operatorname{cosec} x$ are periodic functions with period $P = 2\pi$
$\tan x$, $\cot x$ are periodic function with $P = \pi$

→ If $f(x)$ is a periodic function with period P then $f(ax) = \frac{P}{a}$, $a \neq 0$.

* Convergence of the Fourier series (Dirichlet's condition)

→ $f(x)$ is periodic function i.e $f(x+P) = f(x), \forall x$
→ $f(x)$ and its integrals are finite and single valued
→ $f(x)$ has at most finite number of Maxima & Minima
→ $f(x)$ has at most finite number of Discontinuities i.e piecewise continuous in the interval

* Important Results:

→ $\frac{d}{dx} c = 0$
→ $\frac{d}{dx} \sin ax = a \cos ax$
→ $\frac{d}{dx} \cos ax = -a \sin ax$

$\frac{d}{dx} e^{ax} = a e^{ax}$

$\frac{d}{dx} x^n = n x^{n-1}$

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$\rightarrow \int c\,dx = cx$

$\rightarrow \int e^{ax}\,dx = \frac{e^{ax}}{a}$

$\rightarrow \int x^n\,dx = \frac{x^{n+1}}{n+1}$

$\rightarrow \int \sin ax\,dx = \frac{-\cos ax}{a}$

$\rightarrow \int \cos ax\,dx = \frac{\sin ax}{a}$

$\cos 0 = 1$

$\cos 2n\pi = 1$

$\cos n\pi = (-1)^n, \; n \in Z$

$\sin 0 = 0$

$\sin \pi = 0$

$\sin n\pi = 0, \; n \in Z$

$\rightarrow \int e^{ax}\cos bx\,dx = \frac{e^{ax}}{a^2+b^2}\left[a\cos bx + b\sin bx\right]$

$\rightarrow \int e^{ax}\sin bx\,dx = \frac{e^{ax}}{a^2+b^2}\left[a\sin bx - b\cos bx\right]$

$\rightarrow \int uv\,dx = u(V_1) - u'(V_2) + u''(V_3) - u'''(V_4) + \dots\dots$

Note: LIATE $\rightarrow e^{ax}$

L → log, I → Inverse, A → Algebric eqn, T → Trigonometric $\sin x, \cos x$

u	v
A	T
A	E

$\rightarrow \int_{-a}^{a} f(x)\,dx = 2\int_{0}^{a} f(x)\,dx \rightarrow f(x)$ is even fun.

$= 0 \rightarrow f(x)$ is odd fun.

Date
Page 3

* Fourier series (General Method)

The Fourier series for the function f(x) in the interval $c \le x \le c+2l$ is given by the trigonometric series,

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

where,

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx$$

$$a_n = \frac{1}{l}\int_c^{c+2l} f(x)\cos\frac{n\pi x}{l}\,dx$$

$$b_n = \frac{1}{l}\int_c^{c+2l} f(x)\sin\frac{n\pi x}{l}\,dx$$

which is Euler's formula

Note: $l = \frac{b-a}{2}$

Ex-1 Find the fourier series for $f(x) = e^{-x}$ in the interval $0 < x < 2\pi$. (Summer 2014) (Jun-2015)

Soln Here $l = \frac{b-a}{2} = \frac{2\pi - 0}{2} = \pi$

By Euler's formula

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_0^{2\pi} e^{-x}\,dx$$

$$= \frac{1}{\pi}\left[-\frac{e^{-x}}{}\right]_0^{2\pi}$$

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$$* \int e^{ax} \cos bx \, dx = \frac{e^{ax}}{a^2+b^2}\left[a \cos bx + b \sin bx\right]$$

$$= \frac{1}{\pi}\left[-e^{-2\pi} + 1\right] = \frac{1}{\pi}\left[1 - e^{-2\pi}\right]$$

$$a_n = \frac{1}{l}\int_c^{c+2l} f(x) \cos\frac{n\pi x}{l} \, dx$$

$$= \frac{1}{\pi}\int_0^{2\pi} e^{-x} \cdot \cos nx \, dx$$

$$= \frac{1}{\pi}\left[\frac{e^{-x}}{1+n^2}(-\cos nx + n \sin nx)\right]_0^{2\pi} \quad \left(\because a = -1, \ b = n\right)$$

$$= \frac{1}{\pi}\left[-\frac{e^{-x}}{1+n^2}\cos nx\right]_0^{2\pi} \quad (\because \sin n\pi = 0, \ n \in z)$$

$$= \frac{1}{\pi(1+n^2)}\left[-e^{-2\pi} + 1\right] = \frac{1}{\pi(1+n^2)}\left[1 - e^{-2\pi}\right]$$

$$b_n = \frac{1}{l}\int_c^{c+2l} f(x) \sin\frac{n\pi x}{l} \, dx$$

$$= \frac{1}{\pi}\int_0^{2\pi} e^{-x} \cdot \sin nx \, dx$$

$$= \frac{1}{\pi}\left[\frac{e^{-x}}{1+n^2}(-\sin nx - n \cos nx)\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[\frac{-n \, e^{-x} \cos nx}{1+n^2}\right]_0^{2\pi} \quad (\because \sin n\pi = 0, \ n \in z)$$

$$= \frac{n}{\pi(1+n^2)}\left[-e^{-2\pi} + 1\right] = \frac{n}{\pi(1+n^2)}\left[1 - e^{-2\pi}\right]$$

$$\therefore \quad f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore \quad e^{-x} = \frac{1-e^{-2\pi}}{2\pi} + \sum_{n=1}^{\infty}\left[\frac{(1-e^{-2\pi})}{\pi(1+n^2)}\cos nx + \frac{n(1-e^{-2\pi})}{\pi(1+n^2)}\sin nx\right]$$

Ex-2 Find the Fourier series for $f(x) = (\pi - x)^2$ in $0 < x < 2\pi$.

Sol^n Here $l = \frac{b-a}{n} = \frac{2\pi - 0}{2} = \pi$

By Euler's formulae

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_0^{2\pi}(\pi - x)^2\,dx$$

$$= \frac{1}{\pi}\left[\frac{(\pi - x)^3}{-3}\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[\frac{\pi^3}{3} + \frac{\pi^3}{3}\right] = \frac{2\pi^2}{3}$$

$$a_n = \frac{1}{l}\int_c^{c+2l} f(x)\cos\frac{n\pi x}{l}\,dx$$

$$= \frac{1}{\pi}\int_0^{2\pi}(\pi - x)^2 \cos nx\,dx$$

$$= \frac{1}{\pi}\left[(\pi - x)^2\left(\frac{\sin nx}{n}\right) - (-2(\pi - x))\left(\frac{-\cos nx}{n^2}\right) + 2\left(\frac{-\sin nx}{n^3}\right)\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[-(2\pi - 2x)\frac{\cos nx}{n^2}\right]_0^{2\pi} \quad (\because \sin n\pi = 0,\ n \in \mathbb{Z})$$

$$= \frac{1}{\pi}\left[\frac{2\pi}{n^2} + \frac{2\pi}{n^2}\right] = \frac{4}{n^2}$$

$$b_n = \frac{1}{l}\int_c^{c+2l} f(x)\, \sin\frac{n\pi x}{l}\, dx$$

$$= \frac{1}{\pi}\int_0^{2\pi} (\pi - x)^2 \sin nx\, dx$$

$$= \frac{1}{\pi}\left[(\pi-x)^2\left(-\frac{\cos nx}{n}\right) - \left(-2(\pi-x)\right)\left(\frac{-\sin nx}{n^2}\right) + 2\left(\frac{\cos nx}{n^3}\right)\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[-(\pi-x)^2\frac{\cos nx}{n} + 2\frac{\cos nx}{n^3}\right]_0^{2\pi} \quad (\because \sin n\pi = 0,\ n \in \mathbb{Z})$$

$$= \frac{1}{\pi}\left[\left(-\frac{\pi^2}{n} + \frac{2}{n^3}\right) - \left(-\frac{\pi^2}{n} + \frac{2}{n^3}\right)\right]$$

$$= \frac{1}{\pi}\left[-\frac{\pi^2}{n} + \frac{2}{n^3} + \frac{\pi^2}{n} - \frac{2}{n^3}\right]$$

$$= 0$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore (\pi - x)^2 = \frac{\pi^2}{3} + \sum_{n=1}^{\infty}\left[\frac{4}{n^2}\cos nx\right]$$

