Gandhinagar Institute of Technology

Academic Regulation & Curriculum

for

B.Tech

in

Computer Science and Engineering
(Artificial Intelligence and Machine Learning)
(CSE-AI)

B.Tech PROGRAMME

***w.e.f.* 2026-27**

Preamble

We, the members of the Computer Science and Engineering (Artificial Intelligence) Department, are committed to fostering knowledge, innovation, and technical excellence in the field of Artificial Intelligence and emerging computing technologies. Our goal is to create a dynamic learning environment where students are encouraged to think critically, solve complex problems creatively, collaborate effectively, and develop practical skills to address real-world technological challenges.

The curriculum for the B.Tech. in Computer Science and Engineering (Artificial Intelligence) program has been revised in accordance with the guidelines of University Grants Commission (UGC), All India Council for Technical Education (AICTE), and National Credit Framework (NCrF), aligned with the National Education Policy 2020 (NEP), under Academic Regulation 2022, and blended with global standards inspired by IEEE, effective from the academic session 2026–2027. The program follows an Outcome-Based Curriculum (OBC) with a Choice-Based Credit System (CBCS), enabling students to build strong technical, analytical, and professional competencies through a multidisciplinary approach that aligns with industry demands, higher education pathways, and accreditation standards such as National Board of Accreditation (NBA) and National Assessment and Accreditation Council (NAAC).

To keep pace with rapid technological advancements and industry requirements, the curriculum includes modern and industry-relevant subjects such as Machine Learning, Deep Learning, Natural Language Processing, Computer Vision, Generative Artificial Intelligence, Data Science, Internet of Things (IoT), Cloud Computing, Cyber Security, Robotics, and Design Thinking & Innovation. In addition, students are introduced to emerging areas such as Explainable AI, Edge AI, AI Ethics, Intelligent Automation, and Human-Centered AI, preparing them for future opportunities in intelligent systems and advanced computing domains.

Students are encouraged to pursue MOOC courses and industry-recognized certifications to gain additional knowledge, practical exposure, and honors in specialized areas of Artificial Intelligence and related technologies.

The course coding system has been updated from the respective academic sessions, as recommended by the Office of the Controller of Examinations, to clearly distinguish the revised curriculum from previous versions and ensure systematic academic implementation.

The curriculum and syllabi are continuously reviewed and updated through a structured feedback mechanism involving key stakeholders such as faculty members, academic experts, industry professionals, alumni, and parents. This ensures that the program remains relevant, industry-oriented, practical, and future-ready.

With a strong emphasis on continuous learning, innovation, ethical responsibility, and adaptability, the department aims to develop skilled AI engineers, researchers, entrepreneurs, and future leaders capable of contributing effectively to society and addressing the evolving challenges of the intelligent digital world.

Table of Contents

1.Institutional Vision & Mission

1.1 VISION:

To create a flexible and learner-focused engineering ecosystem that builds strong technical skills, practical knowledge, and innovative thinking, preparing graduates to adapt, perform, and lead in a rapidly evolving technological and societal environment.

1.2 MISSION:

To provide a holistic learning environment that develops technical skilled, innovative, and socially responsible engineers capable of addressing industrial, technological, and societal needs.

2. Program Objectives

The program aims to:

PO1. Engineering Knowledge: Apply knowledge of mathematics, statistics, computer science, and engineering fundamentals to solve problems in Artificial Intelligence and related domains.
PO2. Problem Analysis: Identify, formulate, analyze, and solve complex AI and data-driven problems using computational thinking, machine learning techniques, and engineering principles.
PO3. Design/Development of Solutions: Design and develop intelligent systems, algorithms, and AI-based applications that address societal, industrial, and technological challenges while considering safety and ethical requirements.
PO4. Conduct Investigations of Complex Problems: Utilize research methodologies, data analysis, experimentation, and evaluation techniques to investigate AI-related problems and derive meaningful conclusions.
PO5. Modern Tool Usage: Select and apply modern AI frameworks, programming tools, data analytics platforms, cloud technologies, and software development environments for building intelligent solutions.
PO6. The Engineer and Society: Assess the impact of AI technologies on society, healthcare,

security, business, and public welfare, and perform professional responsibilities accordingly.

PO7. Environment and Sustainability: Develop AI-enabled solutions that contribute to sustainable development while considering environmental, economic, and social impacts.

