

ST.JOSEPH'S COLLEGE (AUTONOMOUS) IRINJALAKUDA, THRISSUR

**NAAC Re-accredited with A++ Grade (4th Cycle)
85th Rank in NIRF 2024, 7th Rank in KIRF 2024**



B.Voc. Mathematics & Artificial Intelligence

FOUR YEAR B.VOC. PROGRAMME STRUCTURE AND SYLLABUS

2025 - '26 ADMISSION ONWARDS

(CUFYVP Regulations 2025)

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BOARD OF STUDIES PANEL 2025-2028

Name	Official Designation	Mail ID	Contact Number	Post
Dr.Sr.Deeni C J	Assistant Professor Department of Mathematics, St. Joseph's College (Autonomous), Irinjalakuda	deenicj@stjosephs.edu.in	9633812409	Chairperson
Dr.Jeepamol J Palathingal	Professor, Dept.of Mathematics PMGC College, Chalakuday	jeepamoljp@gmail.com	9447352943	Subject Expert in Mathematics (University Nominee)
Dr. P.B. Vinodkumar,	Professor and Head, Department of Mathematics, Rajagiri School of Engineering &Technology, Kakkanad, Kochi- 682039.	vinod_kumar@rajagiritech.edu.in	9895775409	Subject Expert
Dr. Sunil Jacob John	Head of the Department of Mathematics, NIT, Calicut.	sunil@nitc.ac.in	9447208759	Subject Expert
Dr. Subramanian K.S Moosath	Professor and Head, Department of Mathematics, Indian Institute of Space Science and Technology (IIST), Valiamala Road, Valiamala, Thiruvananthapuram, Kerala 695547.	smoosath@gmail.com	9495743148	Subject Expert
Dr.Krishnac halitha.K C	Assistant Professor - AIIT Amity University, Bangalore Opp. Deputy Commissioner Office, NH-648 (Old NH-207), Devanahalli - Doddaballapur Road, Bengaluru - 562110, Karnataka.	krishnachalithakc@blr.amity.edu	9840861794	Subject Expert in AI
Dr. Aparna Lakshmanan	Professor, Department of Mathematics, CUSAT, Kalamassery	aparnaren@gmail.com	9847742405	Alumni
Mr. Arun Anirudhan V	Engineer 'D' Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum	arunanirudhan@sctimst.ac.in	9495983679	Industrialist
Ms.Sherin Jose T	Assistant Professor, Department of Mathematics St. Joseph's College (Autonomous),Irinjalakuda.	sherinjaset@gmail.com	9495355330	Faculty

Ms. Sinda Joy	Assistant Professor Department of Mathematics St. Joseph's College, Irinjalakuda	sindajoy@stjosephs.edu.in	9495465285	Faculty
Ms.Dhanya V S	Assistant Professor Department of Mathematics St. Joseph's College, Irinjalakuda	dhanyavs.gvc@gmail.com	8281260609	Faculty
Ms.Alphy Joseph	Assistant Professor Department of Mathematics St. Joseph's College, Irinjalakuda	alphy22joseph@gmail.com	9447707250	Faculty
Ms.Sonadas P	Assistant Professor Department of Mathematics Self- Financing Section St. Joseph's College, Irinjalakuda	sonadas@stjosephs.edu.in	9496783835	Faculty
Ms. Anju P Davis	Assistant Professor Department of Mathematics Self- Financing Section St. Joseph's College, Irinjalakuda	anjudavis2011@gmail.com	9746611840	Faculty

1. REGULATIONS

The existing regulations of Choice-Based Credit Semester System (UO No. 8018/ 2025/ Admn. Dated 29-05-2025) which are applicable for CUFYVP Regulations 2025 are applicable for this programme with the following exceptions.

1.1 Objectives

- i. Develop Strong Foundational Knowledge in Mathematics and Artificial Intelligence**
- ii. Build Practical AI Skills**
- iii. Foster Problem-Solving and Analytical Thinking**
- iv. Promote Industry Readiness and Employability**

2. PROGRAMME OUTCOMES(PO)

At the end of the graduate Programme at Calicut University, a student would:

PO No.	Graduate Attributes	PO Statement
PO 1	Knowledge Acquisition	Demonstrate a profound understanding of knowledge trends and their impact on the chosen discipline of study
PO 2	Communication, Collaboration, Inclusiveness, and Leadership	Become a team player who drives positive change through effective communication, collaborative acumen, transformative leadership, and a dedication to inclusivity

PO 3	Professional Skills	Demonstrate professional skills to navigate diverse career paths with confidence and adaptability.
PO 4	Digital Intelligence	Demonstrate proficiency in varied digital and technological tools to understand and interact with the digital world, thus effectively processing complex information
PO 5	Scientific Awareness and Critical Thinking	Emerge as an innovative problem-solver and impactful mediator, applying scientific understanding and critical thinking to address challenges and advance sustainable solutions.
PO 6	Human Values, Professional Ethics, and Societal and Environmental Responsibility	Become a responsible leader, characterized by an unwavering commitment to human values, ethical conduct, and a fervent dedication to the wellbeing of society and the environment.
PO7	Research, Innovation, and Entrepreneurship	Emerge as a researcher and entrepreneurial leader, forging collaborative partnerships with industry, academia, and communities to contribute enduring solutions for local, regional, and global development.

3. PROGRAMME SPECIFIC OUTCOMES

PSO No.	PSO Statement
PSO1	Attain a good foundation in Mathematics and Artificial Intelligence in the undergraduate level enabling them to take up higher studies in both Mathematics and Artificial Intelligence
PSO2	Introduce to powerful tools for tackling a wide range of topics in Mathematics and Artificial Intelligence
PSO3	Familiarize with additional relevant mathematical & AI techniques subjects to complement the core.
PSO4	Understand a range of topics in almost all areas of Mathematics and Artificial Intelligence
PSO5	Attain Vocational and profession skill in AI system design and IOT programming along with mathematical and statistical problem Solving Skill

4. ELIGIBILITY FOR ADMISSION

Any candidate who passed the Plus Two examination of the Higher Secondary Board of Kerala or Pre-Degree of Calicut University or any other University or Board of Examinations in any state recognised as equivalent to the Plus Two of the Higher Secondary Board in Kerala with Mathematics is one of the core subject

5. QUALIFICATION PACKS (QPs)

Sl. No.	Semester	Sector Skill Council (SSC)	QP Code	Job Role
Under graduate Certificate (NSQF level 4.5)				
QP1	1	SSC NASSCOM (IT-ITeS)	N0511	Python Programmer / Junior Software Developer
QP2	1	SSC NASSCOM (IT-ITeS)	N00011	Python Developer
QP3	1	SSC NASSCOM (IT-ITeS)	Q0508	Junior Software Developer
Under Graduate Diploma (NSQF level 5.0)				
QP5	3	SSC NASSCOM (IT-ITeS)	Q8113	AI – Machine Learning Engineer
QP6	3	SSC NASSCOM (IT-ITeS)	Q8101	AI- Data Quality Analyst
QP7	4	SSC NASSCOM (IT-ITeS)	N8138	AI – Deep Learning Specialist
QP8	4	SSC NASSCOM (IT-ITeS)	Q8112	AI - DevOps Engineer
QP9	4	SSC NASSCOM	Q8102	AI - Business Intelligence

		(IT-ITeS)		Analyst
B. Voc. Degree (NSQF level 5.5)				
QP10	5	SSC NASSCOM (IT-ITeS)	Q8104	AI – Data Scientist
QP11	5	SSC NASSCOM (IT-ITeS)	Q8105	AI - Applied Scientist
QP12	6	SSC NASSCOM (IT-ITeS)	Q8106	AI – Data Engineer
PG Diploma (NSQF level 6.0)				
QP13	7	SSC NASSCOM (IT-ITeS)	Q8107	AI – Data Architect
QP14	7	SSC NASSCOM (IT-ITeS)	Q8108	AI – Solution Architect
QP15	8	SSC NASSCOM (IT-ITeS)	Q8201	IoT – Product Manager
QP16	8	SSC NASSCOM (IT-ITeS)	Q8208	, IoT - Network Specialist

6. TYPES OF COURSES AND AWARDS

The B.Voc. programme follows a credit-based modular structure that allows banking of credits for both general education and skill development components, enabling multiple entry and multiple exit options (MEME). Students can exit the programme at different stages with recognized qualifications, ensuring flexibility in their academic and professional pathways.

B.Voc. Programme offered by the University of Calicut provides four exit options: upon completing two semesters, students receive an Undergraduate Certificate (NSQF Level 4.5); after four semesters, an Undergraduate Diploma (NSQF Level 5.0); after six semesters, a B.Voc Degree (NSQF Level 5.5); and after eight semesters, a PG Diploma equivalent to the Honours Degree (NSQF Level 6.0).

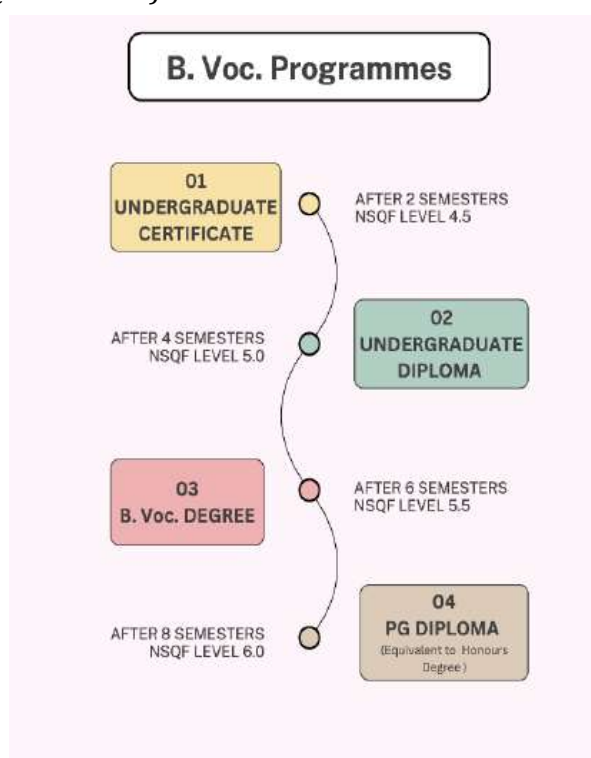


Figure 1: Credit-Based Modular Structure

Table 1: Exit Points / Awards of B.Voc. Programmes

NSQF Level	Credits - Skill Development Component (SDC)	Credits -General Educational Components (GEC)	Total Credit for Award	Normal Duration	Exit Point / Award
4.5	27	23	50 + 8*	2 Semesters	UG Certificate
5.0	64	38	102	4 Semesters	UG Diploma
5.5	98	42	140	6 Semesters	B.Voc. Degree
6.0	126+12**	42+12**	180	8 Semesters	PG Diploma

*Students exiting with a UG Certificate must complete two mandatory 4-credit SDC courses.

** Three online Discipline Specific Course can be studied in either the major or minor disciplines.

7. PROGRAMME STRUCTURE

The B.Voc. curriculum comprises two key components: General Education Components (GEC) and Skill Development Components (SDC). Each academic year integrates both to ensure a well-rounded learning experience. SDC constitutes a minimum of 60% of the total credits, while GEC makes up the reSJMAIning portion. Students shall earn a minimum of 140 credits over three years to graduate with a B.Voc. degree. Additionally, they can complete a one-year apprenticeship or internship or project work along with three (3) online courses of four (4) credit each to earn 40 more credits, leading to a Post Graduate Diploma.

Table 2: B.Voc. Course Structure (Year-wise minimum credit requirements)

Duration	General Education Components (GEC)				Skill Development Component (SDC)				Total Credits
	AEC	MDC	Minor	Total GEC	SEC	VAC	Major	Total SDC	
Undergraduate Certificate (1 Years)	9	6	8	23	3	-	24	27	50
Exit with Undergraduate Certificate (requires two additional 4-credit SDC online courses and 30 hours of mandatory On-The-Job Training (OJT)).									

Duration	General Education Components (GEC)				Skill Development Component (SDC)				Total Credits
	AEC	MDC	Minor	Total GEC	SEC	VAC	Major	Total SDC	
Undergraduate Diploma (2 Years)	9	9	20	38	6	6	52	64	102
Exit with Undergraduate Diploma (60 hours of mandatory On-the-Job Training (OJT)).									

Duration	General Education Components (GEC)				Skill Development Component (SDC)				Total Credits
	AEC	MDC	Minor	Total GEC	SEC	VAC	Major	Total SDC	
B. Voc. Degree (3 Years)	9	9	24	42	9	9	68 +12*	98	140
Exit with a B.Voc. Degree (60 hours of mandatory On-the-Job Training (OJT)) or proceed to the PG Diploma									

* Internship/ Apprenticeship/ Project Work

Duration	Major (SDC) / Minor (GEC) Components	Internship/ Apprenticeship/ Project (SDC)	Total
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PG Diploma (4 th Year)	3 Online Courses of 4 Credits each (12 Credits)	28	40
Exit with B.Voc. Degree + PG Diploma (60 hours of mandatory On-the-Job Training (OJT))			

7.1 General Education Components (GEC)

Students must earn 42-54 credits, in a span of 4 years, from the General Education Components (GEC). The GEC consists of:

- Foundation Courses
- Minor Pathway Courses

Title	Course Type	Credit	No. of Courses	Total Credits
Foundation Courses#	Ability Enhancement Course (AEC)	3	3	9
	Multi-Disciplinary Course (MDC)	3	3	9
Discipline Specific Courses	Minor Pathway Courses (DSC)	4	6 + 3*	24 + 12*
Total Credit for GEC				42 + 12*

Foundation courses offered by various departments are listed in Appendix V.

*Optional three (3) online courses of 4 credits each.

Students may choose a minor pathway from the discipline-specific options listed below. The degree awarded will correspond to the selected minor pathway.

- i. Major with Minor – All six (6) minor courses from same discipline
Eg. B. Voc. Software Development with minor in Data Analysis
- ii. Major with Vocational Minor – All six (6) minor course from same vocational discipline
Eg. B. Voc. Software Development with Vocation Minor in Multimedia
- iii. Major with Multiple discipline – Out of Six (6) minor courses, two groups of three (3) courses from two (2) different disciplines
Eg. B. Voc. Software Development with Mathematics and Statistics
- iv. Single Major – Any six (6) minor courses from different disciplines
Eg. B. Voc. Software Development

7.2 Skill Development Components (SDC)

Skill Development refers to doSJMAIn-specific, demand-driven training aimed at enhancing employability or leading to employment. It comprises of Foundation Courses and Discipline Specific Courses as listed below.

Title	Course Type	Credit	No. of Courses	Total Credits
Foundation Courses	Value Added Course (VAC)	3	3	9
	Skill Enhancement Course (SEC)	3	3	9
	Major pathway Courses (DSC)	4	17 + 3*	68 + 12*

Discipline Specific Courses	Internship / Apprenticeship / Project Work	-	-	12 + 28
	On Job Training (OJT)	60 Hours Mandatory		
Total Credit for SDC				126 + 12*

*Three online Discipline-Specific Courses (DSC), approved by the Board of Studies, may be studied in either the major or minor discipline.

8. SEMESTER WISE COURSE DISTRIBUTION

Semester	Major	Minor	AEC	SEC	MDC	VAC	Total	OJT/ Apprenticeship / Internship	Total Credits	
I	3	1	1	1	1		7	-	25	
II	3	1	2		1		7	OJT*	25	
III	3	2			1	1	7	-	26	
IV	4	1		1		1	7	OJT*	26	
V	4	1		1		1	7	-	26	
VI	Apprenticeship / Internship / Project Work								12	12
Total									140	
VII & VIII	3 Online Major/ Minor Courses (12 Credits)								28	40
Total									180	

Semester	Course Type	Credits	Theory Hours	Practical Hours	Internal	External	Total Marks	Total Credits	Total Hours / Week or Semester	Total Marks
1	Major 1	4	3	2	40	60	100	25	27/29	625
	Major 2	4	3	2	40	60	100			
	Major 3	4	4		40	60	100			
	Minor 1	4	3 / 4	2/0	30	70	100			
	AEC 1	3	2	2	25	50	75			
	SEC 1	3	3		25	50	75			
	MDC 1	3	3		25	50	75			
2	Major 4	4	3	2	40	60	100	25	27/29	625
	Major 5	4	3	2	40	60	100			
	Major 6	4	4		40	60	100			
	Minor 2	4	3 / 4	2/0	30	70	100			
	AEC 2	3	3		25	50	75			
	AEC 3	3	2	2	25	50	75			
	MDC 2	3	3		25	50	75			
	OJT	-	-	30*	-	-	-			
	Major 7	4	3	2	40	60	100			
	Major 8	4	3	2	40	60	100			

3	Major 9	4	4		40	60	100	26	26/28/30	650
	Minor 3	4	3 / 4	2/0	30	70	100			
	Minor 4	4	3 / 4	2/0	30	70	100			
	VAC 1	3	3		25	50	75			
	MDC 3	3	3		25	50	75			
4	Major 10	4	3	2	40	60	100	26	28/30	650
	Major 11	4	3	2	40	60	100			
	Major 12	4	4		40	60	100			
	Elective 1	4	4		40	60	100			
	Minor 5	4	3 / 4	2/0	30	70	100			
	VAC 2	3	3		25	50	75			
	SEC 2	3	2	2	25	50	75			
OJT	-	-	30*	-						
5	Major 13	4	3	2	40	60	100	26	27/29	650
	Major 14	4	3	2	40	60	100			
	Major 15	4	4		40	60	100			
	Elective 2	4	4		40	60	100			
	Minor 6	4	3 / 4	2/0	30	70	100			
	VAC 3	3	3		25	50	75			
	SEC 3	3	3		25	50	75			
6	I/A/P	12			120	180	300	12	500	300
7 & 8	Online 1	4					100	40	1000	1000
	Online 2	4					100			
	Online 3	4					100			
	I/A/P	28			100	600	700			

9.LIST OF MAJOR COURSES OFFERED

Semester	Course Type	Course Code	Course Title	Credits	Theory Hours	Practical Hours	Internal	External	Total Marks
1	Major 1	SJMAI1CJ101	Python Programming	4	3	2	40	60	100
	Major 2	SJMAI1CJ102	Data Structure	4	3	2	40	60	100
	Major 3	SJMAI1CJ103	Calculus for AI	4	4		40	60	100
2	Major 4	SJMAI2CJ101	Introduction to Artificial Intelligence	4	3	2	40	60	100
	Major 5	SJMAI2CJ102	Linear Algebra for Machine learning	4	3	2	40	60	100
	Major 6	SJMAI2CJ103	Multivariable Calculus for AI Optimization	4	4		40	60	100
	Audit	SJMAI2CJ149	OJT	-	-	30#	-	-	-
3	Major 7	SJMAI3CJ201	Introduction to Machine Learning	4	3	2	40	60	100
	Major 8	SJMAI3CJ202	Artificial Neural Network	4	3	2	40	60	100
	Major 9	SJMAI3CJ203	Operation Research for AI-driven optimization	4	4		40	60	100
4	Major 10	SJMAI4CJ201	Advanced Machine Learning	4	3	2	40	60	100
	Major 11	SJMAI4CJ202	Deep Learning	4	3	2	40	60	100
	Major 12	SJMAI4CJ203	Basic Mathematical Analysis	4	4		40	60	100
	Elective 1	XXXXXX XX	Any one elective course from elective 1 list	4	4		40	60	100
	Audit	SJMAI4CJ249	OJT	-	-	30#	-	-	-
5	Major 13	SJMAI5CJ301	Basic Algebra	4	3	2	40	60	100
	Major 14	SJMAI5CJ302	Internet of Things	4	3	2	40	60	100
	Major 15	SJMAI5CJ303	Natural Language Processing	4	4		40	60	100
	Elective 2	XXXXXX XX	Any one elective course from elective 2 list	4	4		40	60	100

6	I/A/P	SJMAI6CJ349	Internship/ Apprenticeship/ Project Work	12			120	180	300
	Online 1	SJMAI8CJ401		4*					100*
7 & 8	Online 2	SJMAI8CJ40 2		4*					100*
	Online 3	SJMAI8CJ40 3		4*					100*
	I/A/P	SJMAI8CJ44 9	Internship/ Apprenticeship/ Project Work	28			280	420	700
TOTAL				108 120*	/		2700 / 3000*		
<p>* Credits and Total Marks depend on the course chosen from the major or minor pathway in the fourth year. # Number of learning hours per semester</p>									

9. LIST OF ELECTIVE COURSES OFFERED

Semester	Course Type	Course Code	Course Title	Credits	Theory Hours	Internal	External	Total Marks
4	Elective 1 (Any one)	SJMAI4EJ21 1	Computer Vision	4	4	40	60	100
		SJMAI4EJ21 2	Data mining	4	4	40	60	100
		SJMAI4EJ21 3	Image Processing	4	4	40	60	100
		SJMAI4EJ21 4	Differential Equations for AI	4	4	40	60	100
5	Elective 2 (Any one)	SJMAI5EJ31 1	Generative AI	4	4	40	60	100
		SJMAI5EJ31 2	Reinforcement Learning	4	4	40	60	100
		SJMAI5EJ31 3	Introduction to Robotics	4	4	40	60	100
		SJMAI5EJ31 4	Numerical Analysis for Computational Intelligence	4	4	40	60	100

10. LIST OF ONLINE COURSES OFFERED

Semester	Course Title	Platform	Course details	Mark
7 & 8	Database Management System	Swayam	https://onlinecourses.swayam2.ac.in/ini25_cs03	100
	Deep Learning for Computer Vision	Swayam	https://onlinecourses.nptel.ac.in/noc25_cs93	100
	Industrial Robotics: Theories for Implementation	Swayam	https://onlinecourses.nptel.ac.in/noc25_me161	100
	Real Analysis	Swayam	https://onlinecourses.swayam2.ac.in/cec25_ma17	100
	Metric spaces and Complex analysis	Swayam	https://onlinecourses.swayam2.ac.in/cec25_ma13	100
	Essentials of Topology	Swayam	https://onlinecourses.nptel.ac.in/noc25_ma60	100

11.LIST OF FOUNDATION COURSES OFFERED

Semester	Course Type	Course Code	Course Title	Credits	Theory Hours	Internal	External	Total Marks
1	SEC 1 - SDC	SJMAI1FS11 1	Introduction to AI tools	3	3	25	50	75
	MDC 1-GEC (Other Dept)	SJMAI1FM10 5	Matrices and basics of Probability theory for AI	3	3	25	50	75
2	MDC 2 -GEC (Other Dept)	SJMAI2FM10 6	Graph theory and LPP for AI	3	3	25	50	75
3	VAC 1-SDC	SJMAI3FV10 8	Computational Logic	3	3	25	50	75
4	VAC 2-SDC	SJMAI4FV10 9	Ethics in handling AI	3	3	25	50	75
	SEC 2- SDC	SJMAI4FS11 2	Mathematical Type Setting System-LaTeX	3	3	25	50	75
5	VAC 3- SDC	SJMAI5FV11 0	AI in Healthcare and Telemedicine	3	3	25	50	75
	SEC 3- SDC	SJMAI5FS11 3	Data visualisation using AI tools	3	3	25	50	75

12.FOUNDATION COURSES FROM OTHER DEPARTMENTS

Sem.	Course Code	Code	Department
1	AEC1	SJENG1FA101(4)	English
	MDC1	SJXXX1FM105	Other than Major department
2	AEC2	SJENG2FA103(4)	English
	AEC3	SJXXX2FA104(4)	Language
	MDC2	SJXXX2FM106	Other than Major department
3	MDC3(KS)	SJXXX3FM107(4)	Language

13.GROUPING OF VOCATIONAL MINOR COURSES

Minor Title: Mathematics and Artificial Intelligence

Groups 1 and 2 may be offered to students from any discipline other than their major. Group 3 is available exclusively to B. Voc. students from other disciplines.