Ex-3 Find the fourier series of $f(x) = x^2$, $(0, 2\pi)$ and Evaluate $\left[\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \right] = \frac{\pi^2}{12}$

Solⁿ Here $l = \frac{b-a}{2} = \frac{2\pi - 0}{2} = \pi$

By Euler's formula

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_0^{2\pi} x^2\,dx$$

$$= \frac{1}{\pi}\left[\frac{x^3}{3}\right]_0^{2\pi} = \frac{1}{\pi}\left[\frac{8\pi^3}{3}\right] = \frac{8\pi^2}{3}$$

$$a_n = \frac{1}{l}\int_c^{c+2l} f(x)\cos\frac{n\pi x}{l}\,dx$$

$$= \frac{1}{\pi}\int_0^{2\pi} x^2 \cos nx\,dx$$

$$= \frac{1}{\pi}\left[x^2\left(\frac{\sin nx}{n}\right) - (2x)\left(-\frac{\cos nx}{n^2}\right) + 2\left(-\frac{\sin nx}{n^3}\right)\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[2x\,\frac{\cos nx}{n^2}\right]_0^{2\pi} \quad (\because \sin n\pi = 0,\ n \in \mathbb{Z})$$

$$= \frac{1}{\pi n^2}\left[4\pi - 0\right] = \frac{4}{n^2} \quad (\because \cos 2n\pi = 1)$$

$$b_n = \frac{1}{l}\int_c^{c+2l} f(x)\sin\frac{n\pi x}{l}\,dx$$

$$= \frac{1}{\pi}\int_0^{2\pi} x^2 \sin nx\,dx$$

$$= \frac{1}{\pi}\left[x^2\left(-\frac{\cos nx}{n}\right) - (2x)\left(-\frac{\sin nx}{n^2}\right) + (2)\left(\frac{\cos nx}{n^3}\right)\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[-x^2 \frac{\cos nx}{n} + 2\frac{\cos nx}{n^3} \right]_0^{2\pi} \quad (\because \sin n\pi = 0, n \in z)$$

$$= \frac{1}{\pi}\left[\left(-4\pi^2 \frac{\cos 2n\pi}{n} + 2\frac{\cos 2n\pi}{n^3}\right) - \left(0 + 2\frac{\cos 0}{n^3}\right)\right]$$

$$= \frac{1}{\pi}\left[\frac{-4\pi^2}{n} + \frac{2}{n^3} - \frac{2}{n^3} \right] \quad \left(\because \begin{array}{l}\cos 2n\pi = 1 \\ \cos 0 = 1\end{array}\right)$$

$$= \frac{-4\pi}{n}$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore f(x) = \frac{4\pi^2}{3} + \sum_{n=1}^{\infty}\left[\frac{4}{n^2}\cos nx - \frac{4\pi}{n}\sin nx\right]$$

Put $x = \pi$,

$$f(\pi) = \frac{4\pi^2}{3} + \sum_{n=1}^{\infty}\left[\frac{4}{n^2}\cos n\pi\right] \quad (\because \sin n\pi = 0, n \in z)$$

$$\therefore \pi^2 = \frac{4\pi^2}{3} + 4\left[\frac{1}{1^2}\cos\pi + \frac{1}{2^2}\cos 2\pi + \frac{1}{3^2}\cos 3\pi + \dots\right]$$

$$= \frac{4\pi^2}{3} + 4\left[-\frac{1}{1^2} + \frac{1}{2^2} - \frac{1}{3^2} + \frac{1}{5^2} - \dots\right]$$

$$\therefore \pi^2 - \frac{4\pi^2}{3} = -4\left[\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{5^2} + \dots\right]$$

$$\therefore -\frac{\pi^2}{3} = -4\left[\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{5^2} + \dots\right]$$

$$\therefore \frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{5^2} + \dots$$

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EX-4 Find the Fourier series of $f(x) = \frac{1}{2}(\pi - x)$ in the interval $(0, 2\pi)$. Hence, deduce that

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots \quad \text{(Dec. 2013)}$$

Sol^n $\therefore l = \frac{b-a}{2} = \frac{2\pi - 0}{2} = \pi$

BY Euler's formula

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_0^{2\pi}\left(\frac{\pi - x}{2}\right)dx$$

$$= \frac{1}{2\pi}\left[\pi x - \frac{x^2}{2}\right]_0^{2\pi}$$

$$= \frac{1}{2\pi}\left[2\pi^2 - 2\pi^2\right] = 0$$

$$a_n = \frac{1}{\pi}\int_0^{2\pi}\left(\frac{\pi - x}{2}\right)\cos nx\,dx$$

$$= \frac{1}{2\pi}\left[(\pi - x)\left(\frac{\sin nx}{n}\right) - (-1)\left(-\frac{\cos nx}{n^2}\right)\right]_0^{2\pi}$$

$$= \frac{1}{2\pi}\left[-\frac{\cos nx}{n^2}\right]_0^{2\pi} \quad (\because \sin n\pi = 0, n \in z)$$

$$= \frac{1}{2\pi}\left[-\frac{\cos 2n\pi}{n^2} + \frac{\cos 0}{n^2}\right]$$

$$= \frac{1}{2\pi}\left[-\frac{1}{n^2} + \frac{1}{n^2}\right] = 0$$

$$\therefore b_n = \frac{1}{\pi}\int_0^{2\pi}\left(\frac{\pi - x}{2}\right)\sin nx \, dx$$

$$= \frac{1}{2\pi}\left[(\pi - x)\left(-\frac{\cos nx}{n}\right) - (-1)\left(-\frac{\sin nx}{n^2}\right)\right]_0^{2\pi}$$

$$= \frac{1}{2\pi}\left[(x-\pi)\frac{\cos nx}{n}\right]_0^{2\pi} \quad (\because \sin n\pi = 0, n \in \mathbb{Z})$$

$$= \frac{1}{2\pi}\left[\pi\frac{\cos 2n\pi}{n} - (-\pi)\frac{\cos 0}{n}\right]$$

$$= \frac{1}{2\pi}\left[\frac{\pi}{n} + \frac{\pi}{n}\right] = \frac{1}{2\pi}\left[\frac{2\pi}{n}\right] = \frac{1}{n}$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore \frac{1}{2}(\pi - x) = \sum_{n=1}^{\infty}\frac{1}{n}\sin nx$$

$$\therefore \frac{1}{2}(\pi - x) = \sin x + \frac{1}{2}\sin 2x + \frac{1}{3}\sin 3x + \frac{1}{4}\sin 4x + \dots$$

