CURRICULUM & SYLLABUS

SRM UNIVERSITY
DELHI-NCR, SONEPAT

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF TECHNOLOGY (B.Tech.)

(4 Year Undergraduate Degree Programme)

IN

COMPUTER SCIENCE AND ENGINEERING

In Artificial Intelligence & Machine Learning

(In Alignment with National Education Policy, 2020)

[w. e. f. 2025-2026]

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM UNIVERSITY DELHI-NCR, SONEPAT

39, Rajiv Gandhi Education City, Sonepat, Haryana-131029

MAPPING OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES

FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES	FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES
Advancement to a professional position by virtue of their knowledge, skills and attitude.	1. An ability to identify, formulate, and solve real time engineering and socio-economic problems by applying principles of engineering, science, mathematics, humanities and social sciences 2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice.
Recognition for solving engineering problems and developing design solutions that consider safety and sustainability	2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice. 3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
Work as successful professionals in diverse engineering disciplines	3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability 4. an ability to adapt and work with multidisciplinary teams and communicate effectively;
Increasing responsibilities of technical and managerial leadership in their work organizations;	4. an ability to adapt and work with multidisciplinary teams and communicate effectively; 5. An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks. 6. an understanding of professional and ethical responsibility;
Professional development through a commitment to career-long learning.	6. an understanding of professional and ethical responsibility; 7. An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

TABLE 1: MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES (TABULAR FORMAT)

MAPPING	FEPELO1	FEEPLO 2	FEEPLO 3	FEEPLO 4	FEEPLO 5	FEEPLO 6	FEEPLO 7
FEEPEO1	✓	✓					
FEEPEO2		✓	✓				
FEEPEO3			✓	✓			
FEEPEO4				✓	✓	✓	
FEEPEO5						✓	✓

B.TECH - COMPUTER SCIENCE AND ENGINEERING

GRADUATES EMPLOYABILITY ATTRIBUTES

EA 1: Sound Knowledge & Skill of Domain Area: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program

EA 2: Problem solving skills: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

EA 3: Cognitive and Analytical skills: Cognitive& Analytical skills help engineering graduates interpret data, remember team goals. These skills help them recall previous information that may relate to their organization's goals and help them make important connections between old and new information so that they can work more effectively.

EA 4: Design Thinking: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, economic, environmental, cultural and societal considerations.

EA 5: **Transferrable Skills:** Transferable skills are skills and abilities that are relevant and helpful across different areas of life: socially & professionally.

- **Interpersonal skills to work in diverse groups:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
- **Communication Skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
- **Positive attitude and thinking:** An ability to have a positive attitude and thinking in challenging situations.
- **Adaptability:** Adapts learning strategies to new conditions. Recognizes parallels, analogies or similarities of new situations to more familiar situations.
- **Learn to Learn:** Learn Unlearn Relearn: An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge.

EA6: Information technology skills: An ability to create, select, adapt, and extend appropriate techniques, resources, and modern ICT tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

EA7: Sustainable Consumption and Production: the demands for system upgrades (domestic and commercial) as well as the move to continuous provision of service (e.g. domestic devices that are always powered and available) needs to be balanced with the views

of sustainable consumption and production. Server based solutions – such as Google Docs (Google Docs, 2009) 0– can be considered as one way of addressing such concerns where individuals need not upgrade their own machines as regularly and install local applications (with subsequent updates).

B.TECH - COMPUTER SCIENCE AND ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1. To nurture strong understanding in logical, mathematical and analytical reasoning among students coupled with a problem solving attitude that prepares them to productively engage in research and higher learning.

PEO2. To build a strong foundation in the field of Computer Science and Engineering among students to be creative and innovative.

PEO3. To prepare students capable of designing and developing real-world computing applications with high societal influence and impact.

PEO4.To provide students with an academic environment that enables them to understand the significance of life-long learning in varied situations and teams in a global perspective.

PEO5. To inculcate ethical practices, professionalism and environmental awareness for sustainable development among students enabling them for prospective employment in their chosen line of profession globally.

PEO6. To instill communication and management skill that generates entrepreneurship and / or leadership qualities.

UNITED NATIONS 17 SUSTAINABLE DEVELOPMENT GOALS (SDGs)

The United Nations Sustainable Development Summit for the adoption of 2030 Agenda and the sustainable development goals was held during three historic days in New York, 25-27 September 2015.

Born out of the Rio+20 Conference through paragraph 283 of the Future We Want outcome document, the platform has been revitalized in preparation for the 2030 Agenda, with the 17 sustainable development goals* at its core.

1. End poverty in all its forms everywhere
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Ensure healthy lives and promote well-being for all at all ages
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Achieve gender equality and empower all women and girls
6. Ensure availability and sustainable management of water and sanitation for all
7. Ensure access to affordable, reliable, sustainable and modern energy for all
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10. Reduce inequality within and among countries
11. Make cities and human settlements inclusive, safe, resilient and sustainable
12. Ensure sustainable consumption and production patterns
13. Take urgent action to combat climate change and its impacts
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

* https://sdgs.un.org/publications/17-sustainable-development-goals-17-partnerships-17979

B.TECH - COMPUTER SCIENCE AND ENGINEERING

PROGRAMME LEARNING OUTCOMES

PLO1-Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and IC design and technology concepts towards modelling and prototyping Integrated systems.

PLO2-Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PLO3-Design/development of solutions: Design methodology to offer hardware solutions to public health, safety and agriculture, consumer electronics along with cultural, societal, and environmental considerations.

PLO4-Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PLO5-Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PLO6-The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PLO7-Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PLO8-Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PLO9-Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PLO10-Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO11-Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PLO12-Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

TABLE 2: MAPPING MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES (PEO) AND PROGRAM LEARNING OUTCOMES (PLO)

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
PEO1	✓	✓										
PEO2			✓	✓								
PEO3					✓	✓						
PEO4							✓	✓				
PEO5									✓			
PEO6										✓	✓	✓

B.TECH COMPUTER SCIENCE AND ENGINEERING

IN

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

PROGRAMME STRUCTURE

The Computer Science and Engineering curriculum is geared towards providing the student with a strong foundation in the discipline and the tools and competence to address new and challenging problems that they have not seen before. In order to earn a B. Tech. degree in Computer Science and Engineering, a student should secure a minimum of **180** credits in the course of their study. The credit requirements for their program of study is comprised of the following Programme Structure:

- **Basic Applied Sciences (BAS) and Engineering Science (ES):** The purpose of Basic Applied Sciences in Engineering study is to lay a strong foundation of basic principles of various disciplines such as Mathematics, Physics, and Chemistry in the mind of the learners so that they proceed to the rest of their years of study with up to date knowledge and training of basic engineering skills. The Engineering Sciences requirements support multiple objectives: first, the courses provide a strong foundation in the basic tools and methodologies common to all engineering disciplines; second, all the students are exposed to basics of each discipline allowing for cross-disciplinary competencies; last, there is a multi-disciplinary project component where students from different engineering disciplines come together on a design project, allowing for practice in collaborative team work.
- **Professional Core Courses (PC):** The Professional core courses are aimed at providing the student with a solid foundation in their chosen field of study as per Industry 4.0 skills and knowledge.
- **Practicals (P):** The labs are fully well equipped with latest software to conduct practical as per the requirement of the University Curriculum.
- **Professional Electives (PE)-Programme-Specific Specialization Electives:** The Professional electives, on the other hand, provide the student with an option to gain exposure to different specializations within the discipline, or an opportunity to study one of the subfields in some depth.
- **Ability Enhancement Courses (AEC)**: Students are required to achieve competency in a Modern Indian Language (MIL) along with English language with special emphasis on

language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and academic writing skills. The focus is on imparting students with necessary skills to articulate their arguments and present their thoughts clearly and coherently and recognize the importance of language as a To understand the fundamentals of big data concepts, architectures, and its growing importance in real-world applications.