Group 1 Title – Artificial Intelligence 1									
Semester	Course Type	Course Code	Course Title	Credits	Theory Hours	Practical Hours	Internal	External	Total Marks
1	Minor 1	SJMAI1MN1 01	Python Programming	4	3	2	30	70	100
2	Minor 2	SJMAI2MN1 01	Introduction to Artificial Intelligence	4	3	2	30	70	100
3	Minor 3	SJMAI3MN2 01	Introduction to Machine Learning	4	3	2	30	70	100

Group 2 Title – Mathematical Foundations for AI									
Semester	Course Type	Course Code	Course Title	Credits	Theory Hours	Practical Hours	Internal	External	Total Marks
1	Minor 1	SJMAI1MN1 02	Calculus for AI	4	3	2	30	70	100
2	Minor 2	SJMAI2MN1 02	Linear Algebra for Machine Learning	4	3	2	30	70	100
3	Minor 3	SJMAI3MN2 02	Operation Research for AI- driven Optimization	4	3	2	30	70	100

Group 3 Title - Artificial Intelligence II (This group is offered together with group 1)									
Semester	Course Type	Course Code	Course Title	Credits	Theory Hours	Practical Hours	Internal	External	Total Marks
3	Minor 4	SJMAI3MN2 03	Artificial Neural Network	4	3	2	30	70	100
4	Minor 5	SJMAI4MN2 01	Deep Learning	4	3	2	30	70	100
5	Minor 6	SJMAI5MN3 01	Natural Language Processing	4	3	2	30	70	100

14. SCHEME OF EVALUATION

Mark Distribution (General Foundation Courses)

General Foundation Courses						
3 Credit Course with Open Ended Module (50 ESE + 25 CCA)						
External (50)	Theory Internal (20)			Open Module Internal (5)		
End Semester Examination	Mid Semester Examination	Rubrics 1	Rubrics 2	Test	Rubrics 1	Rubrics 2
50	10	6	4	2	2	1
3 Credit Course with Practical / Practicum (50 ESE + 25 CCA)						
External (50)	Theory Internal I (10)			Practical / Practicum Internal (15)		
End Semester Examination	Mid Semester Examination	Rubrics 1	Rubrics 2	Practical / Exercise	Exam / Viva	Record
50	5	3	2	8	5	2

Mark Distribution (Minor Pathway Courses)

Minor Pathway Courses						
4 Credit Courses with Open Ended Module (70 ESE + 30 CCA)						
External (70)	Theory - Internal (20)			Open Ended Module - Internal (10)		
End Semester Examination	Mid Semester Examination	Rubrics 1	Rubrics 2	Test	Rubrics 1	Rubrics 2
70	10	6	4	4	4	2
4 Credit paper with Practical / Practicum (70 ESE + 30 CCA)						
External (70)	Theory Internal (10)			Practical / Practicum Internal (20)		
End Semester Examination	Mid Semester Examination	Rubrics 1	Rubrics 2	Practical / Exercise	Exam / Viva	Record
70	5	3	2	10	7	3

Mark Distribution (Major Pathway Courses)

Major Pathway Courses (Vocational)						
4 Credit paper with Open Ended Module (60 ESE + 40 CCA)						
External (60)	Theory Internal (30)			Open Ended Module Internal (10)		
End Semester Examination	Mid Semester Examination	Rubrics 1	Rubrics 2	Test	Rubrics 1	Rubrics 2
60	20	5	5	5	3	2
4 Credit paper with Practical / Practicum (60 ESE + 40 CCA)						
External (60)	Theory Internal (10)			Practical / Practicum Internal (30)		
End Semester Examination	Mid Semester Examination	Rubrics 1	Rubrics 2	Practical / Exercise	Exam/Viva	Record
60	5	3	2	15	10	5

15. GUIDELINES FOR OJT / INTERNSHIP / APPRENTICESHIP / PROJECT WORK

a. On Job Training (OJT)

Students shall undertake mandatory On-the-Job Training (OJT) for a minimum duration of thirty (30) hours in both Semester II and Semester IV. These skill development components shall be designated as audit courses.

To be eligible for a 'Pass' in an audit course, students are required to achieve a minimum of seventy-five percent (75%) attendance. Students who fulfil this attendance requirement are exempt from participation in continuous assessment for the audit course. Notwithstanding the foregoing, a student who does not meet the attendance requirement shall be required to undergo a prescribed evaluation to satisfy the course requirements.

Successful completion of an audit course, evidenced by meeting the attendance requirement or, where applicable, by successfully passing the prescribed evaluation, shall result in a 'Pass' grade with zero (0) academic credits.

b. Internship / Apprenticeship / Project Work (I/A/P)

Internship, Apprenticeship, or Project work constitute a critical capstone component of the B.Voc. programme. This component provide students with structured opportunities to apply theoretical knowledge in real-world settings, develop doSJMAIn-specific competencies, promote workplace readiness, and align learning outcomes with industry standards and expectations.

I/A/P may be completed in any recognised industry, organisation, startup, research laboratory, or field site. Each student shall be assigned a faculty supervisor by the parent department and, where applicable, shall be supported by an industrial mentor. A learning agreement shall be signed by the student, faculty supervisor, and the host institution / industry prior to the commencement of the I/A/P.

I/A/P Report

Upon successful completion of the I/A/P, each student shall prepare a comprehensive report detailing the observations made and knowledge gained during the training period. Students are advised to consult their industrial mentor or faculty supervisor for the assignment of specific topics or problems upon which the final report shall be based. SJMAIntaining a daily diary throughout the I/A/P is mandatory, as it shall serve as a valuable resource for compiling the final report by systematically incorporating daily learning and experiences. The final report must be duly signed by both the industrial mentor and faculty supervisor to be considered valid.

The evaluation of the report shall be based on the following criteria:

Sl.	Criteria	Description
1	Originality	Uniqueness and independent thought demonstrated in the report.
2	Content Adequacy and Relevance	Thoroughness, coherence, and purposefulness of the write-up

3	Presentation Quality	Organisation, adherence to specified format, clarity of visual aids (drawings, sketches), writing style, and language
4	Learning Experience	Breadth, depth, and relevance of the practical learning acquired during the I/A/P
	Application and Theory Linkage	Demonstration of practical applications and the clear connection to basic theoretical concepts taught in the academic curriculum

Evaluation Process

A minimum of three (3) internal reviews shall be conducted to evaluate progress during the I/A/P. Internal evaluation shall be conducted jointly by the faculty supervisor and the industrial mentor, while the final evaluation shall be carried out by an evaluation panel comprising: one (1) external examiner from the University-approved panel, one (1) internal faculty member from the college, and one (1) industry representative.

Students shall be required to submit the following documents at the time of the evaluation: an internship completion certificate, an attendance statement and an I/A/P report. Each student shall present their work and participate in a viva voce before the evaluation panel. To be eligible for a 'Pass', students must obtain a minimum of fifty percent (50%) marks in the I/A/P.

Internship - Evaluation Components

Sl. No.	Components of Evaluation of Internship / Apprentice	Type	Marks of Evaluation (300)	Marks of Evaluation (700)
1.	Attendance	Internal Evaluation (120 / 280)	20	40
2.	Team work evaluation		20	40
3.	Log book		20	50
4.	Reviews (3)		60	150
5.	Internship Report	External Evaluation (180 / 420)	60	140
6.	Presentation		60	140
7.	Viva Voce		60	140
	Total		300	700

Apprenticeship - Evaluation Components

Sl. No.	Components of Evaluation of Apprenticeship	Type	Marks of Evaluation (300)	Marks of Evaluation (700)
1.	Attendance	Internal Evaluation (120 / 280)	20	40
2.	Skill proficiency evaluation		20	40
3.	Log book		20	50
4.	Reviews (3)		60	150
5.	Work Report	External Evaluation (180 / 420)	60	140
6.	Presentation		60	140
7.	Viva Voce		60	140
	Total		300	700

Project Work - Evaluation Components

Sl. No	Component of External Evaluation	Type	Marks of External Evaluation (300)	Marks of External Evaluation (700)
1	Project Proposal and Planning	Internal Evaluation (120 / 280)	15	25
	Objectives and Problem Definition		15	25
	Literature Review / Background Work		15	80
	Methodology / System Design		15	30
2	Reviews (3)		60	120
4	Project Report	External Evaluation (180 / 420)	60	120
5	Project Demonstration		60	150
6	Viva Voce		60	150
Total Marks			300	700

16. LETTER GRADES AND GRADE POINTS

Letter Grade	Grade Point	Percentage of Marks (CCA & ESE Put Together)	Class
O (Outstanding)	10	95 % and above	First Class with Distinction
A+ (Excellent)	9	Above 85% and below 95%	
A (Very Good)	8	75 % to below 85%	
B+ (Good)	7	65 % to below 75%	First
B (Above Average)	6	55 % to below 65%	
C (Average)	5	45 % to below 55%	Second
P (Pass)	4	35 % to below 45% aggregate (CCA + ESE) with a minimum of 30 % in the external valuation	Third
F (Fail)	0	Below an aggregate of 35% or below 30% in external evaluation	Fail
Ab (Absent)	0	-	Fail

17.1 Computation of SGPA and CGPA

The following method shall be used to compute the Semester Grade Point Average (SGPA):

The SGPA equals the product of the number of credits (C_i) with the grade points (G_i) scored by a student in each course in a semester, summed over all the courses taken by a student in the semester, and then divided by the total number of credits of all the courses taken by the student in that semester

$$SGPA = \frac{\text{Sum of the credit points of all the courses in a semester}}{\text{Total credits in that semester}}$$

SGPA Calculation:

Semester	Course	Credit	Letter Grade	Grade Points	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 x 8 = 24
	Course 2	3	B+	7	3 x 7 = 21
	Course 3	3	B	6	3 x 6 = 18
	Course 4	4	O	10	4 x 10 = 40
	Course 5	4	B	6	4 x 6 = 24
	Course 6	4	C	5	4 x 5 = 20
	Course 7	4	B	6	4 x 6 = 24
	Total	25			171
	SGPA		171 / 25		6.840

The Cumulative Grade Point Average (CGPA) of the student shall be calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students.

CGPA for the three-year programme in CUFYVP shall be calculated by the following formula.

$$CGPA = \frac{\text{Sum of the credit points of all the courses in six semesters}}{\text{Total credits in six semesters (140)}}$$

CGPA for the four-year programme in CUFYVP shall be calculated by the following formula.

$$CGPA = \frac{\text{Sum of the credit points of all the courses in eight semesters}}{\text{Total credits in eight semesters (180)}}$$

17.2 Course Evaluation

Course Type	Continuous Comprehensive Assessment (CCA)	End Semester Examination (ESE)
4-Credit GEC Course (3 Theory + 1 Practical)	30 Marks	70 Marks
4-Credit GEC Course (Theory Only)	30 marks	70 Marks
4-Credit SDC Course (3 Theory + 1 Practical)	40 Marks	60 Marks
4-Credit SDC Course (Theory Only)	40 Marks	60 Marks
3-Credit SDC Course (2 Theory + 1 Practical)	25 Marks	50 Marks
3-Credit SDC Course (Theory Only)	25 Marks	50 Marks

Modification of Existing Syllabus:

To incorporate technological advancements and emerging trends, modifications of up to 30% may be made to the existing course syllabi.

All such modifications shall be made solely on the recommendations of the relevant Board of Studies (BoS) or expert committee and require approval from the Academic Council. This should be completed before the commencement of the semester concerned.

17.DETAILED SYLLABUS OF MAJOR COURSES

SEMESTER I

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI1CJ101				
Course Title	Python Programming				
Type of Course	Major				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in fundamentals of programming				
Course Summary	This course introduces the fundamentals of Python programming, covering data types, control structures, functions, and basic file handling. It emphasizes practical problem-solving through hands-on coding, making it suitable for beginners from any discipline				

Course Outcomes :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the core syntax, data types, and control structures of Python programming.	U	C	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO2	Apply functions, recursion, and string operations to solve structured problems.	Ap	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO3	Utilize lists, tuples, dictionaries, and files to organize and manage data efficiently.	Ap	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO4	Implement object-oriented programming concepts and interact with databases using Python.	An	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO5	Develop and test Python programs through practical exercises involving real-world tasks.	C	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:				
Module	Unit	Content	Hrs (45+30)	Marks (60)
I	Introduction to Python		10	15
	1	Introduction: The Python Programming Language, History, features,		
	2	Installing Python, Running Python program		
	3	Debugging : Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging		
	4	Variables : Values and Types, Variables, Variable Names and Keywords, Type conversion		
	5	Expressions : Operators and Operands, Interactive Mode and Script Mode, Order of Operations		
	6	Conditional Statements: if, if-else, nested if –else Looping: for, while, nested loops Control statements: Terminating loops, skipping specific conditions		
II	Functions		10	15
	7	Functions: Definitions and Uses, Function Calls, Flow of Execution, Type Conversion Functions, Math Functions,		
	8	Parameters and Arguments, Fruitful Functions and Void Functions, Return Values		
	9	Incremental Development, Composition, Boolean Functions		
	10	More Recursion, Leap of Faith, Checking Types		
	11	Strings: A String Is a Sequence, Traversal with a for Loop, String Slices, Strings Are Immutable.		
	12	Searching, Looping and Counting, String Methods, The in Operator, String Operations		
III	Lists, Tuples and Dictionaries		12	15
	13	Lists: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List, Built-in List Operators, Built-in List functions and methods		
	14	Tuples and Dictionaries: Tuples, Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Built-in Tuple Functions and Methods		
	15	Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions and Methods		
	16	Files: Text Files, The File Object Attributes, Directories		
	17	Exceptions: Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions		

Classes and Python with sqlite3				
IV	18	Classes and Objects: Overview of OOP (Object Oriented Programming), Class Definition	13	15
	19	Creating Objects, Instances as Arguments, Instances as return values, Built-in Class Attributes,		
	20	Inheritance, Method Overriding, Data Encapsulation, Data Hiding		
	21	Modules: Importing module, Creating and exploring modules, Math module, Random module, Time module		
	22	Programming in Python with sqlite3: Creating Tables, Querying (Inserting Tuples, Selecting Rows and Updating Tuples) Using Cursor to Iterate over Selected Tuples.		
V	Practical		30	
	1	<ul style="list-style-type: none"> a. Write a function to check the input value is Armstrong and also write the function for Palindrome. b. Write a recursive function to print the factorial for a given number. c. Take a list, say for example this one: a = [1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89] and write a program that prints out all the elements of the list that are less than 5. d. Write a program that takestwo lists and returns True if they have at least one common member. e. Write a Python program to print a specified list after removing the 0th ,2nd, 4thand 5thelements 		
	2	Programs based on lists, conditional constructs, the for statement and the range function; interactively using the built-in functions len, sum, max, min.		
	3	<ul style="list-style-type: none"> a. Programs related to string manipulation. b. Programs using list comprehensions and anonymous functions 		
	4	<ul style="list-style-type: none"> a. Programs related to dictionaries. b. Programs using the built-in methods of the string, list and dictionaryclasses 		
	5	<ul style="list-style-type: none"> a. Design a class that store the information of Employee and display the same. b. Implement the concept of inheritance using python 		
	6	Programs to read and write files.		
	7	Program to demonstrate exception handling		
	8	<ul style="list-style-type: none"> Modules a. Write a program to implement user-defined module. b. Write a python program to demonstrate random module. 		
	References			

1. Allen Downey. (2012). Think Python. Needham, Massachusetts: O'Reilly.
2. Allen Downey. (2012). Think Python. Retrieved from <http://www.greenteapress.com/thinkpython/thinkpython.pdf>
3. Goodrich, Tamassia, Goldwasser.(2016).Data Structures and Algorithms in Python: J. Wiley
4. Wiley.Rance D. Necaise, College of William and Mary.(2016).Data Structures and Algorithms Using Python:
5. Introduction to Computing Using Python: An Application Development Focus, 2nd Edition, Ljubomir Perkovic, ISBN: 978-1-118-89094-3.

Mapping of COs with PSOs and POs:													
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO4	PO5	PO6	PO7
CO 1	2	1	1	3	1	1	0	3	2	2	2	2	2
CO 2	2	2	2	3	2	1	1	2	3	2	3	3	3
CO 3	2	2	2	3	2	1	1	2	3	2	3	3	3
CO 4	3	2	2	3	3	1	1	2	2	3	3	3	3
CO 5	2	2	2	3	2	1	2	2	3	2	2	3	3

Mapping of COs to Assessment Rubrics					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI1CJ102				
Course Title	Data Structures				
Type of Course	Major				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Fundamentals of Programming and Mathematics Concept				
Course Summary	This course explores implementations of linked list and array-based data structures, delving into the inner workings of basic data structures including lists, stacks, queues, trees, and graphs.				

Course Outcomes (CO) :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand and analyze fundamental data structures like arrays, linked lists, stacks, and queues..	U	C	Internal Exam/ Practical/Assign ment/Seminar/ Viva/End Sem Exam
CO2	Apply appropriate data structures for solving linear and non-linear problems using trees and graphs.	Ap	P	Internal Exam/ Practical/Assign ment/Seminar/ Viva/End Sem Exam
CO3	Implement searching, sorting, and hashing algorithms and evaluate their performance.	C,E	M,P	Internal Exam/ Practical/Assign ment/Seminar/ Viva/End Sem Exam
CO4	Develop solutions to real-world problems using data structures in an optimized and efficient manner..	C	C,P	Internal Exam/ Practical/Assign ment/Seminar/ Viva/End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus :				
Module	Unit	Content	Hrs (45+ 30)	Marks (60)
I		Introduction to Data Structure	8	15
	1	Introduction, Data and Information, Data Structure, Classification of Data Structures, Primitive Data Types, Abstract Data Types, Operations on Data Structure		
	2	Algorithm, Importance of Algorithm Analysis, Complexity of an Algorithm		
	3	Asymptotic Analysis and Notations, Rate of Growth and Big O Notation		
	4	Array Introduction, One Dimensional Array, Memory Representation of One Dimensional Array, Traversing, Insertion, Deletion, Searching, Merging of Arrays,		
	5	Multidimensional Arrays, Memory Representation of Two Dimensional Arrays, General Multi-Dimensional Arrays, Sparse Arrays, Sparse Matrix, Memory		
	6	Representation of Special kind of Matrices, Advantages and Limitations of Arrays.		
II		Linked List	11	15
	7	Linked List, One-way Linked List, Traversal of Linked List, Searching, Memory Allocation and De-allocation		
	8	Insertion in Linked List, Deletion from Linked List, Reversing One way linked List		
	9	Two way Linked List, Traversing a Two way Linked List, Searching in a Two way linked List		
	10	Insertion of an element in Two way Linked List, Deleting a node from Two way Linked List		
	11	Header Linked List, Applications of the Linked list, Circular Linked List, Applications of Circular Linked List		
III		Stack and Queue	11	15
	13	Stack : Introduction, Operations on the Stack, Implementation of Stack using array and linked list, Applications of Stack,		
	14	Evaluation of Arithmetic Expression, Matching Parenthesis, infix and postfix operations, Recursion, Backtracking, 8 Queens Problem		
	15	Queue : Introduction, Operations on the Queue, Implementation of Queue using array and linked list, Applications of Queue		
	16	Types of Queue : Circular Queue, Doubly ended queue, Priority Queue, implementation and applications		
		Tree and Graph		

IV	17	Binary Tree : Properties , Memory Representation,Types, Operations-Insertion,Deletion ,Traversals	15	15	
	18	Binary Search Tree, Operations on Binary Search Tree, Huffman Algorithm , Min-Max Algorithm			
	19	Graph: Introduction, Graph Terminology, Graph Representations : Adjacency list and Adjacency Matrix,			
	20	Graph Traversal-BFS,DFS, Applications of the Graph, Reachability, Shortest Path Problems, Spanning Trees.			
	21	Searching Techniques – Linear Search,Binary Search Sorting –Bubble sort,Insertion sort,Selection Sort,Heap Sort,merge Sort			
	22	Hashing: Hash Tables, Hash Functions, Different Hash Functions – Division method, Multiplication method, Mid square method, Folding Method			
V	Practical		30		
	1	Implement Singly Linked list and perform insertion,deletion and display			
	2	Implement Doubly Linked list and perform insertion,deletion and display			
	3	Implement Circular Linked list and perform insertion,deletion and display			
	4	Implement Stack using array and linked list			
	5	Implement Queue using array and linked list			
	6	Convert Infix expression to its postfix expression			
	7	Implement Binary tree and perform insertion,deletion			
	8	Implement Binary Search tree and perform insertion,deletion,Traversals			
	9	Implement Linear search and Binary Search			
	10	Implement Sorting : Bubble,selection,insertion,merge,heap			
	References				
	<ol style="list-style-type: none"> 1. “Introduction to Algorithms”, Thomas Coreman et al. 2. Horowitz and Sahani, ”Fundamentals of Computer Algorithms”, 2ND Edition. University Press, ISBN: 978 81 7371 6126, 81 7371 61262 3. Gilles Brassard and Paul Bartley, ”Fundamental of Algorithmics”, PHI, New Delhi 4. Algorithms, Kenneth Berman and Jerome Paul, Cenage Learning, ISBN-13 978-81-315-0521-2 5. Dinesh.P Mehta and Sartaj Sahni, Handbook of Data structures 				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	3	2	3	1	3	1	1	2	2	1	0
CO 2	2	3	2	3	2	2	1	2	2	3	1	0

CO 3	2	2	2	2	3	2	1	2	2	3	1	0
CO 4	2	3	2	3	2	3	1	1	2	2	1	0

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4		✓		✓	✓

Programme	B. Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI1CJ103			
Course Title	CALCULUS FOR AI			
Type of Course	Major			
Semester	I			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Basic knowledge of Sets, Relations and Functions, School Level Algebra and Real Numbers (0-99 level).			
Course Summary	The course covers fundamental concepts in calculus, including functions, shifting of graphs, limits, continuity, differentiation, extreme values, the Mean Value Theorem, graphing with derivatives, and limits at infinity with asymptotes. Students learn techniques for evaluating limits, finding extrema, and graphing functions using derivatives, preparing them for further studies in calculus and related fields.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
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CO1	Analyse a function for its limits, continuity and differentiability and evaluate limits and derivatives.	An	F	Internal Exam/Assignment/Seminar/Viva/ End Sem Exam
CO2	Apply first and second derivatives and related theorems to find extrema of functions. Sketch the graph of functions by analysing critical points and asymptotes	Ap	F	Internal Exam/Assignment/Seminar/Viva/ End Sem Exam
CO3	Apply integration formulas to find the area between two curves ,the surface area and volume of a solid of revolution	An	F	Internal Exam/Assignment/Seminar/Viva/ End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge (F), Conceptual Knowledge (C), Procedural Knowledge (P), Metacognitive Knowledge (M)				

Detailed Syllabus :				
Textbook	Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney, Pearson Publications, 2010, ISBN: 978-8174906168.			
Module	Unit	Content	Hrs (48+12)	Marks
				Ext: 60
I	Module I		12	Min.15
	1.	Preliminaries: Section 3 - Functions		
	2.	Preliminaries: Section 4 - Shifting Graphs.		
	3.	Section 1.1-Rates of Change and Limits - Limits of Function Values onwards.		
	4.	Section 1.2 - Rules for Finding Limits.		
	5.	Section 1.3 - Formal Definitions of Limits.		
	6.	Section 1.4- Extensions of the Limit Concept.		
II	Module II		15	Min.15
	7.	Section 1.5 - Continuity.		
	8.	Section 2.1 - The Derivative of a Function		
	9.	Section 2.2 - Differentiation Rules.		
	10	Section 2.3 - Rates of Change.		
	11	Section 2.4 - Derivatives of Trigonometric Functions		
	12	Section 2.5 - The Chain Rule.		
III	Module III		11	Min.15
	13	Section 3.1 - Extreme Values of Functions.		

	14	Section 3.2 - The Mean Value Theorem -Topics up to and including Example 4.		
	15	Section 3.2 - The Mean Value Theorem- Increasing Functions and Decreasing Functions		
	16	Section 3.3 - The First Derivative Test for Local Extreme Values.		
IV	Module IV		10	Min.15
	17	Section 4.1 - Indefinite Integrals.		
	18	Section 5.1 - Areas Between Curves. - Topics up to and including Example 2.		
	19	Section 5.1 - Areas Between Curves- Topics from Boundaries with Changing Formulas		
	20	Section 5.2 - Finding Volumes by Slicing. (Example 2 may be done as open ended).		
	21	Section 5.3 - Volumes of Solids of Revolution- Disks and Washers - Topics up to and including Example 4.		
	22	Section 5.5 - Lengths of Plane Curves. - Topics up to and including Example 2.		
	23	Section 5.6 - Areas of Surfaces of Revolution- Topics up to and including Example 2.		
V	Module V (Open Ended)		12	
	Trigonometric Functions, Derivatives of Trigonometric Functions, Power Rule of Differentiation for rational powers, Optimization, Linearization and Differentials.			

References

1. Howard Anton, Biven, & Stephen Davis, Calculus, 7thEd., Wiley India
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEd, John Wiley & Sons.
3. Robert T Smith and Roland B Minton, Calculus, 4th Ed. McGraw-Hill Companies
4. Soo T Tan, Calculus, 9th Ed. Brooks/Cole Pub Co.
5. Tom M. Apostol, Calculus, Vol 1: One Variable Calculus with an Introduction to Linear Algebra, 2nd Ed, John Wiley & Sons.
6. Michael Van Biezen Calculus Lectures:
<https://youtu.be/YZYxPclo2rg?si=qKct6ty8m5dBR4DG>

Mapping of COs with PSOs and POs:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	2	3	0	2	1	3	0	1
CO 2	2	3	2	1	13	3	0	2	1	3	0	1
CO 3	2	3	2	1		3	0	2	2	3	0	1

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

SEMESTER II

Programme	B.Voc. Mathematics and Artificial intelligence					
Course Code	SJMAI2CJ101					
Course Title	Introduction to Artificial Intelligence					
Type of Course	Major					
Semester	II					
Academic Level	100-199					
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours	
	4	3	-	2	75	
Pre-requisites	A basic knowledge of programming, logical reasoning, and foundational mathematics is recommended					
Course Summary	This course provides a foundational understanding of Artificial Intelligence, covering core concepts like intelligent agents, problem-solving, search strategies, and knowledge representation					

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand foundational concepts, problem spaces, and intelligent agent design in Artificial Intelligence..	U	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO2	Apply heuristic and logic-based techniques for problem solving and knowledge representation.	Ap	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO3	Analyze reasoning methods under uncertainty, including probabilistic and non-monotonic reasoning..	An	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO4	Explore knowledge structures and implement adversarial search strategies for decision making in games.	U,C	P,M	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO5	Implement and assess algorithms through practical experiments and projects.	U,C	P,M	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus				
Module	Unit	Content	Hrs (45+ 30)	Marks (60)
1	Introduction to Artificial Intelligence		11	15
	1	What is Artificial Intelligence: The AI Problems, The Underlying assumption		
	2	What is an AI Technique?, The Level of the model, Criteria for success		
	3	Problems, problem spaces, and search: Defining, the problem as a state space search		
	4	Production systems, Production system characteristics, Issues in the design of search programs, Additional Problems.		
	5	Intelligent Agents: Agents and Environments, The nature of environments, The structure of agents		
II	Heuristic Search and Logical Knowledge Representation		13	15
	6	Heuristic search techniques: Generate-and-test, Hill climbing, Best-first search,		
	7	Problem reduction, Constraint satisfaction, Mean-ends analysis.		
	8	Knowledge representation issues: Representations and mappings,		
	9	Approaches to knowledge representation, Issues in knowledge representation, The frame problem.		
	10	Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution		
	11	Natural Deduction. Logical Agents: Knowledge –based agents, the Wumpus world		
	12	Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic		
III	Reasoning		11	15
	13	Probabilistic reasoning: Bayes rule, Bayesian networks, hidden Markov model		
	14	Symbolic Reasoning Under Uncertainty: Introduction to non-monotonic reasoning,		
	15	Logic for non-monotonic reasoning, Implementation Issues, Augmenting a problem solver		
	16	Implementation: Depth-first search		
	17	Implementation: Breadth-first search.		
IV	Knowledge Structures and Adversarial Search		10	15
	18	Weak Slot-and-filter structures: Semantic Nets, Frames.		
	19	Strong slot-and –filler structures: Conceptual dependency, scripts, CYC.		
	20	Adversarial Search: Games, Optimal Decision in Games,		
	21	Min max algorithm ,Alpha-Beta Pruning		
	22	Summary		
V	Practical			40
	1	Write a program to implement depth first search algorithm.		
	2	Write a program to implement breadth first search algorithm		
	3	Write a program to simulate 4-Queen / N-Queen problem.		