Put $x = \frac{\pi}{2}$ on both sides,

$$\therefore \frac{\pi}{4} = \sin\frac{\pi}{2} + \frac{1}{2}\sin\pi + \frac{1}{3}\sin\frac{3\pi}{2} + \frac{1}{4}\sin 2\pi + \dots$$

$$\therefore \frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

Ex-5 obtain the Fourier series of $f(x) \left(\frac{\pi - x}{2}\right)^2$ in the interval $0 \le x \le 2\pi$. Hence, deduce that

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} + \dots \quad \text{(Dec. 2014)}$$

Solⁿ

$\therefore\ l = \frac{b-a}{2} = \frac{2\pi - 0}{2} = \pi$

By Euler's formula

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_0^{2\pi} \frac{(\pi-x)^2}{4}\,dx$$

$$= \frac{1}{4\pi}\left[\frac{(\pi-x)^3}{-3}\right]_0^{2\pi}$$

$$= \frac{1}{4\pi \times (-3)}\left[(\pi-x)^3\right]_0^{2\pi}$$

$$= \frac{1}{-12\pi}\left[-\pi^3 - \pi^3\right]$$

$$= \frac{1}{-12\pi}\left[-2\pi^3\right] = \frac{\pi^2}{6}$$

$$a_n = \frac{1}{\pi}\int_0^{2\pi} \frac{(\pi-x)^2}{4}\cos nx\,dx$$

$$= \frac{1}{4\pi}\left[(\pi-x)^2\left(\frac{\sin nx}{n}\right) - 2(\pi-x)(-1)\left(-\frac{\cos nx}{n^2}\right) + 2(-1)(-1)\left(-\frac{\sin nx}{n^3}\right)\right]_0^{2\pi}$$

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$$= \frac{1}{4\pi}\left[-2(\pi-x)\frac{\cos nx}{n^2}\right]_0^{2\pi} \quad (\because \sin n\pi = 0,\ n\in\mathbb{Z})$$

$$= \frac{1}{4\pi}\left[2\pi\frac{\cos 2n\pi}{n^2} + 2\pi\frac{\cos 0}{n^2}\right]$$

$$= \frac{1}{4\pi}\left[\frac{2\pi}{n^2} + \frac{2\pi}{n^2}\right] = \frac{1}{4\pi}\left[\frac{4\pi}{n^2}\right] = \frac{1}{n^2}$$

$$b_n = \frac{1}{\pi}\int_0^{2\pi}\frac{(\pi-x)^2}{4}\sin nx\,dx$$

$$= \frac{1}{4\pi}\left[(\pi-x)^2\left(-\frac{\cos nx}{n}\right) - 2(\pi-x)(-1)\left(-\frac{\sin nx}{n^2}\right) + 2(-1)(-1)\left(\frac{\cos nx}{n^3}\right)\right]_0^{2\pi}$$

$$= \frac{1}{4\pi}\left[(x-\pi)^2\frac{\cos nx}{n} + 2\frac{\cos nx}{n^3}\right]_0^{2\pi} \quad (\because \sin n\pi = 0,\ n\in\mathbb{Z})$$

$$= \frac{1}{4\pi}\left[\pi^2\frac{\cos 2n\pi}{n} + 2\frac{\cos 2n\pi}{n^3} - \pi^2\frac{\cos 0}{n} - 2\frac{\cos 0}{n^3}\right]$$

$$= \frac{1}{4\pi}\left[\frac{\pi^2}{n} + \frac{2}{n^3} - \frac{\pi^2}{n} - \frac{2}{n^3}\right] = 0$$

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n\cos\frac{n\pi x}{l} + b_n\sin\frac{n\pi x}{l}\right]$$

$$\therefore \left(\frac{\pi - x}{2}\right)^2 = \frac{\pi^2}{12} + \sum_{n=1}^{\infty} \frac{1}{n^2} \cos nx$$

Put $x = \pi$,

$$0 = \frac{\pi^2}{12} + \sum_{n=1}^{\infty} \frac{1}{n^2} \cos n\pi$$

$$\therefore \quad 0 = \frac{\pi^2}{12} + \sum_{n=1}^{\infty} \frac{1}{n^2} (-1)^n \quad \left(\because \cos n\pi = (-1)^n\right)$$

$$\therefore \quad 0 = \frac{\pi^2}{12} - \frac{1}{1^2} + \frac{1}{2^2} - \frac{1}{3^2} + \frac{1}{4^2} - \cdots$$

$$\therefore \quad -\frac{\pi^2}{12} = -\left[\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots\right]$$

$$\therefore \quad \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots = \frac{\pi^2}{12}$$

Ex-6 Find the Fourier series of $f(x) = x + x^2$ in the interval $(-\pi, \pi)$ and deduce that

$$\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots \quad \text{(Dec. 2012)}$$

Sol^n $\therefore \quad l = \frac{b-a}{2} = \frac{\pi + \pi}{2} = \pi$

By Euler's formula

$$a_0 = \frac{1}{l} \int_c^{c+2l} f(x)\, dx = \frac{1}{\pi} \int_{-\pi}^{\pi} (x + x^2)\, dx$$

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$$= \frac{1}{\pi}\left[\frac{x^2}{2} + \frac{x^3}{3}\right]_{-\pi}^{\pi}$$

$$= \frac{1}{\pi}\left[\frac{\pi^2}{2} + \frac{\pi^3}{3} - \frac{\pi^2}{2} + \frac{\pi^3}{3}\right]$$

$$= \frac{2\pi^2}{3}$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi}(x+x^2)\cos nx \, dx$$

$$= \frac{1}{\pi}\left[(x+x^2)\left(\frac{\sin nx}{n}\right) - (1+2x)\left(\frac{-\cos nx}{n^2}\right) + (2)\left(\frac{-\sin nx}{n^3}\right)\right]_{-\pi}^{\pi}$$

$$= \frac{1}{\pi}\left[(1+2x)\frac{\cos nx}{n^2}\right]_{-\pi}^{\pi} \quad (\because \sin n\pi = 0,\ n \in z)$$

$$= \frac{1}{\pi}\left[(1+2\pi)\frac{\cos n\pi}{n^2} - (1-2\pi)\frac{\cos(-n\pi)}{n^2}\right]$$

$$= \frac{1}{\pi}\left[1+2\pi-1+2\pi\right]\frac{\cos n\pi}{n^2}$$

$$= \frac{4(-1)^n}{n^2} \quad (\because \cos n\pi = (-1)^n)$$

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi}(x+x^2)\sin nx \, dx$$

$$= \frac{1}{\pi}\left[(x+x^2)\left(-\frac{\cos nx}{n}\right) - (1+2x)\left(-\frac{\sin nx}{n^2}\right) + (2)\left(\frac{\cos nx}{n^3}\right)\right]_{-\pi}^{\pi}$$

$$= \frac{1}{\pi}\left[-(x+x^2)\frac{\cos nx}{n} + 2\frac{\cos nx}{n^3}\right]_{-\pi}^{\pi} \quad (\because \sin n\pi = 0, n \in \mathbb{Z})$$

$$= \frac{1}{\pi}\left[-(\pi+\pi^2)\frac{\cos n\pi}{n} + 2\frac{\cos n\pi}{n^3} + (\pi^2-\pi)\frac{\cos n\pi}{n} - 2\frac{\cos n\pi}{n^3}\right]$$

$$= \frac{1}{\pi}\left[-\pi - \pi^2 + \pi^2 - \pi\right]\frac{\cos n\pi}{n}$$

$$= \frac{-2\pi}{\pi}\frac{(-1)^n}{n} = (-2)\frac{(-1)^n}{n}$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore x + x^2 = \frac{\pi^2}{3} + \sum_{n=1}^{\infty}\left[\frac{4(-1)^n}{n^2}\cos nx - 2\frac{(-1)^n}{n}\sin nx\right]$$