PO8. Ethics: Demonstrate professional ethics, accountability, transparency, fairness, privacy protection, and responsible use of Artificial Intelligence technologies.

PO9. Individual and Team Work: Function effectively as an individual, team member, or leader in multidisciplinary and multicultural environments involving AI projects.

PO10. Communication: Communicate technical concepts, AI models, research findings, and project outcomes effectively through reports, presentations, and professional documentation.

PO11. Project Management and Finance: Apply project management principles, entrepreneurship skills, and financial considerations in planning and executing AI-based projects and innovations.

PO12. Life-long Learning: Engage in continuous learning and adapt to emerging trends, technologies, and advancements in Artificial Intelligence, Machine Learning, Data Science, and related fields.

3.Program Educational Objectives (PEOs)

PEO 1: To prepare graduates with strong foundations in Artificial Intelligence, Machine Learning, Data Science, and allied technologies for successful careers in industry, higher education, and research.

PEO 2: To equip graduates with analytical, computational, and problem-solving skills required to develop innovative AI-driven solutions for real-world challenges.

PEO 3: To enable graduates to design, develop, and deploy intelligent systems using modern AI tools, techniques, and engineering practices while adapting to emerging technologies.

PEO 4: To nurture professionals with ethical values, leadership qualities, effective communication skills, and a commitment to lifelong learning and societal well-being.

4.Program Details

4.1 Program Structure & Duration

- Duration & Intake: 4 Years & 120 Seats
- Semesters: 8
- Mode: Full Time
- Credit Structure: As per UGC/NCrF norms
- Medium of Instruction: English

4.2 Eligibility Criteria for Admission

Admission to the Bachelor of Technology (B.Tech.) program in Computer Science and Engineering (Artificial Intelligence) shall be governed by the norms and guidelines prescribed by the All India Council for Technical Education (AICTE), University Grants Commission (UGC), and the respective State Government/Admission Committee from time to time. Candidates seeking admission must have passed the Higher Secondary Examination (10+2) or its equivalent from a recognized board with Physics and Mathematics as compulsory subjects, along with one of the following subjects: Chemistry, Computer Science, Information Technology, Electronics or Biology. At least 45% aggregate marks (40% for reserved categories like SC/ST/OBC/EWS) in the above subjects taken together. Admission is typically based on merit in national/state tests (e.g., JEE Main, CUET, or state-level CETs) or university-specific entrance exams.

4.3Admission Procedure

Admission to the Bachelor of Technology (B.Tech.) program in Computer Science and Engineering (Artificial Intelligence) shall be granted based on merit, entrance examination scores, and reservation policies as applicable under the regulations of AICTE, UGC, and the affiliating university. The ACPC based admission process generally includes online registration, document verification, merit list publication, choice filling, seat allotment, payment of prescribed fees, and confirmation of admission. Reservation policies, eligibility requirements, and admission procedures shall be implemented as per the prevailing norms of ACPC, UGC, AICTE, and the affiliating university.

4.4 Credit Summary for B.Tech. Course in Computer Science and Engineering (Artificial Intelligence) with effect from 2026-2027

Sl. No.	Course Type	AI Cradit
1.	Humanities and Social Sciences including Management Courses	3
2.	Basic Science Courses	18
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	4
4.	Program Core Courses	100
5.	Multidisciplinary	0
6.	Project/Training	15
7.	Skills (AEC, VAC, SEC)	26
8.	Indian Knowledge System	08
	Total	**174**

Definition of Credit(as per UGC / AICTE):

- 1HourLecture(L)per Week=1Credit
- 1HourTutorial(T)per Week=1Credit
- 1HourPractical(P)per Week=0.5Credits
- 2HoursPractical(Lab)per Week