	4	Write a program to solve tower of Hanoi problem.	30	
	5	Write a program to implement alpha beta search.		
	6	Write a program for Hill climbing problem.		
	7	Write a program to implement A*algorithm		
	8	Design the simulation of tic-tac-toe game using min-max algorithm		
	9	Write a program to shuffle Deck of cards		
	10	Write a program to derive the predicate.		
	11	Develop a game using Pygame community.		
	References			
1.“Artificial Intelligence” -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill 2.Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig, PHI 3.Introduction to Prolog Programming By Carl Townsend. 4.“PROLOG Programming For Artificial Intelligence” -By Ivan Bratko(Addison-Wesley) 5.A First Course in Artificial Intelligence, Deepak Khemani,TMH				

Mapping of COs with PSOs and POs :												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	1	2	2	2	1	3	2	2	3	2
CO 2	3	1	2	3	3	1	2	3	3	3	3	3
CO 3	3	1	2	2	3	1	2	2	2	3	3	3
CO 4	3	1	3	3	3	2	3	3	2	3	3	3
CO 5	3	1	3	3	3	1	3	3	3	3	3	3

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓		✓
CO 4	✓	✓	✓	✓	✓
CO 5	✓			✓	✓

Programme	B.Voc Mathematics and Artificial Intelligence			
Course Code	SJMAI2CJ102			
Course Title	LINEAR ALGEBRA FOR MACHINE LEARNING			
Type of Course	MAJOR			
Semester	II			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	3	2	75
Pre-requisites	Foundations in Mathematics			
Course Summary	Course aims to provide basics of linear algebra which is useful in understanding machine learning problems			

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Solve system of linear equations	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Apply vector spaces and its properties	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Understand basics of matrix algebra and its applications	U	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:				
Textbook	Introduction to Linear Algebra" by Gilbert Strang, Wellesley-Cambridge Press, 2016, ISBN: 978-0980232776			
Module	Unit	Content	Hrs (45+30)	Marks (60+40)
		Solving Linear Equations		

I	1	Vectors and Linear Equation	12	Min.15
	2	The Idea of Elimination		
	3	Elimination Using Matrices		
	4	Rules for Matrix Operations		
	5	Inverse Matrices		
	6	Elimination = Factorization: $A = LU$		
	7	Transposes and Permutations		
II		Vector Spaces and Subspaces	12	Min.15
	8	Spaces of Vectors		
	9	The Null space of A : Solving $Ax = 0$		
	10	The Rank and the Row Reduced Form		
	11	The Complete Solution to $Ax = b$		
	12	Independence, Basis and Dimension		
	13	Dimensions of the Four Subspaces		
III		Orthogonality	8	Min.15
	14	Orthogonality of the Four Subspaces		
	15	Projections		
	16	Least Squares Approximations		
	17	Orthogonal Bases and Gram-Schmidt		
IV		Eigenvalues and Eigenvectors	13	Min.15
	18	Introduction to Eigenvalues		
	19	Diagonalizing a Matrix		
	20	Symmetric Matrices		
	21	Positive Definite Matrices		
	22	Similar Matrices		
	23	Singular Value Decomposition (SVD)		
		OPEN MODULE	30	
		Solving Problems of above four modules using python library		

		Reference		
1	"Linear Algebra and Its Applications" by David C. Lay, Steven R. Lay, and Judi J. McDonald, Pearson, 2020,ISBN: 978-0134860244			
2	Linear Algebra: Concepts and Applications" by Charles R. Johnson and Dean E. Riess, Wiley, 2017,ISBN: 978-1118612596			
3	Linear Algebra: A Modern Introduction" by David Poole, Cengage Learning, 2016, ISBN: 978-1305658004			
4	Linear Algebra for Machine Learning" by Jason Brownlee, Machine Learning Mastery, 2021			
5	Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy, and Matplotlib" by Robert Johansson, Apress, 2018, ISBN: 978-1484242452			

Mapping of COs with PSOs and POs:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	2	3	0	2	1	3	0	1
CO 2	2	3	2	1	13	3	0	2	1	3	0	1
CO 3	2	3	2	1		3	0	2	2	3	0	1

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Programme	B.Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI2CJ103			
Course Title	MULTIVARIABLE CALCULUS FOR AI OPTIMIZATION			
Type of Course	Major			
Semester	II			
Academic Level	100-199			
Course Details	Credit	Lecture/ Tutorial per week	Practical per week	Total Hours
	4	3	2	75
Pre-requisites	Basic knowledge of vectors, dot product, cross product, triple products, lines and planes in 3-dimensional space			
Course Summary	Multivariable Calculus takes the concepts learned in the single variable calculus course and extends them to multiple dimensions. Topics discussed include: Parameterizations of Plane Curves, Polar Coordinates, Lines and Planes in Space, Cylinders and Quadric Surfaces, Cylindrical and Spherical Coordinates, functions of many variables, limit, continuity, differentiation, and integration of vector-valued functions; application of vector-valued functions limits, and derivatives of multivariable functions, tangent planes and normal lines of surfaces, applying double and triple integrals to multivariable functions to find area, volume, surface area, vector fields, finding curl and divergence of vector fields; line integrals; Green's Theorem; parametric surfaces, including normal vectors, tangent planes, and areas; orientation of a surface; Divergence Theorem; and Stokes's Theorem.			

Course outcome (CO) :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe various coordinate systems—Cartesian, polar, cylindrical, and spherical—to represent, analyse, and interpret geometric figures and spatial relationships.	Ap	C	Internal Examination/ Assignment/ End Sem examination
CO2	Compute and apply limits, partial derivatives, and multiple integrals for functions of several variables to solve complex mathematical and real-world problems.	Ap	C	Internal Examination/Seminar/ Assignment/ Report/ End Sem examination
CO3	Apply advanced integration techniques and vector calculus principles to evaluate integrals in various coordinate systems and analyse vector fields and their applications in physics and engineering.	An	C	Internal Examination/Seminar/ Assignment/ Report/ End Sem examination

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive

Detailed Syllabus :				
Module	Unit	Content	Hrs (48+12)	Mark (60)
Module I				
I	1	Section 9.4: Parameterizations of Plane Curves Topics up to and including Example 7	12	15
	2	Section 9.6: Polar Coordinates Definition of Polar Coordinates, Negative Values of r, Elementary Coordinate Equations and Inequalities, Cartesian Versus Polar Coordinates.		
	3	Section 10.5: Lines and Planes in Space Lines and Line Segments in Space, The Distance from a Point to a Line in Space, Equations for Planes in Space, Angles Between Planes; Lines of Intersection.		
	4	Section 10.6: Cylinders and Quadric Surfaces Cylinders, Drawing Lesson, Quadric Surfaces, Drawing Lesson.		
	5	Section 10.7: Cylindrical and Spherical Coordinates Cylindrical Coordinates, Spherical Coordinates		
Module II				
II	6	Section 12.1: Functions of Several Variables Functions and Variables, Graphs and Level Curves of Functions of Two Variables, Contour Lines, Level Surfaces of Functions of Three Variables.	12	
	7	Section 12.2: Limits and Continuity Limits, Continuity, Functions of More Than Two Variables.		
	8	Section 12.3: Partial Derivatives Definitions and Notation, Calculations, Functions of More Than Two Variables, The Relationship Between Continuity and the Existence of Partial Derivatives, Second Order Partial Derivatives, Euler's Theorem, Partial Derivatives of Still Higher Order.		

	9	Section 12.4: Differentiability, Linearization, and Differentials		15
		Differentiability, How to Linearize a Function of Two Variables, How Accurate is the Standard Linear Approximation? Predicting Change with Differentials (Topics up to and including Example 7)		
	10	Section 12.5: The Chain Rule The Chain Rule for Functions of Two Variables (Proof of Theorem 5 is optional), The Chain Rule for Functions of Three Variables, The Chain Rule for Functions Defined on Surfaces, Implicit Differentiation, Remembering the Different Forms of the Chain Rule, The Chain Rule for Functions of Many Variables.		
	Module III			
III	11	Section 12.7: Directional Derivatives, Gradient Vectors, and Tangent Planes Directional Derivatives in the Plane, Geometric Interpretation of the Directional Derivative, Calculation, Properties of Directional Derivatives, Gradients and Tangent to Level Curves, Functions of Three Variables.	12	
	12	Section 12.7: Directional Derivatives, Gradient Vectors, and Tangent Planes Equations for Tangent Planes and Normal Lines, Planes Tangent to a Surface $z=f(x,y)$, Algebra Rules for Gradients.		
	13	Section 12.8: Extreme Values and Saddle points The Derivative Tests.		
	14	Section 12.8: Extreme Values and Saddle points Absolute Maxima and Minima on Closed Bounded Regions, Conclusion.		
	15	Section 12.9: Lagrange Multipliers Constrained Maxima and Minima, The Method of Lagrange Multipliers (Theorem 9 and Corollary of Theorem 9 are optional).		
	16	Section 12.9: Lagrange Multipliers Lagrange Multipliers with Two Constraints.		
	Module IV			
IV	17	Section 13.1: Double Integrals, Double Integrals over Rectangles, Properties of Double Integrals, Double Integrals as Volumes, Fubini's Theorem for Calculating Double Integrals.		
	18	Section 13.1: Double Integrals Double Integrals over Bounded Nonrectangular Regions, Finding the Limits of Integration.		
	19	Section 13.2: Areas, Moments and Centers of Mass Areas of Bounded Regions in the Plane, Average Value.		

	20	Section 13.3: Double Integrals in Polar Form Integrals in Polar Coordinates, Limits of Integration, Changing Cartesian Integrals into Polar Integrals.	12	15
	21	Section 13.4: Triple Integrals in Rectangular Coordinates Triple Integrals, Properties of Triple Integrals, Volume of a Region in Space, Evaluation.		
	22	Section 13.4: Triple Integrals in Rectangular Coordinates Average Value of a Function in Space.		
V	OPEN MODULE		12	
	Solving Problems of above four modules using python library			
References:				
<ol style="list-style-type: none"> 1. Anton, Bivens & Davis: Calculus Early Transcendentals (10/e) John Wiley & Sons, Inc. (2012) ISBN: 9780470647691 2. Arnold Ostebee & Paul Zorn: Multivariable Calculus (2/e) W. H. Freeman Custom Publishing, N.Y. (2008) ISBN: 9781429230339 3. James Stewart: Calculus (8/e) Brooks/Cole Cengage Learning (2016) ISBN:9781285740621 4. Jerrold E. Marsden & Anthony Tromba: Vector Calculus (6/e) W. H. Freeman and Company, New York (2012) ISBN: 9781429215084 5. Joel Hass, Christopher Heil & Maurice D. Weir: Thomas' Calculus (14/e) Pearson (2018) ISBN 0134438981 6. Jon Rogawski: Multivariable Calculus Early Transcendentals (2/e) W. H. Freeman and Company (2012) ISBN: 1429231874 7. Robert A Adams & Christopher Essex: Calculus: A complete Course (8/e) Pearson Education Canada (2013) ISBN: 032187742X 8. William Wade: An Introduction to Analysis, (4/e) Pearson Education 				
TEXT BOOK : Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney, Pearson Publications, 2010, ISBN: 978-8174906168.				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	3	3	3	3	2	1	1	1	1	3
CO 2	3	2	2	2	2	3	2	1	-	3	-	1
CO 3	3	2	1	1	1	3	2	1	1	1	-	1

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	√	√			√
CO 2	√		√	√	√
CO 3	√		√	√	√

SEMESTER III

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI3CJ201				
Course Title	Introduction to Machine Learning				
Type of Course	Major				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	A basic understanding of programming, linear algebra, probability, and statistics is recommended				
Course Summary	This course introduces the core principles of machine learning, including supervised learning, model evaluation, and basic algorithms like decision trees and neural networks. It emphasizes practical applications and developing models to solve real-world problems effectively				

Course Outcomes (CO) :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamental concepts, learning paradigms, and types of problems in machine learning.	U	C	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO2	Apply regression and classification techniques to analyze and model real-world data.	Ap	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO3	Evaluate models using regularization and performance metrics to improve generalization	E	P,M	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO4	Develop neural networks and decision trees for predictive modeling and pattern recognition	C	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO5	Implement and assess machine learning algorithms through practical experiments and projects.	An	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (45+ 30)	Marks 60
1	Introduction to Machine Learning		11	15
	1	Introduction to Machine Learning: Definition, goals, and impact across doSJMAlns		
	2	Learning Paradigms: Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning		
	3	Types of Learning Problems: Classification, Regression, Clustering, Ranking		
	4	Conceptual Foundations: Hypothesis space, inductive bias, and generalization		
	5	Parameter Estimation Techniques: Maximum Likelihood Estimation (MLE) and Maximum A Posteriori (MAP), Bayesian Foundations: Bayes' theorem and its application to learning models		
II	Regression and Classification		12	15
	6	Linear Regression: Model formulation, cost function, assumptions		
	7	Optimization in Regression: Gradient descent, convergence, and feature scaling		
	8	Non-linear Regression: Polynomial regression and basis function expansion		
	9	Logistic Regression: Probabilistic interpretation and classification boundaries		
	10	Multiclass Classification: One-vs-All and One-vs-One strategies, Practical Aspects of Model Training: Learning rate selection, convergence diagnostics, implementation tips		
III	Regularization and Performance Metrics		11	15
	11	The Bias-Variance Trade-off: Underfitting, overfitting, and generalization error		
	12	Regularization Techniques: Ridge (L2) and LASSO (L1) regression		
	13	Data Partitioning Strategies: Hold-out method, cross-validation, and bootstrapping		
	14	Performance Metrics for Classification: Accuracy, Precision, Recall, F1 Score, and confusion matrix		
	15	Advanced Evaluation Methods: ROC curves, AUC, and model calibration		
	16	Performance Metrics for Regression: MAE, MSE, RMSE, and R ² score		
IV	Perceptron and Neural Network		11	15
	17	The Perceptron: Structure, learning algorithm, and limitations		
	18	Multilayer Neural Networks: Feedforward architecture and activation functions (ReLU, Sigmoid, Tanh)		
	19	Training Neural Networks: Backpropagation and gradient-based optimization		
	20	Decision Tree Fundamentals: Splitting criteria (Entropy, Gini), ID3 algorithm		
	21	Handling Real-World Data in Trees: Missing values, categorical attributes, and noisy features		

	22	Tree Pruning and Overfitting Control: Pre-pruning, post-pruning, and performance tuning		
V		Practical	30	
	1	Perform the data classification using classification algorithm		
	2	Perform the data clustering using clustering algorithm		
	3	Perform the Simple Linear regression on the given warehouse data		
	4	Perform the Multi Linear regression on the given warehouse data		
	5	Perform the logistic regression on the given data warehouse data		
	6	Implement decision tree learning algorithm		
	7	Program to create sample data for testing		
	8	Apply Lasso and Ridge Regression on a regression dataset; compare performance using RMSE and interpret coefficient shrinkage.		
	9	Evaluate a model using 10-fold Cross-Validation; calculate average F1-score and standard deviation.		
	10	Plot ROC Curve and compute AUC for a binary classifier using a test dataset.		
	References			
	1.M Gopal, McGraw Hill(2018), Applied Machine Learning			
	2.Manaranjan Pradhan U Dinesh Kumar, Wiley(2019), Machine Learning using Python			
	3.M.N. Murty, V.S. Ananthanarayana, Universities Press(2014), Machine Learning: Theory and Practice			
	4.Ethem Alpaydin, MIT Press(2020), Introduction to Machine Learning			
	5.Mohammed J. Zaki Wagner Meira, Cambridge University Press(2016), Data Mining and Analysis: Fundamental Concepts and Algorithms			

Mapping of COs with PSOs and POs:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	2	1	3	1	1	2	2	1	0
CO 2	3	3	3	3	3	2	1	2	3	3	1	1
CO 3	2	3	3	3	3	2	1	2	3	3	1	1
CO 4	3	3	3	3	3	2	1	2	3	3	1	2
CO 5	2	3	3	3	3	2	1	2	2	3	1	1

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI3CJ202				
Course Title	Artificial Neural Network				
Type of Course	Major				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Linear algebra, calculus, probability, and basic machine learning				
Course Summary	This course covers neural networks, including basic neuron models, activation functions, and learning processes . It focuses on Perceptrons, backpropagation, optimization, and advanced techniques like function approximation and network pruning				

Course Outcomes (CO :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the biological motivation, neuron models, and fundamental learning paradigms in neural networks..	U	C	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO2	Apply perceptron learning and gradient-based optimization methods to pattern classification problems..	Ap	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO3	Analyze and implement multilayer perceptrons using backpropagation and related heuristics.	An	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO4	Evaluate the effectiveness of training strategies, validation methods, and generalization techniques.	E	M, P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO5	Develop and test neural network-based solutions for real-world tasks using appropriate programming tools.	C	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (45+30)	Marks (60+40)
1	1	Introduction: Motivation from Human Brain, mathematical model of a neuron		
	2	basic computational unit, Activation Functions		

	3	Neural networks viewed as Directed Graphs, Feedback, Network	11	15
		Architectures, Knowledge Representation		
	4	Learning Process–Supervised, Unsupervised and Reinforcement learning		
	5	Learning TasksPattern Association, recognition, function approximation, control, beamforming		
II	6	Perceptron: Perceptron convergence theorem	11	15
	7	Relation between perceptron and Bayes classifier for a Gaussian Environment		
	8	Computer, batch perceptron algorithm. Model building through regression-linear regression model		
	9	Cost Function, gradient descent algorithm, chain rule		
	10	optimization, Local minima, Global Minima		
III	11	Multilayer Perceptron: Batch learning and Online learning	12	15
	12	Back propagation algorithm, XOR problem		
	13	heuristics for making the back-propagation algorithm perform better		
	14	activation functions, differentiability		
	15	symmetric, feature scaling		
	16	initialization, stopping criteria		
IV	17	Learning: back propagation and differentiation	11	15
	18	Hessian matrix, optimal annealing		
	19	adaptive control of the learning rate		
	20	Approximations of function, Generalization		
	21	Cross validation, Network pruning Techniques		
	22	Virtues and limitations of back propagation learning.		
V		Practical	30	
	1	To Write a program to implement Perceptron		
	2	To write a program to implement AND OR gates using Perceptron.		
	3	Write a Program for pattern reorganization		
	4	To write a program to implement Wine Classification using Back propagation		
	5	To implement Crab Classification using pattern net		
	6	Write a program to implement classification of linearly separable Data with a perceptron		
	7	Write a program to implement classification of non linearly separable Data with a perceptron		
	8	To study Long Short Term Memory for Time Series Prediction		
	9	Write a program to implement basic matrix operations		
		References		
	1.Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004 2.Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017 3.Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018 4.Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw- Hill Inc. 2000 5.Simon Haykin, “Neural Networks and Learning Machines”, Pearson Education India; Third edition 2016			

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	3	1	3	1	1	2	2	1	1
CO 2	2	3	2	2	3	2	2	3	2	2	1	2
CO 3	2	3	3	3	3	2	2	3	3	2	1	2
CO 4	2	2	3	2	2	3	1	2	2	3	2	2
CO5	2	3	2	3	3	2	2	3	3	3	1	3

Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Programme	B. Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI3CJ203			
Course Title	OPERATION RESEARCH FOR AI- DRIVEN OPTIMIZATION			
Type of Course	Major			
Semester	III			
Academic Level	200- 299			
Course Details	Credit	Lecture/Tutorial	Practical	Total Hours
	4	per week 4	per week -	60
Pre-requisites	Basic Calculus and Linear Algebra			
Course Summary	Linear Programming is a mathematical modelling technique in which a linear function is maximized or minimized when subjected to various constraints. This technique has been useful for guiding quantitative decisions in business planning, in industrial engineering, and—to a lesser extent—in the social and physical sciences. This course begins with convex sets and extrema of functions for a sound basis of the subject. It then develops into LP problems including Transportation and Assignment problems.			

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Able to identify and analyse the properties of convex sets, including open and closed sets, convex hulls, and vertices.	An	C	Internal Exam/Assignment/Seminar/ Viva / End Sem Exam
CO2	To demonstrate proficiency in applying optimization techniques such as gradient descent, constrained extrema, and the method of Lagrange multipliers to solve real-valued functions.	Ap	P	Internal Exam/Assignment/Seminar/ Viva / End Sem Exam
CO3	To formulate and solve linear programming problems, including transportation and assignment problems, using techniques such as simplex method and duality.	U	P	Internal Exam/Assignment/Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Text book		Optimization Methods in Operation Research and System Analysis (4th edition), K.V Mittal, C Mohan, New Age International (P)Limited (2016)		
Module	Unit	Content	Hrs(45+30)	Marks (60)
I	Module I		12	15
	1	Chapter 1 Section 11: Open and Closed sets in E_n		
	2	Section 12: Convex Linear Combination, Convex Sets		
	3	Section 13: Intersection of Convex Sets, Convex Hull of a Set Section 14: Vertices or Extreme Points of a Convex Set		
	4	Section 15: Convex Polyhedron Section 16: Hyperplanes, Half-spaces and Polytopes		
	5	Section 17: Separating and Supporting Hyperplanes Section 18: Vertices of a Closed Bounded Convex Set Section 19: Summary Section 20: Quadratic Forms		
II	Module II		13	15
	6	Chapter 2 Section 11: Convex Functions		
	7	Section 12: General Problem of Mathematical Programming		
	8	Chapter 3 Section 1: Introduction Section 2: LP in Two-Dimensional Space		
	9	Section 3: General L P Problem Section 4: Feasible Solutions Section 5: Basic Solutions Section 6: Basic Feasible Solutions Section 7: Optimal Section 8: Summary		
	10	Section 9: Simplex Method Section 10: Canonical Form of Equations Section 11: Simplex Method (Numerical Example) Section 12: Simplex Tableau		
	11	Section 13: Finding the First b.f.s; Artificial Variables Section 14: Degeneracy		
	12	Section 15: Simplex Multipliers		
III	Module III		10	15
	13	Chapter 3 Section 17: Duality in LP Problems		
	14	Section 18: Duality Theorems Section 19: Applications of Duality		
	15	Section 20: Dual Simplex Method		

		Section 21: Summary of Simplex Methods (III Revised Simplex Method is optional)		
	16	Section 22: Applications of LP		
IV	Module IV		10	15
	17	Chapter 4 Section 1: Introduction Section 2: Transportation Problem Section 3: Transportation Array Section 4: Transportation Matrix Section 5: Triangular Basis Section 6: Finding a Basic Feasible Solution		
	18	Section 7: Testing for Optimality		
	19	Section 8: Loop in Transportation Array Section 9: Changing the Basis		
	20	Section 10: Degeneracy Section 11: Unbalanced Problem		
	21	Section 14: Assignment Problem		
	22	Section 15: Generalized Transportation Problem Exercise Questions in Assignment Problem		
	Open Ended			
V		Solving Problems of above four modules using python library	30	
<p>. References:</p> <ol style="list-style-type: none"> 1. G. Hadley: Linear Programming Addison-Wesley Pub Co Reading, Mass (1975) 2. S.S. Rao: Optimization – Theory and Applications (2nd Edn.) Wiley Eastern (P) Ltd. New Delhi. 3. Russel L Ackoff and: Fundamentals of Operation Research Maurice W.Sasioni Wiley Eastern Ltd. New Delhi. (1991) 4. Charles S. Beightler: Foundations of Optimization D.T. Philips & D.J. Wilde (2nd Edn.) Prentice Hall of India, Delhi (1979) 				
<p>Programming References for Open-Ended section:</p> <ol style="list-style-type: none"> 1. Linear Programming using Scipy, https://python.quantecon.org/lp_intro.html 2. Vanderbei’s book homepage: https://vanderbei.princeton.edu/LPbook/ 3. CPLEX Jupyter Notebook: https://github.com/IBMDecisionOptimization/tutorials/blob/master/jupyter/Linear_Programming.ipynb <p>Installation: http://ibmdecisionoptimization.github.io/docplex-doc/README.md.html</p> <ol style="list-style-type: none"> 4. Solving Transportation Problem using Linear Programming in Python: https://machinelearninggeek.com/solving-transportation-problem-using-linear-programming-in-python/ 5. Changhyun Kwon, Julia Programming for Operations Research 2/e 				

<https://www.softcover.io/read/7b8eb7d0/juliabook2/simplex>

Mapping of COs with PSOs and POs:											
	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	3	1	2	1	3	0	1
CO 2	3	3	3	2	2	1	3	1	3	0	1
CO 3	2	3	3	2	3	1	3	1	3	0	2

Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

SEMESTER IV

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI4CJ201				
Course Title	Advanced Machine Learning				
Type of Course	Major				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Machine Learning				
Course Summary	This course introduces the principles of advanced machine learning, including supervised learning, Support vector Machine, and basic algorithms like advanced decision trees . It emphasizes practical applications and developing models to solve real-world problems effectively				

