SHRI. SOMESHWAR SHIKSHAN PRASARAK MANDAL'S

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY, SOMESHWARNAGAR

Record No:-

Revision:-3

Date:- 8/12/2023

Courses File Index

Name of Faculty: Kadam S.S.   Department: Humanity & Science   Subject: Engineering Mathematics-I

Sr. No.	Content		
1	Academic Calendars	University Calendar	✓
		College Calendar	✓
		Department Calendar	✓
2	Time Table	Class Time Table	✓
		Individual Time Table	✓
3	Vision-Mission	College/Institute	✓
		Department	✓
4	PEOs		✓
5	POs		✓
6	Course Objective and Course Outcome		✓
7	Course Syllabus		✓
8	Content beyond the syllabus to bridge the gap		✓
9	University Question Papers and Model Solution- At least 03		✓
10	Question Bank	Theory Unit-wise	✓
		Objective Questions	✓
		Oral/Pr Questions	✓
11	Teaching Plan	Theory	✓
		Practical	—
12	Unit Test	Question Paper	✓
		Attendance Record	✓
		Result	✓
		Sample answer sheet	✓
13	Student Attendance Record	Theory	✓
		Practical	—
		Remedial Class	✓
14	Continuous Assessment Record		✓
15	Notes (Handwritten)		✓

Course file Checking:

Date-	22/02/2023			
H.O.D.	[signature]			
Academic Coordinator	[signature] 22/02/2023			
Principal	[signature]			

Savitribai Phule Pune University

Circular No.153of 2023

Dates of Commencement and Conclusion of the Academic Year 2023-24 for Affiliated Colleges and Institutes.

It is hereby informed that, the dates of commencement and conclusion of the First and Second term of Courses, under the faculty of **Science & Technology**, for the academic year 2023-24 shall be as under:

Term – I

Sr. No.	Course, Programme, Year	Commencement	Conclusion	Tentative Commencement Exam	Vacation	
					From	To
1	B.E. - I /B.Tech.- I	07/08/2023	16/12/2023	19/12/2023	18/12/2023	06/01/2024
2	M.E. I /M.Tech.- I	14/08/2023	09/12/2023	11/12/2023	11/12/2023	31/12/2023
3	M.Arch. - I	07/08/2023	30/11/2023	04/12/2023	01/12/2023	20/12/2023

Term – II

Sr. No.	Course, Programme, Year	Commencement	Conclusion	Tentative Commencement Exam	Vacation	
					From	To
1	B.E. - I /B.Tech.- I	08/01/2024	04/05/2024	06/05/2024	06/05/2024	16/06/2024
2	M.E. I /M.Tech.- I	01/01/2024	30/04/2024	02/05/2024	01/05/2024	09/06/2024
3	M.Arch. - I	26/12/2023	20/04/2024	25/04/2024	25/04/2024	02/06/2024

NOTE :

In case, the Head of the college requires to give additional holidays in exceptional circumstances, he/she may do so by compensating the same by keeping the college working on holidays.

Ref. No. PGS/3416
Date: 04/08/2023

Deputy Registrar
(P.G.Admission)

Copy to: for Information and necessary action

The Members of the Management Council.
The Deans of Faculties.
The Registrar, Savitribai Phule Pune University, Pune.
The Director, Board of Examinations & Evaluation, Savitribai Phule Pune University, Pune.
The Heads of all University Departments.
The Principals of all Affiliated Colleges.
The Directors of all Recognized Institutes.
The Heads of all the Administrative Sections of the University Office.
Asstt. Registrar, office of the Hon. Vice-Chancellor, Savitribai Phule Pune University
Asstt. Registrar, office of the Hon. Pro-Vice-Chancellor, Savitribai Phule Pune University

COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin 412 306)

SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY, SOMESHWARNAGAR

A.Y.:-2023-2024

ACADEMIC CALENDAR

Semester:-I

Week No.	Month	MON	TUE	WED	THU	FRI	SAT	SUN	No. of Working Days	Events
1	JUL	10	11	12	13	14	15	16	6	TE, BE Commencement of Teaching - 10 July, Course File Checking
2		17	18	19	20	21	22	23	6	Someshwar Techeathon 2K23 on 21st and 22nd July
3		24	25	26	27	28	29	30	5	Attendance monitoring & Phone Calls
4		31							1	
	AUG		1	2	3	4	5	6	5	Monthly Dept Academic Monitoring on 1st Aug
5		7	8	9	10	11	12	13	6	Commencement of SE - 10 Aug, Librarian's Day 12 Aug, First Defaulter list after a month
6		14	15	16	17	18	19	20	4	Independence Day 15 August
7		21	22	23	24	25	26	27	6	Tentative date of Unit Test 1 For T.E & B.E on 21st to 26th Aug
8		28	29	30	31			-	4	Parents Teacher meet on 25th Aug
	SEPT					1	2	3	2	Monthly Dept Academic Monitoring on 1st Sept
9		4	5	6	7	8	9	10	6	Teachers Day 5th Sept., Tentative dates of SPPU In-Sem for T.E ,B.E 4th to 10th Sept
10		11	12	13	14	15	16	17	5	Engineers Day 15 Sept
11		18	19	20	21	22	23	24	5	
12		25	26	27	28	29	30		5	Tentative dates of Unit Test 1 For S.E on 25th to 28th Sept
	OCT							1	0	
13		2	3	4	5	6	7	8	5	Campus Cleaning on occasion of Gandhi Jayanti 2 Oct., Monthly Dept Academic Monitoring on 3rd Oct.
14		9	10	11	12	13	14	15	6	Defaulter list after second month
15		16	17	18	19	20	21	22	6	Tentative dates of SPPU In-Sem for S.E. 16th to 21st Oct.
16		23	24	25	26	27	28	29	5	Tentative date of Unit Test 2 For T.E and B.E on 23rd to 28th Oct
		30	31						2	
17	NOV			1	2	3	4	5	4	Final Defaulter list, Term Submission of T.E and B.E 2nd and 3rd Nov, Conclusion of Teaching for TE, BE - 4th Nov.
18		6	7	8	9	10	11	12	5	Monthly Dept Academic Monitoring End Semester Exam Academic Monitoring on 6st Nov.
19		13	14	15	16	17	18	19	4	SPPU Oral and Practical Examination of T.E and B.E
20		20	21	22	23	24	25	26	6	SPPU Theory Examination of T.E and B.E, Tentative date of Unit Test 2 For S.E. on 20th to 25th Nov.
		27	28	29	30				3	Internal FeedBack
21	DEC					1	2	3	2	Final Defaulter list, Term Submission of S.E 1st and 2nd Dec
22		4	5	6	7	8	9	10	6	Conclusion of Teaching for SE - 4 Dec.
23		11	12	13	14	15	16	17	6	SPPU Oral and Practical Examination of S.E.
24		18	19	20	21	22	23	24	6	SPPU Theory Examination for S.E.
25		25	26	27	28	29	30	31	5	
No. of Week Days		21	21	23	24	24	24		137	

HOLIDAYS
29/07 Moharam
15/08 Independence Day
16/08 Parsi New Year
11/09 Last Shravani Somwar
19/09 Ganesh Chaturthi
28/09 Anant Chaturdashi
02/10 Mahatma Gandhi Jayanti
24/10 Dasara
10/11 Dhantrayodashi
14/11 Diwali
15/11 Bhaubij
27/11 Guru nanak Jayanti
25/12 Christmas

NOTE:-

Principal Meet will be conduct as and when required

HOD Meet will be conduct as and when required

CFM Meet will be conduct as and when required

Continuous assessment of assignment/ experiments /project/seminar by respective Guide/Subject teacher once in month.

Academic Coordinator

Principal

[logo]	SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S SHARADCHANDRA PAWAR CLLEGE OFENGINEERING AND TECHNOLOGY, SOMESHWARNAGAR	Record No.:- ACD/R/01 Revision:- 00 Date:-25/08/2023

DEPARTMENT OF HUMANITY & SCIENCE

A.Y.:-2023-2024	DEPARTMENTAL ACADEMIC CALENDER	Semester:-I

Week No.	Month	MON	TUE	WED	THU	FRI	SAT	SUN	No. of Working Days	Events
1	SEPT					1	2	3	2	FE Commencement of Teaching -01 Sep 2023
2		4	5	6	7	8	9	10	6	Attendance monitoring & Phone Calls - 16 Sep 2023, Teachers Day 5th Sept.
3		11	12	13	14	15	16	17	5	Engineers Day 15 Sept
4		18	19	20	21	22	23	24	5	Course File Checking
5		25	26	27	28	29	30		5	Regular Teaching & continuous assessment
	OCT							1	0	Campus Clearing on occasion of Gandhi Jayanti 2 Oct., Monthly Dept Academic Monitoring on 3rd Oct.
6		2	3	4	5	6	7	8	5	
7		9	10	11	12	13	14	15	6	Unit Test 1 For FE on 02nd Oct to 7th Oct
8		16	17	18	19	20	21	22	6	University Insem Exam from 09/10/2023 to 13/10/2023
9		23	24	25	26	27	28	29	5	Regular Teaching & continuous assessment
10		30	31						2	1 Month Attendance monitoring FE
11	NOV			1	2	3	4	5	4	Regular Teaching & continuous assessment
12		6	7	8	9	10	11	12	5	Attendance monitoring & Phone Calls - 04 Nov 2023
13		13	14	15	16	17	18	19	4	Diwali Holiday 08 Nov 2023 to 20 Nov 2023
14		20	21	22	23	24	25	26	6	Industrial Visit for FE 23 Nov 2023
15		27	28	29	30				3	FE Parents Meeting
16	DEC					1	2	3	2	1 Month Attendance monitoring FE
17		4	5						2	Regular Teaching & continuous assessment
										Student feedback at the end of semester- I
										Final Defaulter list
										submission/oral/term work/practical before 05/12/2023
No. of Week Days		11	11	12	12	13	14		73	

HOLIDAYS
11/09 Last Shravani Somwar
19/09 Ganesh Chaturthi
28/09 Anant Chaturdashi
02/10 Mahatma Gandhi Jayanti
24/10 Dasara
10/11 Dhantrayodashi
14/11 Diwali
15/11 Bhaubij
27/11 Guru nanak Jayanti
25/12 Christmas

NOTE:-

- Principal Meet will be conduct as and when required
- HoDs will address the students of department once in a month
- Industrial visit, guest lectures, expert lectures will be conducted on department level.
- HOD Meet will be conduct as and when required
- OFM Meet will be conducted once in a week.
- Continuous assessment of assignment/ experiments /project/seminar by respective Guide/Subject teacher once in month.

Academic Coordinator

HOD

HEAD OF DEPARTMENT
HUMANITY & SCIENCE

SOMESHWARNAGAR
EST 2010

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL BARAMATI, DIST-PUNE (PIN-412306)

SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY SOMESHWARNAGAR

Record No:-
Revision:- 03
Date:- 02/01/2020

TIME TABLE Div (A)

Department: First Year | Class: FE | Semester: I | Academic Year: 2023-24 | W.E.F.: 28/08/2023

DAY/TIME	9:00-10:00	10:00-11:00	11.00-12.00	12:00-12:45	12:45-1:45	1:45-2:00	2.00-3.00 / 3:00-4:00
MONDAY	ENG Language	ENG Language	SME	LUNCH BREAK	M-I	SHORT BREAK	BEE (A) EM (B) CHE (C)
TUESDAY	BEE	M-I	SME		EM		Workshop (A) CHE (B) SME (C)
WEDNESDAY	SME	CHE	ENV-I		EM		EM (A) SME (B) Workshop (C)
THURSDAY	EM	CHE	BEE		M-I		CHE (A) Library Hour(B) EM (C)
FRIDAY	EM	CHE	M-I		BEE		SME (A) BEE (B) Library Hour (C)
SATURDAY	BEE	M-I	ENV-I		CHE		Library hour (A)Workshop (B) BEE (C)

Choice Code	Subject Name	Faculty Name	TH/PR
107001	M-I- Engineering Mathematics I	Prof. Kadam S.S.	TH
107009	CHE- Engineering Chemistry	Prof. Wable N.S.	TH+PR
103004	BEE- Basic Electrical Engineering	Prof.Changan D.D.	TH+PR
102003	SME- Systems in Mechanical Engg.	Prof. Bhagat S.N	TH+PR
101011	EM- Engineering Mechanics	Prof. Kate D.B.	TH+PR
101007	ENV-I- Environmental Studies	Prof.Thombare S.P.	TH
111006	Workshop Practices.	Prof. Bhagat S.N	TW
	Library Hour	Miss.Kadam V.S.	

Batch	Roll NO.
A	FE101 to FE120
B	FE121 to FE140
C	FE 141 to FE 160

Prof. Attar K.C.
Time Table Incharge

Prof. Wable N.S.
Head of the Dept.

Dr. Bhokare S.A.
Principal

HEAD OF DEPARTMENT
HUMANITY AND SCIENCE

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412 306)

SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY SOMESHWARNAGAR

Record No:-
Revision:- 03
Date:- 02/01/2020

PERSONAL TIME TABLE

Department: First Year | Class: FE | Semester: I | Academic Year: 2023-24 | W.E.F.: 28/08/2023

DAY/TIME	9:00-10:00	10:00-11:00	11.00-12.00	12.00-12:45	12:45-1:45	1:45-2:00	2.00-3.00	3:00-4:00
MONDAY			M-I	LUNCH BREAK	M-I	SHORT BREAK		
TUESDAY	M-I	M-I						
WEDNESDAY		M-I						
THURSDAY		M-I			M-I			
FRIDAY			M-I					
SATURDAY	M-I	M-I						

Choice Code	Subject Name	Faculty Name	TH/PR
107001	M-I- Engineering Mathematics I	Prof.Kadam S.S.	TH

Prof. Kadams S.
Time Table [illegible]

Prof. Wable N.S.
Head of the Dept.

Dr. Deokar S.A.
Principal

HEAD OF DEPARTMENT
HUMANITY AND SCIENCE

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412306)

Institute Vision and Mission

Vision

- ✓ Our vision is to achieve excellence in technical education and make the engineers for socio-economic development of rural India.

Mission

- To prepare rural students for a productive and rewarding career in engineering profession.
- To provide students with comprehensive knowledge and fundamentals of engineering.
- To create barrier free environment through technical education in rural area.
- Development of technical human resource for socio-economic development of rural India.
- To impart value education and skill through technical education.

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY

SOMESHWARNAGAR

PRINCIPAL

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY

SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412 306)

SOMESHWAR SHIKSHAN PRASARAK MANDAL's
Sharadchandra Pawer College of Engineering and Technology
Someshwarnagar, Baramati-412306
DEPARTMENT OF HUMANITY AND SCIENCE

Department of Humanity and Science

Vision-

- To become a leading Institute in producing high quality technical professionals for Nation Building.

Mission

- To nurture the students with a high-quality education.
- To promote creativity, excellence, and discipline.
- To explore career opportunities for the students.
- To enhance industry-institute interaction and research activities.
- To create social and environmental awareness.

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412 306)

SOMESHWAR SHIKSHAN PRASARAK MANDAL's
Sharadchandra Pawer College of Engineering and Technology
Someshwarnagar, Baramati-412306
DEPARTMENT OF HUMANITY AND SCIENCE

Program Educational Outcomes (PEOs)-

PEO-1 : Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PEO-2 : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PEO-3 : Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PEO-4 : Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PEO-5 : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PEO-6 : Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PRINCIPAL
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SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412306)

SOMESHWAR SHIKSHAN PRASARAK MANDAL's
Sharadchandra Pawer College of Engineering and Technology
Someshwarnagar, Baramati-412306
DEPARTMENT OF HUMANITY AND SCIENCE

Program Outcomes (POs)-

- **CO1 :** Student will be able to solve system of linear equations by using matrices.
- **CO2 :** Student will be able to solve many engineering problems by using De'moivres theorems
- **CO3 :** Student will be able to find the nature of Infinite series and also to find nth derivatives of any function.
- **CO4 :** Student will be able to expand any function in the series form, also find limit of any functions by using L-Hospital Rule.
- **CO5 :** Student will be able to find partial Derivative using Euler's theorems.
- **CO6 :** Student will be able to find Jocobian of any function and Error , also Maximum and Minimum value of functions of two variables.
- **CO7 :** Student will be able to solve Differential equations by using the various methods like Variable separable, Homogeneous, Exact, Linear ect.
- **CO8 :** Student will be able to solve many Applications of Differential Equations in Mechanical, Electrical, Civil and Chemical engineering.
- **CO9 :** Student will be able to find the nature of Fourier series and Integral Calculus.
- **CO10 :** Student will be able to expand differentiation under the integral sign and Tracing of curves like Cartesian, polar and parametric curves.
- **CO11 :** Student will be able to find the equations of Sphere, Cone and Cylinder.
- **CO12 :** Student will be able to solve Multiple integrals and study applications in area, volume and RMS values, Centre of gravity and Moment of inertia.

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (PIN-412 306)

COURSE OBJECTIVE

Course Objective	Descriptions
1	To make the students familiarize with concepts and techniques in Calculus, Fourier series and Matrices.
2	The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

COURSE OUTCOMES

Course Outcomes	Descriptions
CO1	Mean value theorems and its generalizations leading to Taylors and Maclaurin's series useful in the analysis of engineering problems.
CO2	The Fourier series representation and harmonic analysis for design and analysis of periodic continuous and discrete systems.
CO3	To deal with derivative of functions of several variables that are essential in various branches of Engineering.
CO4	To apply the concept of Jacobian to find partial derivative of implicit function and functional dependence. Use of partial derivatives in estimating error and approximation and finding extreme values of the function.
CO5	The essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, finding linear and orthogonal transformations, Eigen values and Eigen vectors applicable to engineering problems.