5.Curriculum Structure

(Gandhinagar Institute of Technology 01)								
Program Name: Bachelor of Technology (01) **Semester / Year :** 01 / 01			**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**					
NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCR – 4.5	10000101	Basic Science	Engineering Mathematics-I	5	3	2	0	5
	10050101	Professional Core	Programming for Problem Solving	5	4	0	2	6
	10010105	Engineering Science	Engineering Foundation	4	3	0	2	5
	10050102	Professional Core	ICT Fundamental & Workshop	4	4	0	0	4
	SEC001	SEC-I	Animation & Graphics Design	2	2	0	0	2
	VAC003	VAC-I	Awareness of Cyber crime and Ethical Hacking	2	2	0	0	2
	AEC016	AEC-I	Practical English	2	2	0	0	2
				24	**20**	**2**	**4**	**26**
Program Name: Bachelor of Technology (01) **Semester / Year :** 02 / 01			**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**					
NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCR – 4.5	10000201	Basic Science	Engineering Mathematics-II	5	3	2	0	5
	10000003	Basic Science	Engineering Physics	4	3	0	2	5
	10050201	Professional Core	Basics of Python / Fundamental of Civil	4	3	0	2	5
	10030101	Professional Core	Basic of Electrical& Electronics	4	3	0	2	5
	SEC019	SEC-II	Social Media Management	2	2	0	0	2
	VAC021	VAC-II	Stress & Time Management	2	2	0	0	2
	AEC015	AEC-II	Personality Development for Effective Leadership	2	2	0	0	2
	IKS0201	IKS	Indian Ancient Hystory& Cultural Heritage	2	1	0	2	3

				25	**19**	**2**	**6**	**26**

Program Name: Bachelor of Technology (01)	**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**
Semester / Year : 03 / 02	

NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCR – 5.0	10050301	Professional Core (IEEE)	Data Structures	4	3	0	2	5
	10050302	Professional Core (IEEE)	Database Management Systems	4	3	0	2	5
	10300301	Professional Core	Fundamentals of Artificial Intelligence	4	3	0	2	5
	10000302	Humanities and Social Science	Economics and Management	3	3	0	0	3
	10000301	Basic Science (IEEE)	Probability and Statistics	4	3	1	0	4
	VAC	VAC	Value Addition Course	2	2	0	0	2
			Total	**21**	**17**	**1**	**6**	**24**

Program Name: Bachelor of Technology (01)	**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**
Semester / Year : 04 /02	

NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCR – 5.0	10050402	Professional Core (IEEE)	Operating System	4	3	0	2	5
	10300401	Professional Core (IEEE)	Machine Learning	4	3	0	2	5
	10300403	Professional Core (IEEE)	Reinforcement Learning	4	3	0	2	5
	10300406	Professional Core (IEEE)	Statistical Methods	4	3	1	0	4
	SEC	SEC	Skill Enhancement Course	2	2	0	0	3
	IKS	IKS	Indian Knowledge Systems	2	2	0	0	2
			Total	**20**	**16**	**1**	**6**	**24**

\

Program Name: Bachelor of Technology (01)	**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**

Semester / Year : 05 / 03								
NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCR – 5.5	10270501	Professional Core (NPTEL)	Computer Communication and Network	4	3	0	2	5
	10300501	Professional Core (NPTEL)	Neural Networks and Deep Learning	4	3	0	2	5
	10270504	Professional Core (NPTEL)	Data Analysis and Visualization	4	3	0	2	5
	10300504	Professional Core (IEEE)	Computer Vision	4	3	0	2	5
	-	Professional Elective (IEEE)	Professional Elective - I	4	3	0	2	5
	AEC	AEC	Ability Enhancement Course	2	0	0	4	4
			Total	22	15	0	14	27
	10300503	Professional Elective - I		Foundations of AI, Robotics and Drones				
	10300505	Professional Elective - I		Society and Artificial Intelligence				

Program Name: Bachelor of Technology (01)	**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**
Semester / Year : 06 / 03	

NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCR – 5.5	10050703	Professional Core (IEEE)	Image Processing	4	3	0	2	5
	10060603	Professional Core (IEEE)	Software Engineering	4	3	0	2	5
	10300606	Professional Core (IEEE)	LLM Engineering	4	3	0	2	5
	10300602	Professional Core (IEEE)	Privacy, Ethics and Regulations of Artificial Intelligence	3	3	0	0	3
	-	Professional Elective	Professional Elective - II	4	3	0	2	5
	AEC	AEC	Ability Enhancement Course	2	2	0	0	2
	IKS	IKS	Minor Project on IKS	2	0	0	4	4
			Total	**23**	**17**	**0**	**12**	**29**
		Professional Elective - II						
	10300603	Professional Elective - II	Industrial Automation & AI					
	10300604	Professional Elective - II	AI for Healthcare					
	10300605	Professional Elective - II	AI for IOT					