Course Outcomes (CO) :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand and compare key supervised learning algorithms like SVM, Naive Bayes, and k-NN.	U	C	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO2	Understand and Apply ensemble methods and interpret model performance using metrics and visualizations.	U,Ap	C,P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO3	Analyze clustering and dimensionality reduction techniques for pattern discovery.	An	P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam
CO4	Evaluate models using cross-validation, bootstrapping, and error estimation.	E	M, P	Internal Exam/ Practical/Assignment/Seminar/ Viva/End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
 # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)
 Metacognitive Knowledge (M)

Detailed Syllabus				
Module	Unit	Content	Hrs (45+ 30)	Marks (60)
I	1	Reintroduction to Supervised Learning: Key concepts recap: hypothesis space, generalization, model complexity	11	15
	2	Support Vector Machines (SVM): Theory and Margins: Optimal hyperplane, margin maximization, hinge loss		
	3	Kernel Methods for Nonlinear Classification: Kernel trick, RBF and polynomial kernels, parameter tuning		
	4	Naive Bayes Classification: Probabilistic model assumptions, Gaussian and multinomial variants		
	5	Instance-Based Learning: K-Nearest Neighbors: Distance metrics, model behavior, scalability challenges, Comparative Analysis of Classifiers: Performance trade-offs, interpretability, and use-case alignment		
II	6	Advanced Decision Trees: CART methodology, impurity measures, greedy splitting	12	15
	7	Preventing Overfitting in Trees: Pruning strategies, minimum leaf size, early stopping		
	8	Random Forests: Ensemble learning via bagging, feature sampling, OOB error estimation		
	9	Boosting Algorithms: AdaBoost, Gradient Boosting, XGBoost— principles and mechanics		
	10	Interpreting Tree Ensembles: Feature importance measures, SHAP values, decision paths, Model Selection and Practical Trade-offs: Accuracy vs. interpretability vs. computational cost		
III	11	Introduction to Clustering Concepts: Similarity measures, intra/inter-cluster distance, evaluation metrics	11	15
	12	K-Means Clustering: Objective function, initialization sensitivity, convergence behavior		
	13	Hierarchical Clustering: Agglomerative and divisive methods, dendrogram interpretation		
	14	Principal Component Analysis (PCA): Dimensionality reduction, explained variance, geometric interpretation		
	15	Alternative Techniques: MDS and ICA: Multidimensional Scaling (MDS) and Independent Component Analysis (ICA)		
	16	Real-World Applications of Unsupervised Learning: Data compression,		

		topic modeling, anomaly and pattern detection		
IV	17	Cross-Validation and Model Validation Techniques: K-fold, stratified K-fold, LOOCV, model selection via validation curves	11	15
	18	Bootstrapping and Sampling for Robust Estimation: Confidence intervals, resampled error estimates, variance reduction		
	19	Loss Functions and Optimization Strategies: Cross-entropy, hinge, huber, and surrogate loss trade-offs		
	20	Feature Engineering and Data Representation: Encoding categorical variables, normalization, embedding strategies		
	21	Addressing Data Imperfections: Missing value imputation, class imbalance (SMOTE, weighting)		
	22	Building ML Systems for Real-World Use: Data drift, noisy data, reproducibility, and pipeline deployment		
V		Practical	30	
	1	Support Vector Machine: a. Create SVM from scratch b. Program to perform SVM optimization using python.		
	2	Implement feed forward back propagation neural network learning algorithm		
	3	Implement Naive Bayes' learning algorithm		
	4	implement K-Means clustering Algorithm		
	5	Implement Dimensionality reduction using Principal Component Analysis (PCA) method		
	6	Create dataset containing information about customers of a retail store, including features such as age, income, and spending score. Your task is to perform clustering on the dataset to identify distinct groups of customers based on their purchasing behaviour. Use K-means Algorithm		
	7	Create a dataset containing information about patients with diabetes, including features such as age, BMI, blood pressure, and glucose levels, as well as an indication of whether each patient has diabetes or not. Your task is to build a simple neural network classifier to predict whether a patient has diabetes based on their features		
	8	Train a Random Forest model. Output accuracy, feature importance, and OOB error		
	9	Apply gradient boosting (XGBoost or AdaBoost) to a dataset; compare results with Random Forest.		
	10	Implement k-fold and stratified k-fold cross-validation for classification; analyze variation.		
	References			

1. M Gopal, McGraw Hill(2018), Applied Machine Learning
2. Manaranjan Pradhan | U Dinesh Kumar, Wiley(2019), Machine Learning using Python
3. M.N. Murty, V.S. Ananthanarayana, Universities Press(2014), Machine Learning: Theory and Practice
4. Ethem Alpaydin, MIT Press(2020), Introduction to Machine Learning
5. Mohammed J. Zaki | Wagner Meira, Cambridge University Press(2016), Data Mining and Analysis: Fundamental Concepts and Algorithms

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	3	1	3	1	2	2	2	1	1
CO 2	2	3	2	2	3	2	2	3	3	2	1	2
CO 3	2	2	3	2	2	2	1	2	2	3	2	2
CO 4	2	2	2	2	2	2	1	2	2	3	2	2

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI4CJ202				
Course Title	Deep Learning				
Type of Course	Major				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Machine Learning,Artificial Neural Networks				
Course Summary	This course introduces the foundational principles of deep learning and training methodologies. It also offers practical exposure to key applications such as image classification and sequence modeling.				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the architecture, activation functions, and training techniques of deep feedforward networks	U	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO2	Apply optimization techniques and regularization strategies for efficient deep neural network training.	Ap	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO3	Design and implement convolutional neural networks (CNNs) and apply them to image-based tasks.	An	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO4	Develop deep learning models for text processing using RNNs, LSTMs, GRUs, and autoencoders..	C	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO5	Build and evaluate deep learning models using frameworks like TensorFlow or Keras for real-world applications.	C,E	M, P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
<p>* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P),Metacognitive Knowledge (M)</p>				

Detailed Syllabus :				
Module	Unit	Content	Hrs (45+30)	Marks 60
1		Introduction to Deep learning	11	15
	1	Introduction, Deep feed forward network.		
	2	Activation functions – Sign, Sigmoid, Tanh, ReLU, leaky ReLU, Hard Tanh, Softmax, Loss function.		
	3	Training a Neural Network with Backpropagation.		
	4	Practical issues in neural network training. Overfitting, Underfitting		
	5	Hyper parameters and Validation sets, Estimators -Bias and Variance		
II		Network Design parameters	12	15
	6	Introduction, setup and initialization Kaiming, Xavier weight initialization,		
	7	Vanishing and exploding gradient problems		
	8	Optimization techniques - Gradient Descent (GD), Stochastic GDGD with momentum- GD with Nesterov momentum		
	9	Parameter specific learning rates: AdaGrad- RMSProp- Adam ,Regularization Techniques - L1 and L2 regularization- Early stopping		
	10	Dataset augmentation- Parametertying and sharing- Ensemble methods- Dropout- Batch normalization		
III		Convolutional Neural Network	11	15
	11	Basic structure of a CNN		
	12	Basic layers and operations in CNN: Convolution operation- effect of stride and padding,		
	13	Fully Connected layers- CNN layers.		
	14	Building a CNN model: Training a CNN.		
	15	Estimation of Tensor size number of features in CNN layers, Transfer 11 learning (size similarity matrix)		
	16	Pre-trained architectures- AlexNet, ResNet-50, GoogleNet.		
IV		Deep learning models for text processing	11	15
	17	Recurrent Neural Network architecture		
	18	Variants of RNN architectures: Deep Recurrent Neural Network- Recursive Neural Network- Bidirectional recurrent neural network,		
	19	Encoder-Decoder architecture, LSTM, GRU.		
	20	Autoencoders- Variational AutoEncoder-under complete Auto-encoder, stochastic encoder, denoising Encoder.		
	21	Applications of Autoencoders.		
	22	Generative models – Boltzmann machines- Deep Belief Networks- Generative Adversarial Networks		
V		Practical	30	
	1	Implement Simple Programs like vector addition in TensorFlow.		
	2	Implement a simple problem like regression model in Keras.		
	3	Implement a perceptron in TensorFlow/Keras Environment.		
	4	Implement a Feed-Forward Network in TensorFlow/Keras.		
	5	Implement an Image Classifier using CNN in TensorFlow/Keras		
	6	Implement a Transfer Learning concept in Image Classification.		
	7	Implement an Autoencoder in TensorFlow/Keras		

	8	Implement an LSTM to perform sequence prediction (e.g., stock prices or character-level text).		
	9	Apply K-fold cross-validation manually or using libraries for performance validation.		
	10	Apply L1/L2 regularization and Dropout in a feedforward network; evaluate overfitting.		
		<p>References</p> <ol style="list-style-type: none"> 1. M Gopal, Pearson Education(2022), Deep Learning, Core Concepts, Methods and Applications 2. Nikhil Buduma and Nicholas Locascio, O'Reilly Media(2017), Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithm 3. Goodfellow, I., Bengio, Y., and Courville, A., MIT Press(2016), Deep Learning 4. Aggarwal, Charu C, Springer International(2018), Neural Networks and Deep Learning 5. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press(2016), Deep Learning 		

Mapping of COs with PSOs and POs:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	3	1	3	1	2	2	2	1	1
CO 2	2	3	2	2	3	2	2	3	3	2	1	2
CO 3	2	2	3	2	2	2	1	2	2	3	2	2
CO 4	2	2	2	2	2	2	1	2	2	3	2	2
CO 5	2	2	3	2	2	2	1	2	2	3	2	2

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓

Programme	B.Voc.Mathematics and Artificial Intelligence			
Course Code	SJMAI4CJ203			
Course Title	BASIC MATHEMATICAL ANALYSIS			
Type of Course	Major			
Semester	IV			
Academic Level	200 – 299			
Course Details	Credit	Lecture/Tutorial per week	Practicum per week	Total Hours
	4	4	-	60
Pre-requisites	1. Mathematical Logic and necessary exposure to set theory. 2. Basic Calculus			
Course Summary	After introducing the basic notions in set theory, the course develops into the construction of the Real number system. Thereafter Real functions are introduced and the notions of limit and continuity are developed.			

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Demonstrate Proficiency in Set Theory Fundamentals and Real Number Properties	An	C	Internal Exam/ Assignment/Seminar/ Viva/Report/ End Sem Exam
CO2	Apply the completeness property of \mathbb{R} , and solve problems involving intervals and applications of the supremum property.	U	C	Internal Exam/ Assignment/Seminar/ Viva/Report/ End Sem Exam
CO3	Understand and apply the properties, representations, and operations of complex numbers and functions, including polar form, limits, continuity, differentiability	U,Ap	C	Internal Exam/ Assignment/Seminar/ Viva/Report/ End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Textbook	Introduction to Real Analysis, 4/e, Robert G Bartle, Donald R Sherbert John Wiley & Sons (2011)			
Module	Unit	Content	Hrs (60)	External Marks (60)
I	Introduction to Set theory		15	Min.15
	1	Section 1.1 - Sets and functions		
	2	Section 1.2 - Mathematical Induction		
	3	Section 1.3 – Finite and Infinite sets.		

	4	Section 1.3 – Countable and Uncountable sets.		
II	The Real numbers		15	Min.15
	5	Section 2.1 – The algebraic properties of \mathbb{R} .		
	6	Section 2.1 – The order properties of \mathbb{R} .		
	7	Section 2.2 – Absolute value and the Real Line.		
	8	Section 2.3 – Completeness property of \mathbb{R}		
	9	Section 2.4 – Applications of the Supremum property - 2.4.3 to 2.4.6 and 2.4.8 to 2.4.9		
	10	Section 2.5 – Intervals – 2.5.2 to 2.5.4		
III	Introduction to Complex Numbers		15	Min.15
	11	Section 1.1-Complex Numbers and Their Properties		
	12	Section 1.2-Complex Plane		
	13	Section 1.3- Polar Form of Complex Numbers		
	14	Section 1.4- Powers and Roots		
	15	Section 1.5 -Sets of Points in Complex Plane		
	16	Section 2.1 -Complex Functions		
IV	Complex Mappings		15	Min.10
	17	Section 2.2- Complex Functions as Mappings- up to and including Example 4.		
	18	Section 3.1- Limits and Continuity-Limits		
	19	Section 3.1- Limits and Continuity-Continuity		
	20	Section 3.1-Limits and Continuity-Continuity.		
	22	Section 3.2- Differentiability and Analyticity- up to and including Example 2. Section 3.2- Differentiability and Analyticity- All the topics after Example 2.		
V	Open Module			
	Solving Problems of above four modules using python library			
References				
<ol style="list-style-type: none"> 1. Tom.M. Apostol, Calculus I, Wiley & Sons. 2. Tom.M. Apostol, Mathematical Analysis, 2/e, Addison-Wesley. 3. Richard R Goldberg, Methods of Real Analysis, 2/e, Wiley 4. Raymond L Wilder, Introduction to the Foundations of Mathematics,2/e, John WileySons 				
Optional Programming References for Practicum: (1)				
SageMath Calculus Tutorial https://www.sagemath.org/calctut/limits.html (2)SageMath 2D plotting https://doc.sagemath.org/html/en/reference/plotting/sage/plot/plot.html#				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	3	2	2	3	0	3	0	3	0	0
CO2	1	3	2	2	1	3	0	3	0	3	0	0
CO3	3	2	3	3	2	3	0	3	0	3	0	0

Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment/ Report	Seminar	Viva	End Semester Examinations
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓

SEMESTER V

Programme	B.Voc.Mathematics and Artificial Intelligence			
Course Code	SJMAI5CJ301			
Course Title	BASIC ALGEBRA			
Type of Course	Major			
Semester	V			
Academic Level	300-399			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	3	2	75
Pre-requisites	Basic set theory, algebra of Integers, operations on functions, basic proof techniques etc.			
Course Summary	This course explores the algebraic concepts of Binary Operations, Binary Structures, Groups, Rings, Integral DoSJMAInS and Fields. We further study the Theory of Groups. Elementary properties, Subgroups, Finite Groups, Cyclic Groups, Groups of Permutations, Orbits, Cycles, Alternating Groups, Cosets and the Theorem of Lagrange are studied. Then we study mappings between groups or Homomorphisms. Finally, the Open-ended section points to Generating sets, Factor Groups and Field of Quotients of an Integral DoSJMAIn.			

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Discuss about binary operations, isomorphic binary structures and groups	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Analyse and classify subgroups and cyclic groups, and determine their properties using group theory.	An	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Evaluate and apply theorems related to cosets, Lagrange's theorem, homomorphisms, rings, and fields to solve complex algebraic problems.	E	F	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Text book	A first course in abstract algebra, Fraleigh, John B. Seventh Edition, Pearson Education India, 2003			
Module	Unit	Content	Hrs (48+12)	Marks Ext (60)

I	Module I		12	Min.15
	1	Section 2- Binary Operations (2.1 to 2.10)		
	2	Section 2- Binary Operations (2.11 to 2.25)		
	3	Section 3- Isomorphic Binary Structures (3.1 to 3.11).		
	4	Section 3- Isomorphic Binary Structures (3.12 to 3.17)		
	5	Section 4- Groups (4.1 to 4.14)		
II	Module II		14	Min.15
	7	Section 5- Subgroups (5.1 to 5.16)		
	8	Section 5 -Subgroup - Cyclic Subgroups (5.17 to 5.23)		
	9	Section 6 -Cyclic Groups (6.1 to 6.9) (Proof of Theorem 6.3 is optional)		
	10	Section 6- Cyclic Groups (6.10 to 6.17) (Proof of Theorem 6.14 is optional).1		
	11	Section 8-Groups of Permutations (up to 8.6)		
III	Module III		10	Min.15
	13	Section 9 - Orbits, Cycles, and the Alternating Groups (Up to 9.10)		
	14	Section 9 - Orbits, Cycles, and the Alternating Groups (9.11 to 9.21) (Proof 2 of theorem 9.15 is optional).		
	15	Section 10- Cosets and the theorem of Lagrange (Up to 10.9)		
IV	Module IV		12	Min.15
	17	Section 13- Homomorphisms (13.1 to 13.10)		
	18	Section 13-Homomorphism (13.11 to 13.20)		
	19	Section 18-Rings and Fields (18.1 to 18.13)		
	20	Section 18-Rings and Fields (18.14 to 18.18)		
	21	Section 19-Integral DoSJMAIns (19.1 to 19.8)		
V	Practicum		12	-
	Solving Problems of above four modules using python library			

References

1. Herstein, Israel Nathan. *Topics in algebra*. John Wiley & Sons, 1991.
2. Gallian, Joseph. *Contemporary abstract algebra*. Chapman and Hall/CRC, 2021.
3. Wallace, David AR. *Groups, rings and fields*. Springer Science & Business Media, 2001
4. Reis, Clive. *Abstract algebra: an introduction to groups, rings and fields*. World Scientific Publishing Company, 2011.
5. Allan Clark, *Elements of Abstract Algebra*, Dover Publications, 1984
6. C Musili, *Introduction to Rings and Modules*, Narosa Publications, 2009

Mapping of COs with PSOs and POs:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	2	1	0	0	2	0	0	0	2	0	0
CO 2	1	2	3	0	1	2	0	2	0	3	0	0
CO 3	0	1	2	3	2	2	0	3	0	3	0	0

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Programme	B.Voc Mathematics and Artificial Intelligence				
Course Code	SJMAI5CJ302				
Course Title	Internet of Things				
Type of Course	Major				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic understanding of computer science concepts. 2. Familiarity with networking fundamentals. 3. Proficiency in a programming language (e.g., Python, Java).				
Course Summary	A course on the Internet of Things (IoT) typically covers a range of topics to provide students with a comprehensive understanding of this interdisciplinary field like Basic concepts and Components of an IoT system, IOT Architecture and communication protocols, IOT devices and Sensors, IOT security, Data management and Applications				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamentals of IoT architecture, including its genesis and impact.	U	C	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO2	Learn to engineer IoT networks with smart objects, sensors, and actuators.	U	C	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO3	Become familiar with IoT protocols such as XMPP, MQTT, CoAP, SOAP, and HTTP.	U	C	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO4	Develop skills in data analytics for IoT, using machine learning and big data tools	Ap	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO5	Gain practical experience in developing IoT systems using Python, Raspberry Pi, and Arduino.	Ap	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (45+30)	Marks (60)
I	IoT Architecture		11	15
	1	What is IoT, Genesis of IoT, IoT and Digitization,		
	2	IoT Impact, Convergence of IT and IoT, IoT Challenges,		
	3	IoT Network Architecture and Design,		
	4	Drivers Behind New Network Architectures, Comparing IoT Architectures,		
	5	A Simplified IoT Architecture, The Core IoT, Functional Stack,		
	6	IoT Data Management and Compute Stack.		
II	Smart Objects		11	15
	7	Sensors, Actuators, and Smart Objects		
	8	, Sensor Networks, Connecting Smart Objects,		
	9	Communications Criteria, IoT Access Technologies.		
	10	IoT Network Layer: IP as the IoT Network Layer, The Business Case for IP,		
	11	The need for Optimization, Optimizing IP for IoT,		
III	IoT Protocols		11	15
	12	Application Protocols for IoT (XMPP, MQTT, CoAP, SOAP, HTTP only),		
	13	Transport Layer, IoT Application Transport Methods.		

	14	Data Analytics for IoT: Data and Analytics for IoT,		
	15	An Introduction to DataAnalytics for IoT,		
	16	Machine Learning,		
	17	Big Data Analytics Tools andTechnology		
IV	Developing IoT Systems		12	15
	18	IoT Logical Design using Python		
	20	IoT Physical Devices and Endpoints - Raspberry Pi interfaces,		
	21	Programming Raspberry Pi using Python,Wamp.		
	22	Developing Tools: Arduino, Apache NetBeans.		
	Practicals			
V	1	program to Blink a Light Emitting Diode LED	30	
	2	program to fade the led bulb using for loop		
	3	program to connect a led through push button		
	4	program to connect with Servo Motor		
	5	program to run a counter and display in LCD		
	6	program to interface the sensor and led		
	7	program to interface buzzer with LDR and LED		
	8	program to print Hello word in LCD		
	9	program to print all integer number from 0 to 99 using for loop		
	10			
References 1. Designing the Internet of Things Adrian McEwen, Hakim Cassimally WILEY First 2014 2. nternet of Things – Architecture and Design Raj Kamal McGraw Hill First 2017 3. Learning Internet of Things, Peter Waher, PacktPublishing(2015) 4. Mastering the Raspberry Pi, Warren Gay, Apress(2014)				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	1	1	1	3	2	1	3	2	2	1
CO 2	3	3	2	2	2	3	2	2	2	3	1	1
CO 3	2	2	2	2	2	2	2	2	3	2	2	1
CO 4	2	2	2	3	3	2	2	3	3	3	2	2
CO 5	3	3	2	3	3	3	3	3	3	3	2	2

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓		✓
CO 3	✓	✓	✓		✓
CO 4	✓	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓

Programme	B.Voc Mathematics and Artificial Intelligence				
Course Code	SJMAI5CJ303				
Course Title	Natural Language Processing				
Type of Course	Major				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	75
Pre-requisites	Knowledge in statistics, probability, AI and neural networks				
Course Summary	This course provides students with a comprehensive understanding of the natural language processing, design concepts, and practical implementation aspects of NLP using python				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand syntax, semantics, and pragmatics in NLP tasks	U	C	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO2	Understand and apply accurate lexicon usage, POS tagging, and word sense disambiguation	U,Ap	C,P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO3	Implement and utilize various grammars and parsing methods, including resolving ambiguities	Ap	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO4	Link syntax and semantics, interpret noun phrases, and use knowledge representation for discourse management.	Ap	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO5	Implement the models like BERT, GPT-2, ELMO, and RoBERTfor tasks like machine translation, sentiment analysis, and text summarization	An	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (48+ 12)	Marks (60)
I		Introduction to Natural Language Understanding and Linguistics	12	15
	1	Levels of language analysis,		
	2	Syntax, Semantics, Pragmatics.		
	3	Linguistic Background,		
	4	An Outline of English Syntax, Lexicon,		
	5	POS Tagging, Word Senses.		
II		Parsing Techniques and Ambiguity Resolution	12	15
	6	Grammars and Parsing Features,		
	7	Agreement and Augmented Grammars,		
	8	Grammars for Natural Language,		
	9	Parsing methods and Efficient Parsing,		
	10	Ambiguity Resolution, Statistical Methods.		
	11	Probabilistic Context Free Grammar.		
III		Semantic Interpretation and Knowledge Representation in NLP	12	15
	12	Semantics and Logical Form,		
	13	Linking Syntax and Semantics,		
	14	Ambiguity Resolution,		
	15	other Strategies for Semantic Interpretation,		
	16	Scoping and the Interpretation of Noun Phrases.		
	17			
IV		Language Models	12	15
	18	Pre-trained Models		
	19	BERT, GPT-2, ELMO, RoBERT		
	20	Applications and Challenges- Machine Translation,		
	21	Information Retrieval and Extraction, Sentiment Analysis,		
	22	Text Categorization and Summarization.		
V		Openmodule : Case Studies	12	
		<ol style="list-style-type: none"> 1. BERT for Clinical Text Analysis (Google + Mayo Clinic) 2. Mental Health Chatbots (Wysa, Woebot) 3. ESJMAIL Spam Detection (GSJMAIL) 4. Legal Document Summarization (ROSS Intelligence, LexisNexis) 		
		References		

<p>1.Charniak, Eugene, Addison-Wesley(1985), Introduction to Artificial intelligence</p> <p>2.Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Addison-Wesley(1999), Modern Information Retrieval</p> <p>3.U. S. Tiwary and Tanveer Siddiqui, Oxford University Press(2008), Natural Language Processing and Information Retrieval</p> <p>4.D. Jurafsky and J. H. Martin, Prentice Hall India(2000), Speech and Language Processing</p> <p>5.James Allen, Benjamin-Cummings(1988), Natural Language Understanding</p>	
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Mapping of Cos with PSOs and Pos:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	2	2	2	3	3	1	2	2	2	1	1
CO 2	1	2	2	2	3	2	2	2	3	3	2	2
CO 3	1	2	2	3	3	3	2	2	3	2	1	2
CO 4	1	2	2	2	3	2	1	3	3	2	1	3
CO 5	1	1	1	2	2	2	2	2	2	3	3	2