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412 306)

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum

For

First Year
Bachelor of Engineering
(Choice Based Credit System)

(2019 Course)

(With Effect from Academic Year 2019-20)

Savitribai Phule Pune University		
First Year Engineering (2019 Course)		
107001 – Engineering Mathematics – I		
Teaching Scheme: **TH : 3 Hrs./Week** **TUT : 1 Hr/Week**	**Credits** **04**	**Examination Scheme:** **In-Semester Exam :30 Marks** **End-Semester Exam :70 Marks** **TW :25 Marks**

Prerequisites:
Differentiation, Integration, Maxima and Minima, Determinants and Matrices.

Course Objectives:
To make the students familiarize with concepts and techniques in Calculus, Fourier series and Matrices. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes (COs): The students will be able to learn

CO1: Mean value theorems and its generalizations leading to Taylors and Maclaurin's series useful in the analysis of engineering problems.

CO2: the Fourier series representation and harmonic analysis for design and analysis of periodic continuous and discrete systems.

CO3: to deal withderivative of functions of several variables that are essential in various branches of Engineering.

CO4: to apply the concept of Jacobian to find partial derivative of implicit function and functional dependence. Use of partial derivatives in estimating error and approximation and finding extreme values of the function.

CO5: the essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, finding linear and orthogonal transformations, Eigen values and Eigen vectors applicable to engineering problems

Course Contents

Unit I: Differential Calculus: (08 Hrs.)
Rolle's Theorem, Mean Value Theorems, Taylor's Series and Maclaurin's Series, Expansion of functions using standard expansions, Indeterminate Forms, L' Hospital's Rule, Evaluation of Limits and Applications.

Unit II: Fourier Series (08 Hrs.)
Definition, Dirichlet's conditions, Full range Fourier series, Half range Fourier series, Harmonic analysis, Parseval's identity and Applications to problems in Engineering.

Unit III: Partial Differentiation (08Hrs.)
Introduction to functions of several variables, Partial Derivatives, Euler's Theorem on Homogeneous functions, Partial derivative of Composite Function, Total Derivative, Change of Independent variables

Unit IV: Applications of Partial Differentiation (08 Hrs.)
Jacobian and its applications, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

Unit V: Linear Algebra-Matrices, System of Linear Equations (08 Hrs.)
Rank of a Matrix, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Application to problems in Engineering.

Unit VI: Linear Algebra-Eigen Values and Eigen Vectors, Diagonaliztion (08 Hrs.)
Eigen Values and Eigen Vectors, Cayley Hamilton theorem, Diagonaliztion of a matrix, Reduction of Quadratic forms to Canonical form by Linear and Orthogonal transformations.

Text Books:

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412 306)

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi)

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning)
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)
5. Applied Mathematics (Vol. I & Vol. II) by P.N.Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Linear Algebra –An Introduction, Ron Larson, David C. Falvo (Cenage Learning, Indian edition)

Tutorial and Term Work:

i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students maximum) per division.

ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on performance and continuous internal assessment.

107002: Engineering Physics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 Hr/week PR: 02 Hr/Week	05	In-Semester :30 Marks End-Semester :70 Marks PR :25 Marks

Prerequisite Courses, if any:

Fundamentals of: optics, interference, diffraction polarization, wave-particle duality, semiconductors and magnetism

Companion Course, if any: Laboratory Practical

Course Objectives:

To teach students basic concepts and principles of physics, relate them to laboratory experiments and their applications

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Develop understanding of interference, diffraction and polarization; connect it to few engineering applications.

CO2: Learn basics of lasers and optical fibers and their use in some applications.

CO3: Understand concepts and principles in quantum mechanics. Relate them to some applications.

CO4: Understand theory of semiconductors and their applications in some semiconductor devices.

CO5: Summarize basics of magnetism and superconductivity. Explore few of their technological applications.

CO6: Comprehend use of concepts of physics for Non Destructive Testing. Learn some properties of nanomaterials and their application.

Course Contents

Unit I **Wave Optics** **(08 Hrs)**

Interference

- Introduction to electromagnetic waves and electromagnetic spectrum
- Interference in thin film of uniform thickness (with derivation)
- Interference in thin film wedge shape (qualitative)
- Applications of interference: testing optical flatness, anti-reflection coating

Diffraction

PRINCIPAL
SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
A/P. SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE

Total No. of Questions : 9]

SEAT No. :

PA-4296

[Total No. of Pages : 4

[5924]-5

F.E.

ENGINEERING MATHEMATICS - I

(2019 Pattern) (107001) (Semester - I) (End - Sem)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Attempt Q.1 compulsory, Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.*
2) *Use of electronic pocket calculator is allowed.*
3) *Assume suitable data, if necessary.*
4) *Figures to the right indicate full marks.*

Q1) Write the correct option for the following multiple choice questions. **[10]**

a) If $u = x^3 + y^3$ then $\frac{\partial^2 u}{\partial x \partial y}$ is equal to **[2]**

i) 3 ii) -3

iii) 2 iv) 0

b) If $x = u^2 - v^2$, $y = 2uv$ and $\frac{\partial(x,y)}{\partial(u,v)} = 4(u^2+v^2)$ then $\frac{\partial(u,v)}{\partial(x,y)}$ is equal to **[2]**

i) $4(x^2+y^2)$ ii) $4(u^2+v^2)$

iii) $\frac{1}{4(u^2+v^2)}$ iv) 1

c) For $c_1x_1 + c_2x_2 = 0$ where, x_1, x_2 are non-zero vectors and c_1, c_2 are constants then x_1, x_2 are linearly independent if **[2]**

i) $c_1 \neq 0, c_2 \neq 0$ ii) $c_1 \neq 0, c_2 = 0$

iii) $c_1 = 0, c_2 \neq 0$ iv) $c_1 = 0, c_2 = 0$

P.T.O.

d) The quadratic form corresponding to the matrix $M=\begin{bmatrix}1 & 2 & 3\\ 2 & -4 & 6\\ 3 & 6 & 5\end{bmatrix}$ is [2]

i) $Q(x)=x_1^2-4x_2^2+5x_3^2+4x_1x_2+6x_1x_3+12x_2x_3$

ii) $Q(x)=x_1^2+2x_2^2+3x_3^2$

iii) $Q(x)=x_1^2-4x_2^2+5x_3^2+2x_1x_2+3x_1x_3+6x_2x_3$

iv) $Q(x)=x_1-4x_2+5x_3^2$

e) If $u=x^2+y^2+2x$, $\dfrac{\partial u}{\partial y}$ is equal to [1]

i) $2x+2$ ii) $2y$

iii) $2x+2y+2$ iv) 2

f) If for a square matrix M of order 2, sum of diagonal elements = 4 and $|M|=3$ then. Characteristic equation of A is [1]

i) $\lambda^2-3\lambda+4=0$ ii) $\lambda^2-4\lambda+3=0$

iii) $\lambda^2+3\lambda+4=0$ iv) $\lambda^2+4\lambda+3=0$

Q2) a) If $u=2x+3y$, $v=3x-2y$ find value of $\left(\dfrac{\partial u}{\partial x}\right)_y\left(\dfrac{\partial x}{\partial u}\right)_v\left(\dfrac{\partial y}{\partial v}\right)_x\left(\dfrac{\partial v}{\partial y}\right)_u$. [5]

b) If $u=\operatorname{cosec}^{-1}\sqrt{\dfrac{x^{1/2}+y^{1/2}}{x^{1/3}+y^{1/3}}}$ then prove that

$$x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=\frac{\tan u}{144}\left[\tan^2 u+13\right]$$ [5]

c) If $x=u+v+w$, $y=uv+vw+uw$, $z=uvw$ and ϕ is function of x, y, z then prove that $u\cdot\dfrac{\partial\phi}{\partial u}+v\dfrac{\partial\phi}{\partial v}+w\dfrac{\partial\phi}{\partial w}=x\dfrac{\partial\phi}{\partial x}+2y\dfrac{\partial\phi}{\partial y}+3z\dfrac{\partial\phi}{\partial z}$. [5]

OR

Q3) a) If $z = \tan(y + ax) - (y - ax)^{3/2}$ then find value of $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}$. [5]

b) If $u = \log(x^3 + y^3 - x^2y - xy^2)$ then find value of $x^2 \cdot \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \cdot \frac{\partial^2 u}{\partial y^2}$ [5]

c) If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ then find value of $x \cdot \frac{\partial u}{\partial x} + y \cdot \frac{\partial u}{\partial y} + z \cdot \frac{\partial u}{\partial z}$ [5]

Q4) a) If $x = v^2 + w^2, y = w^2 + u^2, z = u^2 + v^2$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ [5]

b) In calculating the volume of a right circular cylinder using the formula : $V = \pi r^2 h$, errors of 2% and 1% are made in measuring the height and radius of base respectively. Find the error in the calculated volume. [5]

c) Find stationary points of : $f(x, y) = 3x^2 - y^2 + x^3$ and find f_{max} where it exists. [5]

OR

Q5) a) If $x = u + v, y = v^2 + w^2, z = u^3 + w^3$ then find $\frac{\partial u}{\partial x}$, using jacobian. [5]

b) Examine for functional dependence :

$$u = \frac{x + y}{1 - xy}, v = \tan^{-1} x + \tan^{-1} y$$ [5]

c) Find stationary value of $u = x^2 + y^2 + z^2$ under the condition $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$ using Lagrange's method. [5]

Q6) a) Solve the following system of linear equations. $4x + 2y + z + 3w = 0$, $6x + 3y + 4z + 7w = 5$, $2x + y + w = -1$. [5]

b) Examine whether the vectors $x_1 = (2, 2, 1), x_2 = (1, 3, 1), x_3 = (1, 2, 2)$ are linearly independent or dependent. If dependent, find the relation between them. [5]

c) Find the values of a, b, c if A is orthogonal, where $A = \frac{1}{9}\begin{bmatrix} -8 & 4 & a \\ 1 & 4 & b \\ 4 & 7 & c \end{bmatrix}$. [5]

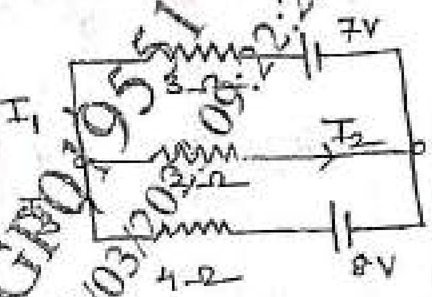
OR

Q7) a) Determine values of K for which the equations $x+y+z=1$, $2x+y+4z=k$, $4x+y+10z=k^2$ are inconsistent. [5]

b) Examine whether the vectors $x_1=(3,1,-4)$, $x_2=(2,2,-3)$, $x_3=(0,-4,1)$ are linearly independent or dependent. If dependent, find the relation between them. [5]

[5]

c) Determine the currents in the following network.



Q8) a) Find the eigen values and eigen vectors of the matrix $A=\begin{bmatrix}14 & -10\\ 5 & -1\end{bmatrix}$. [5]

b) By using cayley Hamilton theorem, find the inverse of the matrix $\begin{bmatrix}2 & 1 & 1\\ 0 & 1 & 0\\ 1 & 1 & 2\end{bmatrix}$, if it exists. [5]

c) Reduce the matrix $\begin{bmatrix}3 & 1 & 4\\ 0 & 2 & 6\\ 0 & 0 & 5\end{bmatrix}$ to its diagonal form by finding modal matrix P. [5]

OR

Q9) a) Find the eigen values of $A=\begin{bmatrix}1 & 0 & -1\\ 1 & 2 & 1\\ 2 & 2 & 3\end{bmatrix}$. Also find eigen vector corresponding to the largest eigen value of A. [5]

b) Verify cayley Hamilton theorem for $A=\begin{bmatrix}1 & 2\\ 2 & -1\end{bmatrix}$. Hence find A^4. [5]

c) Find the transformation which reduces the quadratic form $x_1^2+2x_2^2+3x_3^2+2x_1x_2-2x_1x_3+2x_2x_3$ to the canonical form by using congruent transformations. Also write the canonical form. [5]

Shri Someshwar Shikshan Prasarak Mandal's

8 pages

SOMESHWAR ENGINEERING COLLEGE

Tal : Baramati, Dist : Pune

CLASS TEST NO.: ....

Answer Sheet No. 3893

Roll No. (In figures) :

Name of the Student : Date of Exam : / /20

Name of the Subject : Class

Main Ans. Book	No.of Supplement	Total

Signature Of Supervisor

Q. No.	1	2	3	4	5	6	7	8	9	10	TOTAL MARKS	Signature of Examiner
Marks												

(Write on both sides and start writing from this page.)

Q1

a)

→ iv) 0

b)

→ iii) $\frac{1}{4(u^2+v^2)}$

c)

→ i) $C_1 \neq 0, C_2 \neq 0$

d)

→ iii) $Q(x) = x_1^2 - 4x_2^2 + 6x_3^2 + 2x_1x_2 + 3x_1x_3 + 6x_2x_3$

e)

→ ii) $2y$

f)

→ ii) $\lambda^2 - 4\lambda + 3 = 0$

PRINCIPAL

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY

SOMESHWARNAGAR, TAL-BARAMATI, DIST-PUNE (Pin-412 306)

Q 2

a) $u = 2x + 3y$ — ①

$v = 3x - 2y$ — ②

Consider

$\left(\frac{\partial y}{\partial x}\right)_x$:- considee eq ②

$v = 3x - 2y$

$2y = 3x - v$

$y = \frac{3x - v}{2}$

Diff. w.r.t. y keeping x constant.

$\left(\frac{\partial y}{\partial v}\right)_x = \frac{\partial}{\partial v}\left(\frac{3x - v}{2}\right)$

$= \frac{1}{2}\left[\frac{\partial}{\partial v}(3x) - \frac{\partial}{\partial v}(v)\right]$

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

$\boxed{\left(\frac{\partial y}{\partial v}\right)_x = -\frac{1}{2}}$

consider eqⁿ ①

$u = 2x + 3y$

$u - 2x = 3y$

$\boxed{y = \frac{u - 2x}{3}}$

considee eqⁿ ③

$v = 3x - 2y$

$v = 3x - 2\left(\frac{u - 2x}{3}\right)$

$3v = 13x - 2u$

$2u - 3v = 13x$

$\boxed{\frac{3v - 2u}{13} = x}$

Diff. w.r.t. x keeping v constant

$\left(\frac{\partial x}{\partial u}\right)_v = \frac{\partial}{\partial u}\left(\frac{3v + 2u}{7}\right)$

$\left(\frac{\partial x}{\partial u}\right)_v = \frac{2}{13}$

$u = 2x + 3y$

$\boxed{\frac{3y - u}{2} = x}$

putting in

$v = 3\left(\frac{3y - u}{2}\right) - 2y$

$v = \frac{3y - 9y}{2} - 4y$

$2u - 9y - 4y$

$= 5y - 3y$

$$\boxed{v = \frac{13y - 3u}{2}}$$

to find $\left(\frac{\partial v}{\partial y}\right)_u$

$$\frac{\partial}{\partial y}(v)_u = \frac{\partial}{\partial y}\left(\frac{5y - 3u}{2}\right)$$

$$\frac{\partial}{\partial y}(v) = \frac{\partial\left(\frac{5y-3u}{2}\right)}{\partial y}$$

$$= \frac{1}{2}\frac{\partial}{\partial y}(5y - 3u)$$

$$= \frac{1}{2}\frac{\partial}{\partial y}\left(13y - \frac{\partial(3y)}{\partial y}\right)$$

$$\boxed{\left(\frac{\partial v}{\partial y}\right)_y = \frac{-13}{2}}$$

$$\left(\frac{\partial y}{\partial x}\right)_y \left(\frac{\partial y}{\partial v}\right)_x \left(\frac{\partial x}{\partial u}\right)_v \left(\frac{\partial v}{\partial y}\right)_u = 2\left(\frac{-1}{2}\right)\cdot\left(\frac{2}{13}\right)\cdot\left(\frac{-13}{2}\right)$$

$$\underline{\underline{= 1}}$$

$\Rightarrow$

$$\operatorname{cosec} u = \sqrt{\frac{x^{1/2} + y^{1/2}}{x^{1/3} + y^{1/3}}} = \sqrt{\frac{x^{1/2}[1 + (y/x)^{1/2}]}{x^{1/3}[1 + (y/x)^{1/3}]}} = x^{1/12}\left[\frac{1 + (y/x)^{1/2}}{1 + (y/x)^{1/3}}\right]$$

$$= x^{1/12}\,\phi(y/x)$$

a homogeneous function of x, y of degree $\frac{1}{12}$.