Program Name: Bachelor of Technology (01)			**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**					
Semester / Year : 07/04								
NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCF – 6.0	10300701	Professional Core (IEEE)	Prompt Engineering	4	3	0	2	5
	10300702	Professional Core (IEEE)	Generative AI	4	3	0	2	5
	-	Professional Elective	Professional Elective - III	4	3	0	2	5
	-	Professional Elective	Professional Elective - IV	4	3	0	2	5
	10300707	Project Work	Internship / Minor Project	3	0	0	6	6
	IKS	IKS	IKS-P10 (Ancient India and World)	2	2	0	0	2
			Total	**21**	**14**	**0**	**14**	**28**
NCF – 6.0	**Elective-III**							
	10300703	Professional Elective - III	Agentic AI					
	10300704	Professional Elective - III	Information Retrieval					
	10050604	Professional Elective - III	Distributed Computing					
NCF – 6.0	**Elective-IV**							
	10300705	Professional Elective - IV	Virtual and Augmented Reality					
	10300706	Professional Elective - IV	Remote Sensing & AI					
	10060606	Professional Elective - IV	Cloud Infrastructure and Services					

Program Name: Bachelor of Technology (01)			**Branch Name (Code): AI (030) Batch– III &IV, V 2024-25, 2025-26 & 2026-27**					
Semester / Year : 08/04								
NCrF LEVEL	**Subject Code**	**Course Type**	**Subject Name**	**Credit**	**Hours per week**			
					L	**T**	**P**	**Total**
NCF – 6.0	10300801	Project Work	Internship/Major Project	12	0	0	24	24
	SEC-0801		Open Access & Research Publication	6	0	0	12	12
			Total	**18**	**0**	**0**	**36**	**36**

6. Teaching, Learning & Evaluation

6.1 Teaching Methodology

The program shall adopt:

- Classroom Teaching
- Case Studies
- Industrial Visits
- Workshops
- Presentations
- Software Training
- Research Projects
- Internships
- AI-based Learning Tools
- Blended and Digital Learning (IEEE, NPTEL-MOOC Courses)

6.2 Attendance Rules

- Minimum 75% attendance shall be mandatory in each course.
- Students below prescribed attendance may not be permitted to appear in examination.
- Additional attendance requirements may apply for internships/trainings.

6.3 Examination and Evaluation System

6.3.1 Evaluation Components

- The evaluation may consist of Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).
- Continuous Internal Evaluation (CIE) may include:
    - Mid-Semester Examination
    - Assignments/Lab Manuals
    - Presentations
    - Class Test

- AI Quiz & Viva Voce
- Practical Examination
- Project work
- Research Paper

6.4 Suggested Weightage

- Continuous Internal Evaluation: 50%
- End Semester Examination: 45%

6.5 Passing Standards

- Minimum 50% marks in each component where applicable.
- Minimum 50% aggregate for passing the course/program.
- Separate passing may be required in theory and practical examinations.

6.6 Grading System

- The program shall follow Gandhinagar University grading norms.

6.6.1 Grade Table

Grade	Grade Point	From Marks	To Marks
AA	10	>=80	-
AB	09	73	79
BB	08	66	72
BC	07	60	65
CC	06	55	59
CD	05	50	54
DD	04	45	49
FF	00	<45	-

6.7 Project

Students shall undertake User-defined Project OR Industry-Based Internship.

Requirements may include:

- Proposal Presentation
- Periodic Internal Review
- Final Report Submission
- Viva Voce Examination

The Project Work shall be evaluated by internal and external examiners.

7.Rules and Regulations

7.1 Rules for Promotion

A student shall be promoted to the next semester as per Gandhinagar University rules subject to fulfillment of academic requirements, minimum attendance and Completion of required credits.

7.2 Maximum Duration for Completion

The maximum duration for completing the program shall be 4 years from the date of admission (or as prescribed by the University.