	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	✓

18.DETAILED SYLLABUS OF THE ELECTIVE COURSES(MAJOR) ELECTIVE 1

Programme	B.Voc.Mathematics and Artificial Intelligence				
Course Code	SJMAI4EJ211				
Course Title	Computer Vision				
Type of Course	Elective				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	knowledge of linear algebra, calculus, probability, Python programming, basic image processing, and machine learning				
Course Summary	The course covers topics like image processing, feature detection, camera modeling, stereo vision, and 3D reconstruction, with applications in object recognition, tracking, and scene understanding. It focused on enabling computers to interpret and understand visual information from the world, such as images and videos				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the principles of camera calibration and stereopsis in computer vision.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Apply linear filtering and edge detection techniques for image analysis.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Analyze machine learning and deep learning models for visual perception tasks	An	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Implement clustering-based image segmentation and object detection methods.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Explore advanced vision tasks through open-ended projects using state-of-the-art models.	C	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
- Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (60)	Marks (60)
1	1	Camera Calibration- Pinhole camera model	12	15
	2	Geometric Image Features -Curves, Surfaces		
	3	Analytical Image Features - Elements of AnalyticalEuclidean Geometry, Geometric Camera Parameters,		
	4	Stereopsis - Binocular Camera Geometry, Epipolar Constraint		
	5	Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion		
II	6	Features and Filters :-Linear Filters- Linear Filters and Convolution,	12	15
	7	Shift Invariant Linear Systems.		
	8	Estimating Derivatives with Finite Differences, Noise, Edges and Gradient-based Edge Detectors		
	9	Image Gradients - Computing the Image Gradient, Gradient Based Edge andCorner Detection		
	10	Filters as Templates - Normalized Correlation and Finding		
III	11	Machine Learning - Introduction, Dataset for Machine Perception- Labelled and Unlabelled Data	12	15
	12	Basics of Classification and Clustering, Multi-Class Perspective.		
	13	.Machine Learning for Computer Vision -Machine Learning -Deep Learning Use Cases		
	14	Machine Learning Models for Vision - Image Vision-Pretrained Model, Transfer Learning, Fine-Tuning, Convolutional Networks,		
	15	Convolutional Filters, Stacking Convolutional Layers, Pooling Layers - AlexNet, VGG19		
	16	Modular architecture - ResNet, Neural Architecture Search Design - NASNet		
IV	17	Segmentation Using Clustering Methods - Human vision- Grouping and Gestalt, Applications- Shot Boundary Detection, Background Subtraction,	12	15
	18	Image Segmentation by Clustering Pixels- Simple Clustering Methods		
	19	Clustering and Segmentation by K-means		
	20	Object detection - YOLO, Segmentation-Mask R-CNN and Instance Segmentation		
	21	U-Net and Semantic Segmentation		
	22	Model Quality Metrics		
V	Open Ended Module : Case Studies		12	
	1	Real-Time Object Detection for Public Safety using YOLO		
	2	Medical Image Segmentation for Tumor Detection using U-Net		
	3	Face Recognition-Based Smart Attendance System		
	4	Lane Detection in Autonomous Vehicles using Edge and Gradient Filters		
		References		

	<ol style="list-style-type: none"> 1.Szeliski, Richard, Springer Science & Business Media(2010), Computer vision: algorithms and applications 2.Tao Lei, Asoke K. Nandi, John Wiley & Sons(2022), Image Segmentation: Principles, Techniques, and Applications 3.Ali IsSJMAIL Awad, Mahmoud Hassaballah, CRC Press(2020), Deep Learning in Computer Vision Principles and Applications 4.Forsyth, David, and Jean Ponce, Prentice hall(2011), Computer vision: A modern approach 5.Valliappa Lakshmanan, Martin Görner, Ryan Gillard, O'Reilly Media(2021), Practical Machine Learning for Computer Vision 	
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Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	-	-	-	3	2	1	2	1	-	-
CO 2	3	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	1	-	-	3	2	3	2	2	-	-
CO4	3	3	2	-	-	2	2	3	3	2	-	-
CO5	3	3	3	2	1	2	2	3	3	3	1	1

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	B.Voc Mathematics and artificial Intelligence				
Course Code	SJMAI4EJ212				
Course Title	Data Mining				
Type of Course	Elective				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic knowledge of databases, statistics, programming (preferably Python), and data structures				
Course Summary	This course provides an introduction to data mining techniques such as data preprocessing, association rules, classification, clustering, and outlier detection.				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the basics of data mining and its types of data and patterns.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Use data cleaning, integration, and transformation methods.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Apply association rules and classification techniques to analyze data..	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Use clustering and outlier detection to find hidden patterns.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Explore real-world data mining uses and related ethical issues.	C	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Module	Unit	Content	Hrs (60)	Marks (60)
I	Introduction to Data Mining		10	15
	1	Introduction- Data mining defining, KDD vs Data mining, DBMS vs data mining		
	2	What kind of data can be mined? - database data, data warehouse, transactional data, other types		
	3	What kind of patterns can be mined? - Class/Concept		
		Description: Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Regression for Predictive Analysis, cluster analysis, outlier analysis		
4	Technologies used- statistics, machine learning, data base systems and ware house, information retrieval (Introduction only)			
II	Data Preprocessing		14	15
	5	Data Preprocessing: An Overview		
	6	Data Cleaning- missing value, noisy data, Data Cleaning as a Process		
	7	Data Integration- Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution		
	8	Data Reduction - Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms,		
9	Data Transformation and and Data Discretization- Data Transformation by Normalization, Discretization by Binning			
III	Association Rule Mining & Classification		10	15
	10	Introduction to Association Rule Mining Frequent Itemset, Closed Itemset, and Association Rules		
	11	Frequent Itemset Mining Apriori Algorithm, Generating Association Rules from Frequent Itemsets		
	12	Introductio to classification: Decision tree		
	13	Attribute Selection measures in decision tree		
	14	Bayes Classification methods		
15	Techniques to Improve Classification Accuracy			
IV	Clustering, Outlier Detection		14	15
	16	Introduction to unsupervised techniques: challenges		
	17	Clustering- K Means		
	18	Variants of k- Means		
	19	Hierarchical clustering		
	20	Density Based clustering- DBScan		
	21	Introduction to outliers and novelty detection		
22	Recommender system			
V	Open Ended Module: Case Studies		12	
	1	Real-world applications of data mining		
	2	Market Basket Analysis using Apriori Algorithm		
	3	Customer Segmentation using K-Means Clustering		
	4	Loan Default Prediction using Decision Tree Classification		
References				



1. Jiawei Han, Micheline Kamber, Jian Pei – Data Mining: Concepts and Techniques, Morgan Kaufmann.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar – Introduction to Data Mining, Pearson
3. Ian H. Witten, Eibe Frank, Mark A. Hall – Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann.
4. Meghann Drury, John Wang – Data Mining: Opportunities and Challenges, IGI Global.
5. Daniel T. Larose, Chantal D. Larose – Discovering Knowledge in Data: An Introduction to Data Mining, Wiley.

Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	1	-	-	-	3	2	1	2	1	-	-
CO 2	2	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	2	-	-	3	2	3	2	2	-	-
CO4	3	3	2	1	-	3	2	3	3	2	-	-
CO5	3	3	3	2	2	2	2	2	3	3	2	2

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓

CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	B.Voc Mathematics and artificial Intelligence				
Course Code	SJMAI4EJ213				
Course Title	Image Processing				
Type of Course	Elective				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic knowledge of linear algebra, signals and systems, digital electronics, and programming				
Course Summary	This course provides a comprehensive understanding of digital image processing fundamentals, covering topics such as pixel structure, image formation, and types of images. Students will learn a range of image processing techniques including intensity transformations, spatial filtering, and frequency doSJMAIn filtering, along with their applications in various industries such as medical imaging and multimedia systems.				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the basics of digital images, types of images, and components of an image processing system.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Understand image sensing, acquisition methods, and representation of digital images.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Apply intensity transformation and spatial filtering techniques for image enhancement.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Use frequency doSJMAIn filtering and restoration techniques for improving image quality.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Explore advanced topics in digital image processing through open-ended projects.	C	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (60)	Marks (60)
I	Digital Image and Digital Image Processing		10	15
	1	Digital image and Digital image processing system, Pixels, Resolution of an image, Types of Images – Gray Scale, Binary and Color Images		
	2	Fundamentals steps in digital image processing		
	3	Applications of digital image processing		
	4	Image processing system components		
II	Image Sensing and Acquisition		12	15
	5	Image acquisition using a single sensing element, Image acquisition using sensor strips, Image acquisition using sensor arrays		
	6	A simple image formation model		
	7	Basic Concepts in Sampling and Quantization		
	8	Representing digital images		
	9	Some basic relationships between pixels - neighbors of a pixel, adjacency, connectivity, regions, and boundaries		
III	Intensity Transformation and Spatial Filtering		13	15
	10	Basics of intensity transformations and spatial filtering		
	11	Some basic intensity transformation functions - Image negatives, Log transformations		
	12	Piecewise linear transformation functions - Contrast stretching, Intensity-level slicing		
	13	Histogram processing, Histogram equalization		
	14	Fundamentals of spatial filtering - The mechanics of linear spatial filtering		
	15	Spatial correlation and convolution		
	16	Smoothing (lowpass) spatial filters - box filter kernels, order-statistic (nonlinear) filters		
	17	Sharpening (highpass) spatial filters – The Laplacian, Unsharp masking and highboost filtering, gradient filter		
IV	Frequency DoSJMAn Filtering and Image Restoration		13	15
	18	Filtering in Frequency DoSJMAn - The Discrete Fourier Transformation (DFT)		
	19	Steps for filtering in the frequency doSJMAn, Ideal and Butterworth Low pass and High pass filters		
	20	Image Restoration - degradation model, Properties		
	21	Noise models, Mean Filters – Order Statistics		
	22	Inverse Filtering – Wiener filtering		
V	Open Ended Module : Case Studies		12	
	1	Medical Image Enhancement for Tumor Detection		
	2	Face Detection and Recognition in Real-Time Systems		
	3	License Plate Recognition using Spatial Filtering		
	4	Image Restoration for Old or Noisy Photographs		
	References			
	1. Rafael C. Gonzalez and Richard E. Woods – <i>Digital Image Processing</i> , Pearson Education			
	2. Anil K. Jain – <i>Fundamentals of Digital Image Processing</i> , Prentice-Hall.			
	3. Jayaraman, S., Esakkirajan, S., and Veerakumar, T. – <i>Digital Image Processing</i> , Tata McGraw-Hill.			
	4. William K. Pratt – <i>Digital Image Processing: PIKS Scientific Inside</i> , Wiley			

4. **Bernd Jähne** – *Digital Image Processing*, Springer.

Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	1	-	-	-	3	2	1	2	1	-	-
CO 2	2	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	2	-	-	3	2	3	2	2	-	-
CO4	3	3	2	1	-	3	2	3	3	2	-	-
CO5	3	3	3	2	2	2	2	3	3	3	2	1

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	B. Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI4EJ214			
Course Title	DIFFERENTIAL EQUATIONS FOR AI			
Type of Course	Elective			
Semester	IV			
Academic Level	300-399			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Foundations of basic calculus (0-99 level)			
Course Summary	The course enhances the skill to solve ordinary differential equation using specific methods analytically and computationally for first and higher order differential equations.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Classify and solve first order differential equation by applying appropriate methods	Ap	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Apply different methods to solve higher order homogeneous and non-homogeneous linear differential equations with constant coefficients	Ap	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Use Laplace transform and inverse Laplace transform to solve linear differential equations	Ap	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:				
Textbook	Dennis G. Zill, A First Course in Differential Equations with Modelling Applications 10th Edn, Cengage Learning (2012) ISBN-13 978-1111827052			
Module	Unit	Content	Hrs (60)	Marks
				Ext: 60
I	First order differential equations		14	Min.15
		Quick review of Introduction to differential equations (Definitions only)		
	1	2.1.1-Direction Fields		
	2	2.1.2 - Autonomous First-Order DEs		
	3	2.2 - Separable Equations		
	4	2.3 - Linear Equations		
	5	2.4- Exact Equations		
	6	2.5- Solutions by Substitutions		
	7	Problems from the above sections		
II	Higher-Order Differential Equations		12	Min.15
	8	4.1.1 Initial-Value and Boundary-Value Problems		
	9	4.1.2 Homogeneous Equations (proof of Theorems 4.1.2 and 4.1.5 are optional)		
	10	4.1.3 Nonhomogeneous Equations		
	11	4.2 Reduction of Order		
	12	4.3 Homogeneous Linear Equations with Constant Coefficients		
III	Higher-Order Differential Equations (Cont.)		14	Min.10
	13	4.4 -Undetermined Coefficients— Superposition Approach (up to and including Example 9)		
	14	4.5 - Undetermined Coefficients—Annihilator Approach (up to and including Example 3)		
	15	4.5 - Undetermined Coefficients—Annihilator Approach (all the topics after Example 3)		
	16	4.6- Variation of Parameters		
	17	4.7 - Cauchy-Euler Equation (up to and including Example 4)		
		18		
	19	4.9 - Solving Systems of Linear DEs by Elimination		
IV	Laplace Transforms		8	Min.10
	20	7.1 Definition of the Laplace Transforms (proof of Theorems 7.1.2 and 7.1.3 are optional)		
	21	7.2.1 Inverse Transforms		
	22	7.2.2 Transforms of Derivatives		
V	OPEN MODULE		12	
	Solving Problems of above four modules using python library			
References				
1. G. F. Simmons and S. G. Krantz, Differential Equations: Theory, Technique, and Practice, McGraw Hill (2006), ISBN-13. 978-0072863154				

2. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India (2009). ISBN: 9788120303614
3. E. Boyce, Richard C. Diprima, Douglas B Meade, Elementary Differential Equations and Boundary Value Problems, 11 Edn. William John Wiley & Sons (2017) ISBN: 1119169879
4. William F. Trench, Elementary Differential Equations with Boundary Value Problems, S.Chand (G/L) & Company Ltd (2013) ISBN 13: 9780534368418.
5. S. L. Ross, Differential Equations, 3rd edition, Wiley India, (2007) ISBN-13. 978-8126515370
6. Martha L. Abell, James P. Braselton, Differential Equations with Mathematica, 5th edn. Elsevier Science Publishing Co Inc (2022), ISBN: 9780128241608
7. Amit Saha, Doing Math with Python", No Starch Press, US. (2015), ISBN 13 978-1593276409

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	3	0	3	0	3	0	0
CO 2	2	3	1	2	3	0	3	0	3	0	0
CO 3	2	1	3	3	3	0	3	0	3	0	0

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

ELECTIVE 2

Programme	BVoc. Mathematics and Artificial Intelligence				
Course Code	SJMAISEJ311				
Course Title	Generative AI				
Type of Course	Elective				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Fundamentals of Machine Learning,Probability,Linear algebra				
Course Summary	Focused on creating new content—such as text, images, audio, or code—by learning patterns from existing data using models like GANs, VAEs, diffusion models, and large language models. This course explores the theory, tools, and applications of generative models, along with their ethical and societal implications				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category #	Evaluation Tools used
CO1	Understand the fundamentals of generative and discriminative modeling.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Analyze the architecture and training of autoencoders and GANs..	An	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Apply recurrent and transformer-based models for sequence generation tasks.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Evaluate optimization and fine-tuning techniques for generative AI models	E	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Investigate real-world applications through case studies of generative AI.	An	M	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus :				
Module	Unit	Content	Hrs (60)	Marks (60)
1	1	Generative Modeling - Introduction, Generative Vs. Discriminative Modeling	12	15
	2	Advances in Machine Learning, The Rise of Generative Modeling		
	3	The Generative Modeling Framework, Challenges		
	4	Ethical Considerations , Bias and Fairness		
	5	Responsible use and deployment of generative models		
II	6	Autoencoders - Autoencoders, The Encoder, The Decoder, Joining the Encoder to the Decoder, Analysis of Autoencoder,	12	15
	7	Variational Autoencoders;Kullback–Leibler (KL) divergence loss function		
	8	Generative Adversarial Network - Introduction to GANs, The Discriminator, The Generator, Training the GAN		
	9	GAN Challenges, Oscillating Loss, Mode Collapse		
	10	Uninformative Loss, Hyper parameters		
III	11	Recurrent Neural Network (RNN). Architecture of RNN , Architecture	12	15
	12	Long Short-Term Memory (LSTM), Architecture of LSTM		
	13	Gated Recurrent Unit (GRU),Architecture of GRU		
	14	Encoder-Decoder Models, Question-Answer Generator using RNN and Encoder-Decoder		
	15	Attention mechanisms,Transformer Architecture, Self Attention		
	16	Analysis of the Transformer, BERT,GPT-2 ,Large Language Models (LLM).		
IV	17	Cost Optimization in the Development and Operation of Generative AI Applications	12	15
	18	Fine Tuning and customizability, Parameter Efficient Fine Tuning Methods		
	19	Prompt Tuning, Prefix Tuning, P-Tuning, IA3, Low-Rank Adaptation,		
	20	Prompt Engineering, Clear and Direct Prompts		
	21	Adding Qualifying Words for Brief Responses		
	22	Breaking Down the Request In-context learning (ICL) in LLMs		
V	Open Ended module : Case Studies		12	
	1	StyleGAN by NVIDIA – Realistic image synthesis using GANs		
	2	OpenAI GPT-3/GPT-4 – Text generation using transformer-based LLMs.		
	3	Autoencoders in Anomaly Detection – Used in healthcare and fraud detection.		
	4	Prompt-Tuned AI Chatbots – Customized LLMs for retail customer service.		
References				

<ol style="list-style-type: none"> 1. Jon Krohn, Grant Beylveid, Aglae Bassens, Pearson(2020), Deep Learning Illustrated 2. James Phoenix, Mike Taylor, O'Reilly(2024), Prompt Engineering for Generative AI 3. Jakub Langgr, Vladimir Bok, Manning(2019), GANs in Action: Deep learning with Generative Adversarial Networks 4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT press(2016), Deep Learning 5. David Foster, O'Reily(2019), Generative Deep Learning 	
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Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	–	–	–	3	2	–	–	–	–	–
CO 2	3	3	–	–	–	3	3	2	–	–	–	–
CO 3	2	3	2	–	–	2	3	3	2	–	–	–
CO4	2	3	3	–	–	2	3	3	3	–	–	–
CO5	2	2	3	2	1	2	2	2	3	1	2	2

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	BVoc. Mathematics and Artificial Intelligence				
Course Code	SJMAI5EJ312				
Course Title	Reinforcement Learning				
Type of Course	Elective				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic probability, linear algebra, calculus, machine learning fundamentals, and Python programming.				
Course Summary	This course covers the fundamentals and advanced techniques of Reinforcement Learning, including key algorithms and deep RL methods. It also explores hierarchical models, policy optimization, and real-world applications like robotics and game playing.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category #	Evaluation Tools used
CO1	Understand the core concepts and components of reinforcement learning systems.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Apply key algorithms such as Dynamic Programming, Monte Carlo, and Temporal Difference methods.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Analyze function approximation techniques and policy optimization strategies.	An	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Evaluate deep reinforcement learning architectures and modern optimizers	E	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Investigate hierarchical RL, exploration strategies, and real-world applications.	An	M	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus :				
Module	Unit	Content	Hrs (60)	Marks (60)
I	1	Introduction to RL: Basics and significance of Reinforcement Learning, Key applications	12	15
	2	RL Components: Agent, Environment, States, Actions, Rewards, Interaction and feedback loop		
	3	Exploration vs. Exploitation: Trade-off overview, Balancing learning and decision-making		
	4	Multi-Armed Bandits: K-armed bandit problem, Action-value methods, ϵ -greedy, UCB, gradient methods		
	5	Markov Decision Processes, Definition and components, Bellman equations, Policy evaluation, Value and Policy Iteration		
II	6	Dynamic Programming: Policy Evaluation, Policy Iteration, Value Iteration	12	15
	7	Monte Carlo Methods: Monte Carlo Prediction and Control, Exploring starts, Importance Sampling techniques		
	8	Temporal Difference (TD) Learning: TD(0) method, SARSA and Q-Learning algorithms		
	9	On-policy vs. Off-policy Learning: Conceptual differences, Practical implications in algorithm design		
	10	Eligibility Traces and Multi-step Methods: TD(λ), n-step bootstrapping approaches		
III	11	Fundamentals of Function Approximation: Introduction , Challenges with large or continuous state spaces	12	15
	12	Linear Approximators and Aggregation: Linear function approximation techniques, State aggregation methods for value estimation		
	13	Advanced Function Approximation: Least Squares Temporal Difference (LSTD), Fitted Q-Iteration		

	14	Policy Gradient Methods: Introduction to policy gradient approaches, REINFORCE algorithm and its applications		
	15	Actor-Critic and Modern Optimizers: Actor-Critic methods, Overview of A3C (Asynchronous Advantage Actor-Critic), Proximal Policy Optimization (PPO)		
	16	Deep Reinforcement Learning: Deep Q-Networks (DQN), Double DQN, Dueling Networks, Prioritized Experience Replay		
IV	17	Hierarchical Reinforcement Learning: Concepts of temporal abstraction, Semi-Markov Decision Processes (Semi-MDPs), Options Framework for high-level actions	12	15
	18	Hierarchical Decomposition Techniques: MAXQ Value Function Decomposition, Task decomposition and sub-policy learning		
	19	Exploration Strategies and Uncertain		
	20	Tools and Frameworks: Overview of popular RL libraries and platforms: OpenAI Gym, PyTorch and TensorFlow		
	21	Techniques for effective exploration, Dealing with uncertainty in RL environments		
	22	Real-World Applications: Case studies: Robotics, Game Playing (e.g., Atari, Go), Self-driving Cars		
		Open Ended Module : Case Studies		
	1	AlphaGo by DeepMind – Game playing using deep reinforcement learning.	12	
	2	Self-Driving Cars (Waymo, Tesla) – RL for autonomous navigation and decision-making.		
	3	Robotics (Boston Dynamics) – Hierarchical RL for robot movement and control.		
	4	Personalized Recommendations (Netflix, YouTube) – RL for optimizing content delivery.		
		References		
	1)	“Reinforcement Learning: An Introduction” by Richard S. Sutton and Andrew G. Barto		
	2)	“Deep Reinforcement Learning Hands-On” by Maxim Lapan		
	3)	“Algorithms for Reinforcement Learning” by Csaba Szepesvári		
	4)	“Reinforcement Learning: State-of-the-Art” edited by Marco Wiering and Martijn van Otterlo		
	5)	“Foundations of Deep Reinforcement Learning” by Laura Graesser and Wah Loon Keng		

Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	–	–	–	3	2	–	–	–	–	–
CO 2	3	3	–	–	–	3	3	2	–	–	–	–
CO 3	2	3	2	–	–	2	3	3	2	–	–	–
CO4	2	3	3	–	–	2	3	3	3	–	–	–
CO5	2	2	3	2	1	2	2	2	3	1	2	2

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI5EJ313				
Course Title	Introduction to Robotics				
Type of Course	Elective				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Python Programming, Linear Algebra, calculus, Probability and Statistics, Graph Theory				
Course Summary	This course introduces the fundamentals of robotics, including robot types, kinematics, sensors, actuators, and control systems. It also covers robotic vision, localization, path planning, and the role of automation in modern manufacturing.				

Course Outcomes(CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the basic structure, types, and ethical aspects of robotic systems.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Analyze various sensors and actuators used in robotic applications.	An	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Apply vision systems and transformations in robotic perception and control.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Evaluate localization, mapping, and path planning strategies in mobile robots	E	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Explore automation, control, and the future impact of robotics in manufacturing.	An	M	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (60)	Marks (60)
1	1	Introduction to Robotics :Degree of Freedom	12	15
	2	Types of Robots :Industrial manipulators,Mobile robots: wheeled, legged, aerial, underwater, surface water		
	3	Anatomy of a Robotic Manipulator :Links, joints, actuators, sensors, and controllers		
	4	Robot Configurations :PPP, RPP, RRP, RRR		
	5	Dynamic Characteristics : Motion speed, load capacity, response time		
	6	End Effectors :Mechanical grippers, magnetic, vacuum, adhesive,Active vs Passive grippers		
	7	Ethics in Robotics : Asimov’s Three Laws,Applications and societal impact		
II	8	Sensor : Characteristics	12	15
	9	Sensor Types : Touch, force, proximity, vision		
	10	Internal Sensors : Position, velocity, acceleration, force		
	11	External Sensors : Contact and non-contact types , Camera types: CCD, CMOS, omnidirectional ,Sensors Characterestics		
	12	Actuators : Characterestics		
III	13	Actuators : DC motors, stepper motors, servos ,H-Bridge and PWM control, Hydraulic and pneumatic actuators	12	15
	14	Robotic Vision : Sensing, pre-processing, segmentation,feature extraction, recognition, interpretation,Camera sensor interfacing		
	15	Transformations : Translation, rotation, combined transformations,Transformations relative to rotating frames		
IV	16	Mobile Robotics :Differential-drive robots ,Wheel configurations, degrees of mobility,Holonomic vs non-holonomic robots,Omnidirectional mobile robots	12	15
	17	Position & Orientation : Representing robot position and orientation		
	18	Reactive Navigation & Localization : Basics of reactive methods ,Localization challenges and continuous representations		
	19	Mapping :Decomposition strategies, probabilistic localization (Kalman filter) ,Autonomous mapping and SLAM (overview and types)		
	20	Path Planning : Graph-based search: BFS, DFS, Dijkstra, A*, D*,Potential field methods		
	21	Obstacle Avoidance : Bug algorithm, Vector Field Histogram, Dynamic Window Approach		
22	Navigation Architecture :Modularity, control, and localization integration			
	Open Ended Module : Case Studies			

V	1	Boston Dynamics – Spot and Atlas Robots	12	
	2	KUKA Industrial Robots		
	3	Waymo – Self-Driving Cars		
	4	Amazon Robotics – Warehouse Automation		
		References		
		1. John J. Craig, Introduction to Robotics, Pearson Education 3/e, 2005 2. S. K. Saha, Introduction to Robotics, TATA McGraw Hills 2/e, 2014, 3. Peter Corke, Robotics, Vision and Control- Fundamental Algorithms in MATLAB, Springer-Verlag 1/e, 2021 4. Saeed B. Niku, Introduction to Robotics - Analysis, Control, Applications, Wiley 2/e, 2011 5. Francis X. Govers, Artificial Intelligence for Robotics, Packt 1/e, 2018		

Mapping of COs with PSOs and POs:												
CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	–	–	–	3	2	–	–	–	–	–
CO 2	3	3	–	–	–	3	3	2	–	–	–	–
CO 3	2	3	2	–	–	2	3	3	2	–	–	–
CO4	2	3	3	–	–	2	3	3	3	–	–	–
CO5	2	2	3	2	1	2	2	2	3	1	2	2

Mapping of COs to Assessment Rubrics:				
CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2		✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4		✓	✓	✓
CO 5	✓	✓	✓	

Programme	B. Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAISEJ314			
Course Title	NUMERICAL ANALYSIS FOR COMPUTATIONAL INTELLIGENCE			
Type of Course	Elective			
Semester	V			
Academic Level	300- 399			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	1. Real analysis 2. Linear algebra 3. Basics of Python Programming			
Course Summary	This course familiarises students with the fundamental numerical analysis. Moreover, the course facilitates students to apply results from real analysis and linear algebra to perform quantitative analysis of numerical solutions.			