$f(u) = \operatorname{cosec} u$

By formula $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = n\frac{f(u)}{f'(u)} \quad \frac{\operatorname{cosec} u}{-\operatorname{cosec} u \cdot \cot u} = \frac{-1}{12}\tan$

Diff Partially w.r.t. x and y.

$$x\frac{\partial^2 u}{\partial x^2} + \frac{\partial u}{\partial x} + y\frac{\partial^2 u}{\partial x \partial y} = \frac{-1}{12}\sec^2 u \frac{\partial u}{\partial x}$$

$$x\frac{\partial^2 u}{\partial x \partial y} + y\frac{\partial^2 u}{\partial y^2} + \frac{\partial u}{\partial y} = \frac{-1}{12}\sec^2 u \frac{\partial y}{\partial y}$$

multiplying eqn ② by x and eqn ③ by and adding.

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} + \left(x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}\right) = \frac{-\sec^2 u}{12}\left(x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}\right)$$

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = x\left(\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}\right) \times \left(\frac{-\sec^2 u}{12} - 1\right) = \frac{\tan u}{144}[\tan^2 u$$

Henced proved.

Q2

c) $x = u+v+\omega$, $y = uv + v\omega + u\omega$, $z = uv\omega$,

$$\frac{\partial\phi}{\partial u} = \frac{\partial\phi}{\partial x} \times \frac{\partial x}{\partial u} + \frac{\partial\phi}{\partial y} \times \frac{\partial y}{\partial u} + \frac{\partial\phi}{\partial z} \times \frac{\partial z}{\partial u} \quad — ①$$

$$\frac{\partial x}{\partial u} = 1 \quad \frac{\partial y}{\partial u} = u+\omega \quad \frac{\partial z}{\partial u} = u\omega$$

$$\frac{\partial\phi}{\partial u} = \frac{\partial\phi}{\partial x}(1) + \frac{\partial\phi}{\partial y}(u+\omega) + \frac{\partial\phi}{\partial z}(u\omega) \quad — ②$$

multiply by u by eqn ②

$$u\frac{\partial\phi}{\partial u} = (v+\omega)\frac{\partial\phi}{\partial y} + u^2\omega\frac{\partial\phi}{\partial z} \quad — ③$$

$$\frac{\partial x}{\partial v} = 1 \quad \frac{\partial y}{\partial v} = u+\omega \quad \frac{\partial z}{\partial \omega} = uv$$

$$\frac{\partial\phi}{\partial v} = \frac{\partial\phi}{\partial x} = (1) + \frac{\partial\phi}{\partial y}(u+\omega) + \frac{\partial\phi}{\partial z}(uv) \quad — ⑤$$

eqn ⑤ multip v

$$v\frac{\partial\phi}{\partial v} = (u+\omega)\frac{\partial\phi}{\partial y} + (uv^2)\frac{\partial\phi}{\partial z} \quad — ⑥$$

$$\frac{\partial\phi}{\partial \omega} = \frac{\partial\phi}{\partial x} \times \frac{\partial x}{\partial \omega} + \frac{\partial\phi}{\partial y} \times \frac{\partial y}{\partial \omega} + \frac{\partial\phi}{\partial z} \times \frac{\partial z}{\partial \omega} \quad — ⑦$$

$$\frac{\partial\phi}{\partial \omega} = 1 \ ; \ \frac{\partial y}{\partial \omega} = (u+v) \quad \frac{\partial z}{\partial \omega} = uv$$

$$\frac{\partial\phi}{\partial \omega} = (u+\omega)\frac{\partial\phi}{\partial y} + (uv)\frac{\partial\phi}{\partial z} \quad — ⑧$$

multip by eqn ⑧ by ω

$$\omega\frac{\partial\phi}{\partial \omega} = (u\omega+\omega^2)\frac{\partial\phi}{\partial y} + (uv)\frac{\partial\phi}{\partial z} \quad — ⑨$$

$$LHS = u\frac{\partial\phi}{\partial u} + v\frac{\partial\phi}{\partial v} + \omega\frac{\partial\phi}{\partial \omega}$$

$$= (u+\omega)\frac{\partial\phi}{\partial y} + u^2\omega\frac{\partial\phi}{\partial z} + (u+\omega)\frac{\partial\phi}{\partial y} + (uv)^2\frac{\partial\phi}{\partial z}$$

$$+ (u+\omega)\frac{\partial\phi}{\partial y} + (uv)\frac{\partial\phi}{\partial z}$$

$$= (u+\omega)\left(\frac{\partial\phi}{\partial y}\right) = u^2\omega\frac{\partial\phi}{\partial z} + uv^2\frac{\partial\phi}{\partial z^2} + uv\frac{\partial\phi}{\partial z}$$

$$= x\frac{\partial\phi}{\partial x} + 2y\frac{\partial\phi}{\partial y} + 3z\frac{\partial\phi}{\partial z}$$

$z = \tan(y+ax) - (y-ax)^{3/2}$

Diff. z with respt to y partially

$$\frac{\partial z}{\partial y} = \sec^2(y+ax).1 - 3/2(y-ax)^{1/2}$$

Again Diff. with resp to y

$$\frac{\partial^2 z}{\partial y^2} = 2\sec(y+ax)\sec(y+ax)\tan(y+ax) - \frac{3}{4}(y-ax)^{-1/2}$$

$$\frac{\partial^2 z}{\partial y^2} = 2\sec^2(y+ax)\tan(y+ax) - 3/4(y-ax)^{-1/2} \quad -①$$

multiply by $-a^2$ in eqn ①

$$a^2\frac{\partial^2 z}{\partial y^2} = a^2\sec^2(y+ax)\tan(y+ax) - 3/4a^2(y-ax)^{-1/2} \quad -②$$

Now diff. z with resp to x partially.

$$\frac{\partial z}{\partial x} = a\sec^2(y+ax) + 3/2(y-ax)a$$

Again Diff. w.r.t x

$$\frac{\partial^2 z}{\partial x^2} = 2a^2\sec^2(y+ax)\tan(y+ax) + -\frac{3}{2}a^2(y-ax) \cdot - ③$$

substating eqn ② and ③.

$$\frac{\partial^2 z}{\partial x^2} - a^2\frac{\partial^2 z}{\partial y^2} = 2a^2\sec^2(y+ax)\tan(y+ax) - \frac{3}{4}a^2(y-ax)^{-1/2}$$

$$- 2a^2\sec^2(y+ax)\tan(y+ax) - \frac{3a^2}{4}(y+$$

$$= \underline{0}$$

3

b) $u = \log(x^3 + y^3 - x^2y - xy^2)$

$e^u = \log(x^3 + y^3 - x^2y - xy^2)$

$f(x,y) = \log(x^3 + y^3 - x^2y - xy^2)$

put $x = xt$ & $yt = y$

$f(x,y) = (x^3t^3 + y^3t^3 - x^2t^2yt - xty^2)$

$= t^3(x^3 + y^3 - x^2y - xy^2)$

$f(x,y) = t^3 u$

$f(x,y) = t^3(f(x,y)$

by modified Euler's thm

$$x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{n f(u)}{f'(u)} = \frac{3e^u}{e^u} = 3 - g(u)$$

By Again modified Euler's thm

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = g(u)(g'(u) - 1).$$

$$= 3(0-1)$$

$$3(-1)$$

$$x^2\frac{\partial^2 u}{\partial x^2} + bxy\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = -3.$$

Q.3

c) $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$

$a = \frac{x}{y}$, $b = \frac{y}{x}$, $c = \frac{z}{x}$

$u = f(a,b,c)$

$$\frac{\partial u}{\partial x} = \frac{\partial u}{\partial a}\cdot\frac{\partial a}{\partial x} + \frac{\partial u}{\partial b}\frac{\partial b}{\partial x} + \frac{\partial u}{\partial c}\frac{\partial c}{\partial x}$$

$$= \frac{\partial u}{\partial a}\left(\frac{1}{y}\right) + \frac{\partial u}{\partial b}(0) + \frac{\partial u}{\partial c}\left(\frac{-z}{x^2}\right)$$

$$\frac{\partial u}{\partial x} = \frac{1}{y}\frac{\partial u}{\partial a} - \frac{z}{x^2}\frac{\partial u}{\partial c}$$

Now Diff. u with respt. to y

$$\frac{\partial x}{\partial y} = \frac{\partial u}{\partial a}\cdot\frac{\partial a}{\partial y} + \frac{\partial u}{\partial b}\cdot\frac{\partial b}{\partial y} + \frac{\partial u}{\partial c}\cdot\frac{\partial c}{\partial y}$$

$$\frac{\partial u}{\partial y} = \left(\frac{-x}{y^2}\right)\frac{\partial u}{\partial a} + \frac{1}{z}\left(\frac{\partial u}{\partial b}\right)$$

Diff. u with resp to z

$$\frac{\partial u}{\partial z} = \frac{\partial u}{\partial a}\cdot\frac{\partial a}{\partial z} + \frac{\partial u}{\partial b}\cdot\frac{\partial b}{\partial z} + \frac{\partial u}{\partial c}\cdot\frac{\partial c}{\partial z}$$

$$= \left(-y/z^2\right)\left(\frac{\partial u}{\partial b}\right) + \left(\frac{1}{x}\right)\frac{\partial u}{\partial c}$$

$$\frac{\partial u}{\partial z} = \frac{-y}{z^2}\left(\frac{\partial u}{\partial b}\right) + \frac{1}{x}\frac{\partial u}{\partial c}$$

$$x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = x\left[\frac{1}{y}\frac{\partial u}{\partial a} - \frac{z}{x^2}\cdot\frac{\partial u}{\partial c}\right]$$

$$+ y\left[-\frac{x}{y^2}\cdot\frac{\partial u}{\partial a} + \frac{1}{z}\cdot\frac{\partial u}{\partial b}\right]$$

$$+ z\left[-y/z^2\left(\frac{\partial u}{\partial b}\right) + \frac{1}{x}\left(\frac{\partial u}{\partial c}\right)\right]$$

$$\therefore x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = \frac{x}{y}\cancel{\frac{\partial u}{\partial a}} - \frac{z}{x}\cancel{\frac{\partial u}{\partial c}} - \frac{x}{y}\cancel{\frac{\partial u}{\partial a}} + \frac{y}{z}\cancel{\frac{\partial u}{\partial b}}$$

$$- \frac{y}{z}\cancel{\frac{\partial u}{\partial b}} + \frac{z}{x}\cancel{\frac{\partial u}{\partial c}}$$

$$= \underline{0}$$

$x = v^2 + w^2,\ y = w^2 + u^2,\ z = u^2 + v^2$

$f_1 = x - v^2 - w^2,\ f_2 = y - w^2 - u^2,\ f_3 = z - u^2 - v^2$

$$\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{\dfrac{\partial(f_1,f_2,f_3)}{\partial(x,y,z)}}{\dfrac{\partial(f_1,f_2,f_3)}{\partial(u,v,w)}} = \frac{N}{D}$$

$$N = \frac{\partial(f_1,f_2,f_3)}{\partial(x,y,z)} = \begin{vmatrix} \frac{\partial f_1}{\partial x} & \frac{\partial f_1}{\partial y} & \frac{\partial f_1}{\partial z} \\ \frac{\partial f_2}{\partial x} & \frac{\partial f_2}{\partial y} & \frac{\partial f_2}{\partial z} \\ \frac{\partial f_3}{\partial x} & \frac{\partial f_3}{\partial y} & \frac{\partial f_3}{\partial z} \end{vmatrix}$$

$\frac{\partial f_1}{\partial x} = 1,\ \frac{\partial f_1}{\partial y} = 0,\ \frac{\partial f_1}{\partial z} = 0$

$\frac{\partial f_2}{\partial x} = 0,\ \frac{\partial f_2}{\partial y} = 1,\ \frac{\partial f_2}{\partial z} = 0 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$\frac{\partial f_3}{\partial x} = 0\ \frac{\partial f_3}{\partial y} = 0\ \frac{\partial f_3}{\partial z} = 1$

$= 1(1-0) = 1$

$N = 1$

$$D = \frac{\partial(f_1,f_2,f_3)}{\partial(u,v,w)} = \begin{bmatrix} \frac{\partial f_1}{\partial u} & \frac{\partial f_1}{\partial v} & \frac{\partial f_1}{\partial w} \\ \frac{\partial f_2}{\partial u} & \frac{\partial f_2}{\partial v} & \frac{\partial f_2}{\partial w} \\ \frac{\partial f_3}{\partial u} & \frac{\partial f_3}{\partial v} & \frac{\partial f_3}{\partial w} \end{bmatrix}$$

$\frac{\partial f_1}{\partial u} = 0 \quad \frac{\partial f_2}{\partial u} = -2u \quad \frac{\partial f_3}{\partial u} = -2u$

$\frac{\partial f_1}{\partial v} = -2v \quad \frac{\partial f_2}{\partial v} = 0 \quad \frac{\partial f_3}{\partial v} = -2v$

$\frac{\partial f_1}{\partial w} = -2w \quad \frac{\partial f_2}{\partial w} = -2w \quad \frac{\partial f_3}{\partial w} = 0$

$$\begin{bmatrix} 0 & -2u & -2w \\ -2u & 0 & -2w \\ -2u & -2v & 0 \end{bmatrix}$$

$+2v(0 - 4uw) - 2w(-4uv)$

$= -8uvw + 8uvw = \underline{0} \qquad \underline{D = 0}$

$$\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{N}{D} = \frac{1}{0} = \underline{\underline{0}}$$

Shri Someshwar Shikshan Prasarak Mandal's 8 pages

SOMESHWAR ENGINEERING COLLEGE

Tal : Baramati, Dist : Pune

CLASS TEST NO.: ....

Answer Sheet No. 3900

ll No. (In figures) : ____________________

me of the Student : ____________________ Date of Exam : / /20

me of the Subject : ____________________ Class ____________

Main Ans. Book	No.of Supplement	Total	Signature Of Supervisor
1	+	=	

Q-No.	1	2	3	4	5	6	7	8	9	10	TOTAL MARKS	Signature of Examiner
Marks												

(Write on both sides and start writing from this page.)

b) $100\frac{dv}{v} = ?$

$100\frac{dh}{h} = 2\%$

$100\frac{dr}{r} = 1\%$

Formula $= \pi r^2 h$

$\log v = \log \pi r^2 h$

$\log v = \log \pi + 2\log r + \log h$

multiply by 100

$\log v =$

$100\frac{dv}{v} = 2\,\frac{100dr}{r} + \frac{100dh}{h}$

$= 2(1) + 2$

$\boxed{v = 4\%}$

$\Rightarrow$ $f(x,y) = 3x^2 - y^2 + x^3$

$fx = 6x + 3x^2$

$fy = -2y$

$fxx = 6 + 6x$

$fyy = -2$

$fxy = 0$

Now find stationary point

$f(x) = 0$ | $f(y) = 0$

$\cancel{2}6x + 3x^2 = 0$ | $-2y = 0$

put $y = 0$ | $y = 0$ and $x = 0$

$2x + x^2 = 0$

$x(2 + x) = 0$

$x = 0$ or $x = 2$

$p(0,0)$, or $(2,0)$

$r = 6 + 6x$

$s = 0$

$t = -2$

$(0,0)$	$(-2,0)$
$r = 6, s = 0, t = -2$	$r = -18, s = 0, t = -2$
$rt - s^2 = 0$	$rt - s^2 = 0$
$-\cancel{8}12 - 0$	$-18 - 2$
$-12 \not< 0$	$+36 > 0$
$r < 0$	$r > 0$
then the fu^n is not max or not minimum	then the fu^n is min at $r(-2,0)$

minimum value

$3(4) - 0 + (-2)^3$

$12 - 0 - 8$

$\underline{4}$

5

a) $x = u + v$, $y = v^2 + w^2$, $z = u^3 + w^3$

$\frac{\partial u}{\partial x} = ?$

$f_1 = x - u - v$, $f_2 = y - v^2 + w^2$, $f_3 = z - u^3 - w^3$

$$\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{\frac{\partial(f_1,f_2,f_3)}{\partial(x,y,z)}}{\frac{\partial(f_1,f_2,f_3)}{\partial(u,v,w)}} = \frac{N}{D}$$

$$N = \frac{\partial(f_1,f_2,f_3)}{\partial(x,y,z)} = \begin{vmatrix} \frac{\partial f_1}{\partial x} & \frac{\partial f_1}{\partial y} & \frac{\partial f_1}{\partial z} \\ \frac{\partial f_2}{\partial x} & \frac{\partial f_2}{\partial y} & \frac{\partial f_2}{\partial z} \\ \frac{\partial f_3}{\partial x} & \frac{\partial f_3}{\partial y} & \frac{\partial f_3}{\partial z} \end{vmatrix}$$

$$= \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} = 1(1-0) = 1 = N$$

$$D = \frac{\partial(f_1,f_2,f_3)}{\partial(u,v,w)} = \begin{vmatrix} \frac{\partial f_1}{\partial u} & \frac{\partial f_1}{\partial v} & \frac{\partial f_1}{\partial w} \\ \frac{\partial f_2}{\partial u} & \frac{\partial f_2}{\partial v} & \frac{\partial f_2}{\partial w} \\ \frac{\partial f_3}{\partial u} & \frac{\partial f_3}{\partial v} & \frac{\partial f_3}{\partial w} \end{vmatrix}$$

$$= \begin{vmatrix} -1 & -1 & 0 \\ 0 & -2 & -2 \\ -3 & 0 & -3 \end{vmatrix} = -1(6) + 1(-6) = -12 = D$$

$$\frac{\partial u}{\partial x} = \frac{N}{D} = \frac{1}{-12}$$

$$\boxed{\frac{\partial u}{\partial x} = \frac{1}{-12}}$$

Q 5

b) $u = \dfrac{x+y}{1-xy}$

check for functional dependency

find $J\left(\dfrac{u,v}{x,y}\right) = \dfrac{\partial(u,v)}{\partial(x,y)} = \begin{vmatrix} \dfrac{\partial u}{\partial x} & \dfrac{\partial u}{\partial y} \\ \dfrac{\partial v}{\partial x} & \dfrac{\partial v}{\partial y} \end{vmatrix}$

$$\begin{vmatrix} \dfrac{1+y^2}{(1-xy)^2} & \dfrac{1+x^2}{(1-xy)^2} \\ \dfrac{1}{1+x^2} & \dfrac{1}{1+y^2} \end{vmatrix} = \left[\dfrac{1+y^2}{(1-xy)^2}\right]\left[\dfrac{1}{1+y^2}\right] - \left[\dfrac{1}{1+x^2}\right]\left[\dfrac{1+x^2}{(1-xy)^2}\right]$$

$$= \dfrac{1}{(1-xy)^2} - \dfrac{1}{(1-xy)^2} = 0$$

This is functionally dependences.