Put $x = \pi$,

$$\pi + \pi^2 = \frac{\pi^2}{3} + \sum_{n=1}^{\infty}\left[4\frac{(-1)^n}{n^2}\cos n\pi\right] \quad (\because \sin n\pi = 0, n \in \mathbb{Z})$$

$$\therefore \pi + \pi^2 = \frac{\pi^2}{3} + 4\left[\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots\right] \quad \text{——— (i)}$$

$\rightarrow \cos(-n\pi) = \cos n\pi$

$\rightarrow$

$\therefore$ Put $x = -\pi$,

$$-\pi + \pi^2 = \frac{\pi^2}{3} + \sum_{n=1}^{\infty} 4\frac{(-1)^n}{n^2}\cos(-n\pi)$$

$$\therefore -\pi + \pi^2 = \frac{\pi^2}{3} + 4\left[\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots\right] \quad \text{--- (2)}$$

Adding eqⁿs (1) & (2)

$$\therefore \frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots$$

Ex-7 Find the Fourier series of $f(x) = x + |x|$ in the interval $-\pi < x < \pi$. (Dec. 2014)

Solⁿ $\therefore l = \frac{b-a}{2} = \frac{\pi+\pi}{2} = \pi$

By Euler's formula

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx$$

$$= \frac{1}{\pi}\int_{-\pi}^{\pi} (x + |x|)\,dx$$

$$= \frac{1}{\pi}\left[\int_{-\pi}^{\pi} x\,dx + \int_{-\pi}^{\pi} |x|\,dx\right]$$

$$= \frac{2}{\pi}\int_0^{\pi} |x|\,dx \qquad \left(\because \int_{-a}^{a} f(x)\,dx = 2\int_0^a f(x)\,dx \rightarrow f(x) \text{ even}\right.$$

$$= 0 \quad \rightarrow f(x) \text{ odd}$$

$\rightarrow \quad |x| = x, \quad x > 0$
$\qquad = -x, \quad x < 0$

$$= \frac{2}{\pi}\int_0^{\pi} x \, dx = \frac{2}{\pi}\left[\frac{x^2}{2}\right]_0^{\pi} = \frac{2}{\pi}\left[\frac{\pi^2}{2}\right] = \pi$$

$$a_n = \frac{1}{\pi}\left[\int_{-\pi}^{\pi}(x+|x|)\cos nx \, dx\right]$$

$$= \frac{1}{\pi}\left[\int_{-\pi}^{\pi} x\cos nx \, dx + \int_{-\pi}^{\pi}|x|\cos nx \, dx\right]$$

$$= \frac{1}{\pi}\left[2\int_0^{\pi}|x|\cos nx \, dx\right] \qquad \left(\because \begin{matrix} x\cos nx \Rightarrow \text{odd} \\ |x|\cos nx \rightarrow \text{even}\end{matrix}\right.$$

$$= \frac{2}{\pi}\int_0^{\pi} x\cos nx \, dx$$

$$= \frac{2}{\pi}\left[x\left(\frac{\sin nx}{n}\right) - (1)\left(-\frac{\cos nx}{n^2}\right)\right]_0^{\pi}$$

$$= \frac{2}{\pi}\left[\frac{\cos nx}{n^2}\right]_0^{\pi} \qquad (\because \sin n\pi = 0, \; n \in \mathbb{Z})$$

$$= \frac{2}{\pi}\left[\frac{\cos n\pi}{n^2} - \frac{\cos 0}{n^2}\right]$$

$$= \frac{2}{\pi}\left[\frac{(-1)^n}{n^2} - \frac{1}{n^2}\right] = \frac{2}{\pi n^2}\left[(-1)^n - 1\right]$$

$$b_n = \frac{1}{\pi}\left[\int_{-\pi}^{\pi}(x+|x|)\sin nx \, dx\right]$$

$$= \frac{1}{\pi}\left[\int_{-\pi}^{\pi} x\sin nx \, dx + \int_{-\pi}^{\pi}|x|\sin nx \, dx\right]$$

$$= \frac{1}{\pi}\left[2\int_0^{\pi} x \sin nx \, dx\right] \quad \left(\because x\sin nx \to \text{even},\ |x|\sin nx \to \text{odd}\right)$$

$$= \frac{2}{\pi}\left[x\left(\frac{-\cos nx}{n}\right) - (1)\left(\frac{-\sin nx}{n^2}\right)\right]_0^{\pi}$$

$$= \frac{2}{\pi}\left[-x\frac{\cos nx}{n}\right]_0^{\pi} \quad (\because \sin n\pi = 0,\ n \in z)$$

$$= \frac{2}{\pi}\left[-\pi\frac{\cos n\pi}{n} - 0\right]$$

$$= -\frac{2}{n}(-1)^n$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore x + |x| = \frac{\pi}{2} + \sum_{n=1}^{\infty}\left[\frac{2}{\pi n^2}[(-1)^n - 1]\cos nx - 2\frac{(-1)^n}{n}\sin nx\right]$$

EX-8 Find the Fourier series of $f(x) = x^2, \quad 0 < x < \pi$

$= 0, \quad \pi < x < 2\pi$

(Winter 2012)

Solⁿ $\therefore l = \frac{b-a}{2} = \frac{2\pi - 0}{2} = \pi$

By Euler's formulae

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_0^{2\pi} f(x)\,dx$$

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$$= \frac{1}{\pi}\left[\int_0^{\pi} x^2\, dx + \int_{\pi}^{2\pi} 0\, dx\right]$$

$$= \frac{1}{\pi}\left[\frac{x^3}{3}\right]_0^{\pi} = \frac{1}{\pi}\left[\frac{\pi^3}{3}\right] = \frac{\pi^2}{3}$$

$$a_n = \frac{1}{\pi}\left[\int_0^{\pi} x^2 \cos nx\, dx + \int_{\pi}^{2\pi} 0.\cos nx\, dx\right]$$

$$= \frac{1}{\pi}\left[x^2\left(\frac{\sin nx}{n}\right) - (2x)\left(-\frac{\cos nx}{n^2}\right) + 2\left(-\frac{\sin nx}{n^3}\right)\right]_0^{\pi}$$

$$= \frac{1}{\pi}\left[2x\,\frac{\cos nx}{n^2}\right]_0^{\pi} \quad (\because \sin n\pi = 0, n \in z)$$