Course Outcomes(CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand and apply the Bisection Method, Iteration Method, Newton-Raphson Method, and Secant Method to solve algebraic and transcendental equations numerically.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Implement interpolation methods such as Newton's formulae, Lagrange's interpolation formula, and divided differences to approximate functions from discrete data.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Implement numerical methods such as Euler's method, Modified Euler's Method, Runge-Kutta method, and Adams-Moulton Method to solve ordinary differential equations (ODEs).	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Text Book		[1].S. S. Sastry, Introductory Methods of Numerical Analysis (5/e), PHI Learning (2012) [2].Dimitrios Mitsotakis: Computational Mathematics: An Introduction to Numerical Analysis and Scientific Computing with Python, CRC Press (2023), ISBN 978-1-032-26240-6. [3]. Jupyter Notebooks of [2] available at: https://github.com/dmitsot/computational_mathematics		
Module	Unit	Content	Hrs (48 +12)	Marks (60)
I	Numerical Solutions of Algebraic and Transcendental equations (Text 1)		12	15
	1	2.1 Introduction		
	2	2.2 Bisection Method		
	3	2.4 Iteration Method (Derivation of Condition for Convergence and Acceleration of Convergence are optional)		
	4	2.5 Newton- Raphson Method (Generalized Newton's Method is optional)		
	5	2.7 Secant Method		
II	Interpolation (Text 1)		12	15
	6	3.1 Introduction, 3.3.1 Forward differences, 3.3.2 Backward differences		
	7	3.6 Newton's formulae for interpolation (up to and including Example 3.5)		
	8	3.6 Newton's formulae for interpolation (From Example 3.6)		
	9	3.9.1 Langrange's interpolation formula		
	10	3.10 Divided differences and their properties		
	11	3.10.1 Newton's General interpolation formula		
III	Numerical Differentiation and Integration (Text 1)		12	15
	12	6.1 Introduction, 6.2 Numerical Differentiation (6.2.1, 6.2.2 and 6.2.3 are optional)		
	13	6.4.1 Trapezoidal Rule		
	14	6.4.2 Simpson's 1/3-Rule		
	15	6.4.3 Simpson's 3/8 Rule		
	16	6.10 Numerical Double Integration		
IV	Numerical Solutions of Ordinary Differential Equation (Text 1)		12	15
	17	8.1 Introduction		
	18	8.2 Solution by Taylor's series,		
	19	8.4 Euler's method (8.4.1 is optional)		
	20	8.4.2 Modified Euler's Method		
	21	8.5 Runge-Kutta method 2 nd order		
	22	8.5 Runge-Kutta method 4 th order		
V	Open module		12	
	Lab Practical involving contents of the above modules using Python			
References:				
1. F.B. Hildebrand: Introduction to Numerical Analysis, TMH.				

2. J.B. Scarborough: Numerical Mathematical Analysis, Oxford and IBH
3. Joakim Sundnes, Introduction to Scientific Programming with Python. Springer (2020). ISBN 978-3-030-50355-0. Open Access at: <https://link.springer.com/book/10.1007/978-3-030-50356-7>
4. Sven Linge and Hans Petter Langtangen, Programming for Computations -- Python. A Gentle Introduction to Numerical Simulations With Python. Springer (2018). ISBN 978-3-319-81282-3. Open Access at: <https://link.springer.com/book/10.1007/978-3-319-32428-9>

Mapping of COs with PSOs and POs:											
	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	2	1	3	1	3	3	3	0	2
CO 2	2	3	3	2	3	1	3	3	3	0	2
CO 3	3	3	3	2	3	1	3	3	3	0	2

Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

19.DETAILED SYLLABUS OF THE FOUNDATION COURSES

MULTI DISCIPLINARY COURSES OFFERED BY THE DEPARTMENT

SEMESTER 1

Programme	B.Voc.Mathematics and Artificial Intelligence			
Course Code	SJMAI1FM105			
Course Title	MATRICES AND BASICS OF PROBABILITY THEORY FOR AI			
Type of Course	MDC			
Semester	I			
Academic Level	100 - 199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	3	3	-	45
Pre-requisites	Basic Arithmetic and Computational Skill.			
Course Summary	<p>The course "Matrices and Basics of Probability Theory" provides students with a comprehensive understanding of two fundamental mathematical concepts: matrices and probability. The syllabus begins with a focus on the algebra of matrices, covering operations such as addition, subtraction, multiplication, determinants, and inverses, followed by applications in solving systems of equations. Transitioning to probability theory, students delve into basic concepts, conditional probability, the addition and multiplication rules, and various counting methods. Additionally, the course introduces basic statistics, including frequency distributions, measures of central tendency and variation, and measures of position.</p>			

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the concepts of matrices and determinants.	U	C	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
CO2	Apply matrix theory to solve systems of equations.	Ap	P	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
CO3	Understand concepts like measures of central tendency, measures of variation, measures of position and probability.	U	C	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Texts:				
1. John Bird, Bird's Higher Engineering Mathematics 9/e, Routledge, ISBN: 978-0-367-64373-7, 2021.				
2. Ron Larson & Betsy Farber, Elementary Statistics, Picturing the World 6/e, Pearson Education, ISBN: 978-0-321-91121-6, 2015.				
Module	Unit	Content	Hrs (36+ 9)	Ext. Marks (50)
I	Algebra of Matrices (from text 1)		9	Min 12
	1	Section 20.1 - Matrix notation		
	2	Section 20.2 - Addition, subtraction and multiplication of matrices		
	3	Section 20.3 to 20.4 - The unit matrix, The determinant of a 2 by 2 matrix.		
	4	Section 20.5 - The inverse or reciprocal of a 2 by 2 matrix.		
	5	Section 20.6 - The determinant of a 3 by 3 matrix		
	6	Section 20.7 - The inverse or reciprocal of a 3 by 3 matrix		
II	System of Equations From Text 1		9	Min 13
	7	Section 21.1 - Solution of simultaneous equations by matrices		
	8	Section 21.2 - Solution of simultaneous equations by determinants		
	9	Section 21.3 - Solution of simultaneous equations using Cramer's rule		
	10	Section 21.4 - Solution of simultaneous equations using the Gaussian elimination method.		
III	Basic Statistics From Text 2			
	11	Section 1.1 to 1.2 - An Overview of Statistics, Data Classification		
	12	Section 2.1 - Frequency Distributions and their Graphs	9	Min 12

	13	Section 2.3 - Measures of Central Tendency		
	14	Section 2.4 - Measures of Variation		
	15	Section 2.5 - Measures of Position		
IV	Basics of Probability (from text 2)		9	Min 13
	16	Section 3.1 - Basic Concepts of Probability and Counting.		
	17	Section 3.2 - Conditional Probability and the Multiplication Rule.		
	18	Section 3.3 - The Addition Rule.		
	19	Section 3.4 - Additional topics in probability and counting.		
V	Open Ended		9	
	Data Collection and Experimental Design, More Graphs and Displays (for instance refer sections from Text 2: 1.3 and 2.2)			
References:				
1. Advanced engineering mathematics, 10/e, Erwin Kreyszig, Wiley, 2011.				
2. Introduction to Linear Algebra with Applications, Jim DeFranza and Daniel Gagliardi, Waveland Press, 2015.				
3. Elementary Statistics, 13/e, Mario F. Triola, Pearson Education, 2018.				
4. Elementary Statistics, 8/e, Neil A. Weiss, Pearson Education, 2012.				

Mapping of COs with PSOs and POs :									
	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	0	3	1	3	2	2	1	2
CO 2	3	0	3	1	3	2	3	1	2
CO 3	3	0	3	1	2	2	3	1	3

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Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

SEMESTER 2

Programme	B.Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI2FM106			
Course Title	GRAPH THEORY AND LPP FOR AI			
Type of Course	MDC			
Semester	II			
Academic Level	100 - 199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	3	3	-	45
Pre-requisites	Basic Arithmetic and Geometry.			
Course Summary	<p>The course "Graph Theory and Linear Programming" introduces fundamental concepts in graph theory focusing initially on graph definitions, properties, and structures such as vertex degrees, subgraphs, paths, and cycles. The discussion extends to trees, bridges, spanning trees, cut vertices, and connectivity, emphasizing essential properties and theorems while providing proofs for brevity. Transitioning to linear programming, the course employs graphical methods for solving linear inequalities and optimization problems, progressing to the simplex method for more complex maximization and minimization problems, including duality and nonstandard scenarios. Additionally, the syllabus offers open-ended exploration into graph modellingmixture, matrix representations, and connector problems.</p>			

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand and apply the fundamental concepts in graph theory.	U	C	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
CO2	Analyse properties of graphs and trees.	An	P	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
CO3	Solve linear programming problems by geometrically and Simplex method.	Ap	C	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Texts:				
1. John Clark & Derek Allan Holton, A First Look at Graph Theory: Allied Publishers, First Indian Reprint 1995.				
2. Margaret L. Lial, Raymond N, Finite Mathematics and Calculus with Applications 9/e, Greenwell & Nathan P. Ritchey Pearson Education, Inc, ISBN 0-321-74908-1, 2012.				
Module	Unit	Content	Hrs (36 +9)	Ext. Marks (50)
I	Basics of Graph Theory (from text 1)		9	Min 13
	1	Section 1.1 - Definition of a graph.		
	2	Section 1.3 - More definitions.		
	3	Section 1.4 - Vertex degrees.		
	4	Section 1.5 - Sub Graphs.		
	5	Section 1.6 - Paths and Cycles (Theorem 1.4 statement only).		
II	Basics of Graph Theory From Text 1		9	Min 12
	6	Section 2.1 - Definitions and Simple Properties of trees (Proof of Theorem 2.1, 2.2 and 2.4 omitted).		
	7	Section 2.2 - Bridges: up to and including Theorem 2.8 (Theorem 2.6 and 2.7 are statement only).		
	8	Section 2.2 - Bridges (Theorem 2.9 statement only) contd.		
	9	Section 2.3 - Spanning trees (Theorem 2.12 statement only).		
	10	Section 2.6 - Cut Vertices and Connectivity (Theorem 2.20 and Theorem 2.21 are statements only).		
III	Linear Programming - The Graphical Method From Text 2		9	Min 13
	11	Section 3.1 - Graphing Linear Inequalities.		
	12	Section 3.2 - Solving Linear Programming Problems Graphically; up to and including Example 2.		

	13 Section 3.2 - Solving Linear Programming Problems Graphically contd.		
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	14	Section 3.3 - Applications of Linear Programming; up to and including Example 2.		
	15	Section 3.3 - Applications of Linear Programming contd.		
IV	Linear Programming - The Simplex Method (from text 2)		9	Min 12
	16	Section 4.1- Slack Variables and the Pivot.		
	17	Section 4.2- Maximization Problems.		
	18	Section 4.3- Minimization Problems; Duality.		
	19	Section 4.4- Nonstandard Problems.		
V	Open Ended		9	
	Graphs as models, Matrix representation of graphs, Connector problems (for instance refer sections from 1.2, 1.7 and 2.4 of Text 1).			
References:				
1. Introduction to Graph Theory, 4th ed., R.J. Wilson, LPE, Pearson Education, 1996.				
2. Graph Theory with Applications, J .A. Bondy & U.S.R. Murty, North-Holland,1982				
3. Linear Programming: Foundations and Extensions, 2/e, Robert J. Vanderbei, Springer Science+Business Media LLC, 2001.				
4. An Introduction to Linear Programming and Game Theory (3/e), Paul R. Thie and G. E. Keough, John Wiley and Sons, 2008.				

Mapping of COs with PSOs and POs :									
	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	3	1	3	2	3	1	2
CO 2	3	2	3	1	3	2	3	1	2
CO 3	3	2	3	2	3	2	3	1	2

Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

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SKILL ENHANCEMENT COURSES

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAIIFS111				
Course Title	INTRODUCTION TO AI TOOLS				
Type of Course	SEC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Basics of AI				
Course Summary	This course explores the use of AI tools in education to enhance teaching, personalize learning, automate assessment, and support data-driven decision-making in academic environments				

Course Outcomes(CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the basics of AI and set up development environments and tools.	U	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO2	Apply machine learning techniques using scikit-learn for classification and regression tasks.	Ap	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO3	Develop basic NLP models using NLTK and spaCy for text analysis.	C	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO4	Build and evaluate simple neural networks using TensorFlow and Keras..	E	C	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
CO5	Create AI-powered applications using generative tools for text, visuals, and presentations.	C	P	Internal Exam/ Assignment/Seminar/ Viva/End Sem Exam
Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (45)	Marks (50)
1	1	Basics of Artificial Intelligence and its applications	10	13
	2	Introduction to AI development environments		
	3	Overview of common AI tools and platforms		
	4	Installing and using Jupyter Notebooks		
	5	Introduction to Python for AI		
	6	Setting up Python libraries for AI work (NumPy, Pandas, Matplotlib)		
II	7	Introduction to scikit-learn for ML	10	13
	8	Loading and preprocessing data		
	9	Building classification models		
	10	Building regression models		
	11	Evaluating model performance		
	12	Model improvement and tuning techniques		
III	13	Introduction to NLP and its applications, Using NLTK for text processing	10	12
	14	Text vectorization techniques (Bag of Words, TF-IDF)		
	15	Building simple NLP models		
	16	Introduction to spaCy		
	17	Hands-on with sentiment analysis		
IV	18	Basics of neural networks, Setting up and using TensorFlow and Keras	10	12
	19	Building simple neural networks		
	20	Training and evaluating models		
	21	Using pretrained models		
	22	Practical examples using image or text data		
		Open Ended Module		

	1	Text Generation and Summarization <ul style="list-style-type: none"> • Tool: ChatGPT / Gemini / Claude • Task: Generate summaries, create lesson plans, or draft essays based on prompts. 	5	
	2	AI-Powered Presentations <ul style="list-style-type: none"> • Tool: Tome / Beautiful.ai / Canva (AI feature) • Task: Create an AI-assisted educational or business presentation. 		
	3	AI for Visual Content <ul style="list-style-type: none"> • Tool: DALL-E / Midjourney / Canva AI • Task: Generate visuals, posters, or infographics for a topic or event. 		
		References <ol style="list-style-type: none"> 1. “Artificial Intelligence: A Guide for Thinking Humans” Author: Melanie Mitchell ,Publisher: Penguin Books 2. “Artificial Intelligence: A Modern Approach” (4th Edition) Authors: Stuart Russell & Peter Norvig ,Publisher: Pearson 3. “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow” (2nd Edition),Author: Aurélien Géron,Publisher: O'Reilly Media 4. “AI Crash Course: A Fun and Hands-On Introduction to Machine Learning, Programming, and AI Tools”,Author: Hadelin de Ponteves Publisher: Packt Publishing 5. “Practical Artificial Intelligence with Python”,Authors: Arvind Ravulavaru,Publisher: Packt Publishing 		

Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	-	-	-	3	2	1	2	1	-	-
CO 2	3	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	1	-	-	3	2	3	2	2	-	-
CO 4	3	3	2	-	-	2	2	3	3	2	-	-
CO 5	3	3	3	2	1	2	2	3	3	3	1	1

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	B.Voc. Mathematics and Artificial Intelligence			
Course Title	MATHEMATICAL TYPE SETTING SYSTEM - LATEX			
Course Code	SJMAI4FS112			
Type of Course	SEC			
Semester	IV			
Academic Level	200-299			
Course Details	Credit	Lecture/Tutorial	Practical	Total Hours
	3	per week 3	per week -	45
Pre-requisites	1. Fundamental Mathematics Concepts			
Course Summary	The course will cover topics such as document formatting, mathematical typesetting, graphics and tables, bibliography management, beamer presentation and understanding the Indian language transliteration package for typesetting Sanskrit or Hindi or Malayalam using LaTeX.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Preparing a LaTeX document with title page including contents, references and index	Ap	C	Internal Exam/ Assignment/ Seminar/ Viva / End Sem Exam
CO2	To Display documents with bullets, numbering and aligning or ordering and adding rows and tables	Ap	C	Internal Exam/ Assignment/ Seminar/ Viva / End Sem Exam
CO3	Use mathematical typesetting and equation environments to create professional looking equations and mathematical notation	U	F	Internal Exam/ Assignment/ Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Textbook		Text 1: LATEX TUTORIAL, A PRIMER by Indian TEX Users Group, Edited by E. Krishnan, 2003. Text 2: George Gratzer, More Math Into LaTeX-Springer 2016 (5th Edition),		
Module	Unit	Content	Hrs (36+9)	Ex. Marks (50)
I	Getting Started with LaTeX (Text-1)		8	Min 10
	1	The basics- Tutorial I		
	2	The documents – Tutorial II		
	3	Bibliographic Database- Tutorial III & IV		
	4	Table of contents and Index- Tutorial V (Omit glossary)		
II	Styling Pages		6	Min 10
	5	Displayed Text – Tutorial VI		
	6	Rows and columns – Tutorial VII		
	7	Tables – Tutorial VII .2		
III	Typesetting Mathematics		10	Min 10
	8	Basic Mathematical equation- Tutorial VIII.1, VIII.2		
	9	Groups of Equations and numbering – Tutorial VIII.3		
	10	Matrices, dots, delimiters and affixing symbols- Tutorial VIII.4		
	11	Operators, Equations, Symbols, notations, Greek letters etc. Tutorial VIII.5, VIII.6, VIII.7, VIII.8(In VIII.8 focus only on usual symbols, Greek letters, operations etc. commonly used in mathematics)		
IV	Theorems, figures, Cross references and Presentation (Text-1 and 2)		12	Min 10
	12	Theorem in Latex – Tutorial IX.1		
	13	The AMS theorem package- Tutorial IX.2 (Omit IX.2.2, IX.2.3)		
	14	Boxes – Tutorial X (Section X.1, X.2 Only)		

	15	Floating Images- Tutorial XI (Section XI.I.1, XI.I.2 and XI.I.5 Only)		
	16	Cross Reference – Tutorial XII (Section XII.1, XII.2 Only)		
	17	Footnotes- Tutorial XIII (Section XIII.1 Only)		
	18	Presentation – Text 2, Section 12.1 to 12.2.4		
	19	Presentation – Text 2, Section 12.2.6 to 12.2.9 (Omit 12.2.5 and 12.2.7)		
V	Open Ended		9	
	1	Installation of LaTeX		
	2	Familiarising Overleaf Platform		
	3	Write a chapter in a book that you are studying in any semester having mathematical symbol theorems and figures.		
	4	Create Slides with beamers and posters		
	5	Transliteration symbols with Illustrative examples of the Indian Languages, such as Sanskrit, Hindi (Devanagari) and Malayalam.		
<p>References:</p> <ol style="list-style-type: none"> 1) Tobias Oetiker, Hubert Partl, Irene Hyna and Elisabeth Schlegl, The Not So Short Introduction to LATEX 2ϵ (Online Link: - The Not So Short Introduction to LaTeX (oetiker.ch)) 2) Harvey J. Greenberg, A simplified introduction to LaTeX (Online version) 3) Leslie Lamport (second edition. Addison Wiley,1994)- LaTeX, a Document Preparation System. 4) Donald Knuth (Addison-Wesley, 1984), The TeX book 5) Frank Mittelbach and Michel Goossens (second edition), Addison-Wesley, 2004). 				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	1	0	1	1	2	2	1	0	2	3	0
CO 2	2	3	1	0	1	1	1	3	1	0	2	3	0
CO 3	3	2	1	0	1	1	2	1	1	0	2	2	0

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Programme	BVoc Mathematics and Artificial Intelligence				
Course Code	SJMAI5FS113				
Course Title	Data Visualization using AI tools				
Type of Course	SEC				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	2	-	2	60
Pre-requisites	Python programming and data handling concepts				
Course Summary	This course introduces students to the principles of data visualization and how AI tools can enhance the creation, automation, and interpretation of visual data. Through hands-on practice with platforms like Python, Tableau, and Power BI, students will learn to effectively communicate insights using intelligent visualizations.				

Course Outcomes :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the concepts, techniques, and tools used in visualizing data.	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO2	Create effective data visualizations using Microsoft Excel..	C	P	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO3	Use Python libraries like Matplotlib, Seaborn, and Pandas for visual representation	C	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam

CO4	Design interactive dashboards and visual analytics using Tableau	Ap	P	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO5	Apply data visualization techniques to real-world datasets using modern tools.	Ap	P	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (60)	Marks (50)
1		Fundamentals of Data Visualization	12	13
	1	Introduction to Data Visualization: Importance and Applications		
	2	Ways and Techniques of Representing Visual Data		
	3	Types of Data Visualization (Charts, Maps, Infographics, Dashboards)		
	4	Visualizing Business Intelligence (BI) Data		
	5	Overview of Popular Data Visualization Tools		
II		Data Visualization with Excel and Tableau	12	12
	6	Excel Charts: Combination Charts, Secondary Axis, Chart Elements		
	7	Advanced Excel Visuals: Band Chart, Thermometer Chart, Gantt Chart, Waterfall Chart		
	8	Pivot Charts and Sparklines (With and Without Pivot Tables)		
	9	Tableau Basics: Connecting to Data, “Show Me” Feature		
	10	Building Bar, Line, and Geographic Charts in Tableau		
	11	Managing Metadata, Joins, Blends, and Filtering in Tableau		
III		Python for Data Visualization	13	12
	12	Introduction to Python Visualization Libraries		
	13	Matplotlib, Pandas, Seaborn: Pie, Bar, Histogram, Line, Area, Box, Scatter, Heat Maps		
	14	Plotly: Interactive Charts, Heatmaps, 3D Visuals, Choropleth Maps		
	15	Dash: Building Interactive Web Dashboards, Layouts, Callbacks		
	16	Folium: Geospatial Mapping, Markers, Heatmaps, Choropleths		
	17	PySpark: Data Preparation, Aggregations, Visualization Integration		
IV		Advanced Visualization and BI Integration	13	13
	18	Creating Dashboards: Combining Multiple Charts and Visuals		
	19	Connecting Python Visualizations with BI Tools		
	20	Power BI + Python: Enabling Scripting, Data Transformation		
	21	Creating Custom Visuals in Power BI with Matplotlib, Seaborn, Plotly		
	22	Automating Reports and Advanced Analytics in Power BI with Python		
	23	Trends and Future of Data Visualization Tools		
V		Practical/Practicum/ Open module	10	
	1	Industry-Specific Visualization Applications - Visualization in finance, healthcare, manufacturing, marketing, etc.		
	2	Cross-Platform Dashboard Development - Integrating Excel, Tableau, Power BI, and Python outputs into unified reporting systems.		