Now

$u = \dfrac{x+y}{1-xy} \quad v = \tan^{-1}x + \tan^{-1}y$

$$\tan^{-1}A + \tan^{-1}B = \tan^{-1}\left[\dfrac{A+B}{1-AB}\right]$$

$$v = \tan^{-1}\left[\dfrac{x+y}{1-xy}\right]$$

$$\boxed{v = \tan^{-1}u}$$

Q5

→ let $f = x^2 + y^2 + z^2$

$g = \frac{1}{x} + \frac{1}{y} + \frac{1}{z} - 1$

let $F = f + \lambda g$

$F = x^2 + y^2 + z^2 + \lambda\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z} - 1\right)$

$\frac{\partial F}{\partial x} = 2x + \lambda\left(\frac{-1}{x^2}\right)$

$\frac{\partial F}{\partial y} = 2y + \lambda\left(\frac{-1}{y^2}\right)$

Now $\frac{\partial F}{\partial x} = 0 \Rightarrow 2x - \frac{\lambda}{x^2} = 0$

$\Rightarrow 2x = \frac{\lambda}{x^2}$ — ①

$\frac{\partial F}{\partial y} = 0 \Rightarrow 2y = \frac{\lambda}{y^2}$ — ②

$\frac{\partial F}{\partial z} = 0 \rightarrow 2z = \frac{\lambda}{z^2}$ — ③

Now $\frac{①}{②} \Rightarrow \frac{\cancel{2}x}{\cancel{2}y} = \frac{\cancel{\lambda}/x^2}{\cancel{\lambda}/y^2}$

$= \frac{x}{y} = \frac{y^2}{x^2}$

$= x^3 = y^3$

ie $= x = y$ — ④

$\frac{y}{z} = \frac{z^2}{y^2}$

$y^3 = z^3$

ie $y = z$ — ⑤

by ④ & ⑤ we get $x = y = z$

g) $\Rightarrow \frac{1}{x} + \frac{1}{x} + \frac{1}{x} = 1$

$\Rightarrow \frac{3}{x} = 1$

minimum value $3^2 + 3^2 + 3^2$

$= 27$

$\boxed{y = 3, \ x = 3, \ z = 3}$

Q6

a) In matrix eqn

$$\begin{bmatrix} 4 & 2 & 1 & 3 \\ 6 & 3 & 4 & 7 \\ 2 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ \omega \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \\ -1 \end{bmatrix}$$

$R_3 \to R_1$

$$\left[\begin{array}{cccc|c} 2 & 1 & 0 & 1 & -1 \\ 6 & 3 & 4 & 7 & 5 \\ 4 & 2 & 1 & 3 & 0 \end{array}\right]$$

$R_2 = R_2 - 3R_1$ & $R_3 = R_3 - 2R_1$

$$\left[\begin{array}{cccc|c} 2 & 1 & 0 & 1 & -1 \\ 0 & 0 & 4 & 4 & 8 \\ 0 & 0 & 1 & 1 & 2 \end{array}\right]$$

$R_2 \leftrightarrow R_3$

$$\left[\begin{array}{cccc|c} 2 & 1 & 0 & 1 & -1 \\ 0 & 0 & 1 & 1 & 2 \\ 0 & 0 & 4 & 4 & 8 \end{array}\right]$$

$R_3 = R_3 - 4R_2$

$$\left[\begin{array}{cccc|c} 2 & 1 & 0 & 1 & -1 \\ 0 & 0 & 1 & 1 & 2 \\ 0 & 0 & 0 & 0 & 0 \end{array}\right]$$

let $\omega = t$

By $R_2 = z + \omega = 2$

$z + t = 2$

$z = 2 - t$

By $R_1 = 2x + y + \omega = -1$

$2x + y + t = -1$

$2x = -1 + y + t$

$$\boxed{x = \frac{-1 - y - t}{2}}$$

Q6

b) $x_1 = (2,2,1)$, $x_2 = (1,3,1)$, $x_3 = (1,2,2)$

$c_1x_1 + c_2x_2 + c_3x_3 = 0$

$c_1(2,2,1) + c_2(1,3,1) + c_3(1,2,0)$

$2c_1 + c_2 + c_3 = 0$

$2c_1 + 3c_2 + 2c_3 = 0$

$c_1 + c_2 + 2c_3 = 0$

$$\left[\begin{array}{ccc|c} 2 & 1 & 1 & 0 \\ 2 & 3 & 2 & 0 \\ 1 & 1 & 2 & 0 \end{array}\right]$$

$R_1 \leftrightarrow R_3$

$$\left[\begin{array}{ccc|c} 1 & 1 & 2 & 0 \\ 2 & 3 & 2 & 0 \\ 2 & 1 & 1 & 0 \end{array}\right]$$

$R_2 = R_2 - 2R_1$ & $R_3 = R_3 - 2R_1$

$$\left[\begin{array}{ccc|c} 1 & 1 & 2 & 0 \\ 0 & 1 & -2 & 0 \\ 0 & -1 & -3 & 0 \end{array}\right]$$

$R_3 = R_3 + R_2$

$$\left[\begin{array}{ccc|c} 1 & 1 & 2 & 0 \\ 0 & 1 & -2 & 0 \\ 0 & 0 & -5 & 0 \end{array}\right]$$

$\rho(A) = 3$ & $\rho(A|B) = 3$

$r = 3$ & $n = 3$

$r = n = 3$

By $R_3 = -5c_3 = 0$

$c_3 = 0$

By $R_2 = c_2 - 2c_3 = 0$

$c_2 - 0 = 0$

$c_2 = 0$

By $R_1 = c_1 + c_2 + 2c_3 = 0$

$c_1 + 0 + 0 = 0$

$c_1 = 0$

System passesses a unique sol^n

$c_1 = c_2 = c_3 = 0$

x_1, x_2, x_3 are linear independant

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CLASS TEST NO.: ....

Answer Sheet No. 3902

Roll No. (In figures) :

Name of the Student : Date of Exam : / /20

Name of the Subject : Class

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Q. No	1	2	3	4	5	6	7	8	9	10	TOTAL MARKS	Signature of Examiner
Marks												

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c) $A = \frac{1}{9}\begin{bmatrix} -8 & 4 & a \\ 1 & 4 & b \\ 4 & 7 & c \end{bmatrix}$

let $A \cdot A^T = \frac{1}{9}\begin{bmatrix} -8 & 4 & a \\ 1 & 4 & b \\ 4 & 7 & c \end{bmatrix}\begin{bmatrix} -8 & 1 & 4 \\ 4 & 4 & 7 \\ a & b & c \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$= \frac{1}{9}\begin{bmatrix} 64+16+a^2 & -8+16+ab & -32+28+ac \\ -8+16+ab & 1+16+b^2 & 4+28+bc \\ -32+28+ac & 4+28+bc & 16+49+c^2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 80+a^2 & 8+ab & -4+ac \\ 8+ab & 17+b^2 & 32+bc \\ -4+ac & 32+bc & 65+c^2 \end{bmatrix} = \begin{bmatrix} \frac{1}{9} & 0 & 0 \\ 0 & \frac{1}{9} & 0 \\ 0 & 0 & \frac{1}{9} \end{bmatrix}$

$80 + a^2 = \frac{1}{9}$ — ①

$17 + b^2 = \frac{1}{9}$ — ②

$65 + c^2 = \frac{1}{9}$ — ③

$a^2 = \frac{-80}{9}$

$a^2 = 8.88$

$\boxed{a = 2.97}$

$$b^2 = \frac{17}{9}$$

$$b^2 = 1.88$$

$$\boxed{b = 1.37}$$

$$c^2 = \frac{65}{9}$$

$$c^2 = 7.22$$

$$\boxed{c = 2.687}$$

Q7

a) Given system of eqⁿ in matrix form can be written as

$AX = B$

$$\begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 4 \\ 4 & 1 & 10 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ k \\ k^2 \end{bmatrix}$$

In Augumented form

$$(A|B) = \left[\begin{array}{ccc|c} 1 & 1 & 1 & 1 \\ 2 & 1 & 4 & k \\ 4 & 1 & 10 & k^2 \end{array}\right]$$

$R_2 = R_2 - 2R_1$; $R_3 = R_3 - 4R_1$

$$(A|B) \left[\begin{array}{ccc|c} 1 & 1 & 1 & 1 \\ 0 & -1 & 2 & k-2 \\ 0 & -3 & 6 & k^2-4 \end{array}\right]$$

$R_3 = R_3 - 3R_2$

$$(A|B) = \left[\begin{array}{ccc|c} 1 & 1 & 1 & 1 \\ 0 & -1 & 2 & k-2 \\ 0 & 0 & 0 & k^2-3k+2 \end{array}\right]$$

$k^2 - 3k + 2 = 0$

$\boxed{k = 1, 2}$

Q 7

b) $x_1 = (3, 1, -4)$
$x_2 = (2, 2, -3)$
$x_3 = (0, -4, 1)$

Now consider the madrix eq^n

$c_1 x_1 + c_2 x_2 + c_3 x_3 = 0$

$c_1(3, 1, -4) + c_2(2, 2, -3) + c_3(0, -4, 1) = 0$

$3c_1 + 2c_2 + 0c_3 = 0$

$c_1 + 2c_2 - 4c_3 = 0$

$-4c_1 - 3c_2 + c_3 = 0$

which is homogeneous system

$Ax = B$

$$\begin{bmatrix} 3 & 2 & 0 \\ 1 & 2 & -4 \\ -4 & -3 & 1 \end{bmatrix} \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

In Augumented form

$$(A|B) = \left[\begin{array}{ccc|c} 3 & 2 & 0 & 0 \\ 1 & 2 & -4 & 0 \\ -4 & -3 & 1 & 0 \end{array}\right]$$

$R_1 \leftrightarrow R_2$

$$(A|B) = \left[\begin{array}{ccc|c} 1 & 2 & -4 & 0 \\ 3 & 2 & 0 & 0 \\ -4 & -3 & 1 & 0 \end{array}\right]$$

$R_2 = R_2 - 3R_1$ and $R_4 = R_4 + 4R_1$

$$(A|B) = \left[\begin{array}{ccc|c} 1 & 2 & -4 & 0 \\ 0 & -4 & 12 & 0 \\ 0 & 5 & -15 & 0 \end{array}\right]$$

$R_2 = \frac{R_2}{4}$; $R_3 = \frac{R_3}{5}$

$$(A|B) = \left[\begin{array}{ccc|c} 1 & 2 & -4 & 0 \\ 0 & -1 & 3 & 0 \\ 0 & 1 & -3 & 0 \end{array}\right]$$

$R_3 = R_3 + R_2$

$$(A|B) = \left[\begin{array}{ccc|c} 1 & 2 & -4 & 0 \\ 0 & -1 & 3 & 0 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

$\rho(A) = \rho(A|B) = r = 2$

but $n = 3$

$r < n$

let $c_3 = t$

By R_2

$-c_2 + 3c_3 = 0$

$-c_2 + 3t = 0$

$c_2 = 3t$

By R_1

$c_1 + 2c_2 - 4c_3 = 0$

$c_1 + 2(3t) - 4(t) = 0$

$c_1 = -2t$

As $c_1, c_2, c_3 \neq 0$ given system is linearly dependent

Relation :-

We have

$c_1 X_1 + c_2 X_2 + c_3 X_3 = 0$

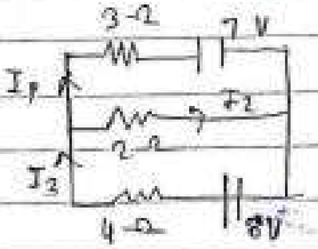
$-2t X_1 + 3t X_2 + t X_3 = 0$

$t(3X_2 + X_3) = t(2X_1)$

$3X_2 + X_3 = 2X_1$

Q.7

c)



Applying KCL and KVL
we get the eqⁿ

$I_1 - I_2 + I_3 = 0$

$3I_1 + 2I_3 = 7$

$2I_2 + 4I_3 = 8$

Consider augmented matriux

$$\left[\begin{array}{ccc|c} 1 & -1 & 1 & 0 \\ 3 & 0 & 2 & 7 \\ 0 & 2 & 4 & 8 \end{array}\right]$$

$R_2 = R_2 - 3R_1$

$$\left[\begin{array}{ccc|c} 1 & -1 & 1 & 0 \\ 0 & 3 & -1 & 7 \\ 0 & 2 & 4 & 8 \end{array}\right]$$

$I_1 - I_2 + I_3 = 0$

$3I_2 - I_3 = 7$

$2I_1 + 4I_3 = 8$

$2I_2 + 4I_3 = 8$

$I_2 + 2I_3 = 4$

$I_2 = 2$

$2 \times 2 + 4I_3 = 8$

$4 + 4I_3 = 8$

$4I_3 = 8 - 4$

$4I_3 = 4$

$\boxed{I_3 = 1}$

$I_1 - 2 + 1 = 0$

$I_1 - 1 = 0$

$I_1 = 1$

$I_1 = 1$

$I_2 = 2$

$I_3 = 1$

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Shri Someshwar Shikshan Prasarak Mandal's

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CLASS TEST NO.: ....

Answer Sheet No. 3901

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Name of the Subject : Class

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a)

→ characterstices eqⁿ is

$\lambda^2 - S_1\lambda + |A| = 0$

S_1 = sum of diagonal ~~matrix~~ elements.

$S_1 = 14 + (-1)$

$S_1 = 13$

and $|A| = \begin{vmatrix} 14 & -10 \\ 5 & -1 \end{vmatrix} = 36$

$\lambda^2 - 13\lambda + 36 = 0$

$\lambda = 4, 9$

Eigen vectors :-

$[A - \lambda I]X = 0$

$\begin{bmatrix} 14-\lambda & -10 \\ 5 & -1-\lambda \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

X_1 for Eigen value $\lambda = 4$

put $\lambda = 4$

$\begin{bmatrix} 10 & -10 \\ 5 & -5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

$10x - 10y = 0$

$x = y$

put $y = t$

$x = t$

$\overline{X_1} \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

Eigen value $\overline{X_2}$.

put $\lambda = 9$

$\begin{bmatrix} 5 & -10 \\ 5 & -10 \end{bmatrix}$

$5x - 10y = 0$

put $y = t$

$5x = 10t$

$x = 2t$

$X_2 = \begin{bmatrix} x \\ y \end{bmatrix}$

$= \begin{bmatrix} 2t \\ t \end{bmatrix} = t\begin{bmatrix} 2 \\ 1 \end{bmatrix}$

$\overline{X_2} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

Q8

b) characterstices eqn for 3X3 matrix

$\lambda^3 - S_1\lambda^2 + S_2\lambda - |A| = 0$

S_1 = sum of diagonal element.

$S_1 = 5$

S_2 = sum of minnor of diagonal element

$S_2 = 7$

$$A = \begin{vmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{vmatrix}$$

$A = 3$

From eqn ①

$\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0$

But according to cayley-Hamilton theorem we can put

$A^3 - 5A^2 + 7A - 3I = 0$

Verification of cayley-Hamilton theorem

$A^2 = A.A$

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

$$A^2 = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 3 \end{bmatrix}$$

and $A^3 = \begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix}$

LHS $= A^3 - 5A^2 + 7A - 3I$

$$= \begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix} + \begin{bmatrix} -25 & -20 & -20 \\ 0 & -5 & 0 \\ -2 & -20 & -25 \end{bmatrix}$$

$$+ \begin{bmatrix} 14 & 7 & 7 \\ 0 & 7 & 0 \\ 7 & 7 & 14 \end{bmatrix} + \begin{bmatrix} -3 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & -3 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} = 0 = RHS$$

$(A^3 - 5A^2 + 7A - 3I)\, A^{-1} = 0$

$A^2 - 5A + 7I - 3A^{-1} = 0$

$\boxed{A^{-1} = A^2 - 5A + 7I}$

Q8

(3)

$\longrightarrow$ $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$

$A - \lambda I = 0$

the characterstics eqn

$\begin{vmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{vmatrix} - \begin{vmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{vmatrix} = 0$

$\begin{vmatrix} 3-\lambda & 1 & 4 \\ 0 & 2-\lambda & 6 \\ 0 & 0 & 5-\lambda \end{vmatrix} = 6$

$(3-\lambda)\left[(2-\lambda)(5-\lambda) - 0\right] - 1\left[0-0\right] + 4\left[0\right]$

$(3-\lambda)(2-\lambda)(5-\lambda) = 0$

$\lambda = 3,\ \lambda = 2,\ \lambda = 5$

Eigen values of given matrix.