- To apply statistical and inferential techniques to analyze structured and unstructured datasets.
- To explore modern data visualization tools and techniques for meaningful representation of big data.
- To introduce OLAP, data mining, and knowledge discovery approaches for decision-making support.
- To design and implement big data solutions using Hadoop ecosystem and distributed computing tools.
- mediator of knowledge and identity.
- **Value Added Courses (VAC):**Course components relating to skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person, the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties.
- **Skill Enhancement Courses (SEC)-Technical & Soft Skills:**

  Technical Skills: Under Technical Skills Broad categories of training to be imparted in Engineering Graduates of various disciplines with common nomenclature. The training is categorized into three categories: Elementary, Intermediate & Advanced keeping in view of the interdisciplinary approach.(One Credit Each from 3rd semester to 6th semester)

  Soft Skills: Under Soft skills training five soft skill courses with defined Nomenclature and course content common to all Engineering disciplines are introduced to inculcate Group Dynamics, Team work &Leadership Traits by engaging students in interactive sessions through Role Play, Group Discussions, and improving presentation

&Communication skills of engineering graduates. (One Credit Course from 3rd Semester to 7th semester).

➢ **Live Projects (LP) and Summer Internship (SI):**

Live Projects is being introduced for all Engineering disciplines from 5th semester - 7th Semester to develop an ability in engineering graduates to apply skills and knowledge attained to solve real life complex problems. (One Credit each semester).

- A student may create a live project as an internship project. In that case, the student will be monitored on a periodic basis, both by the Industry Expert and the Faculty In-charge. The Industry In-charge will submit the Mid-Term and End-Term Evaluation report. However, the faculty in-charge will take periodic presentations to keep a check on the progress of students.
- A student may also create a live project under the supervision of Institutional faculty (in-house or other institutes of repute). Six step comprehensive approach is introduced for Identification of Projects, Allocation & Monitoring of projects through digital platforms.

Summer Internship (SI):

Students will be monitored on a periodic basis, both by the Faculty Mentor from the Industry and the Faculty in-charge from the department. The Faculty Mentor from the Industry will submit the Mid-Term and End-Term Evaluation report. However, the faculty In-charge from the department will take periodic presentations to keep a check on the progress of Students.

- Students are provided with the internship-related document which helps them to prepare a report. In addition to this, it provides a detail to students about internship/project evaluation parameters.

➢ **Multidisciplinary Courses (Humanities and Social Science Courses) (MDC):**

The open elective subject courses provide the student with wide latitude to pursue their interests, be it in humanities, management, arts, or their own chosen field of study in order to have a multidisciplinary approach.

B.TECH COMPUTER SCIENCE AND ENGINEERING

IN

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

TABLE 3: PROGRAMME STRUCTURE

Category of Courses	**Category**	**No. of Courses**	
Basic Applied Sciences	BAS		7
Engineering Sciences	ES		10
Professional Core	PC		13
Professional Electives -Program Specific Specialized Elective Courses	PE		12
Ability Enhancement Courses	AEC		4
Skill Enhancement courses (Technical and Soft skills)	SEC	Technical Skills	4
		Soft Skills	5
Value Added Courses	VAC		3
Practical / Workshop	P/W		17
Live Project & Industrial Visit and Summer Internship	LP/SI	Live Project and Industrial Visit	5^{th} -7^{th} Semester 3
		Minor Project	7^{th} Semester 1
		Major Project	8^{th} Semester 1
Multidisciplinary Courses (Humanities & Social Sciences Courses) (MDC)	MDC		3
TOTAL		**82**	

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATA SCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

TABLE 4: PROGRAMME CREDIT STRUCTURE SEMESTERWISE

SEMESTER COURSES	CATEGORY	I	II	III	IV	V	VI	VII	VIII	TOTAL	%AGE
Basic Applied Sciences	BAS	9	9	4	0	0	0	0	0	22	12.15
Engineering Sciences	ES	9	9	-	0	0	0	0	0	18	9.94
Professional Core	PC	-	-	9	7	5	6	12	0	39	21.55
Professional Electives -Program Specific Specialized Elective Courses	PE	-	-	3	8	10	8	4	0	33	18.23
Ability Enhancement Courses	AEC	5	2	-	0	0	0	0	0	7	3.87
Skill Enhancement courses (Technical and Soft skills)	SEC	-	-	2	2	2	2	1	0	9	4.97
Value Added Courses	VAC	2	2	2	0	0	0	0	0	6	3.31
Practical / Workshop (Major)	P/W	1*	1*	4	3	2	3	3	0	17	9.39
Live Project & Industrial Visit and Summer Internship	LP / SI	-	-	-	0	1	1	6	12	20	11.05
Multidisciplinary Courses (Humanities & Social Sciences Courses) (MDC)	MDC	-	-	-	3	3	3	0	0	9	4.97
TOTAL		**26**	**23**	**24**	**23**	**23**	**23**	**26**	**12**	**180**	**100.0**

COURSE CURRICULUM

TABLE 5: PROGRAMME COURSES CREDIT STRUCTURE SEMESTER WISE

SEMESTER – I

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
1	2XAS101	(BAS)	Engineering Mathematics-I	3	1	0	4	4
OR								
1 (a)	2XAS104	(BAS)	Mathematics-I (For BME students)	2	0	0	2	2
1 (b)	2XAS105	(BAS)	Biology (For BME students)	1	1	0	2	2
2	2XAS102/ 2XAS103	(BAS)	**Quantum Computing/ Applied Chemistry**	3	1	2	6	5
3	2XEE101/ 2XEC101	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	2	5	4
4	2XME101/	(ES)	**Fundamentals of Robotics and AI**	**3**	**0**	**0**	**3**	**3**
	2XME151	(ES)	**Design thinking and Engineering practices Lab**	**0**	**0**	**2**	**2**	**1**
	OR							
	2XCS101/2XCS151	(ES)	Fundamentals of Computer & C Programming	3	0	2	5	4
5	2XHS101	(AEC)	Communicative English	2	0	2	4	3
	2XME152	(ES)	Engineering Graphics & Design Lab	0	0	2	2	1`
6	2XHIN-101-I / 2XFLGR101-I / 2XFLFR101-I	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	2XESEB101/ 2XVAC102	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**18/ 16**	**2**	**8**	**28/26**	**24/22**

** 1 credit practical i.e. 24CAM101- INDUSTRIAL SESSION – I will be offered to IBM Specialization students.[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)
SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE
PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – II

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
1	2XAS201	(BAS)	Engineering Mathematics-II	3	1	0	4	4
OR								
1	2XAS204	(BAS)	Mathematics-II (For BME students)	3	1	0	4	4
2	2XAS202/ 2XAS203	(BAS)	**Quantum Computing/ Applied Chemistry**	3	1	2	6	5
3	2XEE201/ 2XEC201	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	2	5	4
4	2XME201/	(ES)	**Fundamentals of Robotics and AI**	**3**	**0**	**0**	**3**	**3**
	2XME251	(ES)	**Design thinking and Engineering practices Lab**	**0**	**0**	**2**	**2**	**1**
	OR							
	2XCS201/2XCS251	(ES)	Fundamentals of Computer & C Programming	3	0	2	5	4
5	2XHS201	(AEC)	Communicative English	2	0	2	4	3
	2XME252	(ES)	Engineering Graphics & Design Lab	0	0	2	2	1`
6	2XHIN-201 / 2XFLGR201 / 2XFLFR201	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	2XESEB201/ 2XVAC202	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**18/ 16**	**2**	**8**	**28/26**	**24/22**

** 1 credit practical i.e. 24CAM201- INDUSTRIAL SESSION –II will be offered to IBM Specialization students.

L= Lecture, T = Tutorials, P = Practical's & C = Credits

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – III

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
23AS301	Engineering Mathematics-III	BAS	3	1	0	4	4
23CAM2009	Python Programming	PC	3	0	0	3	3
25CS2001	Data Structures	PC	3	0	0	3	3
25CS2005	Database Management Systems	PC	3	0	0	3	3
25CSPExxx	Professional Elective-I	PE	3	0	0	3	3
Total (Theory)			**15**	**1**	**0**	**16**	**16**
Practical							
23CAM2115	Python Programming Lab	P	0	0	2	2	1
25CS2113	Data Structures Lab	P	0	0	2	2	1
25CS2111	Database Management Systems Lab	P	0	0	2	2	1
23VAC103	Sports, Yoga & Fitness	VAC	1	0	2	3	2
25AL3110	Industry Session: AI & ML	P	0	0	2	2*	1
Total (Practical)			**1**	**0**	**10**	**11**	**6**
Skill Enhancement Course							
25CS0201C	Digital Marketing	SEC	0	0	2	2	1
23SS351	Effective Communication Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**16**	**1**	**14**	**31**	**24**

NOTE: At the end of the semester, students will undergo a training and create a project which will be evaluated in the next semester (Live Project-I)

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)
SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE
PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – IV

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
24MDC401	Multidisciplinary Elective-I	MDC	3	0	0	3	3
25AL4002	Mathematical Foundations for AI	PC	2	0	0	2	2
25AL4004	Optimization for Machine Learning	PC	2	0	0	2	2
25CSPEXXX	Professional Elective-II	PE	3	1	0	4	4
25CS2006	Operating Systems	PC	3	0	0	3	3
25CSPEXXX	Professional Elective-III	PE	3	0	0	3	3
Total (Theory)			**16**	**1**	**0**	**17**	**17**
Practical							
25AL4102	Mathematical Foundations for AI Lab	P	0	0	2	2	1
25AL4104	Optimization for Machine Learning Lab	P	0	0	2	2	1
25CS2114	Operating Systems Lab	P	0	0	2	2	1
25CSPEXXX	Professional Elective-III Lab	PE	0	0	2	2	1
Total (Practical)			**0**	**0**	**8**	**8**	**4**
Skill Enhancement Course							
25CS0202B	Design Thinking and Augmented Virtual Reality	SEC	0	0	2	2	1
23SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**16**	**1**	**12**	**29**	**23**

NOTE: At the end of the semester, students will undergo a training and create a project which will be evaluated in the next semester (Live Project-II) ** To be evaluated in the current semester.