7.3Internship Guidelines

7.3.1. Students shall undergo mandatory internship/training in:

- Organizations engaged in Artificial Intelligence (AI), Machine Learning (ML), Deep Learning, Generative AI, Natural Language Processing (NLP), Computer Vision, Robotics, and Intelligent Systems Development.
- Software Development and Engineering Companies working on AI-enabled applications, products, and services.
- Government Organizations, Public Sector Undertakings (PSUs), Research Laboratories, and Research Institutions undertaking projects in Artificial Intelligence, Data Science, and Emerging Technologies.
- Industries working in the domains of Data Science, Big Data Analytics, Cloud Computing, Cyber Security, Blockchain, Internet of Things (IoT), Edge Computing, and Smart Systems.
- Start-ups, Innovation Centers, and Incubation Centers recognized by government agencies, universities, or industry bodies, focusing on AI-based solutions and technology innovation.
- Organizations involved in AI-based Web Development, Intelligent Mobile Application Development, Data Engineering, Database Administration, and AI-driven System Integration.
- Companies engaged in Predictive Analytics, Recommendation Systems, Business Intelligence, Intelligent Automation, and Decision Support Systems.
- Academic and Research Institutions undertaking projects related to Artificial Intelligence, Machine Learning, Data Science, Computational Intelligence, and allied areas.
- Entrepreneurship projects, AI product development initiatives, technology-based innovation projects, and research-driven start-up ventures approved by the Department/Institute.
- Organizations working on AI applications in Healthcare, Agriculture, Finance, Education, Manufacturing, Smart Cities, and other interdisciplinary domains.
- Cloud Service Providers and Technology Companies offering AI/ML platforms, MLOps, AI deployment, and intelligent computing solutions..
- Entrepreneurship projects, product development, or technology-based innovation projects approved by the department/institute.

7.3.2 Students must submit:

- Internship Report
- Monthly Work Report
- Completion Certificate
- Presentation

7.4 Discipline Rules

Students shall maintain discipline, professional ethics, and proper conduct within the institution, during Industrial visits, internships, industry interactions, examinations, and all academic activities. Students are expected to attend classes regularly, follow institutional rules and regulations, respect faculty members, staff, fellow students, and institutional property, and maintain academic integrity in assignments, projects, and examinations. Any form of misconduct, ragging, indiscipline, use of unfair means in examinations, damage to institutional property, harassment, or behaviour affecting the academic environment shall be treated seriously and may result in disciplinary action including warning, suspension, cancellation of examination, withholding of results, or expulsion from the program as per University rules and UGC regulations. Students shall also comply with all safety, ethical, and professional standards prescribed by the institution from time to time.

7.5 Anti-Ragging Policy

The program shall strictly follow:

- UGC Anti-Ragging Regulations
- Anti-Ragging Affidavit requirements
- Institutional disciplinary procedures
- Ragging in any form is strictly prohibited.

7.6 Ethical use of Technology and AI Tools

Students are encouraged to use:

- Artificial Intelligence (AI) Tools and Assistive Technologies for learning, coding assistance, debugging, documentation, and problem-solving.
- Software Development Tools including Integrated Development Environments (IDEs), Version Control Systems, Testing Frameworks, and Project Management Platforms.

- Data Analytics and Visualization Tools for data processing, statistical analysis, business intelligence, and decision-making.
- Cloud Computing Platforms and Virtual Laboratories for application development, deployment, and experimentation.
- Cybersecurity and Network Simulation Tools for security analysis, ethical hacking practices, and network management in authorized environments.
- Database Management and Big Data Tools for handling, storing, and analyzing large-scale datasets.
- Digital Collaboration and Survey Tools for project management, research activities, requirement gathering, and feedback collection.

Use of AI tools shall be ethical and academic integrity must be maintained.

8.Student Support

8.1 Industry Collaboration

The Department of Artificial Intelligence promotes strong industry collaboration to enhance students' practical knowledge and industry readiness. Through partnerships with AI companies, technology firms, startups, research organizations, and industry experts, students gain exposure to real-world applications and emerging technologies.

Industry collaboration activities include internships, industrial visits, expert lectures, workshops, hackathons, live projects, certification programs, and research initiatives. Students are encouraged to work in areas such as Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing (NLP), Robotics, Cloud Computing, and IoT.

The department also collaborates with industries for curriculum enrichment, project mentoring, skill development, innovation, entrepreneurship, and placement opportunities, ensuring graduates are prepared for the evolving AI industry.

8.2 Research and Consultancy

The Department of Artificial Intelligence encourages research, innovation, and consultancy activities to promote the development of intelligent technologies and advanced solutions. Faculty members and students are motivated to undertake research projects, publish scholarly work, develop AI-based applications, and provide innovative solutions to industry and society. The department actively supports research in areas such as Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing, Robotics, and Emerging AI Technologies. Through industry collaboration, funded projects, and consultancy services, the department fosters innovation, entrepreneurship, and technological advancement.

Research Activities

- Research in emerging areas such as Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Generative AI, Computer Vision, Natural Language Processing (NLP), Robotics, and Intelligent Systems.
- Promotion of interdisciplinary and industry-oriented AI research projects.
- Publication of research papers in reputed journals, conferences, and professional forums.