$\Rightarrow$ eigen vector for $\lambda = 2$ is

$(A - \lambda I)\bar{X} = 0$

$\begin{vmatrix} 1 & 1 & 4 \\ 0 & 0 & 6 \\ 0 & 0 & 3 \end{vmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = 0$

$x + y + 4z = 0$

$6z = 0$

$3z = 0$

$\boxed{z = 0}$ $\quad y = k_1 \ \text{let}$

$\boxed{x = -k_1}$

$$\bar{x} = \begin{bmatrix} -k_1 \\ k_1 \\ 0 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$$

$\lambda = 3$

$(A - 3\lambda)\bar{x} = 0$

$$\begin{bmatrix} 0 & 1 & 4 \\ 0 & -1 & 6 \\ 0 & 0 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = 0$$

$y + 4z = 0$

$-y + 6z = 0$

$2z = 0$

$\boxed{x = k_2}$

$$\bar{x} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} k_2 \\ 0 \\ 0 \end{bmatrix} = k_2 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}.$$

Now $\lambda = 5$

$$\begin{bmatrix} -2 & 1 & 4 \\ 0 & -3 & 6 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = 0$$

$-2x + y + 4z = 0$

$-3y + 6z = 0$

let $z = k_3$

$3y = 6k_3$

$\boxed{y = 2k_3}$

$x =$

$$\bar{x} = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$$

Now Diagonal Matrix is

$$\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

And Modal Matrix is

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

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

characteristic eqⁿ is

$$\lambda^3 - S_1\lambda^2 + S_2\lambda - |A| = 0$$

S_1 = sum of diagonal

$$= 1 + 2 + 3$$

$$\boxed{S_1 = 6}$$

S_2 = minor of a_{11} + minor of a_{22} + minor of a_{33}

$$= \begin{vmatrix} 2 & 1 \\ 2 & 3 \end{vmatrix} + \begin{vmatrix} 1 & -1 \\ 2 & 3 \end{vmatrix} + \begin{vmatrix} 1 & 0 \\ 1 & 2 \end{vmatrix}$$

$$= 4 + 5 + 2$$

$$\boxed{S_2 = 11}$$

$$|A| = 1(4) - 0(1) + (-1)(-2)$$

$$|A| = 6$$

eqⁿ ① becomes

$$\lambda^3 - S_1\lambda^2 + S_2\lambda - |A| = 0$$

$$\lambda^3 - 6\lambda^2 + 11\lambda - 6 = 0$$

By using synthetic Division

$\lambda = 1, 2, 3$ Eigen value

Eigen vector

for $\lambda = 3$

we consider matrix eqⁿ

$$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = 0$$

$$\begin{bmatrix} 1-\lambda & 0 & -1 \\ 1 & 2-\lambda & 1 \\ 2 & 2 & 3-\lambda \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = 0$$

$$-2x + 0y - z = 0$$

$$x - y + z = 0$$

$$2x + 2y + 0z = 0$$

By cramer's rule

$$\frac{x}{\begin{vmatrix} -1 & 1 \\ 2 & 0 \end{vmatrix}} = \frac{-y}{\begin{vmatrix} 1 & 1 \\ 2 & 0 \end{vmatrix}} = \frac{z}{\begin{vmatrix} 1 & -1 \\ 2 & 2 \end{vmatrix}}$$

$\frac{x}{-2} = \frac{-y}{-2} = \frac{z}{4} = t$

$x = -2t, y = -2t, z = 4t$

Eigen vector is

$$\overline{x_3} = \begin{bmatrix} -2t \\ -2t \\ 4t \end{bmatrix} = 2t \begin{bmatrix} -1 \\ -1 \\ 2 \end{bmatrix}$$

neglecting 2t,

$$\overline{x_2} = \begin{bmatrix} -1 \\ -1 \\ 2 \end{bmatrix}$$

$$\overline{X_3} = \begin{bmatrix} -1 \\ -1 \\ 2 \end{bmatrix}$$

Q9

(2)

$$A = \begin{vmatrix} 1 & 2 \\ x & -1 \end{vmatrix}$$

characterestices eqn

$\lambda^2 - S_1\lambda + |A| = 0$ — (1)

$S_1 = 1 + (-1)$

$S_1 = 0$

$S_2 = 1 \times 4$

$S_2 = 4$

$x + y - z = 0$

$x + 2y + z = 0$

$-x + y + 3z = 0$

By cramer's rule:

$$\frac{x}{\begin{vmatrix} 1 & 2 \\ -1 & 1 \end{vmatrix}} = \frac{-y}{\begin{vmatrix} 1 & 1 \\ -1 & 3 \end{vmatrix}} = \frac{z}{\begin{vmatrix} 1 & 2 \\ -1 & 1 \end{vmatrix}} = 0$$

$$\text{Eigen vector} = \begin{bmatrix} 3t \\ 4t \\ 3t \end{bmatrix} = 1 \begin{bmatrix} 3 \\ 4 \\ 3 \end{bmatrix}$$

$\lambda = 2$ in eqn (1)

$$\begin{bmatrix} 1-2 & 1 & -1 \\ 1 & 2-2 & 1 \\ -1 & 1 & 3-2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$-x + y - z = 0$

$x + 0y + z = 0$

$-x + y + z = 0$

By cramer's rule

$$\frac{x}{1} = \frac{y}{0} = \frac{z}{-1}$$

Eigen vector $= \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$

$$P = \begin{bmatrix} 3 & 1 & 1 \\ 4 & 0 & 0 \\ 3 & 1 & 1 \end{bmatrix}$$

$$\sqrt{x_1^2 + y_1^2 + z_1^2} = \sqrt{(3)^2 + (4)^2 + (3)^2}$$
$$= \sqrt{28}$$

$$\sqrt{x_2^2 + y_2^2 + z_2^2} = \sqrt{1^2 + (0)^2 + (1)^2}$$
$$\sqrt{2}$$

$$\sqrt{x_3^2 + y_3^2 + z_3^2} = \sqrt{(1)^2 + (0)^2 + (1)^2}$$
$$= \sqrt{2}$$

$$P = \begin{bmatrix} \frac{3}{\sqrt{28}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ -\frac{4}{\sqrt{28}} & 0 & 0 \\ \frac{3}{\sqrt{28}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix}$$

Q9 (3) Comparing eqⁿ

$ax_1^2 + bx_2^2 + cx_3^2 + 2fx_2x_3 + 2gx_3x_1 + 2hx_1x_2$

$a = 1 \quad 2f = 2 \quad 2g = -2 \quad 2h = 2 \quad c = 3$

$b = 2 \quad f = 1 \quad g = -1 \quad h = 1$

symmetic matrix

$$A = \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 \\ 1 & 2 & 1 \\ -1 & 1 & 3 \end{bmatrix}$$

characteristic eqⁿ for 3×3 matrix.

$\lambda^3 - S_1\lambda^2 + S_2\lambda - |A| = 0$ —(1)

$S_1 = 5$

$S_2 = 8$

$|A| = 5 - (4) - 3$

$|A| = -2$

eqⁿ (1) becomes

$\lambda^3 - 5\lambda^2 + 8\lambda + 2 = 0$

Eigen values are

$\lambda = 0, 2, 2$

cannacial form

$\lambda_1 X_1^2 + \lambda_2 X_2^2 + \lambda_3 X_3^2$

$0X_1^2 + 2X_2^2 + 2X_3^2$

Eigen vector of $\lambda = 0$

$$\begin{bmatrix} 1-\lambda & 1 & -1 \\ 1 & 2-\lambda & 1 \\ -1 & 1 & 3-\lambda \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \text{ —(1)}$$

$$= \begin{bmatrix} 1-0 & 1 & -1 \\ 1 & 2-0 & 1 \\ -1 & 1 & 3-0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & -1 \\ 1 & 2 & 1 \\ -1 & 1 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$\bar{x} =$

Conical form

$0X_1^2 + 2X_2^2 + 2X_3^2$

/

SUBJECT : ENGINEERING MATHEMATICS-I
IMP Question Bank for EST

1. If $z = f(r,s)$ where $r = x^2 - y^2$, $s = 2xy$ then prove that $x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y} = \sqrt{u^2+v^2}\,\frac{\partial z}{\partial r}$

2. If $x = \frac{r}{2}(e^\theta + e^{-\theta})$ and $y = \frac{r}{2}(e^\theta - e^{-\theta})$, show that $\left(\frac{\partial x}{\partial r}\right)_\theta = \left(\frac{\partial r}{\partial x}\right)_y$.

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

4. If $z = f(x, y)$ where $x = e^u \cos v$ and $y = e^u \sin v$ then prove that $y\frac{\partial z}{\partial u} + x\frac{\partial z}{\partial v} = e^{2u}\frac{\partial z}{\partial y}$

5. If $u = f(x^2 - y^2, y^2 - z^2, z^2 - x^2)$, prove that $\frac{1}{x}\frac{\partial u}{\partial x} + \frac{1}{y}\frac{\partial u}{\partial y} + \frac{1}{z}\frac{\partial u}{\partial z} = 0$

6. If $x^2 = au + bv$ and $y = au - bv$, show that $\left(\frac{\partial u}{\partial x}\right)_y \left(\frac{\partial x}{\partial u}\right)_v = \left(\frac{\partial v}{\partial y}\right)_x \left(\frac{\partial y}{\partial v}\right)_u$

7. If $u = \tan^{-1}\left(\frac{x^3+y^3}{x+y}\right)$, then find value of $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2}$!

8. If $x = uv, y = \frac{u+v}{u-v}$, find $\frac{\partial(u,v)}{\partial(x,y)}$.

9. If $u = x, v = y + z, w = x + y + z$, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.

10. Examine whether functions $u = x + y + z, v = x^2 + y^2 + z^2, w = xy + yz + zx$ are functionally dependent. If so, find the relation among them.

11. Examine whether functions $u = \sin^{-1} x + \sin^{-1} y, v = x\sqrt{1-y^2} + y\sqrt{1-x^2}$ are functionally dependent. If so, find the relation between them.

12. Discuss maxima and minima of the function $f = 3x^2 - y^2 + x^3$.

13. Discuss maxima and minma of the function $f = x^3 + y^3 - 3axy$. $(a > 0)$

14. The focal length of a mirror is found from the formula $\frac{2}{f} = \frac{1}{v} - \frac{1}{u}$. Find the percentage error in f if u and v both are in error by 2% each.

15. In calculating the volume of a right circular cone with the formula $(v = \frac{1}{3}\pi r^2 h)$, errors of 2% and 1% are made in measuring the height and radius of base respectively, then find the error in volume.

16. Examine the system of simultaneous linear equations for consistency. If consistent, solve the system. $x + y + z = 3, x + 2y + 3z = 4$ and $x + 4y + 9z = 6$.

17. Are the vectors $(1, 3, 4), (2, -1, 3)$ and $(3, -5, 2)$ linearly dependent? If so, find the relation among them.

18. If $A = \frac{1}{3}\begin{bmatrix} 1 & 2 & a \\ 2 & 1 & b \\ 2 & -2 & c \end{bmatrix}$ is orthogonal, find a, b, c.

19. Show that the system $3x + 4y + 5z = \alpha, 4x + 5y + 6z = \beta$ and $5x + 6y + 7z = \gamma$ is consistent only when α, β and γ are in arithmetic progression.

20. Are the vectors $(3, 1, -4), (2, 2, -3)$ and $(0, -4, 1)$ linearly dependent? If so, find the relation among them.

21. If $A = \begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ & & \end{bmatrix}$ is orthogonal, find a, b, c.

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22. Find the value of λ for which following system of equations becomes consistent. $x + 2y + z = 3$, $x + y + z = \lambda$ and $3x + y + 3z = \lambda^2$.

23. Examine the system of simultaneous linear equations for consistency. If consistent, solve the system. $x + y + z = 3$, $x + 2y + 3z = 4$ and $x + 4y + 9z = 6$.

24. Find eigen values of $A = \begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ and corresponding eigen vectors.

25. Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$.

26. Find modal matrix P that diagonalizes the matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$.

27. Find eigen values of $A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$ and corresponding eigen vectors.

28. Find eigen values of $A = \begin{bmatrix} 2 & -1 & 1 \\ 1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and corresponding eigen vectors.

29. Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 2 & 2 & 0 \\ 2 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$.

30. Find modal matrix P that diagonalizes the matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$.

31. Find eigen values of $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 0 & 1 \\ 3 & 1 & 0 \end{bmatrix}$ and corresponding eigen vectors.

SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S

SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY SOMESHWARNAGAR

Record No:-ACD/R/05

Revision:-00

Date:-

TEACHING PLAN

Department: Humanity & Science **Academic Year:** 2023-24

Semester:I Class:F.E(A)**Subject:** Engineering Mathematics- I Date:28/08/2023

Teaching Scheme: **Lectures/Week:** 04 **Tutorials/Week:**01

Examination Scheme: **Insem:**30 **TW:**25 **Endsem:**70

Lect No	Planned Date	Topics planned	References	Method used	Conducted Date	Sign of Faculty
		Unit 01: Differential Calculus				
1	1/9/23	Rolle's Theorem	T1/R2	C/B	1/9/23	Sd/-
2	2/9/23	Mean Value Theorems	T1/R2	C/B	2/9/23	Sd/-
3	4/9/23	Maclaurin's Series	T1/R2	C/B	6/9/23	Sd/-
4	5/9/23	Taylor's Series	T1/R2	C/B	6/9/23	Sd/-
5	8/9/23	Expansion of functions using standard expansions	T1/R2	C/B	7/9/23	Sd/-
6	9/9/23	Indeterminate Forms	T1/R2	C/B	8/9/23	Sd/-
7	11/9/23	L' Hospital's Rule	T1/R2	C/B	9/9/23	Sd/-
8	12/9/23	Evaluation of Limits and Applications.	T1/R2	C/B	14/9/23	Sd/-
		Unit 02 : Fourier Series				
9	14/9/23	Definition	T1/R1	C/B	18/9/23	Sd/-
10	15/9/23	Dirichlet's conditions	T1/R1	C/B	20/9/23	Sd/-
11	16/9/23	Examples on Dirichlet's conditions	T1/R1	C/B	20/9/23	Sd/-
12	18/9/23	Full range Fourier series	T1/R1	C/B	23/9/23	Sd/-
13	21/9/23	Half range Fourier seriesv	T1/R1	C/B	26/9/23	Sd/-
14	22/9/23	Harmonic analysis	T1/R1	C/B	26/9/23	Sd/-

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Lect No	Planned Date	Topics planned	References	Method used	Conducted Date	Sign of Faculty
15	23/9/23	Parseval's identity	T1/R1	C/B	29/9/23	[signature]
16	25/9/23	Parseval's identity and Applications to problems in Engineering.	T1/R1	C/B	30/9/23	[signature]
Unit 03: Partial Differentiation						
17	26/9/23	Introduction to functions of several variables	T1/R1	C/B	16/10/23	[signature]
18	29/9/23	Partial Derivatives	T1/R1	C/B	17/10/23	[signature]
19	30/9/23	Examples on Partial Derivatives	T1/R1	C/B	17/10/23	[signature]
20	31/9/23	Euler's Theorem on Homogeneous functions	T1/R1	C/B	18/10/23	[signature]
21	5/10/23	Partial derivative of Composite Function,	T1/R1	C/B	19/10/23	[signature]
22	6/10/23	Total Derivative	T1/R1	C/B	23/10/23	[signature]
23	7/10/23	Examples on Total Derivative	T1/R1	C/B	27/10/23	[signature]
24	14/10/23	Change of independent variables	T1/R1	C/B	28/10/23	[signature]
Unit 04: : Applications of Partial Differentiation						
25	16/10/23	Jacobian	T2/R2	C/B	31/10/23	[signature]
26	17/10/23	Applications of Jacobian	T2/R2	C/B	2/11/23	[signature]
27	19/10/23	Errors and Approximations	T2/R2	C/B	3/11/23	[signature]
28	20/10/23	Examples on Errors and Approximations	T2/R2	C/B	6/11/23	[signature]
29	21/10/23	Maxima and Minima of functions of two variables	T2/R2	C/B	7/11/23	[signature]
30	23/10/23	Maxima and Minima of functions of two variables	T2/R2	C/B	7/11/23	[signature]
31	26/10/23	Lagrange's method of undetermined multipliers	T2/R2	C/B	20/11/23	[signature]
32	27/10/23	Lagrange's method of undetermined multipliers	T2/R2	C/B	20/11/23	[signature]
Unit 05: Linear Algebra-Matrices, System of Linear Equations						
33	28/10/23	Rank of a Matrix	T2/R1	C/B	21/11/23	[signature]
34	30/10/23	System of Linear Equations	T2/R1	C/B	21/11/23	[signature]
35	31/10/23	Linear Dependence and Independence	T2/R1	C/B	22/11/23	[signature]

Lect No	Planned Date	Topics planned	References	Method used	Conducted Date	Sign of Faculty
36	2/11/23	Examples On Linear Dependence and Independence	T2/R1	C/B	22/11/23	[signature]
37	3/11/23	Linear and Orthogonal Transformations	T2/R1	C/B	23/11/23	[signature]
38	4/11/23	Examples on Linear and Orthogonal Transformations	T2/R1	C/B	28/11/23	[signature]
39	6/11/23	Application to problems in Engineering	T2/R1	C/B	28/11/23	[signature]
40	7/11/23	Application to problems in Engineering	T2/R1	C/B	28/11/23	[signature]
Unit 06: Linear Algebra-Eigen Values and Eigen Vectors, Diagonaliztion						
41	21/11/23	Eigen Values	T1/R1	C/B	29/11/23	[signature]
42	22/11/23	Eigen Vectors	T1/R1	C/B	29/11/23	[signature]
43	24/11/23	Cayley Hamilton theorem	T1/R1	C/B	1/12/23	[signature]
44	25/11/23	Examples on Cayley Hamilton theorem	T1/R1	C/B	2/12/23	[signature]
45	28/11/23	Diagonaliztion of a matrix	T1/R1	C/B	2/12/23	[signature]
46	29/11/23	Examlples on Diagonaliztion of a matrix	T1/R1	C/B	4/12/23	[signature]
47	1/12/23	Reduction of Quadratic forms to Canonical form by Linear transformations.	T1/R1	C/B	4/12/23	[signature]
48	2/12/23	Reduction of Quadratic forms to Canonical form by Orthogonal transformations.	T1/R1	C/B	5/12/23	[signature]

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SUMMARY

Unit No.	Title	Total no. of Lectures	Planned Date of Completion	Actual Date of Completion
1	Differential Calculus	08	12/9/23	14/9/23
2	Fourier Series	08	25/9/23	30/9/23
3	Partial Differentiation	08	14/10/23	28/10/23
4	Applications of Partial Differentiation	08	27/10/23	20/11/23
5	Linear Algebra-Matrices, System of Linear Equations	08	7/11/23	28/11/23
6	Linear Algebra-Eigen Values and Eigen Vectors, Diagonaliztion	08	2/12/23	5/12/23

Text Books:

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi)

References:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)
5. Applied Mathematics (Vol. I & Vol. II) by P.N.Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Linear Algebra –An Introduction, Ron Larson, David C. Falvo (Cenage Learning, Indian edition)

Methodology Used:

C /B: Chalk & Board

Subject In charge

Prof.Kadam S.S

Head of the Department

Prof.Wable N.S.