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – V

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
24MDC501	Multidisciplinary Elective-II	MDC	3	0	0	3	3
25AL5001	AI Principles and Techniques	PC	3	0	0	3	3
25AL5003	Machine Learning	PC	2	0	0	2	2
25CSPEXXX	Professional Elective-IV	PE	3	1	0	4	4
25CSPEXXX	Professional Elective-V	PE	3	1	0	4	4
Total (Theory)			**14**	**2**	**0**	**16**	**16**
Practical							
25AL5101	AI Principles and Techniques Lab	P	0	0	2	2	1
25AL5103	Machine Learning Lab	P	0	0	2	2	1
25CSPEXXX	Professional Elective-V Lab	PE	0	0	2	2	1
25CSPEXXX	Professional Elective-IV Lab	PE	0	0	2	2	1
25CS0303A	Live Project-I & Industrial Training	LP**	0	0	2	2	1
Total (Practical)			**0**	**0**	**10**	**10**	**5**
Skill Enhancement Course							
25CS0301A	Wearable Technology	SEC	0	0	2	2	1
23SS553	Presentation Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**14**	**2**	**14**	**30**	**23**

NOTE: At the end of the semester, students will undergo a training and create a project which will be evaluated in the next semester (Live Project-II)

**** To be evaluated in current semester**

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)
SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE
PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VI

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25AL6002	Image Processing	PC	3	0	0	3	3
25AL6004	Deep Learning	PC	3	0	0	3	3
25CSPEXXX	Professional Elective-VI	PE	3	0	0	3	3
25CSPEXXX	Professional Elective-VII	PE	3	1	0	4	4
24MDCXX	Multidisciplinary Elective-III	MDC	3	0	0	3	3
Total (Theory)			**15**	**1**	**0**	**16**	**16**
Practical							
25AL6102	Image Processing Lab	P	0	0	2	2	1
25AL6104	Deep Learning Lab	P	0	0	2	2	1
25CSPEXXX	Professional Elective-VI lab	PE	0	0	2	2	1
23CAM3014	Industry Session : Deep Learning	P	0	0	2	2	1
25CS0304A	Live Project-III & Industrial Visit	LP**	0	0	2	2	1
Total (Practical)			**0**	**0**	**10**	**10**	**5**
Skill Enhancement Course							
25CS0302D	Data Analytics Tools	SEC	0	0	2	2	1
23SS654	Professional Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**15**	**1**	**14**	**30**	**23**

NOTE: At the end of the semester, students will undergo a training and create a project which will be evaluated in the next semester (Live Project-III)

**** To be evaluated in the current semester.**

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VII

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25AL7001	Computer Vision	PC	3	1	0	4	4
25AL7003	Natural Language Processing	PC	3	1	0	4	4
25AL7005	Robotics	PC	3	1	0	4	4
25CSPEXXX	Professional Elective-VIII	PE	3	1	0	4	4
Total (Theory)			**12**	**4**	**0**	**16**	**16**
Practical							
25AL7101	Computer Vision Lab	P	0	0	2	2	1
25AL7103	Natural Language Processing Lab	P	0	0	2	2	1
25AL7110	Industry Session : Robotics	P	0	0	2	2	1
25CS4115A	Live Project-III & Industrial Training	LP**	0	0	2	2	1
25CS4117A	Minor Project	LP	0	0	10(4)	10(4)*	5
Total (Practical)			**0**	**0**	**12**	**12**	**9**
Skill Enhancement Course							
23SS756	Interpersonal Skills : Strategies	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**2**	**2**	**1**
Total (Theory + Practical+ Skill Enhancement)			**12**	**4**	**14**	**30**	**26**

*** Teaching Load**

**** To be evaluated in current semester**

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VIII

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Practical							
25CS4114	Major Project*	LP/ SI	0	0	24	24	12
Total (Theory + Practical+ Skill Enhancement)			**0**	**0**	**24**	**24**	**12**

** To be monitored at the Institute Level*

*** Teaching Load*

LIST OF ABILITY ENHANCEMENT COURSES

Total: 6 (3*2) Credits						
University Pool Common to all UG Programs						
Course Code	**Course**	**Category**	**L**	**T**	**P**	**Credits**
24HS101/24HS201 24HS151/24HS251	Communicative English Communicative English Lab	AEC	2	0	2	3
24 HIN101-I/24FLGR-I/24FLFR-I	Hindi/ German/French (Phase-I)	AEC	2	0	0	2
24 HIN101-II/24FLGR-II/24FLFR-II	Hindi/ German/French (Phase-II)	AEC	2	0	0	2

LIST OF SKILL ENHANCEMENT COURSES

Course Code	Course	Category	L	T	P	Credits
TECHNICAL TRAINING						
25CS0201A/ 25CS0201B/ 25CS0201C/ 25CS0201D	Data Structure and Algorithms using C or C++/ Industry Automation Level-I/ Digital Marketing/ Fundamentals of CAD for Engineers	SEC	0	0	2	1
25CS0202A/ 25CS0202B/ 25CS0202C	Introduction to SPSS Tool/ Design Thinking and Augmented Virtual Reality/ Programming Using Python for Engineers	SEC	0	0	2	1
25CS0301A/ 25CS0301B/ 25CS0301C/ 25CS0301D/ 25CS0301E	Wearable Technology /Big Data Analytics, Tools and Techniques/ Machine Learning using Python/ Industry Automation Level-II/ RCC Structure Drawing Training	SEC	0	0	2	1
25CS0302A/ 25CS0302B/ 25CS0302C/ 25CS0302D	Artificial Intelligence and Machine Learning/ MATLAB for Engineers/ Structural Analysis using FEM-based Tools/ Data Analytics Tools	SEC	0	0	2	1
SOFT SKILL						
23SS351	Effective Communication Skills	SEC	0	0	2	1
23SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	1
23SS553	Presentation Skills	SEC	0	0	2	1
23SS654	Professional Skills	SEC	0	0	2	1
23AR755	Aptitude and Reasoning	SEC	0	0	2	1

LIST OF VALUE ADDED COURSES

Total: 6 (2*3) Credits						
Course Code	**Course**	**Category**	**L**	**T**	**P**	**C**
23ESEB101/ 23ESEB201	Environment Bioengineering	VAC	2	0	0	2
23VAC101/ 23VAC201	Environment Protection and Sustainable Development	VAC	2	0	0	2
23VAC102/23VAC202	Indian Constitution and Polity	VAC	2	0	0	2
23VAC103	Sports, Yoga and Fitness	VAC	1	0	2	2
Note:						
All Courses are compulsory for the students.						
Students would be encouraged to opt for NCC/NSS.						