- Participation in funded research projects sponsored by government agencies, research organizations, and industries.
- Encouragement of innovation, patent filing, intellectual property creation, and AI-based product development.

- Development of intelligent and data-driven solutions for real-world challenges in healthcare, agriculture, education, finance, and smart cities.

Consultancy Activities

- Providing AI, Machine Learning, and Data Analytics consulting services to industries and organizations.
- Offering expertise in Predictive Analytics, Computer Vision, Natural Language Processing, Intelligent Automation, and AI-driven Decision Support Systems.
- Conducting data analytics, business intelligence, and digital transformation consultancy projects.
- Developing customized AI applications, intelligent software solutions, chatbots, recommendation systems, and predictive models.
- Organizing industry training programs, workshops, certification courses, and technical skill development activities in AI and related technologies.
- Collaborating with industries for AI product development, model deployment, testing, validation, and technology implementation.

8.3 Library and Laboratory Facilities

The library and laboratory facilities provide students with a strong academic foundation, practical exposure, research opportunities, and industry-relevant skills, enabling them to become competent Information Technology professionals capable of addressing contemporary technological challenges.

Library Facilities

The library provides comprehensive learning resources to support the academic, research, and professional development needs of B.Tech. AI students. The library is equipped with a rich collection of textbooks, reference books, journals, magazines, e-books, and digital resources covering various domains of Information Technology and Computer Science.

Laboratory Facilities

The Department of CSE(AI) is equipped with modern laboratories that provide hands-on experience in database management systems, various programming languages, software development, web development, mobile application development, computer networking, cybersecurity, data analytics and emerging technologies. The laboratories are designed to complement classroom learning and facilitate practical skill develop`ent.

8.4 Student Support and Mentoring

A structured system for student support, academic mentoring, and professional guidance shall be implemented for students enrolled in the Bachelor of Technology (B.Tech.) in CSE(AI) program. The department shall facilitate academic counseling, mentoring, career guidance, technical training, research support, and skill development activities to assist students in their academic progress and professional growth. Students shall be encouraged to participate in coding competitions, hackathons, technical workshops and events, seminars, industrial visits, internships, certification programs, research projects, and innovation-driven activities related to Information Technology and emerging technologies. Opportunities for interaction with industry professionals, alumni, researchers, and technology experts shall be provided to enhance technical competence, employability, leadership abilities, communication skills, teamwork, and entrepreneurial mindset. The department shall also support students through mentor-mentee programs, placement preparation activities, higher education guidance, and counseling services. Appropriate mechanisms for addressing academic, personal, and professional concerns shall be made available in accordance with institutional policies to ensure the holistic development and well-being of students.

8.5 Placement and Career Development

The Department of Artificial Intelligence actively promotes placement assistance and career development through industry collaboration, internships, technical training, and campus recruitment initiatives. Strong partnerships with AI companies, technology firms, startups, research organizations, and multinational corporations provide students with opportunities for internships, industry projects, and employment.

The department regularly organizes aptitude training, coding sessions, resume building, interview

preparation, soft skill development programs, certification courses, expert lectures, workshops, hackathons, and innovation challenges. Students are encouraged to develop expertise in Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing (NLP), Robotics, and Emerging AI Technologies, ensuring they are well-prepared for successful careers in the AI industry.

9.Program Credibility

9.1 Executive Summary

The Department of Artificial Intelligence is committed to providing high-quality education that equips students with strong theoretical foundations, practical skills, and professional competencies required to excel in the rapidly evolving field of Artificial Intelligence and Intelligent Systems. The department offers a four-year B.Tech. program designed in accordance with national educational standards, industry requirements, and emerging technological advancements.

The curriculum is carefully structured to provide a balanced blend of fundamental concepts, advanced AI technologies, laboratory work, project-based learning, internships, and interdisciplinary exposure. The program emphasizes core areas such as Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing (NLP), Generative AI, Robotics, Intelligent Systems, Big Data Analytics, Cloud Computing, Internet of Things (IoT), and AI Ethics.

To ensure academic relevance and industry alignment, the curriculum is periodically reviewed and updated through the Board of Studies (BoS) with valuable inputs from academicians, industry experts, alumni, and employers. Contemporary subjects such as Generative AI, Reinforcement Learning, Explainable AI, MLOps, AI in Healthcare, Computer Vision, Natural Language Processing, and Edge AI are incorporated to prepare students for emerging opportunities in the AI ecosystem.