HEAD OF DEPARTMENT
HUMANITY AND SCIENCE

Principal

Prof.Deokar S.A.

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SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY
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COLLEGE OF ENGINEERING & TECHNOLOGY
SOMESHWARNAGAR

Date: 2/11/2023

Sharadchandra Pawar College of Engineering & Technology, Someshwarnag

Class Test

Sub- M-I

Marks - 20

Q1. Find the solution of given matrix $\begin{bmatrix} 2 & -3 & 5 \\ 3 & 1 & -1 \\ 1 & 4 & -6 \end{bmatrix}$.

Q2. Find the rank of $A = \begin{bmatrix} 1 & 1 & -1 & 1 \\ 1 & -1 & 2 & -1 \\ 3 & 1 & 0 & 1 \end{bmatrix}$

Q3. Checkout following vectors are linearly dependent or Independent.

$X_1 = (1,1,1)$, $X_2 = (1,2,3)$, $X_3 = (2,3,8)$

Q4. Show that following matrix is orthogonal.

$$A = \frac{1}{15}\begin{bmatrix} 5 & -14 & 2 \\ -10 & -5 & -10 \\ 10 & 2 & 11 \end{bmatrix}$$

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Shri Someshwar Shikshan Prasarak Mandal's

Sharadchandra Pawar College of Engineering & Technology

Someshwarnagar

Record No.:
Revision:

Date:
25/08/2023

Academic Year: 2023-2024

Class Test Marks

Department: Humanity & Science **Class:** F.E (Div-B)

Sr.No.	Roll No.	Name of Student	Marks
1	FE 161	AGWAN SHIVRAJ PRASHANT	AB
2	FE 162	BAGWAN MOHAMMADSUFIYAN SAKIR	15
3	FE 163	BALIP SANORAKI MANGESH	09
4	FE 164	BARGE SAKSHI SACHIN	20
5	FE 165	BHOSALE JAYRAJ MANOHAR	08
6	FE 166	DHAME GAURAV DATTATRAY	AB
7	FE 167	DHAYGUDE MAYURI SHAMRAO	20
8	FE 168	DHUMAL SHRADDHA GENBA	13
9	FE 169	GADADARE GAUTAM NAVNATH	10
10	FE 170	GADHAVE SHREYA NARAYAN	17
11	FE 171	GAIKWAD PAVAN HARISHCHANDRA	AB
12	FE 172	JADHAV ATHARV VIRENDRA	19
13	FE 173	KADAM ATHARVA BALASO	20
14	FE 174	KADAM OMKAR AJAY	16
15	FE 175	KADAM RUSHIKESH GANESH	12
16	FE 176	KAMBALE VAISHNAVI SADASHIV	13
17	FE 177	KAMBLE OMKAR SANTOSH	13
18	FE 178	KATE ARJUN VINOD	13
19	FE 179	KENGAR SHUBHANGI DATTA	11

20	FE 180	KHALATE SAROJ RAJENDRA	20
21	FE 181	KHOMANE NIKHIL ANANTA	12
22	FE 182	KHOMANE RUSHIKESH BALASO	AB
23	FE 183	KUMBHAR SHIVANJALI RAJENDRA	18
24	FE 184	LAKADE DIPALI SOMNATH	19
25	FE 185	MANDHARE SWAPNIL SHATRUGHNA	AB
26	FE 186	MANE VAISHNAVI MADHUKAR	06
27	FE 187	MOTE ASHWINI YASHVANT	24
28	FE 188	NALAWADE MAYUR DATTATRAY	AB
29	FE 189	NIGADE SHRADDHA ANIL	12
30	FE 190	PATIL VISHAL PRAMOD	AB
31	FE 191	PAWAR PRASAD BABURAO	AB
32	FE 192	PAWAR SIDDHESH SANDIP	AB
33	FE 193	PAWAR VEDANT VIJAY	AB
34	FE 194	PAWAR YOGITA RAMDAS	20
35	FE 195	PHARANDE ADITYA GANESH	08
36	FE 196	PISAL ANJALI SANTOSH	28
37	FE 197	PISAL YASH SATISH	08
38	FE 198	PURI AKASH VIJAY	08
39	FE 199	RAJPURE NILESH DHANANJAY	20
40	FE 200	RANE VAISHNAVI RAMCHANDRA	20
41	FE 201	RASKAR AMIT SAVATA	18
42	FE 202	RAUT SUJAL VITTHAL	10
43	FE 203	SAVANT SANDIP SHANKAR	12
44	FE 204	SAWANT DARSHAN NAMDEV	00

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45	FE 205	SAWANT MANGESH SANTOSH	05
46	FE 206	SHAIKH MEHWISH AADAM	20
47	FE 207	SHAIKH MOHMAD ZAHIR MUNIR	12
48	FE 208	SHAIKH MOHMMAD ASHARAF HARUN	10
49	FE 209	SHAIKH SADDAM SHADUL	23
50	FE 210	SHETE KRUSHNA SANTOSH	21
51	FE 211	SHIVTARE MILIND ASHOK	AB
52	FE 212	SORATE TANISHKA NANASO	06
53	FE 213	SURYAWANSHI SIDDHANT RAJENDRA	20
54	FE 214	TAMBE DISHA JANARDAN	30
55	FE 215	TAMBE SANIKA SAMBHAJI	06
56	FE 216	TARATE ASHISH SACHIN	04
57	FE 217	THOMBARE PRATHMESH DATTATRYA	18
58	FE 218	TORAVE PRATIKSHA SANJAY	20
59	FE 219	WADALE KARTIK DATTATRAY	20
60	FE 220	WAKODE GAYATRI NIMKAR	10
61	FE 221	YADAV ATHARV SANJAY	11
62	FE 222	DESHPANDE AKSHARA SUNIL	06
63	FE 223	NIGADE PURVA KALIDAS	AB

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Dhaygude Mayuri Shamrao
Roll no - 167

Date
2/11/2023

class Test
M - 1

$\frac{20}{20}$

Mark = 20

1] Given matrix equation in form of

$$AX = B$$

$$\begin{bmatrix} 2 & -3 & 5 \\ 3 & 1 & -1 \\ 1 & 4 & -6 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$$

In Augmented form

$$[A|B] = \left[\begin{array}{ccc|c} 2 & -3 & 5 & 1 \\ 3 & 1 & -1 & 2 \\ 1 & 4 & -6 & 1 \end{array}\right]$$

$R_1 \leftrightarrow R_3$

$$\left[\begin{array}{ccc|c} 1 & 4 & -6 & 1 \\ 3 & 1 & -1 & 2 \\ 2 & -3 & 5 & 1 \end{array}\right]$$

$R_2 \to R_2 - 3R_1$
$R_3 \to R_3 - 2R_1$

$$\left[\begin{array}{ccc|c} 1 & 4 & -6 & 1 \\ 0 & -11 & 17 & -1 \\ 0 & -11 & 17 & -1 \end{array}\right]$$

$R_3 \to R_3 - R_2$

$$\left[\begin{array}{ccc|c} 1 & 4 & -6 & 1 \\ 0 & -11 & 17 & -1 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

$\rho(A) = 2$ and $\rho(A|B) = 2$

$\rho(A) = \rho(A|B)$

$\therefore$ System is consistent.

$r = 2$ and $n = 3$

$r < n$

$\therefore$ System possess infinite soln

put $z = t$.

By R_2,

$$-11y + 17z = -1$$
$$-11y + 17t = -1$$
$$-11y = -1 - 17t$$
$$y = \frac{1 + 17t}{11}$$

By R_1

$$x + 4y - 6z = 1$$
$$x + \frac{1 + 17t}{11} - 6t = 1$$

multiply by 11

$$11x + 4 + 68t - 66t = 11$$

[illegible] 10 $11x - 2t$ [illegible]

$x = \cancel{\frac{10-11t}{11}} \quad \frac{7-2t}{11}$

Solutions are $\cancel{x = \frac{10-11t}{11}}$ $\quad y = \frac{1+17t}{11} \quad z = t$

$x = \frac{7-2t}{11}$

2]

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

$R_2 \to R_2 - R_1$

$R_3 \to R_3 - 3R_1$

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

$C_2 \to C_2 - C_1$

$C_3 \to C_3 + C_1$

$C_4 \to C_4 - C_1$

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

$C_2 \to \frac{C_2}{-2}$

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

$R_3 \to R_3 - R_2$

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

$C_3 \to C_3 - 3C_2$

$C_4 \to C_4 + 2C_2$

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

$$A = \begin{bmatrix} I_2 & 0 \\ 0 & 0 \end{bmatrix}$$

Rank = 2.

3) $X_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ $X_2 = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ $X_3 = \begin{bmatrix} 2 \\ 3 \\ 8 \end{bmatrix}$

~~e1~~ = By matrix equation

$c_1 x_1 + c_2 x_2 + c_3 x_3 = 0$

$$c_1 \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + c_2 \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} + c_3 \begin{bmatrix} 2 \\ 3 \\ 8 \end{bmatrix} = 0$$

$c_1 + c_2 + 2c_3 = 0$

$c_1 + 2c_2 + 3c_3 = 0$

$c_1 + 3c_2 + 8c_3 = 0$

Given matrix equation in form of

$AX = B$

$$\begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 1 & 3 & 8 \end{bmatrix} \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

In Augmented form.

$[A|B]$

$$[A|B] = \left[\begin{array}{ccc|c} 1 & 1 & 2 & 0 \\ 1 & 2 & 3 & 0 \\ 1 & 3 & 8 & 0 \end{array}\right]$$

$R_2 \to R_2 - R_1$

$R_3 \to \cancel{R_3 - 2R_1}\ R_3 - R_1$

$$[A|B] = \left[\begin{array}{ccc|c} 1 & 1 & 2 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & \cancel{4}\ 2 & 6 & 0 \end{array}\right]$$

$R_3 - 2R_2$

$R_3 \to \cancel{R_3 - 2R_1}$

$$[A|B] = \left[\begin{array}{ccc|c} 1 & 1 & 2 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 9 & 0 \end{array}\right]$$

$\rho(A) = 3$ and $\rho(A|B) = 3$

$\rho(A) = \rho(A|B)$

System ~~passes~~ is consistent.

$r = 3$ and $n = 3$

$r = n$

System passess unique solution

By R_3

$9C_3 = 0$

$C_3 = 0$

By R_2

$C_2 + C_3 = 0$

$C_2 + 0 = 0$

$C_2 = 0$

By R_1

$C_1 + C_2 + 2C_3 = 0$

$C_1 + 0 + 2(0) = 0$

$C_1 = 0$

Solution are $C_1 = C_2 = C_3 = 0$ $\overline{X_1} = \overline{X_2} = \overline{X_3} = 0$

Vectors are linearly independent.

Q.1)

$$A = \frac{1}{15}\begin{bmatrix} 5 & -14 & 2 \\ -10 & -5 & -10 \\ 10 & 2 & -11 \end{bmatrix}$$

$A \cdot A^T = I.$

$$A^T = \frac{1}{15}\begin{bmatrix} 5 & -10 & 10 \\ -14 & -5 & 2 \\ 2 & -10 & -11 \end{bmatrix}$$

$$A \cdot A^T = \frac{1}{15}\begin{bmatrix} 5 & -14 & 2 \\ -10 & -5 & -10 \\ 10 & 2 & -11 \end{bmatrix} \frac{1}{15}\begin{bmatrix} 5 & -10 & 10 \\ -14 & -5 & 2 \\ 2 & -10 & -11 \end{bmatrix}$$

$$= \frac{1}{225}\begin{bmatrix} 25+196+4 & -50+70-20 & 50-28-22 \\ -50+70-20 & 100+25+100 & -100-10+110 \\ 50-28-22 & -100-10+110 & 100+4+121 \end{bmatrix}$$

$$= \frac{1}{225}\begin{bmatrix} 225 & 0 & 0 \\ 0 & 225 & 0 \\ 0 & 0 & 225 \end{bmatrix}$$

$$A \cdot A^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$AA^T = I$

A is orthogonal matrix

SSPM's SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY, SOMESHWARNAGAR

THEORY ATTENDANCE RECORD

Department: Humanity & Science
Class: FE (Div A)

Academic Year: 2023-24

Semester: I

Subject: Engineering Mathematics-I

Subject In Charge: Kadam S.S.

	Roll No.	Name of Candidate	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
		Date:-	1/9	2/9	6/9	7/9	8/9	9/9	14/9	18/9	20/9	24/9	[illegible]	26/9	29/9	30/9	6/10	17/10	18/10	19/10	[illegible]	27/10	23/10
86	FE101	APSINGKAR SOHAM PRAVIN	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
68	FE102	BAHIRAT SALONI PRAMOD	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P
	FE103	BARKADE SUCHITA SANJAY																					
98	FE104	BEDWAL GANESH BALRAMSING	A	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P
100	FE105	BENGARE BHAGYASHRI NAVNATH	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
92	FE106	BHAGAT SARTHAK BAPURAO	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
71	FE107	BHAGAT SHIVANI SUDAM	P	A	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P
94	FE108	BHAMARE LAJARI ANIL	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
68	FE109	BHOSALE PRATHAMESH MILIND	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P
15	FE110	BHOSALE SHRAVAN SUNIL	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	A
94	FE111	BHOSALE VAISHNAVI VILAS	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A
71	FE112	BILWAL SURAJ DILIP	1	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
100	FE113	BITKE ARATI BHARAT	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P
76	FE114	BODARE HARSHADA RAVINDRA	P	P	P	P	P	P	P	P	P	P	A	P	P	P		P	P	P	P	P	P
52	FE115	CHANDGUDE ADITYA DATTATRAY	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
89	FE116	CHAVAN SNEHA JAGANNATH	P	P	P	P	P	P	P	P	P	A	P	P	A	P	P	P	P	P	A	P	P
94	FE117	DAGADE PAYAL SACHIN	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	A
81	FE118	DAGADE TEJAS ANIL	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
52	FE119	DHATTURE VIKRAM SHANKAR	A	A	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	A
21	FE120	DUDHE SHIVTEJ SUNIL	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P
47	FE121	FOKMARE SHUBHAM GAJANAN	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P
52	FE122	GADGE AMOL BALAJI	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	