LIST OF MULTIDISCIPLINARY COURSES (HUMANITIES & SOCIAL SCIENCES COURSES) (HSS)

Total: 9 (3*3) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23MDC101/ 24MDC101A/ 24MDC101B/ 24MDC101C/ 24MDC101D	(MDC-I)	Statistical Methods/ Computer-Based Numerical and Statistical Technique/ Probability and Random Process/ Biostatistics/ Numerical Methods	3	0	0	3
23MDC102		Environmental Geosciences & Disaster Management	3	0	0	3
23MDC301		IPR in Business	3	0	0	3
23MDC302		Library Information Sciences & Media Literacy	3	0	0	3
23MDC401		Management Process & Organizational Behaviour	3	0	0	3
23MDC103	(MDC-II)	Photonics	3	0	0	3
23MDC104		Chemistry & Society	3	0	0	3
23MDC303		Psychology and Emotional Intelligence	3	0	0	3
23MDC304		Indian Economy	3	0	0	3
23MDC402		Creating an Entrepreneurial Mind	3	0	0	3
24MDC 106A/ 24MDC 106B		Numerical Methods in BME/ Discrete Mathematics	3	0	0	3
23MDC105	(MDC-III)	Life Sciences & Public Health	3	0	0	3
23MDC305		Electoral Literacy in India	3	0	0	3
23MDC403		Personal Financial Planning	3	0	0	3
23MDC404		Interior Design	3	0	0	3
24MDC107		Probability & Statistics	3	0	0	3

Note

1. These courses will be of introductory level and shall have 3 credits.
2. Students will not be allowed to choose or repeat the courses already gone through in class XII and present in Program core and specialization.
3. Students will have the option to choose any 3 out of the pool.

*The course shall be based on applications, tools and techniques.

LIST OF DEPERTMENTAL ELECTIVE COURSES

1. Specialization-I

Elective	Course Code	Course	Category	L	T	P	C
I	25CSPE2007	Computer Architecture & Organization	PE	3	1	0	4
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/ 25CSPE2118	Analysis and Design of Algorithms /Algorithms Lab	PE	3	0	1	4
IV	25CSPE3001/ 25CSPE3117	Compiler Design/CD Lab	PE	3	1	1	5
V	25CSPE3003/ 25CSPE3113	Computer Networks/CN Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/SE Lab	PE	3	0	1	4
VII	25CSPE3030	Neural Networks & Fuzzy Logic	PE	3	1	0	4
	25CSPE3038	Business Intelligence	PE	3	1	0	4
	25CSPE3032	Cyber Security	PE	3	1	0	4
	25CSPE4037	NASSCOM Associate Analytics – II	PE	3	1	0	4
VIII	25CSPE4025	Data Warehousing & Data Mining	PE	3	1	0	4
	25CSPE4039	NASSCOM Associate Analytics – III	PE	3	1	0	4
	25CSPE4019	Network Security & Cryptography	PE	3	1	0	4

1. **Specialization-II**

Elective	Course Code	Course	Category	L	T	P	C
I	25CSPE2007	Computer Architecture & Organization	PE	3	1	0	4
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/ 25CSPE2118	Analysis and Design of Algorithms /Algorithms Lab	PE	3	0	1	4
IV	25CSPE3001/ 25CSPE3117	Compiler Design/CD Lab	PE	3	1	1	5
V	25CSPE3003/ 25CSPE3113	Computer Networks/CN Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/SE Lab	PE	3	0	1	4
VII	25CSPE3024	Software Project Management	PE	3	1	0	4
	25CSPE3028	Object Oriented Analysis & Design	PE	3	1	0	4
	25CSPE3034	Design Thinking	PE	3	1	0	4
VIII	25CSPE4033	Software Testing	PE	3	1	0	4
	25CSPE4031	Open Source Software	PE	3	1	0	4

2. Specialization-III

Elective	Course Code	Course	Category	L	T	P	C
Elective	**Course Code**	**Course**	**Category**	**L**	**T**	**P**	**C**
I	25CSPE2007	Computer Architecture & Organization	PE	3	1	0	4
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/ 25CSPE2118	Analysis and Design of Algorithms /Algorithms Lab	PE	3	0	2	4
IV	25CSPE3001/ 25CSPE3117	Compiler Design/CD Lab	PE	3	1	2	5
V	25CSPE3003/ 25CSPE3113	Computer Networks/CN Lab	PE	3	1	2	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/SE Lab	PE	3	0	2	4
VII	25CSPE3020	Distributed Operating System	PE	3	1	0	4
	25CSPE3026	Grid Computing	PE	3	1	0	4
	25CSPE3040	Internet of Things	PE	3	1	0	4
VIII	25CSPE4023	Wireless Adhoc and Sensor Network	PE	3	1	0	4
	25CSPE4035	Advanced Java Programming	PE	3	1	0	4
	25CSPE4027	Mobile Computing	PE	3	1	0	4

EVALUATION SCHEMES

The bifurcation of Continuous Evaluation (Internal) and End Semester Evaluation marks are as under:

S.No	Course	Continuous Evaluation (Internal)	End Semester	Remarks
1	Professional (PC) : Theory	40	60	
2	Professional Electives –Programme Specific Electives-Theory	40	60	
3	Open Electives-Theory	40	60	
4	Humanities & Social Sciences including Management Courses (HSS)-Theory	40	60	
5	Practical /Workshop - Practical	60	40	
6	Skill Enhancement Courses (SEC)	70	30	
7	Technical Enhancement Courses (TEC)	70	30	
8	Live Projects & Industry Visits (LP/IV) and Internship	60	40	
9	Dissertation/Project	60	40	

SEMESTER - I & SEMESTER – II

SEMESTER – III

INDUSTRY SESSION: AI & ML	
Course Code: 25AL3110	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO's)
1. Understand the real-world applications of AI & ML across industries.
2. Learn about essential skills, tools, and industry standards.
3. Explore job roles and career pathways in AI & ML.
4. Discuss challenges and ethical considerations in AI.

COURSE LEARNING OUTCOMES (CLO's)
1. **Identify** and **explain** real-world applications of Artificial Intelligence (AI) and Machine Learning (ML) across various industries.
2. **Describe** key skills, tools, frameworks, and industry standards relevant to AI and ML practices.
3. **Analyze** different job roles and career pathways in the AI/ML domain and align them with personal goals and skill sets.
4. **Discuss** major challenges and ethical considerations related to the development and deployment of AI systems.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

COs / CLOs	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	✓			
CO2		✓	✓	
CO3			✓	
CO4				✓

Mapped SDGs: SDG-9, SDG-11 & SDG-17

List of Programs

Write a python program to check given no. is positive, negative or zero.

1. Write a python program to get the statistical summary and nature of the data of a given data frame.
2. Draw a different chart and plots (i.e., bar, histogram, pie, line, scattered, and box) for the given data set. [Draw a chart for the given data set.]
3. Write a program to implement Linear Regression algorithm and Logistic Regression algorithm.
4. Write a program to implement k-Nearest Neighbour algorithm to classify data set.
5. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier.

7. Write a program for clustering using k-Means algorithm and Hierarchical clustering algorithm.
8. **Case Study (Generative AI):** Text/image/audio generation using AI models (e.g., ChatGPT, DALL·E, MusicLM).
9. **Case Study (Agentic AI):** Autonomous AI agents that perform tasks proactively using planning, reasoning, and tools (e.g., AutoGPT, BabyAGI).
10. **Case Study (Decision Intelligence Platform):** Combine AI, data analytics, and decision modeling to aid strategic decisions.

Project Statement

Project Title – Text Message Classification Spam or Legitimate

How often have we come across messages saying we have won a trip to Hawaii or won a million dollar or won a cash prize. This form of scam through text messages which are generally spam messages is called smishing. A lot of times they ask us to fill in forms and ask our personal information or SSN number which is really fishy or bound to be a fraud. The goal of this project is to use Data Science to accurately classify whether a message is spam or not.

Since not all online reviews are truthful and trustworthy, it is important to develop techniques for detecting review spam. By extracting meaningful features from the text using Natural Language Processing (NLP), it is possible to conduct review spam detection using various machine learning techniques. Additionally, reviewer information, apart from the text itself, can be used to aid in this process. In this project, we survey the prominent machine learning techniques that have been proposed to solve the problem of review spam detection and the performance of different approaches for classification and detection of review spam.