	3	Emerging Trends and Tools in Data Visualization - AI-generated visuals, ChatGPT-powered dashboards, and no-code visualization platforms	
		References	
		<p>1. VanderPlas, J. (2016). Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly Media.</p> <p>2. Knaflic, C. N. (2015). Storytelling with Data: A Data Visualization Guide for Business Professionals. Wiley.</p> <p>3. Tableau. (2024). Tableau Product Help & Training. Available at: https://help.tableau.com</p> <p>4. Plotly. (2024). Plotly Python Open Source Graphing Library. Available at: https://plotly.com/python</p> <p>5. Microsoft. (2024). Power BI Documentation. Available at: https://learn.microsoft.com/power-bi</p>	

Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	-	-	-	3	2	1	2	1	-	-
CO 2	3	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	1	-	-	3	2	3	2	2	-	-
CO4	3	3	2	-	-	2	2	3	3	2	-	-
CO5	3	3	3	2	1	2	2	3	3	3	1	1

Mapping of COs to Assessment Rubrics:				
CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

DETAILED SYLLABUS OF THE VALUE ADDED COURSES

Programme	B.Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI3FV108			
Course Title	COMPUTATIONAL LOGIC			
Type of Course	VAC			
Semester	III			
Academic Level	200-299			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	3	3	-	45
Pre-requisites	Nil			
Course Summary	The course will cover the basics of propositional and predicate logic, Compactness, and the Resolution Theory.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Determine the Satisfiability of a Propositional Formula Set.	Ap	C	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
CO2	Analyse Theorems of Propositional Logic	Ap	C	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
CO3	Remember Proofs of Major Theorems of Logic	An	M	Internal Exam/Assignment / Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Text book	Logic for Computer Scientists, U. Schoning, Birkhauser, 2008 (Reprint).			
Module	Unit	Content	Hrs (45 = 36 +9)	Ext. Marks (50)
I	Propositional Logic (Chapter 1 of Text Book).		10	Min 10
	1	Syntax and Semantics, Truth Tables, Satisfiability and Validity.		
	2	Equivalence and Normal Forms, Substitution Theorem		
	3	DNF and CNF forms		
	4	Horn Formulas,		
	5	Compactness Theorem for Propositional Calculus		
6	Resolution Theorem and Resolution Algorithm			
II	Introduction to Predicate Logic: Section 2.1, 2.2, Subsection on Mathematical Theories of Section 2.3		9	Min 10
	7	Syntax of Predicate Logic		
	8	Semantics - Structures and Models, Satisfiability and Validity		
	9	Equivalence of formulas - Substitution, Variable Renaming.		
	10	Skolem Normal Form		
	11	Mathematical Theories - Axioms and Models.		
III	Herbrand Theory for Predicate Logic: Section 2.4		9	Min 10
	12	Herbrand Universe and Structures		
	13	Herbrand Model and Satisfiability Theorem		
	14	Skolem Lowenheim Theorem		
	15	Herbrand Expansion and Godel-Herbrand-Skolem Theorem		
	16	Compactness and Herbrand's Theorem		
IV	Resolution for Predicate Logic: Section 2.5		8	Min 10
	17	Ground Resolution and Resolvants		

	18	Ground Resolution Theorem		
	19	Robinson's Unification Theorem and Algorithm		
	20	Lifting Lemma		
	21	Resolution Theorem for Predicate Logic		
V	Logic Programming		9	
	1	Unsolvability of Predicate Logic (Section 2.3 on Text Book)		
	2	SLD Resolution (Section 2.6 of Text Book)		
	3	Introduction to Logic Programming		
4	Horn Clause Programs			
5	Evaluation Strategies for Horn Clause Programs.			
References:				
1. J. H. Gallier, Logic for Computer Science - Foundations of Automatic Theorem Proving, Dower, 2015.				
2. S. Reeves, M Clarke, Logic for Computer Science, Addison Wesley, 1990. coding				

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	2	1	0	0	3	2	2	0	3	2	1
CO 2	3	2	1	0	0	2	1	2	0	2	1	0
CO 3	1	1	0	0	0	3	2	2	0	3	2	1

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJM AI4FV109				
Course Title	Ethics in handling AI				
Type of Course	VAC				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Basic of AI				
Course Summary	This course examines the ethical dimensions of AI, addressing issues like bias, transparency, privacy, and accountability in real-world applications. It prepares students to critically evaluate and responsibly guide the development and use of AI systems for the benefit of society				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Learn about morality and ethics in AI	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO2	Acquire the knowledge of real time application ethics, issues and its challenges.	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO3	Understand the ethical harms and ethical initiatives in AI	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO4	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO5	Learn about the societal issues in AI with National and International Strategies on AI	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :				
Module	Unit	Content	Hrs (45)	Marks (50)
1	INTRODUCTION		10	12
	1	Definition of morality and ethics in AI		
	2	Impact on society		
	3	Impact on human psychology		
	4	Impact on the legal system		
	5	Impact on the environment and the planet		
II	ETHICAL INITIATIVES IN AI		10	13
	7	International ethical initiatives		
	8	Ethical harms and concerns		
	9	Healthcare robots		
	10	Autonomous Vehicles		
	11	Employment and Economy		
III	AI STANDARDS AND REGULATION		10	13
	13	Model Process for Addressing Ethical Concerns During System Design		
	14	Transparency of Autonomous Systems		
	15	Data Privacy Process		
	16	Algorithmic Bias Considerations		
IV	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES		10	12
	18	Challenges - ethical issues in artificial intelligence		
	19	Opportunities - ethical issues in artificial intelligence		
	20	Societal Issues Concerning the Application of Artificial Intelligence in Medicine		
	21	Decision-making role in industries		
V	Open Ended Module		5	
	1	Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense		
	2	Identification on optimization in AI affecting ethics		
	3	Write a personal reflection on the societal role of AI, discussing both the opportunities and ethical concerns it presents		
		References		

	<p>1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017</p> <p>2. Mark Coeckelbergh, "AI Ethics", The MIT Press Essential Knowledge series, April 2020</p> <p>3. y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, "The ethics of artificial intelligence: Issues and initiatives", EPRS European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020</p> <p>4. Patrick Lin, Keith Abney, George A Bekey, "Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.</p>	
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Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	-	-	-	3	2	1	2	1	-	-
CO 2	3	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	1	-	-	3	2	3	2	2	-	-
CO4	3	3	2	-	-	2	2	3	3	2	-	-
CO5	3	3	3	2	1	2	2	3	3	3	1	1

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

Programme	BVoc Mathematics and Artificial Intelligence				
Course Code	SJMAI5FV110				
Course Title	AI in Healthcare and Telemedicine				
Type of Course	VAC				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	foundational knowledge in artificial intelligence, basic understanding of healthcare systems, and familiarity with data analysis and Python programming				
Course Summary	This course explores the application of artificial intelligence in healthcare and telemedicine, focusing on diagnostics, patient monitoring, and decision support systems. It emphasizes the integration of AI tools with medical data to improve healthcare delivery, accuracy, and accessibility				

Course Outcomes(CO) :

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand AI fundamentals, healthcare data types, and ethical regulations.	U	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO2	Apply machine learning and deep learning techniques to healthcare problems..	Ap	P	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO3	Analyze AI applications in remote monitoring, diagnosis, and personalized medicine..	An	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO4	Utilize Python and relevant AI libraries for building healthcare AI models..	C	C	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
CO5	Explore real-world tools, frameworks, and case studies in digital health and telemedicine.	An	P	Internal Exam/ Assignment/Seminar / Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :

Module	Unit	Content	Hrs (45)	Marks (50)
I	1	Introduction to AI: Definition, scope, and milestones of AI, Key applications, especially in healthcare	10	13
	2	Mathematical Foundations: Basics of linear algebra, probability, and optimization for AI		
	3	Healthcare Data: Types and formats of healthcare data (EHR, imaging, genomics), Data representation and management challenges		
	4	Telemedicine Overview: Evolution and models: real-time, store-and-forward, remote monitoring		
	5	Ethics and Regulations: Privacy, ethical concerns, and legal frameworks (HIPAA, GDPR)		
II	6	Machine Learning Basics: Supervised learning, <i>Unsupervised learning Model evaluation</i>	10	12
	7	Deep Learning Foundations: Neural network architecture and training, CNNs for image data, RNNs for sequences		
	8	AI in Medical Imaging: Image segmentation and feature extraction, Applications in radiology and diagnostics		
	9	NLP in Healthcare: Text mining and entity recognition from clinical notes, NLP for EHR analysis and documentation		
	10	AI for Diagnosis and Prediction: AI models for disease detection and outcome prediction, Integration of ML/DL into clinical decision support systems		
III	11	Remote Health Monitoring: Use of wearables and IoT devices, Data-driven management of chronic conditions, Real-time alerts and tracking		
	12	Virtual Consultations: Video-based telehealth platforms, AI-assisted diagnostics and clinical workflows		

	13	Decision Support Systems: Clinical decision-making using AI, Integration with EHR and telemedicine tools	10	13
	14	Personalized Medicine: AI in precision treatment and pharmacogenomics, AI in drug discovery and repurposing		
	15	Data Privacy and Ethics: Patient data protection, Addressing bias and ensuring fairness in algorithms		
	16	Legal and Regulatory Aspects: Compliance with laws like HIPAA and GDPR, Ethical use of AI in digital health		
IV	17	Python for Healthcare AI: Data analysis and model building using Python, Key libraries: NumPy, Pandas, Scikit-learn, TensorFlow, Keras	10	12
	18	Hands-on ML Projects: Practical implementation of ML models on healthcare datasets, Evaluation and visualization of results		
	19	AI Tools and Frameworks: Overview of MONAI, OpenCV, PyTorch, NLP using SpaCy and Hugging Face Transformers		
	20	Medical Imaging Applications: Medical image analysis using MONAI, Use cases in diagnostics and image classification		
	21	Telemedicine System Design: System architecture and AI integration,		
	22	Examples of real-world telehealth platforms		
		Open module : Case Studies	5	
	1	Medical Data Preprocessing		
	2	AI-Powered Medical Image Analysis		
	3	Time-Series Analysis for Patient Monitoring		
	4	Chatbots for Telemedicine		
		References		
		1. Dey, N., Ashour, A. S., & Balas, V. E. (Eds.). <i>Healthcare Data Analytics and Management</i> . Academic Press, 2019.		
		2. Jiang, F., Jiang, Y., Zhi, H., et al. “Artificial Intelligence in Healthcare: Past, Present and Future.” <i>Stroke and Vascular Neurology</i> , 2(4), 230–243, 2017.		
		3. Topol, E. <i>Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again</i> . Basic Books, 2019.		
		4. Rajkomar, A., Dean, J., & Kohane, I. “Machine Learning in Medicine.” <i>New England Journal of Medicine</i> , 380(14), 1347–1358, 2019.		

	5. Yu, K.-H., Beam, A. L., & Kohane, I. S. "Artificial Intelligence in Healthcare." <i>Nature Biomedical Engineering</i> , 2(10), 719–731, 2018.		
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Mapping of COs with PSOs and POs:

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	-	-	-	3	2	1	2	1	-	-
CO 2	3	2	-	-	-	3	2	2	2	2	-	-
CO 3	3	3	1	-	-	3	2	3	2	2	-	-
CO4	3	3	2	-	-	2	2	3	3	2	-	-
CO5	3	3	3	2	1	2	2	3	3	3	1	1

Mapping of COs to Assessment Rubrics:

CO	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	

20.DETAILED SYLLABUS OF THE VOCATION MINOR COURSES

Group 1 Title – Artificial Intelligence 1

SEMESTER 1

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAIIMN101				
Course Title	Python Programming				
Type of Course	Minor				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in fundamentals of programming				
Course Summary	This course introduces the fundamentals of Python programming, covering data types, control structures, functions, and basic file handling. It emphasizes practical problem-solving through hands-on coding, making it suitable for beginners from any discipline				

Course Outcomes :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the core syntax, data types, and control structures of Python programming.	U	C	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO2	Apply functions, recursion, and string operations to solve structured problems.	Ap	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO3	Utilize lists, tuples, dictionaries, and files to organize and manage data efficiently.	Ap	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam

CO4	Implement object-oriented programming concepts and interact with databases using Python.	An	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
CO5	Develop and test Python programs through practical exercises involving real-world tasks.	C	P	Internal Exam/ Practical/Assignment/Seminar / Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+ 30)	Marks (70)
I	Introduction to Python		10	17
	1	Introduction: The Python Programming Language, History, features,		
	2	Installing Python, Running Python program		
	3	Debugging : Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging		
	4	Variables : Values and Types, Variables, Variable Names and Keywords, Type conversion		
	5	Expressions : Operators and Operands, Interactive Mode and Script Mode, Order of Operations		
	6	Conditional Statements: if, if-else, nested if –else Looping: for, while, nested loops Control statements: Terminating loops, skipping specific conditions		
II	Functions		10	18
	7	Functions: Definitions and Uses, Function Calls, Flow of Execution, Type Conversion Functions, Math Functions,		
	8	Parameters and Arguments, Fruitful Functions and Void Functions, Return Values		
	9	Incremental Development, Composition, Boolean Functions		
	10	More Recursion, Leap of Faith, Checking Types		
	11	Strings: A String Is a Sequence, Traversal with a for Loop, String Slices, Strings Are Immutable.		
12	Searching, Looping and Counting, String Methods, The in Operator, String Operations			
III	Lists, Tuples and Dictionaries		12	18
	13	Lists: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List, Built-in List Operators, Built-in List functions and methods		
	14	Tuples and Dictionaries: Tuples, Accessing values in Tuples, Tuple		

		Assignment, Tuples as return values, Variable-length argument tuples, Built-in Tuple Functions and Methods		
	15	Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions and Methods		
	16	Files: Text Files, The File Object Attributes, Directories		
	17	Exceptions: Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions		
IV	Classes and Python with sqlite3		13	17
	18	Classes and Objects: Overview of OOP (Object Oriented Programming), Class Definition		
	19	Creating Objects, Instances as Arguments, Instances as return values, Built-in Class Attributes,		
	20	Inheritance, Method Overriding, Data Encapsulation, Data Hiding		
	21	Modules: Importing module, Creating and exploring modules, Math module, Random module, Time module		
	22	Programming in Python with sqlite3: Creating Tables, Querying (Inserting Tuples, Selecting Rows and Updating Tuples) Using Cursor to Iterate over Selected Tuples.		
V	Practical		30	
	1	a. Write a function to check the input value is Armstrong and also write the function for Palindrome. b. Write a recursive function to print the factorial for a given number. c. Take a list, say for example this one: a = [1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89] and write a program that prints out all the elements of the list that are less than 5. d. Write a program that takestwo lists and returns True if they have at least one common member. e. Write a Python program to print a specified list after removing the 0 th ,2nd, 4thand 5thelements		
	2	Programs based on lists, conditional constructs, the for statement and the range function; interactively using the built-in functions len, sum, max, min.		
	3	a. Programs related to string manipulation. b. Programs using list comprehensions and anonymous functions		
	4	a. Programs related to dictionaries. b. Programs using the built-in methods of the string, list and dictionaryclasses		
	5	a. Design a class that store the information of Employee and display the same. b. Implement the concept of inheritance using python		
	6	Programs to read and write files.		
	7	Program to demonstrate exception handling		
	8	Modules a. Write a program to implement user-defined module. b. Write a python program to demonstrate random module.		

References	
1)	Allen Downey. (2012). Think Python. Needham, Massachusetts: O'Reilly.
2)	Allen Downey. (2012). Think Python. Retrieved from http://www.greenteapress.com/thinkpython/thinkpython.pdf
3)	Goodrich, Tamassia, Goldwasser.(2016).Data Structures and Algorithms in Python: J. Wiley
4)	Wiley.Rance D. Necaie, College of William and Mary.(2016).Data Structures and Algorithms Using Python:
5)	Introduction to Computing Using Python: An Application Development Focus, 2nd Edition, Ljubomir Perkovic, ISBN: 978-1-118-89094-3.

Mapping of COs with PSOs and POs:													
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO4	PO5	PO6	PO7
CO 1	2	1	1	3	1	1	0	3	2	2	2	2	2
CO 2	2	2	2	3	2	1	1	2	3	2	3	3	3
CO 3	2	2	2	3	2	1	1	2	3	2	3	3	2
CO 4	3	2	2	3	3	1	1	2	2	3	3	3	3
CO 5	2	2	2	3	2	1	2	2	3	2	2	3	3

Mapping of COs to Assessment Rubrics					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓

SEMESTER 2

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI2MN101				
Course Title	INTRODUCTION TO ARTIFICIAL INTELLIGENCE				
Type of Course	Minor				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	A basic knowledge of programming, logical reasoning, and foundational mathematics is recommended				
Course Summary	This course provides a foundational understanding of Artificial Intelligence, covering core concepts like intelligent agents, problem-solving, search strategies, and knowledge representation				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand foundational concepts, problem spaces, and intelligent agent design in Artificial Intelligence..	U	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO2	Apply heuristic and logic-based techniques for problem solving and knowledge representation.	Ap	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO3	Analyze reasoning methods under uncertainty, including probabilistic and non-monotonic reasoning..	An	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO4	Explore knowledge structures and implement adversarial search strategies for decision making in games.	U,C	P,M	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam

CO5	Implement and assess algorithms through practical experiments and projects.	U,C	P,M	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (45+ 30)	Marks (70)
1	Introduction to Artificial Intelligence		11	17
	1	What is Artificial Intelligence: The AI Problems, The Underlying assumption		
	2	What is an AI Technique?, The Level of the model, Criteria for success		
	3	Problems, problem spaces, and search: Defining, the problem as a state space search		
	4	Production systems, Production system characteristics, Issues in the design of search programs, Additional Problems.		
5	Intelligent Agents: Agents and Environments, The nature of environments, The structure of agents			
II	Heuristic Search and Logical Knowledge Representation		13	18
	6	Heuristic search techniques: Generate-and-test, Hill climbing, Best-first search,		
	7	Problem reduction, Constraint satisfaction, Mean-ends analysis.		
	8	Knowledge representation issues: Representations and mappings,		
	9	Approaches to knowledge representation, Issues in knowledge representation, The frame problem.		
	10	Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution		
	11	Natural Deduction. Logical Agents: Knowledge –based agents, the Wumpus world		
12	Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic			
III	Reasoning		11	18
	13	Probabilistic reasoning: Bayes rule, Bayesian networks, hidden Markov model		
	14	Symbolic Reasoning Under Uncertainty: Introduction to non-monotonic reasoning,		
	15	Logic for non-monotonic reasoning, Implementation Issues, Augmenting a problemsolver		
	16	Implementation: Depth-first search		
17	Implementation: Breadth-first search.			
IV	Knowledge Structures and Adversarial Search		10	17
	18	Weak Slot-and-filter structures: Semantic Nets, Frames.		
	19	Strong slot-and –filler structures: Conceptual dependency, scripts, CYC.		
	20	Adversarial Search: Games, Optimal Decision in Games,		
	21	Min max algorithm ,Alpha-Beta Pruning		
22	Summary			
V	Practical			
	1	Write a program to implement depth first searchalgorithm.		
	2	Write a program to implement breadth first searchalgorithm		
	3	Write a program to simulate 4-Queen / N-Queen problem.		
4	Write a program to solve tower of Hanoi problem.			

	5	Write a program to implement alpha beta search.	30	
	6	Write a program for Hill climbing problem.		
	7	Write a program to implement A*algorithm		
	8	Design the simulation of tic-tac-toe game using min-max algorithm		
	9	Write a program to shuffle Deck of cards		
	10	Write a program to derive the predicate.		
	11	Develop a game using Pygame community.		
	References			
1	“Artificial Intelligence” -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill			
2	Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig, PHI			
3	Introduction to Prolog Programming By Carl Townsend.			
4	“PROLOG Programming For Artificial Intelligence” -By Ivan Bratko(Addison-Wesley)			
5	A First Course in Artificial Intelligence, Deepak Khemani, TMH			

Mapping of COs with PSOs and POs :												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	1	2	2	2	1	3	2	2	3	2
CO 2	3	1	2	3	3	1	2	3	3	3	3	3
CO 3	3	1	2	2	3	1	2	2	2	3	3	3
CO4	3	1	3	3	3	2	3	3	2	3	3	3
CO 5	3	1	3	3	3	1	3	3	3	3	3	3

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓		✓
CO 4	✓	✓	✓	✓	✓
CO5	✓			✓	✓

SEMESTER 3

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI3MN201				
Course Title	INTRODUCTION TO MACHINE LEARNING				
Type of Course	Minor				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	A basic understanding of programming, linear algebra, probability, and statistics is recommended				
Course Summary	This course introduces the core principles of machine learning, including supervised learning, model evaluation, and basic algorithms like decision trees and neural networks. It emphasizes practical applications and developing models to solve real-world problems effectively				

Course Outcomes (CO) :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamental concepts, learning paradigms, and types of problems in machine learning.	U	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO2	Apply regression and classification techniques to analyze and model real-world data.	Ap	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO3	Evaluate models using regularization and performance metrics to improve generalization	E	P,M	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO4	Develop neural networks and decision trees for predictive modeling and pattern recognition	C	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO5	Implement and assess machine learning algorithms through practical experiments and projects.	An	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :

Module	Unit	Content	Hrs (45+ 30)	Marks 70
I	Introduction to Machine Learning		11	17
	1	Introduction to Machine Learning: Definition, goals, and impact across doSJMAlns		
	2	Learning Paradigms: Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning		
	3	Types of Learning Problems: Classification, Regression, Clustering, Ranking		
	4	Conceptual Foundations: Hypothesis space, inductive bias, and generalization		
II	Regression and Classification		12	18
	6	Linear Regression: Model formulation, cost function, assumptions		
	7	Optimization in Regression: Gradient descent, convergence, and feature scaling		
	8	Non-linear Regression: Polynomial regression and basis function expansion		
	9	Logistic Regression: Probabilistic interpretation and classification boundaries		
III	Regularization and Performance Metrics		11	17
	11	The Bias-Variance Trade-off: Underfitting, overfitting, and generalization error		
	12	Regularization Techniques: Ridge (L2) and LASSO (L1) regression		
	13	Data Partitioning Strategies: Hold-out method, cross-validation, and bootstrapping		
	14	Performance Metrics for Classification: Accuracy, Precision, Recall, F1 Score, and confusion matrix		
	15	Advanced Evaluation Methods: ROC curves, AUC, and model calibration		
IV	Perceptron and Neural Network		11	18
	17	The Perceptron: Structure, learning algorithm, and limitations		
	18	Multilayer Neural Networks: Feedforward architecture and activation functions (ReLU, Sigmoid, Tanh)		
	19	Training Neural Networks: Backpropagation and gradient-based optimization		
	20	Decision Tree Fundamentals: Splitting criteria (Entropy, Gini), ID3 algorithm		
	21	Handling Real-World Data in Trees: Missing values, categorical		

		attributes, and noisy features		
	22	Tree Pruning and Overfitting Control: Pre-pruning, post-pruning, and performance tuning		
V		Practical	30	
	1	Perform the data classification using classification algorithm		
	2	Perform the data clustering using clustering algorithm		
	3	Perform the Simple Linear regression on the given warehouse data		
	4	Perform the Multi Linear regression on the given warehouse data		
	5	Perform the logistic regression on the given data warehouse data		
	6	Implement decision tree learning algorithm		
	7	Program to create sample data for testing		
	8	Apply Lasso and Ridge Regression on a regression dataset; compare performance using RMSE and interpret coefficient shrinkage.		
	9	Evaluate a model using 10-fold Cross-Validation; calculate average F1-score and standard deviation.		
10	Plot ROC Curve and compute AUC for a binary classifier using a test dataset.			
		References		
1	M Gopal, McGraw Hill(2018), Applied Machine Learning			
6)	Manaranjan Pradhan U Dinesh Kumar, Wiley(2019), Machine Learning using Python			
7)	M.N. Murty, V.S. Ananthanarayana, Universities Press(2014), Machine Learning: Theory and Practice			
8)	Ethem Alpaydin, MIT Press(2020), Introduction to Machine Learning			
9)	Mohammed J. Zaki Wagner Meira, Cambridge University Press(2016), Data Mining and Analysis: Fundamental Concepts and Algorithms			

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	2	1	3	1	1	2	2	1	0
CO 2	3	3	3	3	3	2	1	2	3	3	1	1
CO 3	2	3	3	3	3	2	1	2	3	3	1	1
CO 4	3	3	3	3	3	2	1	2	3	3	1	2
CO 5	2	3	3	3	3	2	1	2	2	3	1	1

Mapping of COs to Assessment Rubrics :					
	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Group 2 Title – Mathematical foundations for AI 1

SEMESTER 1

Programme	B. Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI1MN102			
Course Title	CALCULUS FOR AI			
Type of Course	Minor			
Semester	I			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Basic knowledge of Sets, Relations and Functions, School Level Algebra and Real Numbers (0-99 level).			
Course Summary	The course covers fundamental concepts in calculus, including functions, shifting of graphs, limits, continuity, differentiation, extreme values, the Mean Value Theorem, graphing with derivatives, and limits at infinity with asymptotes. Students learn techniques for evaluating limits, finding extrema, and graphing functions using derivatives, preparing them for further studies in calculus and related fields.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Analyse a function for its limits, continuity and differentiability and evaluate limits and derivatives.	An	F	Internal Exam/Assignment/Seminar/Viva/ End Sem Exam
CO2	Apply first and second derivatives and related theorems to find extrema of	Ap	F	Internal Exam/Assignment/S

	functions.			eminar/Viva/ End Sem Exam
CO3	Sketch the graph of functions by analysing critical points and asymptotes	An	F	Internal Exam/Assignment/Seminar/Viva/ End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge (F), Conceptual Knowledge (C), Procedural Knowledge (P), Metacognitive Knowledge (M)				

Detailed Syllabus:

Textbook	Calculus and Analytic Geometry, 9 th Edition, George B. Thomas, Jr. Ross L. Finney, Pearson Publications, 2010, ISBN: 978-8174906168.			
Module	Unit	Content	Hrs (48+12)	Marks
				Ext: 70
I	Module I		12	17
	1.	Preliminaries: Section 3 - Functions		
	2.	Preliminaries: Section 4 - Shifting Graphs.		
	3.	Section 1.1-Rates of Change and Limits - Limits of Function Values onwards.		
	4.	Section 1.2 - Rules for Finding Limits.		
	5.	Section 1.3 - Formal Definitions of Limits.		
II	Module II		15	18
	7.	Section 1.5 - Continuity.		
	8.	Section 2.1 - The Derivative of a Function		
	9.	Section 2.2 - Differentiation Rules.		
	10	Section 2.3 - Rates of Change.		
	11	Section 2.4 - Derivatives of Trigonometric Functions		
III	Module III		11	18
	13	Section 3.1 - Extreme Values of Functions.		
	14	Section 3.2 - The Mean Value Theorem -Topics up to and including Example 4.		
	15	Section 3.2 - The Mean Value Theorem- Increasing Functions and Decreasing Functions		
16	Section 3.3 - The First Derivative Test for Local Extreme Values.			
IV	Module IV		10	17
	17	Section 4.1 - Indefinite Integrals.		
	18	Section 5.1 - Areas Between Curves. - Topics up to and including Example 2.		
	19	Section 5.1 - Areas Between Curves- Topics from		

		Boundaries with Changing Formulas		
	20	Section 5.2 - Finding Volumes by Slicing. (Example 2 may be done as open ended).		
	21	Section 5.3 - Volumes of Solids of Revolution- Disks and Washers - Topics up to and including Example 4.		
	22	Section 5.5 - Lengths of Plane Curves. - Topics up to and including Example 2.		
	23	Section 5.6 - Areas of Surfaces of Revolution- Topics up to and including Example 2.		
V	Module V (Open Ended)		12	
	Trigonometric Functions, Derivatives of Trigonometric Functions, Power Rule of Differentiation for rational powers, Optimization, Linearization and Differentials.			
References				
<ol style="list-style-type: none"> Howard Anton, Biven, & Stephen Davis, Calculus, 7thEd., Wiley India Erwin Kreyszig, Advanced Engineering Mathematics, 10thEd, John Wiley & Sons. Robert T Smith and Roland B Minton, Calculus, 4th Ed. McGraw-Hill Companies Soo T Tan, Calculus, 9th Ed. Brooks/Cole Pub Co. Tom M. Apostol, Calculus, Vol 1: One Variable Calculus with an Introduction to Linear Algebra, 2nd Ed, John Wiley & Sons. Michael Van Biezen Calculus Lectures: https://youtu.be/YZYxPclo2rg?si=qKCt6ty8m5dBR4DG 				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	3	0	2	1	3	0	1
CO 2	2	3	2	1	3	0	2	1	3	0	1
CO 3	2	3	2	1	3	0	2	2	3	0	1

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

SEMESTER 2

Programme	B.Voc Mathematics and Artificial Intelligence			
Course Code	SJMAI2MN102			
Course Title	LINEAR ALGEBRA FOR MACHINE LEARNING			
Type of Course	MINOR			
Semester	II			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	3	2	75
Pre-requisites	Foundations in Mathematics			
Course Summary	Course aims to provide basics of linear algebra which is useful in understanding machine learning problems			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Solve system of linear equations	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Apply vector spaces and its properties	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Understand basics of matrix algebra and its applications	U	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Textbook		Introduction to Linear Algebra'' by Gilbert Strang, Wellesley-Cambridge Press, 2016, ISBN: 978-0980232776		
Module	Unit	Content	Hrs (45+30)	Marks (70)
I		Solving Linear Equations	12	17
	1	Vectors and Linear Equation		
	2	The Idea of Elimination		
	3	Elimination Using Matrices		
	4	Rules for Matrix Operations		
	5	Inverse Matrices		
	6	Elimination = Factorization: $A = LU$		
	7	Transposes and Permutations		
II		Vector Spaces and Subspaces	12	18
	8	Spaces of Vectors		
	9	The Null space of A: Solving $Ax = 0$		
	10	The Rank and the Row Reduced Form		
	11	The Complete Solution to $Ax = b$		
	12	Independence, Basis and Dimension		
III		Orthogonality	8	18
	14	Orthogonality of the Four Subspaces		
	15	Projections		
	16	Least Squares Approximations		
	17	Orthogonal Bases and Gram-Schmidt		
IV		Eigenvalues and Eigenvectors	13	17
	18	Introduction to Eigenvalues		
	19	Diagonalizing a Matrix		
	20	Symmetric Matrices		

	21	Positive Definite Matrices		
	22	Similar Matrices		
	23	Singular Value Decomposition (SVD)		
		OPEN MODULE Solving Problems of above four modules using python library	30	
		Reference		
	1	"Linear Algebra and Its Applications" by David C. Lay, Steven R. Lay, and Judi J. McDonald, Pearson, 2020,ISBN: 978-0134860244		
	2	Linear Algebra: Concepts and Applications" by Charles R. Johnson and Dean E. Riess, Wiley, 2017,ISBN: 978-1118612596		
	3	Linear Algebra: A Modern Introduction" by David Poole, Cengage Learning, 2016, ISBN: 978-1305658004		
	4	Linear Algebra for Machine Learning" by Jason Brownlee, Machine Learning Mastery, 2021		
	5	Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy, and Matplotlib" by Robert Johansson, Apress, 2018, ISBN: 978-1484242452		

Note: Proofs of all the results are exempted for the end semester exam.