$$= \frac{1}{\pi n^2}\left[2\pi(-1)^n - 0\right] = \frac{2(-1)^n}{n^2}$$

$$b_n = \frac{1}{\pi}\left[\int_0^{\pi} x^2 \sin nx\, dx + \int_{\pi}^{2\pi} 0 \sin nx\, dx\right]$$

$$= \frac{1}{\pi}\left[x^2\left(-\frac{\cos nx}{n}\right) - (2x)\left(-\frac{\sin nx}{n^2}\right) + 2\left(\frac{\cos nx}{n^3}\right)\right]_0^{\pi}$$

$$= \frac{1}{\pi}\left[-x^2\frac{\cos nx}{n} + 2\frac{\cos nx}{n^3}\right]_0^{\pi} \quad (\because \sin n\pi = 0, n \in z)$$

$$= \frac{1}{\pi}\left[-\pi^2\frac{(-1)^n}{n} + 2\frac{(-1)^n}{n^3} - \frac{2}{n^3}\right]$$

$$\therefore f(x) = \frac{\pi^2}{6} + \sum_{n=1}^{\infty}\left[\frac{2(-1)^n}{n^2}\cos nx - \left(\frac{2(-1)^n}{n^3} - \pi^2\frac{(-1)^n}{n} - \frac{2}{n^3}\right)\sin nx\right]$$

* Fourier series of discontinuous point

$f(x) = h(x) \quad c < x < d$

$\quad = g(x) \quad d < x < c+2\pi$

Ex-9 Find the Fourier series $f(x) = -\pi, \quad -\pi < x < 0$

$= x, \quad 0 < x < \pi$

Hence, deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$

(Summer 2014)

Solⁿ

Here $l = \frac{b-a}{2} = \frac{\pi+\pi}{2} = \pi$

By Euler's formula

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\,dx$$

$$= \frac{1}{\pi}\left[\int_{-\pi}^{0} -\pi\,dx + \int_0^{\pi} x\,dx\right]$$

$$= \frac{1}{\pi}\left[\left[-\pi x\right]_{-\pi}^{0} + \left[\frac{x^2}{2}\right]_0^{\pi}\right]$$

$$= \frac{1}{\pi}\left[(0-\pi^2) + \left(\frac{\pi^2}{2} - 0\right)\right]$$

$$= \frac{1}{\pi}\left[-\frac{\pi^2}{2}\right] = -\pi/2$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\cos nx\,dx = \frac{1}{\pi}\left[\int_{-\pi}^{0} -\pi\cos nx\,dx + \int_0^{\pi} x\cos nx\,dx\right]$$

$$= \frac{1}{\pi}\left[-\pi\left[\frac{\sin nx}{n}\right]_{-\pi}^{0} + \left[x\left(\frac{\sin nx}{n}\right) - (1)\left(\frac{-\cos nx}{n^2}\right)\right]_0^{\pi}\right]$$

$$= \frac{1}{\pi}\left[0 + \left[\frac{\cos nx}{n^2}\right]_0^{\pi}\right] \quad (\because \sin n\pi = 0,\ n \in Z)$$

$* \; f(d) = \frac{1}{2}\left[f(d+) + f(d-)\right]$

↓ discontinuous point

$= \frac{1}{\pi n^2}\left[(-1)^n - 1\right] \quad \left(\because \cos n\pi = (-1)^n, \; \cos 0 = 1\right)$

$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin nx \, dx$

$= \frac{1}{\pi}\left[\int_{-\pi}^{0} -\pi \sin nx \, dx + \int_{0}^{\pi} x \sin nx \, dx\right]$

$= \frac{1}{\pi}\left[-\pi\left(-\frac{\cos nx}{n}\right)_{-\pi}^{0} + \left[x\left(-\frac{\cos nx}{n}\right) - (1)\left(\frac{-\sin nx}{n^2}\right)\right]_{0}^{\pi}\right]$

$= \frac{1}{\pi}\left[-\pi\left[-\frac{1}{n} + \frac{(-1)^n}{n}\right] + \left[-\pi\frac{(-1)^n}{n}\right]\right] \left(\because \sin n\pi = 0, \; n \in Z\right)$

$= \frac{1}{\pi}\left[\frac{\pi}{n} - \pi\frac{(-1)^n}{n} - \pi\frac{(-1)^n}{n}\right]$

$= \frac{1}{n}\left[1 - 2(-1)^n\right]$

$\therefore f(x) = \frac{-\pi}{4} + \sum_{n=1}^{\infty}\left[\frac{1}{\pi n^2}\left((-1)^n - 1\right)\cos nx + \frac{1}{n}\left[1 - 2(-1)^n\right]\sin nx\right]$

Put $x = 0$,

$\therefore f(0) = \frac{-\pi}{4} + \sum_{n=1}^{\infty}\frac{1}{\pi n^2}\left[(-1)^n - 1\right]$

$\left[\because f(0) = \frac{1}{2}\left[\lim_{x\to 0^-} f(x) + \lim_{x\to 0^+} f(x)\right] = \frac{1}{2}\left[-\pi + 0\right] = \frac{-\pi}{2}\right]$

$$\therefore \frac{-\pi}{2} = \frac{-\pi}{4} - \frac{1}{\pi}\sum_{n=1}^{\infty} \frac{1-(-1)^n}{n^2}$$

$$\therefore \frac{-\pi}{2} = \frac{-\pi}{4} - \frac{1}{\pi}\sum_{n=1}^{\infty} \frac{1+(-1)^{n+1}}{n^2}$$

now n by $2n-1$

$$\therefore \frac{-\pi}{2} = \frac{-\pi}{4} - \frac{1}{\pi}\sum_{n=1}^{\infty} \frac{2}{(2n-1)^2}$$

$$\therefore \frac{-\pi}{2} + \frac{\pi}{4} = -\frac{2}{\pi}\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$$

$$\therefore \frac{-\pi}{4} = \frac{-2}{\pi}\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$$

$$\therefore \frac{\pi^2}{8} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$$

Ex-10 Find the Fourier series of the periodic function with a period 2 of

$f(x) = \pi \qquad 0 \le x \le 1$

$\quad = \pi(2-x), \quad 1 \le x \le 2$ (Summer 2013)

Solⁿ $\therefore l = \frac{b-a}{2} = \frac{2-0}{2} = 1$

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{1}\int_0^2 f(x)\,dx$$

$$= \left[\int_0^1 \pi \, dx + \int_1^2 \pi(2-x) \, dx \right]$$

$$= \left[[\pi x]_0^1 + \pi \left[2x - \frac{x^2}{2} \right]_1^2 \right]$$

$$= \left[\pi + \pi \left[4 - 2 - 2 + \frac{1}{2} \right] \right]$$

$$= \left[\pi + \frac{\pi}{2} \right] = \frac{3\pi}{2}$$

$$a_n = \frac{1}{1} \int_0^2 f(x) \cos n\pi x \, dx$$

$$= \left[\int_0^1 \pi \cos n\pi x \, dx + \int_1^2 \pi (2-x) \cos n\pi x \, dx \right]$$

$$= \left[\pi \left[\frac{\sin n\pi x}{n\pi} \right]_0^1 + \pi \left[(2-x) \left(\frac{\sin n\pi x}{n\pi} \right) - (-1) \left(\frac{-\cos n\pi x}{n^2\pi^2} \right) \right]_1^2 \right]$$