The department is supported by qualified and experienced faculty members who actively engage in teaching, research, consultancy, innovation, and professional development activities. Modern pedagogical approaches such as experiential learning, project-based learning, case studies, hackathons, flipped classrooms, industry-sponsored projects, and AI-driven learning platforms are utilized to enhance student learning outcomes.

Students gain hands-on experience through AI laboratories, research projects, internships, innovation challenges, coding competitions, industrial visits, expert lectures, certification programs, and collaborative research initiatives. The department actively promotes research and innovation in areas such as intelligent automation, healthcare AI, smart agriculture, autonomous systems, predictive analytics, smart cities, and sustainable technologies.

Upon completion of the program, graduates are well prepared for careers in Artificial Intelligence, Machine Learning, Data Science, Robotics, Intelligent Automation, AI Product Development,

Research and Development, Entrepreneurship, and Higher Studies. The department aims to develop skilled AI professionals, researchers, innovators, and future leaders capable of addressing real-world challenges through intelligent technologies.

9.2 Scope and Career Opportunities

Graduates of the program may work in:

- Artificial Intelligence and Machine Learning
- Data Science and Analytics
- Deep Learning and Neural Networks
- Computer Vision and Image Processing
- Natural Language Processing (NLP)
- Generative AI and Large Language Models (LLMs)
- Robotics and Intelligent Automation
- Cloud-based AI Solutions
- Internet of Things (IoT) and Smart Systems
- Big Data and Predictive Analytics
- Healthcare AI and Bioinformatics
- FinTech and Financial Analytics
- Smart Manufacturing and Industry 4.0
- Autonomous Systems and Intelligent Transportation
- Cybersecurity and AI Security
- Research and Development Organizations
- Government and Public Sector Organizations
- AI Startups and Innovation Centers
- Consulting and Technology Services
- Entrepreneurship and Product Development

9.3 Potential Job Roles

Graduates of the program may work as:

- Artificial Intelligence Engineer
- Machine Learning Engineer
- Deep Learning Engineer

- Data Scientist
- Data Analyst
- AI Research Associate
- Research Engineer
- Computer Vision Engineer
- Natural Language Processing (NLP) Engineer
- Generative AI Engineer
- Prompt Engineer
- MLOps Engineer
- AI Solutions Architect
- Robotics Engineer
- Intelligent Automation Engineer
- AI Application Developer
- AI Product Developer
- Big Data Engineer
- Business Intelligence Analyst
- Predictive Analytics Specialist
- Cloud AI Engineer
- AI Consultant
- AI Software Engineer
- AI System Designer
- Recommendation System Engineer
- Autonomous Systems Engineer
- AI Ethics and Governance Analyst
- Innovation Engineer
- Technology Analyst
- Research Associate
- Technical Officer
- Scientific Assistant
- Startup Founder
- Technology Entrepreneur

9.4 Higher Study & Professional Opportunities

Students may pursue:

- Postgraduate Programs (M.Tech. in Artificial Intelligence, Machine Learning, Data Science, Robotics, Computer Science and Engineering)
- Management and Interdisciplinary Programs (MBA, MCA)
- International Higher Education (MS)
- Research Opportunities in National and International Research Organizations
- Competitive Examination Opportunities (GATE, UGC-NET, CAT, GRE, etc.)
- Entrepreneurship Opportunities in AI Products, Intelligent Systems, Data Analytics, Robotics, AI Consulting, and Technology Startups

Professional Certification Opportunities

1. Artificial Intelligence & Machine Learning Certifications

- Microsoft Certified: Azure AI Engineer Associate
- Google Professional Machine Learning Engineer
- IBM AI Engineering Professional Certificate
- TensorFlow Developer Certification
- NVIDIA Deep Learning Institute Certifications

2. Data Science Certifications

- IBM Data Science Professional Certificate
- Google Data Analytics Professional Certificate
- Microsoft Data Scientist Certification
- SAS Data Science Certifications

3. Cloud AI Certifications

- AWS Certified Machine Learning Engineer
- AWS Certified Solutions Architect
- Microsoft Azure AI Fundamentals
- Google Cloud Professional AI Engineer

4. Generative AI Certifications

- Google Generative AI Certifications
- Microsoft Generative AI Certifications
- OpenAI and LLM Application Development Programs
- NVIDIA Generative AI Certifications