Mapping of COs with PSOs and POs:

	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	3	1	2	2	3	1	1
CO 2	3	2	3	1	2	2	3	1	1
CO 3	3	3	3	1	2	2	3	1	1

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

SEMESTER 3

Programme	B.Voc. Mathematics and Artificial Intelligence			
Course Code	SJMAI3MN202			
Course Title	OPERATION RESEARCH FOR AI- DRIVEN OPTIMIZATION			
Type of Course	Minor			
Semester	III			
Academic Level	200 - 299			
Course Details	Credit	Lecture/Tutorial	Practical	Total Hours
		per week	per week	
	4	4	-	60
Pre-requisites	Basic Calculus and Linear Algebra			
Course Summary	Linear Programming is a mathematical modelling technique in which a linear function is maximized or minimized when subjected to various constraints. This technique has been useful for guiding quantitative decisions in business planning, in industrial engineering, and—to a lesser extent—in the social and physical sciences. This course begins with convex sets and extrema of functions for a sound basis of the subject. It then develops into LP problems including Transportation and Assignment problems.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Able to identify and analyse the properties of convex sets, including open and closed sets, convex hulls, and vertices.	An	C	Internal Exam/Assignment/Seminar/ Viva / End Sem Exam
CO2	To demonstrate proficiency in applying optimization techniques such as gradient descent, constrained extrema, and the method of Lagrange multipliers to solve real-valued functions.	Ap	P	Internal Exam/Assignment/Seminar/ Viva / End Sem Exam

CO3	To formulate and solve linear programming problems, including transportation and assignment problems, using techniques such as simplex method and duality.	U	P	Internal Exam/Assignment/Seminar/ Viva / End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:				
Text book	Optimization Methods in Operation Research and System Analysis (4th edition), K.V Mittal, C Mohan, New Age International (P)Limited (2016)			
Module	Unit	Content	Hrs(45+30)	Marks (70)
I	Module I		12	17
	1	Chapter 1 Section 11: Open and Closed sets in E_n		
	2	Section 12: Convex Linear Combination, Convex Sets		
	3	Section 13: Intersection of Convex Sets, Convex Hull of a Set Section 14: Vertices or Extreme Points of a Convex Set		
	4	Section 15: Convex Polyhedron Section 16: Hyperplanes, Half-spaces and Polytopes		
	5	Section 17: Separating and Supporting Hyperplanes Section 18: Vertices of a Closed Bounded Convex Set Section 19: Summary Section 20: Quadratic Forms		
II	Module II		13	18
	6	Chapter 2 Section 11: Convex Functions		
	7	Section 12: General Problem of Mathematical Programming		
	8	Chapter 3 Section 1: Introduction Section 2: LP in Two-Dimensional Space		
	9	Section 3: General L P Problem Section 4: Feasible Solutions Section 5: Basic Solutions Section 6: Basic Feasible Solutions Section 7: Optimal Section 8: Summary		
	10	Section 9: Simplex Method Section 10: Canonical Form of Equations Section 11: Simplex Method (Numerical Example) Section 12: Simplex Tableau		
	11	Section 13: Finding the First b.f.s; Artificial Variables Section 14: Degeneracy		
	12	Section 15: Simplex Multipliers		
	Module III			
	13	Chapter 3 Section 17: Duality in LP		

III		Problems	10	17
	14	Section 18: Duality Theorems Section 19: Applications of Duality		
	15	Section 20: Dual Simplex Method Section 21: Summary of Simplex Methods (III Revised Simplex Method is optional)		
	16	Section 22: Applications of LP		
IV	Module IV		10	18
	17	Chapter 4 Section 1: Introduction Section 2: Transportation Problem Section 3: Transportation Array Section 4: Transportation Matrix Section 5: Triangular Basis Section 6: Finding a Basic Feasible Solution		
	18	Section 7: Testing for Optimality		
	19	Section 8: Loop in Transportation Array Section 9: Changing the Basis		
	20	Section 10: Degeneracy Section 11: Unbalanced Problem		
	21	Section 14: Assignment Problem		
22	Section 15: Generalized Transportation Problem Exercise Questions in Assignment Problem			
	Open Ended			
V		Solving Problems of above four modules using python library	30	

. References:

1. G. Hadley: Linear Programming Addison-Wesley Pub Co Reading, Mass (1975)
2. S.S. Rao: Optimization – Theory and Applications (2nd Edn.) Wiley Eastern (P) Ltd. New Delhi.
3. Russel L Ackoff and: Fundamentals of Operation Research Maurice W.Sasioni Wiley Eastern Ltd. New Delhi. (1991)
4. Charles S. Beightler: Foundations of Optimization D.T. Philips & D.J. Wilde (2nd Edn.) Prentice Hall of India, Delhi (1979)

Programming References for Open-Ended section:

1. Linear Programming using Scipy, https://python.quantecon.org/lp_intro.html
2. Vanderbei's book homepage: <https://vanderbei.princeton.edu/LPbook/>

3. CPLEX Jupyter

Notebook: https://github.com/IBMDecisionOptimization/tutorials/blob/master/jupyter/Linear_Programming.ipynb

Installation: <http://ibmdecisionoptimization.github.io/docplex-doc/README.md.html>

4. Solving Transportation Problem using Linear Programming in

Python: <https://machinelearninggeek.com/solving-transportation-problem-using-linear-programming-in-python/>

5. Changhyun Kwon, Julia Programming for Operations Research 2/e

, <https://www.softcover.io/read/7b8eb7d0/juliabook2/simplex>

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	1	3	1	2	1	3	0	1
CO 2	3	3	3	2	2	2	1	3	1	3	0	1
CO 3	2	3	3	2	2	3	1	3	1	3	0	2

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Group 3 Title : Artificial Intelligence II

SEMESTER 3

Programme	B.Voc. Mathematics and Artificial Intelligence
Course Code	SJMAI3MN203
Course Title	Artificial Neural Network
Type of Course	Minor

Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Linear algebra, calculus, probability, and basic machine learning				
Course Summary	This course covers neural networks, including basic neuron models, activation functions, and learning processes . It focuses on Perceptrons, backpropagation, optimization, and advanced techniques like function approximation and network pruning				

Course Outcomes (CO :				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the biological motivation, neuron models, and fundamental learning paradigms in neural networks..	U	C	Internal Exam/ Practical/Assignmen t/Seminar/ Viva/End Sem Exam
CO2	Apply perceptron learning and gradient-based optimization methods to pattern classification problems..	Ap	P	Internal Exam/ Practical/Assignmen t/Seminar/ Viva/End Sem Exam
CO3	Analyze and implement multilayer perceptrons using backpropagation and related heuristics.	An	P	Internal Exam/ Practical/Assignmen t/Seminar/ Viva/End Sem Exam
CO4	Evaluate the effectiveness of training strategies, validation methods, and generalization techniques.	E	M, P	Internal Exam/ Practical/Assignmen t/Seminar/ Viva/End Sem Exam
CO5	Develop and test neural network-based solutions for real-world tasks using appropriate programming tools.	C	P	Internal Exam/ Practical/Assignmen t/Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus :

Module	Unit	Content	Hrs (45+ 30)	Marks (70)
I	1	Introduction: Motivation from Human Brain, mathematical model of a neuron	11	18
	2	basic computational unit, Activation Functions		
	3	Neural networks viewed as Directed Graphs, Feedback, Network Architectures, Knowledge Representation		
	4	Learning Process–Supervised, Unsupervised and Reinforcement learning		
	5	Learning TasksPattern Association, recognition, function approximation, control, beamforming		
II	6	Perceptron: Perceptron convergence theorem	11	17
	7	Relation between perceptron and Bayes classifier for a Gaussian Environment		
	8	Computer, batch perceptron algorithm. Model building through regression-linear regression model		
	9	Cost Function, gradient descent algorithm, chain rule		
	10	optimization, Local minima, Global Minima		
III	11	Multilayer Perceptron: Batch learning and Online learning	12	18
	12	Back propagation algorithm, XOR problem		
	13	heuristics for making the back-propagation algorithm perform better		
	14	activation functions, differentiability		
	15	symmetric, feature scaling		
	16	initialization, stopping criteria		
IV	17	Learning: back propagation and differentiation	11	17
	18	Hessian matrix, optimal annealing		
	19	adaptive control of the learning rate		
	20	Approximations of function, Generalization		
	21	Cross validation, Network pruning Techniques		
	22	Virtues and limitations of back propagation learning.		
V		Practical	30	
	1	To Write a program to implement Perceptron		
	2	To write a program to implement AND OR gates using Perceptron.		
	3	Write a Program for pattern reorganization		
	4	To write a program to implement Wine Classification using Back propagation		
	5	To implement Crab Classification using pattern net		
	6	Write a program to implement classification of linearly separable Data with a perceptron		

	7	Write a program to implement classification of non linearly separable Data with a perceptron		
	8	To study Long Short Term Memory for Time Series Prediction		
	9	Write a program to implement basic matrix operations		
		References		
	1	Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004		
	2	Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017		
	3	Francois Chollet, "Deep Learning with Python", Manning Publications, 2018		
	4	Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw- Hill Inc. 2000		
	5	Simon Haykin, "Neural Networks and Learning Machines", Pearson Education India; Third edition 2016		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	3	1	3	1	1	2	2	1	1
CO 2	2	3	2	2	3	2	2	3	2	2	1	2
CO 3	2	3	3	3	3	2	2	3	3	2	1	2
CO 4	2	2	3	2	2	3	1	2	2	3	2	2
CO5	2	3	2	3	3	2	2	3	3	3	1	3

Mapping of COs to Assessment Rubrics:					
	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER 4

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI4MN201				
Course Title	DEEP LEARNING				
Type of Course	Minor				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Machine Learning, Artificial Neural Networks				
Course Summary	This course introduces the foundational principles of deep learning and training methodologies. It also offers practical exposure to key applications such as image classification and sequence modeling.				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the architecture, activation functions, and training techniques of deep feedforward networks	U	C	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO2	Apply optimization techniques and regularization strategies for efficient deep neural network training.	Ap	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO3	Design and implement convolutional neural networks (CNNs) and apply them to image-based tasks.	An	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO4	Develop deep learning models for text processing using RNNs, LSTMs, GRUs, and autoencoders..	C	P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
CO5	Build and evaluate deep learning models using frameworks like TensorFlow or Keras for real-world applications.	C,E	M, P	Internal Exam/ Practical/Assignment/ Seminar/ Viva/End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P),Metacognitive Knowledge (M)				

Module	Unit	Content	Hrs (45+30)	Marks 70
1		Introduction to Deep learning	11	18
	1	History of Deep Learning, Deep Learning Success Stories		
	2	Basics of Convolutional Neural Networks, Layers in CNNs: Convolution, Pooling, Activation, Fully Connected		
	3	Concepts : Invariance and Stability,		
	4	Variability Models: Deformation Models, Stochastic Models		

	5	Properties: Invertibility, Stability, Invariance		
	6	Implementation :TensorFlow, Keras, and tf.keras		
	7	Trained Architectures : LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO,		
II		Convolutional Neural Networks	12	17
	8	Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods,		
	9	Batch Normalization, Learning Vectorial Representations Of Words,		
	10	Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream,Deep Art,		
		Fooling Convolutional Neural Networks, Recurrent Neural Networks,		
	12	Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients,Truncated BPTT		
III		Gated Recurrent Units (GRUs)	11	17
	13	Gated Recurrent Units (GRUs), Long Short Term Memory (LSTM) Cells, Solving the vanidhing gradient ,problem with LSTMs, Encoder Decoder Models,		
	14	Attention Mechanism, Attention over images, Hierarchical Attention, Directed Graphical Models,		
	15	Markov Networks,Using joint distributions for classification and sampling, Latent Variables.		
	16	Restricted Boltzmann Machines, Unsupervised Learning, Motivation for Sampling, Markov Chains,		
	17	Gibbs Sampling for training RBMs, Contrastive Divergence for training RBMs, Variational autoencoders.		
	18	Autoregressive Models: NADE, MADE,PixelRNN,		
IV		Generative Adversarial Networks (GANs)	11	18
	19	Generative Adversarial Networks (GANs)		
	20	Discriminative vs. Generative Modeling,		
	21	Generative Adversarial Nets, Conditional GAN,		
	22	Super-Resolution GAN, CycleGAN.		
V		Practical	30	
	1	Implement Simple Programs like vector addition in TensorFlow.		
	2	Implement a simple problem like regression model in Keras.		
	3	Implement a perceptron in TensorFlow/Keras Environment.		
	4	Implement a Feed-Forward Network in TensorFlow/Keras.		
	5	Implement an Image Classifier using CNN in TensorFlow/Keras		
	6	Implement a Transfer Learning concept in Image Classification.		
	7	Implement an Autoencoder in TensorFlow/Keras		
	8	Implement an LSTM to perform sequence prediction (e.g., stock prices or character-level text).		
	9	Implement an Opinion Mining in Recurrent Neural network		
	10	Implement an Object Detection using CNN.		
		References		

1	M Gopal, Pearson Education(2022), Deep Learning, Core Concepts, Methods and Applications
2	Nikhil Buduma and Nicholas Locascio, O'Reilly Media(2017), Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithm
3	Goodfellow, I., Bengio, Y., and Courville, A., MIT Press(2016), Deep Learning
4	Aggarwal, Charu C, Springer International(2018), Neural Networks and Deep Learning
5	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press(2016), Deep Learning

Mapping of COs with PSOs and POs:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	3	1	3	1	2	2	2	1	1
CO 2	2	3	2	2	3	2	2	3	3	2	1	2
CO 3	2	2	3	2	2	2	1	2	2	3	2	2
CO 4	2	2	2	2	2	2	1	2	2	3	2	2
CO 5	2	2	3	2	2	2	1	2	2	3	2	2

Mapping of COs to Assessment Rubrics:					
CO	Internal Exam	Assignment	Seminar	Practical Evaluation	End Semester Examinations
CO 1	✓	✓	✓		✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓

SEMESTER 5

Programme	B.Voc. Mathematics and Artificial Intelligence				
Course Code	SJMAI5MN301				
Course Title	NATURAL LANGUAGE PROCESSING				
Type of Course	Minor				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Knowledge in statistics, probability, AI and neural networks				
Course Summary	This course provides students with a comprehensive understanding of the natural language processing, design concepts, and practical implementation aspects of NLP using python				

Course Outcomes (CO):				
CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand syntax, semantics, and pragmatics in NLP tasks	U	C	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO2	Understand and apply accurate lexicon usage, POS tagging, and word sense disambiguation	U,Ap	C,P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO3	Implement and utilize various grammars and parsing methods, including resolving ambiguities	Ap	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO4	Link syntax and semantics, interpret noun phrases, and use knowledge representation for discourse management.	Ap	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam
CO5	Implement the models like BERT, GPT-2, ELMO, and RoBERTa for tasks like machine translation, sentiment analysis, and text summarization	An	P	Internal Exam/ Practical/Assignment /Seminar/ Viva/End Sem Exam

Module	Unit	Content	Hrs (60)	Marks (70)
I		Introduction to Natural Language Understanding and Linguistics	12	18
	1	Levels of language analysis,		
	2	Syntax, Semantics, Pragmatics.		
	3	Linguistic Background,		
	4	An Outline of English Syntax, Lexicon,		
	5	POS Tagging, Word Senses.		
II		Parsing Techniques and Ambiguity Resolution	12	17
	6	Grammars and Parsing Features,		
	7	Agreement and Augmented Grammars,		
	8	Grammars for Natural Language,		
	9	Parsing methods and Efficient Parsing,		
	10	Ambiguity Resolution, Statistical Methods.		
	11	Probabilistic Context Free Grammar.		
III		Semantic Interpretation and Knowledge Representation in NLP		18
	12	Semantics and Logical Form,		
	13	Linking Syntax and Semantics,		
	14	Ambiguity Resolution,		
	15	other Strategies for Semantic Interpretation,		

	16	Scoping and the Interpretation of Noun Phrases.		
	17		12	
IV	Language Models		12	17
	18	Pre-trained Models		
	19	BERT, GPT-2, ELMO, RoBERT		
	20	Applications and Challenges- Machine Translation,		
	21	Information Retrieval and Extraction, Sentiment Analysis,		
	22	Text Categorization and Summarization.		
V	Openmodule – Case Studies		12	
		<ol style="list-style-type: none"> 1. BERT for Clinical Text Analysis (Google + Mayo Clinic) 2. Mental Health Chatbots (Wysa, Woebot) 3. ESJMAIL Spam Detection (GSJMAIL) 4. Legal Document Summarization (ROSS Intelligence, LexisNexis) 		
	References			
	1	Charniak, Eugene, Addison-Wesley(1985), Introduction to Artificial intelligence		
	2	Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Addison-Wesley(1999), Modern Information Retrieval		
	3	U. S. Tiwary and Tanveer Siddiqui, Oxford University Press(2008), Natural Language Processing and Information Retrieval		
	4	D. Jurafsky and J. H. Martin, Prentice Hall India(2000), Speech and Language Processing		
	5	James Allen, Benjamin-Cummings(1988), Natural Language Understanding		

Mapping of Cos with PSOs and Pos:												
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	2	2	2	3	3	1	2	2	2	1	1
CO 2	1	2	2	2	3	2	2	2	3	3	2	2
CO 3	1	2	2	3	3	3	2	2	3	2	1	2
CO 4	1	2	2	2	3	2	1	3	3	2	1	3
CO 5	1	1	1	2	2	2	2	2	2	3	3	2

	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	✓

Format of the Question Papers – Type I (Foundation Courses)

I Semester B. Voc. Degree Examinations – October 2025

SJMAI1FS113: Introduction to AI

Tools (Credits: 3)

Maximum Time: 1:30 Hours

Maximum Marks: 50

Course Outcomes (COs)

Co #	CO Statement
CO1	Understand the basics of AI and set up development environments and tools.
CO2	Apply machine learning techniques using scikit-learn for classification and regression tasks.
CO3	Develop basic NLP models using NLTK and spaCy for text analysis.
CO4	Build and evaluate simple neural networks using TensorFlow and Keras.
CO5	Create AI-powered applications using generative tools for text, visuals, and presentations.

Section A

[Answer all questions. Each question carries 2 marks] (Ceiling: 16 Marks)

1. Define Artificial Intelligence and mention any two applications. [CO1]
2. List any two AI tools and platforms commonly used. [CO1]
3. What is the use of Jupyter Notebooks in AI development? [CO1]
4. Mention two important Python libraries used for AI and their purpose. [CO1]
5. What are classification models? Name one algorithm used. [CO2]
6. What is the purpose of model evaluation in ML? [CO2]
7. Name any two text vectorization techniques. [CO3]
8. What is sentiment analysis in NLP? [CO3]
9. Mention two key features of TensorFlow. [CO4]
10. What is the advantage of using pretrained models? [CO4]

Section B

[Answer all questions. Each question carries 6marks] (Ceiling:24 Marks)

11. Explain the steps to set up a Python environment for AI, including necessary libraries. [CO1]
12. Describe the process of building and evaluating a regression model using scikit-learn. [CO2]
13. Discuss the use of NLTK for basic text processing in NLP. [CO3]
14. Explain how to build and train a simple neural network using Keras. [CO4]
15. Describe any real-world application of AI using generative tools. [CO5]

Section C

[Answer any One. Each question carries 10 marks]

16. Design an end-to-end machine learning workflow using scikit-learn for a classification problem. Include preprocessing, model building, and evaluation. [CO2]
17. Build a complete NLP pipeline using spaCy to extract named entities from a given text corpus and explain each step. [CO3]

Format of the Question Papers – Type II (Major Courses)

I Semester B. Voc. Degree Examinations – October 2025

SJMAI1CJ101: Python Programming

(Credits: 4)

Maximum Time: 2 Hours

Maximum Marks: 60

Course Outcomes (COs)

Co #	CO Statement
CO1	Understand the basic concepts of Python programming language.
CO2	Understand and Apply problem-solving skills using the basic constructs in Python programming
CO3	Apply modular programming using functions in Python
CO4	Analyse the various data structures and operations on it using Python
CO5	Apply various packages available in Python
CO6	Apply visualization tools in Python

Section A

[Answer all questions. Each question carries 2 marks] (Ceiling: 20 Marks)

1. What are the key features of Python programming? [CO1]
2. Explain the difference between syntax error and runtime error. [CO2]
3. Write a short note on type conversion in Python. [CO2]
4. List and explain two control statements used in Python. [CO2]
5. List and explain Looping statements used in Python. [CO2]
6. What is a function in Python? Give an example. [CO3]
7. What is a Class in Python? Give an example. [CO3]
8. What is a tuple? How is it different from a list? [CO4]
9. Mention any two string operations available in Python. [CO4]
10. What is inheritance in Python classes? [CO5]
11. Name two built-in modules in Python and their uses. [CO5]
12. Write a short note on exception handling in Python. [CO6]

Section B

[Answer all questions. Each question carries 6marks] (Ceiling: 30 Marks)

11. Discuss the history and features of Python programming language. [CO1]
12. Explain the conditional and looping constructs in Python with examples. [CO2]
13. Describe the concept of fruitful and void functions with examples. [CO3]
14. Explain operations on lists and dictionaries in Python. [CO4]
15. Explain about Inheritance.[CO4]
16. Discuss the use of sqlite3 in Python with relevant code examples. [CO5]

Section C

[Answer any One. Each question carries 10 marks]

17. Write a Python program that demonstrates use of functions, lists, and control statements for solving a practical problem. Explain the logic. [CO3]
18. Design a Python class to represent a student with details like name, marks in three subjects. Include methods to compute average and grade. Demonstrate with examples. [CO5]

Format of the Question Papers – Type III (Minor Courses)
II Semester B. Voc. Degree Examinations – October 2025
SJMAI2MN102: Linear Algebra for Machine Learning
(Credits: 4)

Maximum Time: 2 Hours

Maximum Marks: 70

Course Outcomes (COs)

Co #	CO Statement
CO1	Solve system of linear equations
CO2	Apply vector spaces and its properties
CO3	Understand basics of matrix algebra and its applications

Section A

[Answer all questions. Each question carries 3 marks] (Ceiling: 24 Marks)

1. Define linear equation and give an example. [CO1]
2. What is the purpose of matrix elimination? [CO1]
3. Explain LU factorization in solving systems. [CO1]
4. Define vector space with one example. [CO2]
5. What is null space of a matrix A? [CO2]
6. Explain the concept of basis and dimension. [CO2]
7. State the Gram-Schmidt orthogonalization process. [CO3]
8. What is the least squares approximation? [CO3]
9. Define eigenvalue and eigenvector. [CO3]
10. Mention two applications of diagonalization. [CO3]

Section B

[Answer all questions. Each question carries 6marks] (Ceiling: 36 Marks)

11. Solve the following system of linear equations using matrix elimination. [CO1]
12. Explain inverse matrices with properties and example. [CO1]
13. Discuss the complete solution to $Ax = b$ and how rank is used in it. [CO2]
14. Illustrate independence, basis, and dimension with a numerical example. [CO2]
15. Explain the row reduced form of a matrix and its uses. [CO2]
16. Describe orthogonality and projections with an example. [CO3]
17. Explain the steps of diagonalizing a matrix. [CO3]
18. What is SVD? Explain its application in linear algebra. [CO3]

Section C

[Answer any One. Each question carries 10 marks]

19. Using an example, demonstrate how LU decomposition is used to solve a system of equations. [CO1]
20. Explain and compute the orthogonal projection of a vector onto a subspace using Gram-Schmidt process. [CO3]

APPENDICES