TEXT/REFERENCE BOOKS

1. **Python Data Science Handbook**: Essential Tools for Working with Data by Jake VanderPl
2. **Python Crash Course:** by Eric Matthes (3rd Edition, 2023)

OPEN EDUCATION RESOURCES

1. MIT OpenCourseWare. (2023). *Artificial Intelligence (6.034), Fall 2023*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2023
2. MIT OpenCourseWare. (2023). *Artificial Intelligence (6.034), Fall 2023*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2023
3. Srinivasa, K. G. (n.d.). *Introduction to artificial intelligence* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/106/106/106106179/

SEMESTER – IV

MATHEMATICAL FOUNDATION FOR AI	
Course Code: 25AL4002	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES

1. **Foundational Knowledge**: Introduce fundamental mathematical concepts essential for understanding AI and machine learning.
2. **Problem-Solving Skills**: Equip students with the ability to apply linear algebra, calculus, probability, and discrete mathematics to solve AI-related problems.
3. **AI Relevance**: Demonstrate the role of mathematics in AI applications like data representation, optimization, and decision-making.
4. **Practical Understanding**: Provide hands-on experience in implementing mathematical models using computational tools.
5. **Preparation for Advanced Topics**: Lay the groundwork for more advanced AI and machine learning courses.

COURSE LEARNING OUTCOMES (CLO)

After completion of course, students would be able to:

1. **Apply Linear Algebra**: Use vectors, matrices, and their operations in data representation and transformations, including simple dimensionality reduction techniques.
2. **Understand Probabilistic Models**: Analyze problems involving uncertainty using basic probability concepts, Bayes' theorem, and distributions.
3. **Perform Basic Optimization**: Utilize derivatives and gradient-based methods for optimizing mathematical functions relevant to AI models.
4. **Use Discrete Structures**: Implement foundational concepts from logic, set theory, and graph theory to represent and solve AI problems such as search and traversal.
5. **Develop Simple AI Models**: Apply mathematical techniques to implement basic AI applications, such as linear regression and simple classifiers, using programming tools.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-4, SDG-8, SDG-9, & SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Linear Algebra Basics** **Vectors and Matrices**: Introduction to vectors and matrices, Basic operations: Addition, scalar multiplication, and dot product, Matrix multiplication and transpose, Identity and inverse matrices; **Systems of Linear Equations**: Solving systems using row reduction, Gaussian elimination; **Applications in AI**: Representing data as matrices, Introduction to dimensionality reduction.
UNIT-II	**Probability and Statistics Foundations** **Probability Basics**: Definition of probability and basic rules, Conditional probability and independence, Bayes' theorem (basic applications); **Introduction to Random Variables**: Mean, variance, and standard deviation, Introduction to common distributions (Uniform, Normal); **Applications in AI**: Probability in decision-making, Basics of Naïve Bayes classifier.
UNIT-III	**Calculus Essentials** **Differential Calculus**: Functions and limits, Derivatives and their interpretation, Gradients and basic optimization concepts; **Integral Calculus**: Understanding definite and indefinite integrals, Simple applications in AI: Area under curves for probability; **Applications in AI**: Gradient descent (basic idea, no heavy proofs), Cost function minimization.
UNIT-IV	**Discrete Mathematics Fundamentals** **Set Theory**: Basic operations on sets, Cartesian products and power sets, **Logic and Propositional Calculus**: Propositional and predicate logic, Basic logical operations and truth tables; **Graph Theory**: Introduction to graphs, vertices, and edges, Simple graph traversal: BFS and DFS; **Applications in AI**: Search problems (e.g., shortest path), Knowledge representation using logic.
UNIT-V	**Introduction to AI Applications** **Numerical Methods**: Simple numerical solutions to equations, Basics of iterative methods; **Information Theory**: Introduction to entropy and its relevance, Basics of mutual information, **Hands-On Applications**: Linear regression (using least squares method), Basic classification (e.g., perceptron algorithm).

TEXT/REFERENCE BOOKS

1. G. Strang, *Introduction to Linear Algebra*, 5th ed., Wellesley, MA: Wellesley-Cambridge Press, 2016.
2. H. Anton, I. Bivens, and S. Davis, *Calculus: Early Transcendentals*, 11th ed., Hoboken, NJ: Wiley, 2016.
3. S. M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, 6th ed., Amsterdam: Elsevier, 2020.
4. M. P. Deisenroth, A. A. Faisal, and C. S. Ong, *Mathematics for Machine Learning*, Cambridge, U.K.: Cambridge University Press, 2020.
5. K. H. Rosen, *Discrete Mathematics and Its Applications*, 8th ed., New York, NY: McGraw-Hill, 2019.
6. T. M. Cover and J. A. Thomas, *Elements of Information Theory*, 2nd ed., Hoboken, NJ: Wiley, 2006.

OPEN EDUCATION RESOURCES

1. Srinivasa, K. G., & Anuradha, J. (n.d.). *Mathematical foundations for artificial intelligence* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/106/106/106106224/
2. Deisenroth, M. P., Faisal, A. A., & Ong, C. S. (2020). *Mathematics for machine learning*. Cambridge University Press. https://mml-book.github.io/
3. MIT OpenCourseWare. (2010). *Mathematics for computer science (6.042J)*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/

SEMESTER – V

MACHINE LEARNING	
Course Code: 25AL5003	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES
1. To introduce students to the foundational concepts and types of machine learning, including supervised and unsupervised learning.
2. To provide an understanding of basic machine learning models, such as regression, classification, and clustering, and their applications.
3. To equip students with practical skills in using Python libraries for implementing machine learning algorithms.
4. To introduce the basics of neural networks and their role in solving real-world problems.
5. To create awareness of the ethical considerations, challenges, and societal impact of machine learning technologies.

COURSE LEARNING OUTCOMES (CLO)
After completion of course, students would be able to:
1. Explain the fundamental principles of machine learning and differentiate between supervised and unsupervised learning.
2. Implement basic regression and classification models using Python for practical problem-solving.
3. Apply clustering techniques and dimensionality reduction methods to analyze and visualize data.
4. Develop simple neural networks using frameworks like TensorFlow or Keras for introductory-level deep learning tasks.
5. Analyze and discuss ethical challenges in machine learning, including fairness, bias, and societal impact

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-4, SDG-8, SDG-9, SDG-10, SDG-11, SDG-17

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Basics of Machine Learning** **Introduction to Machine Learning: About** machine learning, Real-world examples: spam filtering, image recognition, recommendation systems; Types of machine learning: supervised, unsupervised, reinforcement learning; **Understanding Data:** Features, labels, and datasets, Types of data: structured vs. unstructured, Data preprocessing: handling missing values, normalization; **Introduction to Python for ML:** Overview of libraries: NumPy, pandas, matplotlib, scikit-learn.
UNIT-II	**Supervised Learning Basics** **Regression:** Concept of regression and its applications, Linear regression with a single variable, Metrics: mean absolute error, mean squared error; **Classification:** Binary classification: logistic regression, Introduction to decision trees. Performance evaluation: accuracy, precision, recall, F1-score; **Hands-on Exercises:** Simple regression and classification problems using scikit-learn.
UNIT-III	**Unsupervised Learning Essentials** **Clustering:** Concept of clustering and its applications, k-means clustering; **Association:** Association Rule Mining, Apriori Algorithm, ECLAT (Equivalence Class Clustering and bottom-up Lattice Traversal), **Dimensionality Reduction:** Basics of Principal Component Analysis (PCA), Applications of dimensionality reduction, **Hands-on Implementation:** Using Python to perform clustering and PCA
UNIT-IV	**Introduction to Neural Networks** **Basics of Neural Networks:** Concept of perceptron and activation functions, Simple feedforward neural networks; **Deep Learning Introduction:** Overview of deep learning and its real-world applications, Using pre-trained models for basic tasks; **Practical Work:** Simple neural network implementation with TensorFlow/Keras
UNIT-V	**Applications and Ethics in Machine Learning** **Applications of Machine Learning:** Case studies: healthcare, finance, recommendation systems; **Challenges in Machine Learning:** Overfitting and underfitting, Data bias and fairness; **Ethics in Machine Learning:** Privacy concerns and explainability of models, The role of AI in society.

TEXT/REFERENCE BOOKS

0. **T. M. Mitchell**, *Machine Learning*. New York, NY, USA: McGraw-Hill, 1997.

1. **A. Géron**, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019.

- **S. Raschka and V. Mirjalili**, *Python Machine Learning*, 3rd ed. Birmingham, UK: Packt Publishing, 2019.

- **C. M. Bishop**, *Pattern Recognition and Machine Learning*. New York, NY, USA: Springer, 2006.

- **I. Goodfellow, Y. Bengio, and A. Courville**, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.