$$= \left[\pi \left[- \frac{\cos n\pi x}{n^2\pi^2} \right]_1^2 \right] \quad (\because \sin n\pi = 0, n \in Z)$$

$$= \frac{-1}{n^2\pi} \left[\cos 2n\pi - \cos n\pi \right]$$

$$= \frac{-1}{n^2\pi} \left[1 - (-1)^n \right] = \frac{1}{n^2\pi} \left[(-1)^n - 1 \right]$$

$$(\because \cos 2n\pi = 1, \cos n\pi = (-1)^n)$$

$$b_n = \frac{1}{1}\int_0^2 f(x)\sin n\pi x\,dx$$

$$= \left[\int_0^1 \pi\sin n\pi x\,dx + \int_1^2 \pi(2-x)\sin n\pi x\,dx\right]$$

$$= \left[\pi\left[-\frac{\cos n\pi x}{n\pi}\right]_0^1 + \pi\left[(2-x)\left(-\frac{\cos n\pi x}{n\pi}\right) - (-1)\left(-\frac{\sin n\pi x}{n^2\pi^2}\right)\right]_1^2\right]$$

$$= \left[\pi\left[-\frac{\cos n\pi}{n\pi} + \frac{\cos 0}{n\pi}\right] + \pi\left[(x-2)\frac{\cos n\pi x}{n\pi}\right]_1^2\right]$$

$$= \left[\frac{1}{n}\left[1-(-1)^n\right] + \left[0 - (-1)\frac{(-1)^n}{n}\right]\right]$$

$$= \left[\frac{1}{n} - \frac{(-1)^n}{n} + \frac{(-1)^n}{n}\right]$$

$$= \frac{1}{n}\left[1 - 2(-1)^n\right]$$

$$\therefore f(x) = \frac{3\pi}{4} + \sum_{n=1}^{\infty}\left[\frac{1}{n^2\pi}\left((-1)^n - 1\right)\cos n\pi x + \frac{1}{n}\left[1-2(-1)^n\right]\sin n\pi x\right]$$

Ex-11 Find the fourier series for $f(x) = 2x - x^2$ in the interval $(0, 3)$ i.e $0 < x < 3$.

Solⁿ

$$\therefore\ l = \frac{b-a}{2} = \frac{3-0}{2} = \frac{3}{2}.$$

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx = \frac{1}{3/2}\int_0^3 (2x - x^2)\,dx$$

$$= \frac{2}{3}\left[2\frac{x^2}{2} - \frac{x^3}{3}\right]_0^3$$

$$= \frac{2}{3}\left[9 - \frac{27}{3}\right] = \frac{2}{3}\left[9 - 9\right] = 0$$

$$a_n = \frac{1}{l}\int_c^{c+2l} f(x)\cos\left(\frac{n\pi x}{l}\right)dx$$

$$= \frac{2}{3}\int_0^3 (2x - x^2)\cos\left(\frac{2n\pi x}{3}\right)dx$$

$$= \frac{2}{3}\left[(2x - x^2)\left(\frac{\sin\left(\frac{2n\pi x}{3}\right)}{\frac{2n\pi}{3}}\right) - (2 - 2x)\left(\frac{-\cos\left(\frac{2n\pi x}{3}\right)}{\left(\frac{2n\pi}{3}\right)^2}\right) + (-2)\left(\frac{\sin\left(\frac{2n\pi x}{3}\right)}{\left(\frac{2n\pi}{3}\right)^3}\right)\right]_0^3$$

$$= \frac{2}{3}\left[\frac{9}{4n^2\pi^2}(2 - 2x)\cos\left(\frac{2n\pi x}{3}\right)\right]_0^3 \quad (\because \sin n\pi = 0,\ n \in \mathbb{Z})$$

$$= \frac{3}{2n^2\pi^2}\left[(2 - 2x)\cos\left(\frac{2n\pi x}{3}\right)\right]_0^3$$

$$= \frac{3}{2n^2\pi^2}\left[(-4)\cos 2n\pi - 2\cos 0\right]$$

$$= \frac{3}{2n^2\pi^2}\left[(-4) - 2\right] \quad \left(\because \begin{array}{l}\cos 0 = 1\\ \cos 2n\pi = 1\end{array}\right)$$

$$= \frac{3}{2n^2\pi^2}[-6] = \frac{-9}{n^2\pi^2}$$

$$b_n = \frac{1}{l}\int_c^{c+2l} f(x)\sin\left(\frac{n\pi x}{l}\right)dx$$

$$= \frac{2}{3}\int_0^3 (2x - x^2)\sin\left(\frac{2n\pi x}{3}\right)dx$$

$$= \frac{2}{3}\left[(2x-x^2)\left(\frac{-\cos\left(\frac{2n\pi x}{3}\right)}{2n\pi/3}\right) - (2-2x)\left(\frac{-\sin\left(\frac{2n\pi x}{3}\right)}{(2n\pi/3)^2}\right) + (-2)\left(\frac{\cos\left(\frac{2n\pi x}{3}\right)}{(2n\pi/3)^3}\right)\right]_0^3$$

$$= \frac{2}{3}\left[\frac{-3}{2n\pi}(2x-x^2)\cos\left(\frac{2n\pi x}{3}\right) - \frac{54}{8n^2\pi^2}\cos\left(\frac{2n\pi x}{3}\right)\right]_0^3$$

$$= \frac{2}{3}\left[\left(\frac{-3}{2n\pi}(6-9)\cos 2n\pi - \frac{54}{8n^2\pi^2}\cos 2n\pi\right) - \left(0 - \frac{54}{8n^2\pi^2}\cos 0\right)\right]$$

$$= \frac{2}{3}\left[\frac{9}{2n\pi} - \frac{54}{8n^2\pi^2} + \frac{54}{8n^2\pi^2}\right]$$

$$= \frac{2}{3}\left[\frac{9}{2n\pi}\right] = \frac{3}{n\pi}$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\left(\frac{n\pi x}{l}\right) + b_n \sin\left(\frac{n\pi x}{l}\right)\right]$$

$$\therefore 2x - x^2 = 0 + \sum_{n=1}^{\infty}\left[\left(\frac{-9}{n^2\pi^2}\right)\cos\frac{2n\pi x}{3} + \left(\frac{3}{n\pi}\right)\sin\frac{2n\pi x}{3}\right]$$

Ex-12 Find the fourier series of $f(x) = x, \quad -1 < x < 0$
$= 2, \quad 0 < x < 1$
(winter-2012)