PRINCIPAL

Roll No.	Name		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
[illegible]	GAIKWAD HARSHAD NAVNATH	56	P	P	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A
FE124	GAIKWAD TUSHAR DATTATRAY	68	P	P	P		P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	
FE125	GAVALI DISHA RAMESH	94	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P
FE126	GAWADE AMAR RAHUL	63	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
FE127	GAWADE PRANAY BABASO	86	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	A	P	P	A
FE128	GAWADE SALRABH MARUTI	68	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
FE129	GHUGARKAR GAURAV APPASAHEB	50	P		P	P	P	A	P	P	P	P	P	P	A	P	P	P	P	P	A	P	P
FE130	GORADE TEJAS RASIK	65	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P
FE131	HAKE NIKITA VITTHAL	89	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	P	P	P
FE132	BHWALE MEHR SUNIL	63	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	P	P
FE133	JADHAV ANIKET NITIN	63	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	A	P	P	A
FE134	JADHAV DISHA RAJENDRA	78	P	P	P	P	P	A	P	A	P	P	P	P	P	P	P	A	P	P	P	P	P
FE135	JADHAV HARSHWARDHAN APPASO	60	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P
FE136	JADHAV POONAM HEMANT	73	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P	P	A	P	P	P	A
FE137	JAGDALE GAURAV HARISHCHANDRA	57	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
FE138	JAGDHANE VISHAL SANTOSH	89	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
FE139	JAGTAP SIDDHANT SANTOSH	62	P	P	P	A	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	A
FE140	JAGTAP VIVEK VIJAY	63	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A
FE141	JARKOTE OMKAR HANMANT	60	P	A	P	P	P	P	P	P	P	P	P	P	A	P	P	P	A	P	P	A	A
FE142	JAYBHAYE PRATIKSHA SANJAY	86	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P
FE143	KADAM MAHESH RAJENDRA	89	P	P	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P	P	A	P	P
FE144	KARANKALAE MUKESH KISHOR	72	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P
FE145	KHARAT OM CHANDRAKANAT	57	P	P	P	A	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P
FE146	KHEDKAR PRAVIN SHIVAJI	34	P	P	P	P	A	P	A	P	P	P	P	A	P	P	P	P	P	P	P	P	A
FE147	KOKARE SONAL SHAHAJI	100	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
FE148	KORADE ABHAY DATTATRAY	[illegible]	P	P	A	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A
FE149	KUTWAL SHRADDHA ASHOK	100	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

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[illegible]	LONKAR ABHISHEK MANOHAR	63	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P
[illegible]	MADANE RUSHIKESH UTTAM	47	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	A
[illegible]	MAHADIK MANAS SHANTARAM	63	P	P	A	P	P	A	P	P	P	P	P	A	P	P	P	P	P	A	P	P	P
FE153	MAHAMUNI RAJAT PRAKASH	52	P	P	P	A	P	P	P	P	P	P	A	P	P	P	P	P	A	P	[illegible]	P	A
FE154	MANDHARE SHRIKANT YOGESH	57	P		P	P	P	A	P	A	A	P	P	P	P	P	P	P	P	P	A	P	P
FE155	MORE VIRAJ RAHUL	71	P	P	P	A	P	P	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P
FE156	MORE JAGRUTI SUDHIR	84	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	P	P	P	A	P
~~FE157~~	~~NAGARGOJE PRATIKSHA AJAY~~																						
FE158	NARUTE DHIRAJ SHARAD	69	P	P	P	A	P	P	P	A	P	P	A	P	A	P	A	A	P	P	P	P	P
FE159	NARUTE NIKITA LALASO	84	A	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
FE160	PANDARKAR TEJASVI BABASAHEB	76	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	A	P	P
FE161	PAWAR NIKHIL GANESH	50	A	P	P	P	P	P	P	A	A	P	P	P	A	P	P	P	A	A	P	P	A
FE162	PAWAR PRAMILA BABAN	84	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

W.

PRINCIPAL

ShriSomeshwarShikshanPrasarakMandal's
SharadchandraPawar College of Engineering & Technology, Someshwarnagar Tal – Baramati, Dist – Pune 412

Date: 22/03/2024

Notice

All the students of First Year Engineering are hereby informed that your **Remedial Classes** for Sem-I will be start from 28th Mar 2024 after insem examination, so all concern students must be present for the same as per given time table.

Day	Time	Div-A	Div-B
Saturday	9.00 to 10.00	BEE	SME
	10.00 to 11.00	M-I	PPS
	11.00 to 12.00	SME	PHY
	12.45 to 01.45	CHE	BEE
	02.00 to 03.00	EM	M-I

22/03/24
HoD

Principal

SSPM's SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY, SOMESHWARNAGAR

REMEDIAL ATTENDANCE RECORD

Department: Humanity & Science | Academic Year: 2023-24

Class: FE (Div A) | Subject: | Subject In Charge:

Date:-		30/3	13/4	13/4	27/4	27/4	28/4	28/4													
Roll No.	Name of Candidate	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FE103	BEDWAL GANESH BALRAMSING	P	P	A	P	P	P	P													
FE104	BENGARE BHAGYASHRI NAVNATH	P	A	P	P	P	A	P													
FE108	BHOSALE PRATHAMESH MILIND	P	P	P	P	P	P	A													
FE109	BHOSALE SHRAVAN SUNIL	P	P	P	A	P	P	P													
FE111	BILWAL SURAJ DILIP	P	A	P	P	P		P													
FE112	BITKE ARATI BHARAT	P	P	P	P	P	P	P													
FE113	BODARE HARSHADA RAVINDRA	P	P	A	A	P	P	P													
FE114	CHANDGUDE ADITYA DATTATRAY	P	P	P	P	A	P	P													
FE115	CHAVAN SNEHA JAGANNATH	P	P	P	P	P	P	A													
FE118	DHATTURE VIKRAM SHANKAR	A	A	P	P	P	P	P													
FE120	FOKMARE SHUBHAM GAJANAN	P	P	A	P	P	P	P													
FE121	GADGE AMOL BALAJI	P	P	P	A	A	P	P													
FE122	GAIKWAD HARSHAD NAVNATH	P	P	P	P	P	P	A													
FE123	GAIKWAD TUSHAR DATTATRAY	P	P	P	P	P	P	A													
FE124	GAVALI DISHA RAMESH	A	P	P	P	P	P	A													
FE127	GAWADE SAURABH MARUTI	P	P	P	P	P	A	A													
FE129	GORADE TEJAS RASIK	P	P	A	P	P	P	A													
FE131	HIWALE MIHIR SUNIL	P	P	P	A	P	P	A													
FE132	JADHAV ANIKET NITIN	P	P	A	P	P	P	A													
FE134	JADHAV HARSHWARDHAN APPASO	P	A	P	P	P	P	A													
FE136	JAGDALE GAURAV HARISHCHANDRA	P	P	P	A	P	P	A													
FE137	JAGDHANE VISHAL SANTOSH	P	P	P	P	A	A	A													
FE138	JAGTAP SIDDHANT SANTOSH	P	P	P	P	P	A	A													

FE140	JARIKOTE OMKAR HANMANT	P	P	P	A	P	P	P													
FE141	JAYBHAYE PRATIKSHA SANJAY	P	A	P	P	P	P	P													
FE143	KARANKALAE MUKESH KISHOR	A	P	P	P	P	P	P													
FE144	KHARAT OM CHANDRAKANAT	A	A	P	P	P	P	P													
FE145	KHEDKAR PRAVIN SHIVAJI	P	P	P	A	P	P	P													
FE147	KORADE ABHAY DATTATRAY	P	P	P	P	P	P	A													
FE149	LONKAR ABHISHEK MANOHAR	P	P	P	A	P	P	P													
FE150	MADANE RUSHIKESH UTTAM	P	P	P	P	P	P	A													
FE151	MAHADIK MANAS SHANTARAM	P	P	P	P	A	P	P													
FE152	MAHAMUNI RAJAT PRAKASH	P	P	P	P	P	P	A													
FE156	NARUTE DHIRAJ SHARAD	A	A	P	P	P	P	P													
FE158	PANDARKAR TEJASVI BABASAHEB	P	P	A	P	P	P	P													
FE159	PAWAR NIKHIL GANESH	P	P	P	A	P	P	P													

SSPM's SHARADCHANDRA PAWAR COLLEGE OF ENGINEERING & TECHNOLOGY , SOMESHWARNAGAR

ASSESMENT RECORD

Department: Humanity & SCIENCE
Class: FE (DIV-A)

Academic Year: 2023-24
Subject: Engineering Mathematics I

Semester: I
Subject In Charge: *Prof. Kadam S.S.*

Roll No.	Name of Candidate	TUT1 A	TUT1 B	TUT1 C	TUT1 D	TUT2 A	TUT2 B	TUT2 C	TUT2 D	TUT3 A	TUT3 B	TUT3 C	TUT3 D	TUT4 A	TUT4 B	TUT4 C	TUT4 D	TUT5 A	TUT5 B	TUT5 C	TUT5 D	TUT6 A	TUT6 B	TUT6 C	TUT6 D	Total	Out of 25
FE101	APSINGKAR SOHAM PRAVIN	02	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE102	BAHIRAT SALONI PRAMOD	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE103	BEDWAL GANESH BALRAMSING	1	2	2	1	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	38	15
FE104	BENGARE BHAGYASHRI NAVNATH	02	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE105	BHAGAT SARTHAK BAPURAO	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE106	BHAGAT SHIVANI SUDAM	1	2	2	1	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	38	15
FE107	BHAMARE LAJARI ANIL	2	1	2	3	2	3	2	2	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	58	23
FE108	BHOSALE PRATHAMESH MILIND	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	28	11
FE109	BHOSALE SHRAVAN SUNIL	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	26	10
FE110	BHOSALE VAISHNAVI VILAS	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE111	BILWAL SURAJ DILIP	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	34	13
FE112	BITKE ARATI BHARAT	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE113	BODARE HARSHADA RAVINDRA	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3	2	2	50	20
FE114	CHANDGUDE ADITYA DATTATRAY	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE115	CHAVAN SNEHA JAGANNATH	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE116	DAGADE PAYAL SACHIN	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE117	DAGADE TEJAS ANIL	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	3	2	2	50	20
FE118	DHATTURE VIKRAM SHANKAR	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	28	11
FE119	DUDHE SHIVTEJ SUNIL	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3	2	2	50	20
FE120	FOKMARE SHUBHAM GAJANAN	1	2	2	1	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	38	15
FE121	GADGE AMOL BALAJI	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	28	11
FE122	GAIKWAD HARSHAD NAVNATH	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	28	11

PRINCIPAL

FE123	GAIKWAD TUSHAR DATTATRAY	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	2	2	2	2	2	2	2	3	2	50	20
FE124	GAVALI DISHA RAMESH	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE125	GAWADE AMAR RAHUL	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE126	GAWADE PRANAY BABASO	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE127	GAWADE SAURABH MARUTI	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE128	GHUGARKAR GAURAV APPASAHEB	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE129	GORADE TEJAS RASIK	1	2	2	1	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	38	15
FE130	HAKE NIKITA VITTHAL	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE131	HIWALE MIHIR SUNIL	1	2	2	1	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	38	15
FE132	JADHAV ANIKET NITIN	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE133	JADHAV DISHA RAJENDRA	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE134	JADHAV HARSHWARDHAN APPASO	1	2	2	1	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	1	2	2	1	38	15
FE135	JADHAV POONAM HEMANT	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE136	JAGDALE GAURAV HARISHCHANDRA	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE137	JAGDHANE VISHAL SANTOSH	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE138	JAGTAP SIDDHANT SANTOSH	1	1	1	2	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	28	11
FE139	JAGTAP VIVEK VIJAY	2	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	2	1	1	28	11
FE140	JARIKOTE OMKAR HANMANT	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE141	JAYBHAYE PRATIKSHA SANJAY	2	2	2	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2	3	2	3	2	3	56	22
FE142	KADAM MAHESH RAJENDRA	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE143	KARANKALAE MUKESH KISHOR	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE144	KHARAT OM CHANDRAKANAT	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE145	KHEDKAR PRAVIN SHIVAJI	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2	1	28	11
FE146	KOKARE SONAL SHAHAJI	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE147	KORADE ABHAY DATTATRAY	2	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	28	11
FE148	KUTWAL SHRADDHA ASHOK	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24
FE149	LONKAR ABHISHEK MANOHAR	2	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	28	11

PRINCIPAL

FE150	MADANE RUSHIKESH UTTAM	1	1	1	2	1	1	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	28	11
FE151	MAHADIK MANAS SHANTARAM	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1	2	28	11
FE152	MAHAMUNI RAJAT PRAKASH	1	1	1	2	1	1	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	28	11
FE153	MANDHARE SHRIKANT YOGESH	2	2	2	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	50	20
FE154	MORE VIRAJ RAHUL	1	1	1	2	1	1	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	28	11
FE155	MORE JAGRUTI SUDHIR	2	2	2	3	2	2	2	3	2	2	3	2	2	2	3	2	3	3	2	3	2	3	2	3	56	22
FE156	NARUTE DHIRAJ SHARAD	2	2	2	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	50	20
FE157	NARUTE NIKITA LALASO	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	~~60~~ 24
FE158	PANDARKAR TEJASVI BABASAHEB	2	2	2	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	50	20
FE159	PAWAR NIKHIL GANESH	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	50	20
FE160	PAWAR PRAMILA BABAN	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	60	24

A : Regular attendance = 02 marks, B- Timely completion = 03 marks C- Neat and clean writing = 02 marks D-Depth of understanding = 03 marks

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M-I

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SOMESHWAR ENGINEERING COLLEGE

Tal : Baramati, Dist : Pune

CLASS TEST NO. :

Answer Sheet No. 178

Roll No. (In figures) :

Name of the Student : Date of Exam : / /20

Name of the Subject : Class

Main Ans. Book	No.of Supplement	Total	
1 +		=	Signature Of Supervisor

Q. No.	1	2	3	4	5	6	7	8	9	10	TOTAL MARKS	Signature of Examiner
Marks												

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Unit - I

Differential Calculus

* Rolle's Theorem:

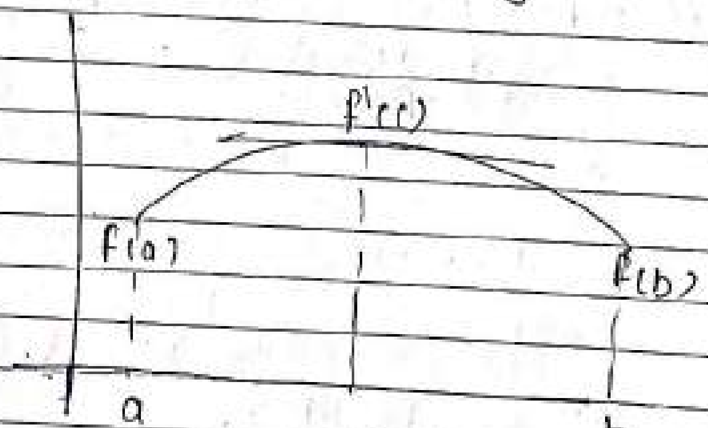
There are three conditions for Rolles th^m.

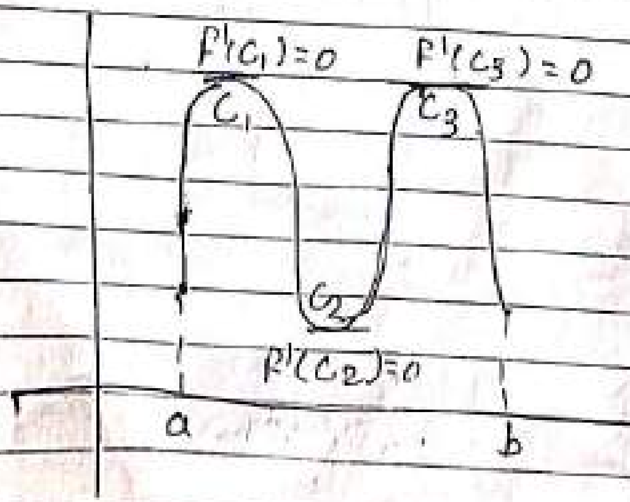
1) $f(x)$ is continuous on a $[a,b]$ i.e $a \le x \le b$.
2) $f(x)$ is differentiable on a (a,b) i.e $a < x < b$.
3) $f(a) = f(b)$

Then there exist at least a point $c \in (a,b)$ such that $f'(c) = 0$

* Geometrical Interpretation of Rolle's Th^m:

For function $f(x)$ continuous & differentiable in $[a,b]$ with $f(a) = f(b)$ at least one maxima & minima. Say at $f'(c) = 0$; $a < c < b$.





* Algebric Interpretation:

$f(x) = x+1$

we know, $f(x)$ is continuous & differen

$f(a) = f(b)$

then by Rolle's th^m

$f'(c) = 0$

where c is polynomial root.

* Remarks:

1. A polynomial function is continuous & differentiable everywhere.

2. The exponential functions, sine & cosine fu are continuous & differentiable everywher

3. Logarthmic fu^n is continuous & differentiab in it's domain.

4. $\tan x$ is not continuous at $x = \pm\frac{\pi}{2}, \pm\frac{3\pi}{2}, \ldots$

5. $|x|$ is not differentiable at $x=0$.

6. If $f'(x)$ tends to $\pm\infty$ then $f'(x)$ is not differentiable.

7. Let $f(x)$ be a polynomial function with $f(a)=f(b)$ then a, b are roots of the given polynomia function.

8. Further more ~~any~~ bet^n any 2 roots of a polynomial $f(x)$ there is always a root of f

9. Converse of Rolle's th^m is not true.

For eg. $f(x) = \frac{1}{x} + \frac{1}{1-x}$ in $[0,1]$.

$f'(c) = 0$ at $c = 1/2$

But $f(x)$ is not continuous at 0 & 1.

* Examples on Rolle's th^m:

1. Verify Rolle's th^m for $f(x) = x^2 - 10x + 16$ on the interval $[3,7]$. Then find the point where $f'(x) = 0$.

→ here $f(x) = x^2 - 10x + 16$, $x \in [3,7]$

We know that every polynomial fu^n is continuous & differentiable everywhere.