OPEN EDUCATION RESOURCES

1. **Aggarwal, C. C.** (n.d.). *Machine learning* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/106/106/106106202/
2. **Google.** (n.d.). *Machine learning crash course*. https://developers.google.com/machine-learning/crash-course
3. **Stanford University.** (n.d.). *CS229: Machine learning* [Lecture Notes]. Stanford University. https://cs229.stanford.edu/

SEMESTER – VI

IMAGE PROCESSING LAB	
Course Code:	Continuous Evaluation: 40 Marks
Pre-Requisite : Python and Machine Learning	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
1. To understand the fundamental concepts of digital images and their processing.
2. To implement image enhancement, restoration, and segmentation techniques.
3. To apply filtering and morphological operations for noise removal and feature extraction.
4. To explore basic image compression techniques.

COURSE LEARNING OUTCOMES (CLO's)
1. **Explain** fundamental concepts of digital images, including image formation, representation, and basic properties.
2. **Implement** techniques for image enhancement, restoration, and segmentation using programming tools.
3. **Apply** spatial and frequency domain filtering, as well as morphological operations, for noise removal and feature extraction.
4. **Demonstrate** basic image compression techniques and **analyze** their effectiveness in reducing storage while preserving quality.

COs / CLOs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3		✓	✓	
CO4				✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-9, SDG-11 & SDG-17

List of Programs

1. To study different types of images : Load and display grayscale, RGB, and binary images using MATLAB/Python.
2. To understand how images are digitized and quantized : Convert an image into different resolutions and analyze its effects.
3. To perform basic image manipulations like resizing, cropping, and format conversion: Read, modify, and save images in different formats (BMP, JPEG, PNG).

4. To implement brightness and contrast enhancement techniques: Adjust brightness and contrast using linear and nonlinear techniques.
5. To apply spatial filters for smoothing and sharpening images: Implement averaging and median filtering for noise removal; apply sharpening filters.
6. To identify different noise types in images: Add Gaussian and salt-and-pepper noise to images and analyze their effects.
7. To implement median filtering and basic frequency domain filtering: Remove salt-and-pepper noise using median filtering.
8. To implement simple and adaptive thresholding for segmentation: Convert grayscale images into binary images using thresholding techniques.
9. To apply edge detection techniques to images: Implement Sobel and Canny edge detection filters.
10. To perform dilation, erosion, and their applications: Apply morphological operations for noise removal and feature extraction.
11. To study basic image compression techniques: Compress and decompress an image using JPEG compression.
12. **Case Study:** Automated Tumor Detection in Brain MRI Images (Build an image processing pipeline to classify or segment brain tumors using MRI images.)
13. **Case Study:** Fingerprint-Based Attendance System (Design a system that uses fingerprint images for authentication).

Tools Required

- **Software:** MATLAB / Python (OpenCV, NumPy, Matplotlib)
- **Hardware:** Standard PC with necessary software installed

References

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing," Pearson.
2. Anil K. Jain, "Fundamentals of Digital Image Processing," PHI Learning.

OPEN EDUCATION RESOURCES
4. **Prof. P. K. Biswas.** (n.d.). *Digital image processing* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/117/105/117105135/ 5. **Scikit-Image Documentation.** (n.d.). *scikit-image: Image processing in Python*. https://scikit-image.org/ 6. **MIT OpenCourseWare. (2004).** *Digital signal processing (6.341)*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-341-discrete-time-signal-processing-fall-2005/

Deep Learning LAB	
Course Code: 25AL6104	Continuous Evaluation: 40 Marks
Pre-Requisite : Python/MATLAB	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
1. Develop proficiency in installing and utilizing deep learning frameworks like TensorFlow and Keras for model development and experimentation.
2. Implement various neural network architectures, including basic neural networks, CNNs, and RNNs, for tasks such as image classification and text analysis.
3. Apply regularization methods like L2 and dropout, perform hyperparameter tuning, and leverage transfer learning to enhance model performance.
4. Utilize deep learning techniques to address real-world problems by preprocessing datasets, training models, and evaluating results in a comprehensive final project.

COURSE LEARNING OUTCOMES (CLO's)
1. **Install** and **use** deep learning frameworks like TensorFlow and Keras for developing and experimenting with neural network models.
2. **Implement** different neural network architectures (e.g., basic NN, CNN, RNN) for tasks such as image classification and text analysis.
3. **Apply** regularization techniques (e.g., L2, dropout), **perform** hyperparameter tuning, and **use** transfer learning to improve model performance.
4. **Develop** a complete deep learning solution for a real-world problem, including dataset preprocessing, model training, evaluation, and result interpretation.

COs / CLOs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-9, SDG-11 & SDG-17

List of Programs

1. Install TensorFlow and Keras. Write a simple script to verify installation, Load and visualize a sample dataset (e.g., MNIST).
2. Implement a basic neural network using Keras for the MNIST dataset, Train the model and evaluate accuracy, Experiment with one activation function (ReLU or Sigmoid).
3. Implement a CNN for classifying the MNIST dataset, Use convolution, pooling, and dense layers, Evaluate the model's performance.
4. Add L2 regularization to a neural network, Use dropout regularization in a CNN, Compare model performance with and without regularization.
5. Implement a simple RNN for text classification or sentiment analysis (using the IMDB dataset), Train and evaluate the model.
6. Use a pre-trained CNN (e.g., VGG16) on a new dataset (e.g., CIFAR-10), Fine-tune the pre-trained model for the specific dataset, Evaluate the model's performance.

7. Tune the learning rate, batch size, and number of epochs for a neural network, Observe the effect of tuning on model accuracy.
8. Build a simple autoencoder to perform dimensionality reduction (using MNIST or CIFAR-10), Evaluate the reconstruction error of the model.
9. Choose a real-world dataset (e.g., image classification, sentiment analysis), Preprocess the data, build a model (CNN or RNN), and train the model, Evaluate model performance and present results.
10. To understand the architecture and working of Generative Adversarial Networks (GANs) and implement a basic GAN for generating handwritten digits using the MNIST dataset.

Tools Required

- **Software:** MATLAB / Python (OpenCV, NumPy, Matplotlib)
- **Hardware:** Standard PC with necessary software installed

References

3. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing," Pearson.
4. Anil K. Jain, "Fundamentals of Digital Image Processing," PHI Learning.
5. MATLAB/Python documentation for image processing.

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7. **Balasubramanian, V. N.** (n.d.). *Deep learning* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/106/106/106106213/

8. **Google.** (n.d.). *TensorFlow tutorials*. TensorFlow.org. https://www.tensorflow.org/tutorials

9. **MIT OpenCourseWare.** (2022). *Deep learning for self-driving cars (6.S191)*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s191-introduction-to-deep-learning-january-iap-2020/

Computer Vision	
Course Code: 25AL7001	Continuous Evaluation: 30 Marks
Pre-Requisite : Machine Learning & Image Processing	End Semester Examination: 70 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES
● To introduce students to the fundamental concepts of computer vision, including image representation and basic image processing techniques.
● To develop an understanding of geometric transformations, feature detection, and their applications in computer vision tasks.
● To provide foundational knowledge of machine learning techniques relevant to vision tasks, including neural networks and transfer learning.
● To enable students to implement real-world computer vision applications using popular tools and libraries like OpenCV.
● To foster an appreciation for the ethical implications of computer vision, including issues of privacy and bias in automated systems.

COURSE LEARNING OUTCOMES (CLO)
After completion of course, students would be able to:
● Understand and explain the basic principles of computer vision, including image formation, processing, and enhancement techniques.
● Perform geometric transformations and apply feature detection methods to analyze and manipulate images.
● Use machine learning and neural network-based techniques to solve simple image classification problems.
● Implement practical computer vision applications, such as face detection and optical character recognition, using OpenCV.
● Demonstrate awareness of ethical considerations in computer vision applications and propose strategies to address challenges like bias and privacy concerns.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-4, SDG-8, SDG-9, SDG-10, SDG-11, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Computer Vision and Image Basics** **Understanding Digital Images:** Pixels, resolution, image formats, and color spaces (grayscale, RGB, HSV); **Basic Image Processing:** Image filtering (smoothing, sharpening), Edge detection (Sobel, Canny); **Overview of Applications:** image classification, object detection, facial recognition, AR/VR. **Introduction to OpenCV:** Setting up OpenCV in Python, Basic operations: reading, displaying, and saving images.
UNIT-II	**Geometric Transformations and Image Enhancements** **Image Transformations:** Scaling, rotation, translation, Flipping and cropping images; **Image Enhancements:** Histogram equalization for brightness adjustment, Thresholding (binary and adaptive); **Perspective Transformations:** Understanding homography, Correcting distorted images (e.g., documents, planar objects).
UNIT-III	**Feature Detection and Matching** **Introduction to Features:** Features in images, Corner detection (Harris corner); **Feature Descriptors:** Introduction to SIFT, ORB (basic understanding), Matching techniques (Euclidean distance, Brute-Force Matcher); **Applications of Feature Matching:** Image stitching (basic concept).
UNIT-IV	**Machine Learning Basics for Computer Vision** **Introduction to Machine Learning in Vision:** Overview of supervised learning for image classification, Basic concepts: training, testing, accuracy, and datasets (MNIST, CIFAR-10); **Introduction to Neural Networks for Vision:** Basics of neural networks: layers, weights, and activations; **Using Pre-trained Models:** Understanding transfer learning, Overview of popular pre-trained CNN models like VGG16, ResNet, MobileNet, DenseNet; **Vision Transformers:** Architecture of ViTs, Implementation and Training of ViTs; Applications of Vision Transformers.
UNIT-V	**Real-World Applications and Simple Projects** **Real-World Applications:** Object detection basics (overview of YOLO and Haar cascades), Face detection and recognition using OpenCV, Basic understanding of optical character recognition (OCR); **Ethics in Computer Vision:** Challenges related to bias and privacy in vision systems; **Mini-Projects:** Build a face detection system, Implement OCR to extract text from an image.