Solⁿ $\therefore l = 1$

$$a_0 = \frac{1}{l}\int_c^{c+2l} f(x)\,dx$$

$$= \frac{1}{1}\int_{-1}^{1} f(x)\,dx = \left[\int_{-1}^{0} x\,dx + \int_0^1 2\,dx\right]$$

$$= \left\{\left[\frac{x^2}{2}\right]_{-1}^{0} + \left[2x\right]_0^1\right\}$$

$$= \left\{\left[0 - \frac{1}{2}\right] + \left[2 - 0\right]\right\}$$

$$= \left[-\frac{1}{2} + 2\right] = \frac{3}{2}$$

$$a_n = \frac{1}{1}\int_{-1}^{1} f(x)\cos\frac{n\pi x}{l}\,dx$$

$$= \left[\int_{-1}^{0} x\cos n\pi x\,dx + \int_0^1 2\cos n\pi x\,dx\right]$$

$$= \left[x\left(\frac{\sin n\pi x}{n\pi}\right) - (1)\left(-\frac{\cos n\pi x}{n^2\pi^2}\right)\right]_{-1}^{0} + 2\left[\frac{\sin n\pi x}{n\pi}\right]_0^1$$

$$= \left[\frac{\cos n\pi x}{n^2\pi^2}\right]_{-1}^{0} \quad (\because \sin n\pi = 0,\ n \in z)$$

$$= \left[\frac{\cos 0}{n^2\pi^2} - \frac{\cos n\pi}{n^2\pi^2}\right] \quad (\because \cos(-n\pi) = \cos n\pi)$$

$$= \frac{1}{n^2\pi^2}\left[1 - (-1)^n\right]$$

$$b_n = \frac{1}{l}\int_c^{c+2l} f(x) \sin\frac{n\pi x}{l}\, dx$$

$$= \frac{1}{1}\int_{-1}^{1} f(x) \sin n\pi x\, dx$$

$$= \left[\int_{-1}^{0} x \sin n\pi x\, dx + \int_0^1 2 . \sin n\pi x\, dx\right]$$

$$= \left[x\left(-\frac{\cos n\pi x}{n\pi}\right) - 1\left(-\frac{\sin n\pi x}{n^2\pi^2}\right)\right]_{-1}^{0} + 2\left[-\frac{\cos n\pi x}{n\pi}\right]_0^1$$

$$= \left[-x\frac{\cos n\pi x}{n\pi}\right]_{-1}^{0} - \frac{2}{n\pi}\left[\cos n\pi x\right]_0^1$$

$$= \left[0 - \frac{\cos n\pi}{n\pi}\right] - \frac{2}{n\pi}\left[\cos n\pi - \cos 0\right]$$

$$= -\frac{\cos n\pi}{n\pi} - 2\frac{\cos n\pi}{n\pi} + \frac{2\cos 0}{n\pi}$$

$$= -\frac{3\cos n\pi}{n\pi} + 2\frac{\cos 0}{n\pi}$$

$$= \frac{1}{n\pi}\left[2 - 3(-1)^n\right]$$

$$\therefore f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right]$$

$$\therefore f(x) = \frac{3}{4} + \sum_{n=1}^{\infty}\left[\frac{1}{n^2\pi^2}(1-(-1)^n)\cos n\pi x + \frac{1}{n\pi}(2-3(-1)^n)\sin n\pi x\right]$$

Other-Study-Materials-and-Videos

Topic Name-Convergence of Series

Sr. No	Title of Video Lecture	Link
1	Lec1/Convergence of Series	https://www.youtube.com/watch?v=JDhcBfp0VXQ&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=108
2	Lec2/Geometrics Series	https://www.youtube.com/watch?v=-jLINkupLhY&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=109
3	Lec3/nth Term Test for Divergence	https://www.youtube.com/watch?v=cOKWy7NYG4k&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=110
4	Lec4/Integral Test	https://www.youtube.com/watch?v=YeN8iM8CtxY&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=111
5	Lec5/p-series	https://www.youtube.com/watch?v=usLh-J0lNr0&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=112
6	Lec6/The Comparison Test	https://www.youtube.com/watch?v=RSiMaBhJONo&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=113
7	Lec7/The Limit Comparison Test	https://www.youtube.com/watch?v=IY6mYKSbHM8&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=114

Topic Name-Fourier Series		
Sr. No	**Title of Video Lecture**	**Link**
1	Lec1/Fourier Series	https://www.youtube.com/watch?v=lT3WgzIABhg&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=121
2	Lec2/Fourier Series of Period 2pi	https://www.youtube.com/watch?v=k3Rd_gIDPo8&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=122
3	Lec3/Examples on Fourier Series of Period 2pi	https://www.youtube.com/watch?v=3Rc4kmzTKwo&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=123
4	Lec4/ Examples on Fourier Series of Period 2pi	https://www.youtube.com/watch?v=KRbamtybgLo&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=124
5	Lec5/Examples	https://www.youtube.com/watch?v=NO42Nr3-a3A&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=125
7	Lec7/Functions of Any Period	https://www.youtube.com/watch?v=oa7hKouqKBY&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=127
8	Lec8/ Functions of Any Period	https://www.youtube.com/watch?v=X_lmtgCwxgU&list=PLxaL_Pkhcom8VjWs1uXw9c72SqX2QnGWy&index=128

Topic Name-Limit and Continuity of Functions of Two Variables		
Sr. No	**Title of Video Lecture**	**Link**
1	Lec01/Limit and Continuity of Functions of Two Variables	https://youtu.be/gEN4SHoJRxc
2	Lec2/Limit and Continuity of a Functions of Two Variables	https://youtu.be/yxOQRNriFfk
3	Lec3/Limit and Continuity of Functions of Two Variables	https://youtu.be/2GY8oJURI4E
4	Lec4/Limit and Continuity of Functions of Two Variables	https://youtu.be/PADTOG2WYw4
5	Lec5/Limit and Continuity of Functions of Two Variables	https://youtu.be/f4qmIrrQB0w
6	Lec6/Limit and Continuity of Functions of Two Variables	https://youtu.be/0E7NhLLpWME

Topic Name-Partial Derivatives		
Sr. No	**Title of Video Lecture**	**Link**
1	Lec1/Partial Derivatives/Introduction	https://youtu.be/a-T6hFIhW6E
2	Lec2/Partial Derivatives/Higher Order Partial Derivatives	https://youtu.be/D8uvZ5k7Ogs
3	Lec3/Partial Derivatives/Examples	https://youtu.be/iRBLP_ae6qA

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4	Lec4/Partial Derivatives/Chain Rule	https://youtu.be/a1Tjmvcb5jI
5	Lec5/Partial Derivatives/Chain rule-Examples	https://youtu.be/GE-pSK1jnMU
6	Lec6/Partial Derivatives/Examples	https://youtu.be/VMvB6pRX4Ro
7	Lec7/Partial Derivatives/Examples on Heat, Laplace and Wave Equations	https://youtu.be/jtRY80Zx8wA
8	Lec8/Partial Derivatives/Chain Rule-Case I	https://youtu.be/H1IWojhDv_M
9	Lec9/Partial Derivatives/Chain Rule-Case II	https://youtu.be/o5oURMobhy8
10	Lec10/Partial Derivatives/Chain Rule-Case II/Examples	https://youtu.be/A2uJIZ-mJtg
11	Lec11/Partial Derivatives/Chain Rule-Case II/Examples	https://youtu.be/s2GVegQHxXM
12	Lec12/Partial Derivatives/Chain Rule-Case II/Solved Problems	https://youtu.be/OZERHVgFwEQ
13	Lec13/Partial Derivatives/Implicit Differentiation	https://youtu.be/5rKK1-Bm168
14	Lec14/Partial Derivatives/Implicit Differentiation/Second Order Derivative	https://youtu.be/GvoyX4PH6l8
15	Lec15/Partial Derivatives/Implicit Differentiation/Examples	https://youtu.be/9_tdmLRTiS0