∴ $f(x)$ is continuous at $[3,7]$
& $f(x)$ is differentiable at $(3,7)$

End points of interval are 3 & 7.
then
Consider $f(x) = x^2 - 10x + 16$
put $x = 3$

$$\therefore f(3) = (3)^2 - \cancel{10x+16} - 10(3) + 16$$
$$= 9 - 30 + 16$$
$$= -21 + 16$$
$$= -5$$

again $f(x) = x^2 - 10x + 16$
put $x = 7$

$$f(7) = (7)^2 - 10(7) + 16$$
$$= 49 - 70 + 16$$
$$= -21 + 16$$
$$= -5$$

$$\therefore f(3) = f(7)$$

Hence by Rolle's th^m, there exist at least one point $c \in (3,7)$ such that $f'(c) = 0$

$$f(x) = x^2 - 10x + 16$$
$$f'(x) = 2x - 10.$$

put $x = c$ $\therefore f'(c) = 2c - 10.$

But by Rolle's thm.

$f'(c) = 0$

$\therefore 2c - 10 = 0$

$\therefore 2c = 10$

$c = \frac{10}{2}$

$\boxed{c = 5} \in (3, 7)$

Hence Rolle's thm verified

& $x = 5$ is point where $f'(x) = 0$

$f'(x) = 2x - 10$

$f'(5) = 2(5) - 10 = 10 - 10 = 0$

2. Verify Rolle's thm for
$f(x) = (x+3)(x-4)^2$ in $[-2, 1]$

→ We know that every polynomial fun is continuous & differentiable

$\therefore f(x) = (x+3)(x-4)^2$ in $[-2, 1]$

$f(x)$ is ~~dif~~ continuous at $[-2, 1]$
$f(x)$ is differentiable at $(-2, 1)$

values of $f(x)$ on ~~p~~ end points -2 & 1 are

$f(-2) = (-2+3)(-2-4)^2$
$= (1)(-6)^2$
$= 36$

$f(1) = (+1+3)(+1-4)^2$
$= 4(-3)^2$
$= 4(9)$
$= 36$

$\therefore f(-2) = f(1)$
Hence by Rolle's thm there exists at least one point $c \in (-2, 1)$ such that $f'(c) = 0$.

$f(x) = (x+3)(x-4)^2$

$= (x+3)(x^2-8x+16)$

$= x^3 - 8x^2 + 16x + 3x^2 - 24x + 48$

$f(x) = x^3 - 5x^2 - 8x + 48$

$\therefore f'(x) = (x+3)2(x-4)(1-0) + (x-4)^2(1+0)$

$= (x+3)2(x-4) + (x-4)^2$

$= (x-4)[2(x+3) + (x-4)]$

$= (x-4)[2x+6+x-4]$

$f'(x) = (x-4)[3x+2)$

Put $x = c$

$\therefore f'(c) = (c-4)(3c+2)$

but by Rolle's thm,
$f'(c) = 0$

$\therefore \quad (c-4)(3c+2) = 0$

$\therefore (c-4) = 0 \quad$ or $\quad (3c+2) = 0$

$\therefore \quad c = 4 \quad$ or $\quad 3c = -2$

$c = \frac{-2}{3}$

0.6
-20
18

but $c = 4$ does not lies in $(-2, 1)$
~~but~~ $c = \frac{-2}{3}$ lies in $(-2, 1)$

$\therefore$ at $c = \frac{-2}{3}$ derivative of given fun becomes zero.

$\therefore$ Rolle's thm is verified.

3. verify Rolle's th^m for $x^3 - 12x$ in $[0, 2\sqrt{3}]$

→ $f(x) = x^3 - 12x$ $x \in [0, 2\sqrt{3}]$

We know that every polynomial fu^n is continuous & differentiable everywhere

∴ $f(x)$ is continuous at $[0, 2\sqrt{3}]$
$f(x)$ is differentiable at $(0, 2\sqrt{3})$

Now values of $f(x)$ at the end points of $2\sqrt{3}$ are

$f(x) = x^3 - 12x$
$f(0) = (0)^3 - 12(0)$
$= 0$

$f(x) = x^3 - 12x$
$f(2\sqrt{3}) = (2(\sqrt{3}))^3 - 12(2\sqrt{3})$
$= [2\sqrt{3} \times 2\sqrt{3} \times 2\sqrt{3}] - 12(2\sqrt{3})$
$= [8(\sqrt{3} \times \sqrt{3} \times \sqrt{3})] - 24\sqrt{3}$
$= 8(3\sqrt{3}) - 24\sqrt{3}$
$= 24\sqrt{3} - 24\sqrt{3}$
$= 0$

∴ $f(0) = f(2\sqrt{3})$

∴ By Rolle's th^m there exist at least one val c in $(0, 2\sqrt{3})$ such that $f'(c) = 0$

∴ $f(x) = x^3 - 12x$
$f'(x) = 3x^2 - 12$
Put $x = c$
∴ $f'(c) = 3c^2 - 12$
But $f'(c) = 0$
∴ $3c^2 - 12 = 0$
$3c^2 = 12$
$c^2 = \frac{12}{3}$

$c^2 = 4$

$\therefore \boxed{c = \pm 2}$

$\because c = +2$ or -2 in $c = 2$ lie in $(0, 2\sqrt{3})$

& $c = -2$ does not lie in $(0, 2\sqrt{3})$

$\therefore \quad c = 2 \in (0, 2\sqrt{3})$

Hence Rolle's thm are verified.

4. verify Rolle's thm for $f(x) = e^x \sin x, x \in [0, \pi]$

→ Let $f(x) = e^x \sin x \quad ; x \in [0, \pi]$

We know that every polynomial fun is continuous & diff. everywhere.

$\therefore f(x)$ is continuous at $[0, \pi]$
$f(x)$ is diff. at $(0, \pi)$

Now values of $f(x)$ at end point 0 & π are

$f(x) = e^x \sin x$
$f(0) = e^0 \sin(0)$
$= 1 \cdot (0) \quad (\because \sin 0 = 0)$
$f(0) = 0$

$f(\pi) = e^{\pi} \cdot \sin(\pi)$
$= e^{\pi} \times 0 \quad (\because \sin \pi = 0)$
$f(\pi) = 0$

$\therefore \quad f(0) = f(\pi)$

Hence by Rolle's thm there exist at least one point $c \in (0, \pi)$ such that $f'(c) = 0$.

$f(x) = e^x \sin x$
$\therefore f'(x) = e^x \cos x + e^x \sin x$
$= e^x (\cos x + \sin x)$

Put $x = c$

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SOMESHWAR ENGINEERING COLLEGE

Tal : Baramati, Dist : Pune

~~CLASS TEST NO.: ....~~

Answer Sheet No. 181

Roll No. (In figures) :

Name of the Student : Date of Exam : / /20

Name of the Subject : Class

Main Ans. Book	No.of Supplement	Total	
1 +	=		Signature Of Supervisor

Q. No.	1	2	3	4	5	6	7	8	9	10	TOTAL MARKS	Signature of Examiner
Marks												

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$\therefore f'(c) = e^c (\cos c + \sin c)$

But $f'(c) = 0$

$\therefore e^c(\cos c + \sin c) = 0$

$\therefore \cos c + \sin c = 0$

$\sin c = -\cos c$

Dividing both sides by cos c

$\therefore \tan c = -1$

$\therefore \tan c = -(\tan \frac{\pi}{4})$ $(\because \tan \frac{\pi}{4} = (45)^\circ =$

we have,

$\tan \theta = \tan \phi$

$\theta = n\pi + \phi$

$\theta = n\pi + (-\frac{\pi}{4})$

$\theta = n\pi - \frac{\pi}{4}$ where $n = 0, 1, 2, 3, 4 \ldots$

$\therefore c = \frac{-\pi}{4}, \frac{3\pi}{4}, \frac{7\pi}{4}, \frac{11\pi}{4}$

$\therefore c = \frac{3\pi}{4} \in (0, \pi)$

$\therefore$ Hence Rolle's thm are verified.

Chain Rule $\frac{d}{dx}(u \cdot v) = \frac{du}{dx} \cdot v + \frac{dv}{dx} \times u$

5. verify Rolle's thm for $f(x) = (x-a)^m (x-b)^n$, where m, n are positive integers in $[a,b]$

→ Let $f(x) = (x-a)^m (x-b)^n$; $x \in [a,b]$

We know that every polynomial is continuous & diff. everywhere.

∴ $f(x)$ is continuous on $[a,b]$
$f(x)$ is diff. on (a,b)

∴ values of $f(x)$ on end points of b are.

$f(x) = (x-a)^m (x-b)^n$

∴ $f(a) = (a-a)^m (a-b)^n$
$= 0(x-b)^n$
$f(a) = 0$

$f(b) = (b-a)^m (b-b)^n$
$= (b-a)^m (0)^n$
$f(b) = 0$
∴ $f(a) = f(b)$

Hence there exist atleast one point $c \in (a,b)$ such that $f'(c) = 0$

here $f(x) = (x-a)^m (x-b)^n$
∴ Diff. w.r.t. x
∴ $f'(x) = m(x-a)^{m-1}(x-b)^n + (x-a)^m n(x-b)^{n-1}$

$= (x-a)^m (x-b)^n [n(x-b)^{-1} + m(x-a)^{-1}]$

$= (x-a)^m (x-b)^n [\frac{n}{\ }$

$= (x-a)^m (x-b)^n [m(x-a)^{-1} + n(x-b)^{-1}$

$= (x-a)^m (x-b)^n \left[\frac{m}{x-a} + \frac{n}{x-b}\right].$

Put $x=c$

$\therefore f'(c) = (c-a)^m (c-b)^n \left[\frac{m}{c-a} + \frac{n}{c-b}\right]$.

But $f'(c)=0$.

$\therefore (c-a)^m (c-b)^n \left[\frac{m}{c-a} + \frac{n}{c-b}\right] = 0$

$\therefore \frac{m}{c-a} + \frac{n}{c-b} = 0$.

$\frac{m(c-b)+n(c-a)}{(c-a)(c-b)} = 0$.

$mc - mb + nc - na = 0(c-a)(c-b)$

$c(m+n) - na - mb = 0$

$\therefore c(m+n) = na+mb$

$\therefore c = \frac{mb+na}{m+n} \in (a,b)$

Hence Rolle's thm are verified.

6 verify Rolle's thm for $\frac{\sin x}{e^x}$ in $[0,\pi]$

$\rightarrow f(x) = \frac{\sin x}{e^x}$, $x \in [0,\pi]$

We know that sine fu^n & exponential fu^n are continuous & diff. everywhere.

$\therefore f(x)$ is continuous on $[0,\pi]$
$f(x)$ is differentiable on $(0,\pi)$

Now values of $f(x)$ on end points 0 & π.

$f(0) = \frac{\sin 0}{e^0} = \frac{0}{1} = 0$.

$f(\pi) = \frac{\sin\pi}{e^{\pi}}$

$= \frac{0}{e^{\pi}}$

$f(\pi) = 0$

$\therefore \quad f(0) = f(\pi)$

$\therefore$ By Rolle's th^m there exist at least one point $c \in (0, \pi)$ such that $f'(c) = 0$

$\therefore$ Here $f(x) = \frac{\sin x}{e^x}$

Here we use

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v \cdot \frac{du}{dx} - u \cdot \frac{dv}{dx}}{v^2}$$

$$\therefore f'(x) = \frac{e^x \cos x - \sin x \, e^x}{e^{2x}}$$

$$= \frac{e^x(\cos x - \sin x)}{e^{2x}}$$

$$f'(x) = \frac{\cos x - \sin x}{e^x}$$

Put $x = c$

$$\therefore f'(c) = \frac{\cos c - \sin c}{e^c}$$

but $f'(c) = 0$

$$\therefore \frac{\cos c - \sin c}{e^c} = 0$$

$$\therefore \cos c - \sin c = 0$$

Dividing by $\cos c$,

$$\therefore 1 - \tan c = 0.$$

$\therefore \tan c = 1$

$\therefore \quad c = \tan^{-1}(1)$

$c = \tan^{-1}\left(\frac{\pi}{4}\right)$

Again here $\tan\theta = \tan\phi$

$$\theta = n\pi + \phi = n\pi + \frac{\pi}{4}$$

where $n = 0, 1, 2, 3, 4, \ldots$

$\therefore \quad c = \frac{\pi}{4}, \frac{9\pi}{4}, \ldots$

but $c = \frac{\pi}{4} \in (0, \pi)$

Hence Rolle's thm are verified.

* Langranges Mean Value Theorem (LMVT) :-

Let $f(x)$ be real valued fun on $[a, b]$.

1) $f(x)$ be continuous in $[a, b]$

2) $f(x)$ be differentiable in (a, b)

Then there exist atleast one point $c \in$ such that,

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

* Another statement:

If $f(x)$ is polynomial & satisfises t condition of LMVT in $[a, a+h]$ then the exist θ where $0 < \theta < 1$ such that,

$$f'(a + \theta h) = \frac{f(a+h) - f(a)}{h}$$

* Examples on LMVT *

1. Verify LMVT for the function $f(x) = x^3$ in $[-2, 2]$

→ Let $f(x) = x^3$; $x \in [-2, 2]$

$f(x)$ is polynomial fun

$\therefore$ $f(x)$ is continuous on $[-2, 2]$

$f(x)$ is differentiable on $(-2, 2)$

$\therefore$ By LMVT,

$\exists$ at least a point $c \in (-2, 2)$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

here $b = -2$ & $a = 2$

$f(x) = x^3$

$f'(x) = 3x^2$ $\therefore$ $f'(c) = 3c^2$

$f(a) = f(2) = (2)^3 = 8$

$f(b) = f(-2) = (-2)^3 = -8$

$$\therefore f'(c) = \frac{f(b) - f(a)}{b - a}$$

$$3c^2 = \frac{-8 - 8}{-2 - 2}$$

$$3c^2 = \frac{-16}{-4}$$

$$3c^2 = \frac{\cancel{16}\,4}{\cancel{4}}$$

$$3c^2 = 4$$

$$c^2 = \frac{4}{3}$$

$\therefore$ Taking square root,

$c = \pm \frac{2}{\sqrt{3}} \in (-2, 2)$.

Hence LMVT is verified.

2 Verified LMVT for the fun $f(x) = \log x$ in $[1, e]$

→ Let $f(x) = \log x$; $x \in [1, e]$

we know that logarithmic fun is continuous & differentiable in it's domain.

$\therefore$ $f(x)$ is continuous on $[1, e]$
$f(x)$ is differentiable on $(1, e)$

$\therefore$ By LMVT,
$\exists$ atleast a point $c \in (1, e)$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

here $a = 1$, $b = e$

$f(1) = \log 1 = 0$
$f(e) = \log e = 1$

$f(x) = \log x$
$f'(x) = \frac{1}{x}$

$f'(c) = \frac{1}{c}$

$$\therefore f'(c) = \frac{f(e) - f(1)}{e - 1}$$

$$\frac{1}{c} = \frac{1 - 0}{e - 1}$$

$$\frac{1}{c} = \frac{1}{e-1}$$

Taking reciprocal on both sides,

$\therefore \quad c = e-1$

since $\quad 2 < e < 3$

$2-1 < e-1 < 3-1$

$1 < e-1 < 2 < e$

$1 < e-1 < e$

$\therefore \quad c = e-1 \in (1, e)$

Hence LMVT verified.

3. Verified LMVT for the $f(x) = lx^2 + mx + n$ where $x \in [a, b]$.

→ Let $f(x) = lx^2 + mx + n \quad ; \quad x \in [a, b]$

$f(x)$ is polynomial fu^n.

$\therefore f(x)$ is continuous on $[a, b]$

$f(x)$ is differentiable on (a, b)

$\therefore$ By LMVT,

$\exists$ at least a point $c \in (a, b)$ such tha

$$f'(c) = \frac{f(b) - f(a)}{b-a}$$

$\therefore f(a) = la^2 + ma + n$

$f(b) = lb^2 + mb + n$

$f(x) = lx^2 + mx + n$

$f'(x) = 2lx + m$

$\therefore f'(c) = 2lc + m$

$$f'(c) = \frac{(lb^2 + mb + n) - (la^2 + ma + n)}{b-a}$$

8 pages

Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR ENGINEERING COLLEGE

Tal : Baramati, Dist : Pune

~~CLASS TEST NO.~~ ....

Answer Sheet No. 185

Roll No. (In figures) : ______________________ Date of Exam : / /20

Name of the Student : ______________________ Class : ______________

Name of the Subject : ______________________

Main Ans. Book	No.of Supplement	Total	Signature Of Supervisor
1	+	=	

Q. No.	1	2	3	4	5	6	7	8	9	10	TOTAL MARKS	Signature of Examiner
Marks												

(Write on both sides and start writing from this page.)

$$2lc+m = \frac{lb^2+mb+\cancel{n}-la^2-ma-\cancel{n}}{b-a}$$

$$= \frac{l(b^2-a^2)+m(b-a)}{b-a}.$$

$$= \frac{l[(b-a)(b+a)]+m(b-a)}{b-a}.$$

$$2lc+m = \frac{\cancel{(b-a)}[l(b+a)+m]}{\cancel{b-a}}$$

$$2lc+\cancel{m} = lb+la+\cancel{m}$$

$$2\cancel{l}c = \cancel{l}(a+b)$$

$$2c = a+b$$

$$c = \frac{a+b}{2} \in (a,b)$$

Hence LMVT verified.