TEXT/REFERENCE BOOKS

1. R. Szeliski, *Computer Vision: Algorithms and Applications*, 2nd ed. Springer, 2022.
2. G. Bradski and A. Kaehler, *Learning OpenCV 4: Computer Vision with Python*, 1st ed. O'Reilly Media, 2019.
3. D. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*, 2nd ed. Pearson, 2011.
4. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, 1st ed. MIT Press, 2016.
5. A. Bovik, *The Essential Guide to Image Processing*, 2nd ed. Academic Press, 2009.

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10. *OpenCV Documentation*. [Online]. Available: https://docs.opencv.org/

11. A. Ng, *Deep Learning Specialization*, Coursera. [Online]. Available: https://www.coursera.org/specializations/deep-learning

12. A. Ng, *Deep Learning Specialization*, Coursera. [Online]. Available: https://www.coursera.org/specializations/deep-learning

Introduction to Robotics	
Course Code: 25AL7005	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 4 0 0	
Credits: 4	

COURSE OBJECTIVES(COs)

1. **Introduce basic robotics concepts**: To provide students with a foundational understanding of robotics, including robot types, components, and basic operations.
2. **Develop practical skills with robot components**: To teach students how to interact with and control robot sensors, actuators, and basic control systems using hands-on experiments.
3. **Understand robot motion and kinematics**: To provide knowledge of simple kinematics, including forward and inverse kinematics, as well as basic control methods for robotic movement.
4. **Introduce control systems for robotics**: To introduce the principles of robot control, focusing on basic open-loop and closed-loop control mechanisms like PID for robot motion control.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. **Understand fundamental robotics components**: Students will be able to identify and explain the roles of key robot components, such as sensors, actuators, and control units.
2. **Demonstrate basic robot kinematics**: Students will be able to apply basic kinematic models to calculate and simulate the movement of a robot's end effector.
3. **Control robot movement using basic control systems**: Students will be able to implement basic control techniques (e.g., PID control) to manage robot motion and speed.
4. **Build and program simple robots**: Students will develop the ability to design and program simple robots to perform tasks such as line following and obstacle avoidance.

COURSE LEARNING OUTCOMES (CLOs)-COURSE OBJECTIVES (COs) MAPPING

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2				✓	
CO3		✓			
CO4			✓	✓	
CO5					✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-4, SDG-8, SDG-9, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Robotics and Robot Components** **Introduction**: Definition, history, and types of robots (industrial, mobile, autonomous); **Basic Components of Robots**: Actuators (motors and servos), sensors (proximity, touch, infrared, ultrasonic), and control units; **Robot Structure**: Simple robot architectures and degrees of freedom; **Basic Operations**: Input-output flow, control logic, and actuators.
UNIT-II	**Robot Kinematics** **Basic Kinematics**: Robot movement, linear and rotational motion; **Coordinate Systems**: Overview of Cartesian and polar coordinate systems; **Forward Kinematics**: Calculating the position of the robot's end effector based on joint parameters (simplified version); **Inverse Kinematics**: Introduction to solving inverse kinematics problems (concepts only, not complex math).
UNIT-III	**Actuators and Sensors** **Actuators**: Types of motors used in robots (DC motors, servos, stepper motors), and their control basics; **Sensors**: Types of sensors used in robotics, including ultrasonic sensors, infrared sensors, and touch sensors; **Control of Actuators and Sensors**: Basic interfacing of sensors and actuators with microcontrollers (e.g., Arduino or Raspberry Pi).
UNIT-IV	**Robot Control** **Introduction to Robot Control**: Control in robotics, Open-loop vs. closed-loop control; **PID Control**: Basic understanding of the Proportional-Integral-Derivative (PID) controller and its application in robot motion; **Motion Control**: How motors and actuators are controlled for movement.
UNIT-V	**Basic Applications of Robotics** **Robotics in Everyday Life**: Basic examples of robots used in household tasks (vacuum robots, robotic arms in manufacturing); **Mobile Robots**: Simple mobile robots, line-following robots, and obstacle-avoidance robots; **Collaborative Robots (Cobots)**: Introduction to how robots can collaborate with humans in workspaces; **Robotic Process Automation (RPA)**: RPA, RPA Vs traditional robotics; **RPA Tools**: Introduction to UiPath, Blue Prism, Automation Anywhere, Power Automate.

TEXT/ REFERENCE BOOKS

- **John J. Craig**, *Introduction to Robotics: Mechanics and Control*, 3rd ed., Pearson, 2005.
- **S. K. Saha**, *Introduction to Robotics*, Pearson Education, 2008.
- **M. P. T. P. S. Sharma**, *Introduction to Robotics*, PHI Learning, 2017.
- **Peter Corke**, *Robotics, Vision and Control: Fundamental Algorithms in MATLAB*, Springer, 2017.

5. **Oussama Khatib**, *Introduction to Robotics: A Guide for Practical Applications*, Wiley, 2007.
6. **Mark W. Spong, Seth Hutchinson, M. Vidyasagar**, *Robot Modeling and Control*, Wiley, 2006.
7. **J. Edward. K. Smith**, *Robot Dynamics and Control*, Wiley, 1990.
8. **J. B. J. Moore and S. L. McFarlane**, *Control of Robot Manipulators*, Prentice Hall, 1993.

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13. **Prof. Sudhir Kumar.** (n.d.). *Introduction to robotics* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/112/107/112107289/

14. **MIT OpenCourseWare. (2005).** *Introduction to robotics (6.141)*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-141-robotic-science-and-systems-i-fall-2005/

15. **Coursera / University of Pennsylvania.** (n.d.). *Robotics: Aerial Robotics* [Free to audit]. https://www.coursera.org/learn/robotics-flight

Natural Language Processing LAB	
Course Code: 25AL7103	Continuous Evaluation: 40 Marks
Pre-Requisite : Nil	End Semester Examination:60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. **Understanding Text Preprocessing and Representation:** Learn fundamental text preprocessing techniques, including tokenization, stemming, lemmatization, and feature extraction methods like Bag of Words (BoW) and TF-IDF for text analysis.
2. **Applying NLP Techniques for Text Analysis:** Implement core NLP tasks such as Part-of-Speech (POS) tagging, Named Entity Recognition (NER), and sentiment analysis using machine learning models and pre-trained frameworks.
3. **Developing and Evaluating NLP Models:** Build and train models for text classification, sequence modeling with RNNs, and word embeddings using deep learning techniques like Word2Vec, LSTMs, and GRUs, evaluating performance with appropriate metrics.
4. **Exploring Advanced NLP Applications:** Utilize transformer-based models such as BERT for text classification, implement text summarization using extractive and abstractive methods, and apply NLP techniques to real-world problems.

COURSE LEARNING OUTCOMES (CLO's)

1. **Apply** fundamental text preprocessing techniques such as tokenization, stemming, lemmatization, and represent text using BoW and TF-IDF.
2. **Implement** core NLP tasks including POS tagging, Named Entity Recognition (NER), and sentiment analysis using machine learning models and libraries.
3. **Develop** deep learning models for text classification and sequence modeling using RNNs, Word2Vec, LSTM, and GRU, and **evaluate** model performance using standard metrics.
4. **Utilize** advanced transformer-based models (e.g., BERT) for NLP tasks like classification and summarization, and **solve** real-world text-based problems.