Topic Name-Improper Integrals		
Sr. No	**Title of Video Lecture**	**Link**
1	Lec1/Improper Integrals/Type I	https://youtu.be/0gDJmfF9pzo
2	Lec2/Improper Integrals/Type I/Examples	https://youtu.be/tfpCULNm_H4
3	Lec3/Improper Integrals/Type II	https://youtu.be/kEYON2AumBk
4	Lec4/Improper Integrals/Type II/Examples	https://youtu.be/bNd2cEguTo8
5	Lec5/Improper Integrals/Direct Comparison Test	https://youtu.be/9cEssiJcpok
6	Lec6/Improper Integrals/Limit Comparison Test	https://youtu.be/PYTeOV3PXuc
7	Lec7/Improper Integrals/Integral of Rational Function/Example	https://youtu.be/8O7hH9nYtXw
8	Lec8/Improper Integrals/Examples	https://youtu.be/-ssbYhlbB7w
9	Lec9/Improper Integrals/Examples	https://youtu.be/ujdM4IJE7tA
10	Lec10/Improper Integrals/Examples	https://youtu.be/qC4cMzr9Oyo

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Topic Name-Beta and Gamma Functions		
Sr. No	**Title of Video Lecture**	**Link**
1	Lec1/Beta and Gamma Functions	https://youtu.be/zf-FxlXJiLs
2	Lec2/Beta and Gamma Functions/Fundamental Property of Gamma Function	https://youtu.be/rJ_KBBjsCXY
3	Lec3/Beta and Gamma Functions/Examples on Gamma Function	https://youtu.be/SJ1cxdjgCYw
4	Lec4/Beta and Gamma Functions/Beta Function	https://youtu.be/EcBQvH4cBT4
5	Lec5/Beta and Gamma Functions/Relation between Beta and Gamma Function	https://youtu.be/GbHHi9PEUvw
6	Lec6/Beta and Gamma Functions/Euler's Formula/Examples	https://youtu.be/n5EkSZ7e30o
7	Lec7/Beta and Gamma Functions/Solved Problems	https://youtu.be/RRvwtDAckfk
8	Lec8/Beta and Gamma Functions/Examples	https://youtu.be/NvRwmQ3qo88

LABORATORY PLANNING:

S.P.B. Patel Engineering College
Saffrony Institute of Technology
CE/IT Department
Lab Conduction Plan / Tutorial Conduction Plan
Winter 2023

Name of Faculty Member: Prof. Nainsi Soni		Semester: 7th IT					
Subject Name: Internet of Things		Winter 2023					
Subject Code: 3171108		Teaching Scheme: 2L + 2P					
Sr. No.	**Name of Practical**	**Date of conduction (7th IT)**					
		Batch A		**Batch B**		**Batch C**	
		Planned Date	**Actual Date**	**Planned Date**	**Actual Date**	**Planned Date**	**Actual Date**
1	Getting started with NodeMCU, Arduino with ESP8266 and ESP32 in the Arduino IDE.	28/8/2023	28/8/2023	22/8/2023	22/8/2023	23/8/2023	23/8/2023
2	Interfacing with DHT11 Sensor with Arduino.	09-04-2023	09-04-2023	29/8/2023	29/8/2023	09-06-2023	09-06-2023
3	Interfacing with Ultrasonic Sensor with Arduino.	09-11-2023	09-11-2023	09-12-2023	09-12-2023	13/9/2023	13/9/2023
4	Study of Raspberry pi and its different models, installation and GUI.	25/9/2023	25/9/2023	26/9/2023	26/9/2023	20/9/2023	20/9/2023
5	Interfacing of Raspberry Pi and blink LED Light.	26/9/2023	26/9/2023	10-10-2023	10-10-2023	25/9/2023	25/9/2023
6	Transferring the Sensor data to the cloud using Thingspeak and Wokwi Simulator.	10-09-2023	10-09-2023	10-10-2023	10-10-2023	27/9/2023	27/9/2023
7	Interfacing Between Arduino and NodeMCU.	16/10/2023	16/10/2023	17/10/2023	17/10/2023	10-11-2023	10-11-2023
8	IoT Mini Project	16/10/2023	30/10/2023	17/10/2023	17/10/2023	18/10/2023	18/10/2023

LIST OF EXPERIMENTS:

S.P.B. Patel Engineering College
Saffrony Institute of Technology
Computer Engineering/Information Technology Department
Practical List
Winter 2023

Name of Faculty Member: Prof. Nainsi Soni	Semester: 7th IT
Subject Name: Internet of Things	Winter 2023
Subject Code: 3171108	Teaching Scheme: 2L + 2P

Sr. No.	Name of Practical
1	Getting started with NodeMCU, Arduino with ESP8266 and ESP32 in the Arduino IDE.
2	Interfacing with DHT11 Sensor with Arduino.
3	Interfacing with Ultrasonic Sensor with Arduino.
4	Study of Raspberry pi and its different models, installation and GUI.
5	Interfacing of Raspberry Pi and blink LED Light.
6	Transferring the Sensor data to the cloud using Thingspeak and Wokwi Simulator.
7	Interfacing Between Arduino and NodeMCU.
8	IoT Mini Project

GTU FIGHTER

The Staffrony Institute of Technology's innovative "GTU Fighter" program is a testament to the institution's dedication to enhancing the academic performance of students identified as slow learners or those currently underperforming. This initiative highlights the Institute's commitment to recognizing students in need of additional support and providing them with tailored educational resources to enrich their academic journey. Within this program, students demonstrating exceptional academic performance are honored as "Shining Stars," signifying their outstanding achievements.

Selection Criteria for GTU Fighters

The GTU Fighter selects participants based on a series of specific criteria aimed at identifying students who would benefit the most from this specialized support. A student may be designated as a GTU Fighter if they meet any one or more of the following conditions:

- Failure in one or both mid-semester examinations.
- Scoring less than 35 out of 70 in any mid-semester examination.
- Demonstrating overall poor academic performance throughout the semester.

Implementation of GTU Fighter Sessions

Following the end of the semester term, GTU Fighter sessions are strategically organized. Students chosen for this initiative are informed about their GTU Fighter status in specific subjects by faculty members, ensuring transparency and awareness.

S.P.B. Patel Engineering College
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PARENTS TEACHERS MEETING (PTM)

Parent-teacher meetings play a vital role in fostering collaboration between college educators and parents. These meetings are typically held on campus, offering parents the chance to engage with their child's professors to discuss academic progress, behavior, and overall welfare.

During these sessions, professors provide insights into students' performance in specific courses, highlighting strengths and areas for improvement. They may also address attendance, assignment completion, and any behavioral issues.

Parents, in turn, can share observations about their child's study habits, home environment, and any challenges faced. These meetings facilitate a deeper understanding of the student's academic journey and allow for collaborative strategies to support growth and development.

Overall, parent-teacher meetings encourage a partnership between parents and college educators to ensure student success and well-being. They contribute to trust-building and strengthen the relationship between home and campus, ultimately enhancing students' academic achievements and personal development.

PTM AT S.P.B. PATEL ENGINEERING COLLEGE

S. P. B. PATEL Engineering College conducts parent-teacher meetings twice a year, covering all odd and even semesters. During these meetings, all student documents, such as attendance reports, progressive reports, test marks, mid-semester results, and undertaking forms, are made available. Most counselors bring their laptops to efficiently document feedback from parents during the sessions. All counselors use comprehensive counseling sheets (CCS) to streamline the process. The PTM receives an overwhelming response. Additionally, some parents proactively meet with counselors before the scheduled meeting, demonstrating strong engagement in student welfare.

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