COs / CLOs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-9, SDG-11 & SDG-17

List of Programs

1. Tokenize a text corpus into words and sentences, Perform case normalization, stopword removal & stemming, and apply lemmatization and compare the results with stemming.
2. Implement Bag of Words (BoW) to create a document-term matrix from a text corpus, Use TF-IDF to assign weights to terms in the corpus and compare the results.
3. Implement POS tagging using the NLTK or spaCy library, Visualize the POS tags for a sample text and analyze the results.
4. Use a pre-trained NER model from spaCy or Hugging Face, Extract named entities from a sample text and classify them into categories, Evaluate the results and visualize the named entities using entity recognition tools.
5. Preprocess a dataset of reviews or tweets and Implement sentiment analysis using a machine learning model (e.g., Naive Bayes or SVM), Evaluate the model performance using metrics such as accuracy and F1-score.
6. Build a text classification system using Naive Bayes on a labeled dataset (e.g., spam classification), Train and evaluate the model using accuracy and confusion matrix, Experiment with different text preprocessing steps and observe the impact on performance.
   Train a Word2Vec model on a text corpus, Visualize the word vectors using t-SNE or PCA to understand word similarities, Experiment with finding similar words or analogies using the trained Word2Vec model.
7. Build and train a simple RNN using TensorFlow or PyTorch to predict the next word in a sequence, Generate text based on the trained model and analyze its coherence, Experiment with LSTM (Long Short-Term Memory) and GRU (Gated Recurrent Unit) cells.
   Fine-tune a pre-trained BERT model on a classification dataset (e.g., sentiment analysis or spam detection), Use Hugging Face's Transformers library for model implementation and fine-tuning, Evaluate the performance of the model using metrics such as accuracy, precision, and recall.
   Implement extractive summarization using techniques like TF-IDF or TextRank, Experiment with an abstractive summarization model using pre-trained transformer models (e.g., BART), Evaluate the quality of summaries using ROUGE scores or human evaluation.

8. Implement the following (at least 3 system):
   a. Text-to-Speech System using NLP
   b. Build a Speech Recognition System
   c. Real-Time Language Translator (Speech to Speech)
   d. Design an Intelligent Voice-Based Interactive System
   e. Build an NLP-Based Chatbot

1. **Software Tools:**

- **Python Programming Language** – The primary language for NLP tasks.
- **Jupyter Notebook / Google Colab** – Interactive coding environment for executing NLP experiments.
- **NLTK (Natural Language Toolkit)** – For text preprocessing, tokenization, stemming, and POS tagging.
- **spaCy** – A fast NLP library for Named Entity Recognition (NER), POS tagging, and dependency parsing.
- **Scikit-learn** – Provides machine learning algorithms for text classification and sentiment analysis.
- **Gensim** – Used for training Word2Vec and topic modeling.
- **Hugging Face Transformers** – For implementing transformer-based models like BERT and GPT.
- **TensorFlow / PyTorch** – Deep learning frameworks for training RNNs, LSTMs, and Transformer models.

2. **Hardware Requirements:**

- **Computer or Laptop** – At least **8GB RAM** (16GB+ recommended for deep learning models).
- **GPU (Optional, but Recommended)** – Required for training large deep learning models efficiently.

3. Datasets & Text Corpora:

16. **NLTK Corpora** – Includes preloaded datasets like Gutenberg, Brown, and WordNet.
17. **IMDB Reviews Dataset** – Used for sentiment analysis tasks.
18. **Spam/Ham Email Dataset** – Used for text classification tasks.
19. **News Articles Dataset** – Used for Named Entity Recognition and text summarization.
20. **Custom Text Corpora** – Any dataset related to the chosen NLP problem statement for final projects.

4. **Additional Libraries & APIs:**

- **Matplotlib & Seaborn** – For data visualization and analysis.
- **BeautifulSoup & Scrapy** – For web scraping and collecting text data.
- **Tesseract OCR (Optional)** – For extracting text from scanned documents.

TEXT/ REFERENCE BOOKS
● **Daniel Jurafsky & James H. Martin**, *Speech and Language Processing*, 3rd Edition draft, 2023. ● **Denis Rothman**, *Transformers for Natural Language Processing*, 1st Edition, 2021.

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21. **Prof. Mausam.** (n.d.). *Natural language processing* [NPTEL Course]. National Programme on Technology Enhanced Learning. https://nptel.ac.in/courses/106/106/106106187/

- **Jurafsky, D., & Martin, J. H.** (2023). *Speech and language processing* (3rd ed. draft). https://web.stanford.edu/~jurafsky/slp3/

INDUSTRY SESSION: ROBOTICS	
Course Code: 25AL7100	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO)
1. To understand the fundamentals of **robotics**, including kinematics, dynamics, and control systems.
2. To gain insight into **robotic perception, sensors, and actuators** used in industrial and autonomous robots.
3. To interpret the impact of **robotics in industries**, such as manufacturing, healthcare, and automation.
4. To develop hands-on expertise in **robotic programming** using platforms like ROS (Robot Operating System).
5. To explore **AI-driven robotics**, including machine learning, deep learning, and vision-based automation.

COURSE LEARNING OUTCOMES (CLO)
After completion of course, students would be able to:
1. Understand how **robotics solutions** are transforming various industries.
2. Develop knowledge of **robotic motion planning, control algorithms, and simulation tools**.
3. Acquire hands-on expertise using **ROS, Python, and C++ for robot programming**.
4. Design and implement **autonomous robotic systems** using AI and computer vision techniques.
5. Explore real-world **robotics applications**, such as self-driving cars, robotic arms, and drones.

COs / CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

SUSTAINABLE DEVELOPMENT GOALS (SDGs): SDG-9, SDG-11 & SDG-17

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Robotics and Robotic Systems** Introduction to robotics, classification of robots, applications of robotics, overview of kinematics, dynamics, and control. Introduction to **robotic sensors and actuators**, and their roles in motion control
UNIT-II	**Robot Kinematics and Motion Planning** Forward and inverse kinematics, homogeneous transformations, trajectory planning, and velocity control. Implementing motion planning algorithms in **simulation environments like Gazebo or V-REP**.
UNIT-III	**Introduction to Robot Operating System (ROS) and Simulation** Overview of ROS, setting up ROS environment, understanding ROS topics, nodes, messages, and services. Hands-on projects using **TurtleBot and simulated robotic arms**.
UNIT-IV	**Artificial Intelligence in Robotics** Machine learning and deep learning applications in robotics. Introduction to **computer vision for robotics** using OpenCV. Object detection, SLAM (Simultaneous Localization and Mapping), and autonomous navigation techniques.
UNIT-V	**Robotics in Industry and Future Trends** Industrial robotics applications in **manufacturing, healthcare, agriculture, and autonomous vehicles**. Case studies on robotics in **Industry 4.0, warehouse automation, and surgical robots**. Future trends in **humanoid robotics, swarm robotics, and human-robot interaction (HRI)**.

List of Experiments:

1. Simulate a basic differential drive robot in a virtual environment (Tools: ROS, Gazebo/Webots, Python).
2. Implement forward and inverse kinematics for a 2-link planar manipulator (Tools: Python (NumPy/Matplotlib), or MATLAB Robotics Toolbox.
3. Interface sensors with microcontroller and display real-time readings (Tools: Arduino IDE, IR & ultrasonic sensors, Serial Monitor).
4. Control position and speed of actuators using PWM signals (Tools: Arduino or Raspberry Pi, Motor Driver Modules).
5. Use PID control logic to navigate a robot along a predefined path (Tools: Arduino, IR sensors, Python (for visualization)).
6. Control and navigate a TurtleBot in a ROS environment using teleoperation and autonomous navigation (Tools: ROS, RViz, TurtleBot Simulator).
7. Case Study: Analyze real-world robotic systems used in industry and present a case study report (Tools: Research-based (PPT, Report, Videos).

TEXT/ REFERENCE BOOKS

5. **John J. Craig**, *Introduction to Robotics: Mechanics and Control*, 4th Edition, 2017.
6. **Lentin Joseph**, *Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy*, 2nd Edition, 2021.

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- **IFR International Federation of Robotics.** (n.d.). *Robotics in industry: Reports and statistics*. https://ifr.org/ifr-press-releases/news