5. Big Data and Analytics Certifications

- Databricks Data Engineer Certification
- Cloudera Data Platform Certifications
- Hadoop and Spark Certifications

6. Robotics and Automation Certifications

- Robotics Process Automation (RPA) Certifications
- UiPath Certified Professional
- Automation Anywhere Certifications

7. Project Management & Agile Certifications

- Project Management Professional (PMP)
- PRINCE2 Certification
- Agile and Scrum Certifications
- Certified Scrum Master (CSM)

8. Research and Innovation Opportunities

- Patent Filing and Intellectual Property Development
- Research Fellowships
- Startup Incubation Programs
- Innovation and Product Development Initiatives
- National and International AI Competitions and Hackathons

10.Collaborative Field Work / Experimental Work

The Department of Artificial Intelligence strongly promotes collaborative field work and experimental learning as an integral part of the academic curriculum. Students are encouraged to participate in industry-oriented projects, research activities, internships, live case studies, innovation challenges, and technology-driven problem-solving assignments that provide practical exposure to real-world applications of Artificial Intelligence.

Collaborative field work is carried out in association with industries, startups, research organizations, government agencies, and academic institutions. Students work on identifying real-world problems, collecting and analyzing data, developing AI-based models, validating results, and deploying intelligent solutions. Such activities enable students to gain hands-on experience in applying theoretical concepts to practical situations and understanding industry requirements.

Experimental work includes the design, development, testing, evaluation, and implementation of solutions in areas such as Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing (NLP), Robotics, Intelligent Automation, Recommender Systems, Predictive Analytics, Generative AI, Internet of Things (IoT), and Smart Systems. Students are encouraged to use modern AI frameworks, cloud platforms, data analytics tools, and software development environments to build innovative applications and research prototypes.

The department also promotes interdisciplinary projects involving healthcare, agriculture, education, finance, smart cities, environmental monitoring, and industrial automation, enabling students to address societal and industrial challenges through intelligent technologies. Participation in hackathons, project exhibitions, innovation competitions, research publications, and collaborative development activities further enhances students' analytical, technical, teamwork, communication, and problem-solving skills.

Through collaborative field work and experimental learning, the department aims to foster innovation, research aptitude, entrepreneurship, and industry readiness, ensuring that graduates are capable of developing impactful AI-driven solutions for real-world challenges.

11.Market Survey

11.1 Strategic Feasibility for B.Tech. Artificial Intelligence in Ahmedabad

11.1.1 Executive Summary

Ahmedabad has emerged as one of the rapidly growing technology and innovation hubs in Gujarat, creating significant opportunities for Artificial Intelligence (AI) professionals. The increasing adoption of AI technologies across sectors such as healthcare, finance, manufacturing, agriculture, e-commerce, education, smart cities, and information technology has generated substantial demand for skilled AI engineers and data professionals. Government initiatives promoting digital transformation, Industry 4.0, startup ecosystems, and innovation-driven enterprises further strengthen the need for specialized AI education.

The B.Tech. Artificial Intelligence program is strategically positioned to address the growing demand for AI talent by providing students with knowledge and practical skills in Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing, Robotics, and Intelligent Systems. The program aligns with national educational priorities, industry requirements, and emerging technological trends, making it highly relevant and sustainable in the current and future job market.

11.2 Market Demand & Industry Trends

- Rapid adoption of Artificial Intelligence and Machine Learning across industries.
- Increasing demand for AI-enabled automation and intelligent decision-making systems.
- Growth of Generative AI, Large Language Models (LLMs), and AI-powered applications.
- Expansion of Data Science, Predictive Analytics, and Business Intelligence solutions.
- Growing implementation of AI in healthcare, agriculture, manufacturing, finance, and education sectors.
- Increasing investments in AI startups, research centers, and innovation ecosystems.
- Rising demand for cloud-based AI platforms, MLOps, and intelligent automation solutions.
- Government initiatives supporting AI research, smart cities, and digital transformation programs.
- Emergence of Industry 4.0 technologies integrating AI, IoT, Robotics, and Big Data Analytics.

11.3 Skill Gap Identified by Industry

- Industry feedback indicates a shortage of professionals with expertise in:
- Artificial Intelligence and Machine Learning Algorithms
- Deep Learning and Neural Networks
- Data Science and Advanced Analytics
- Natural Language Processing (NLP)
- Computer Vision and Image Processing
- Generative AI and Large Language Models (LLMs)
- MLOps and AI Model Deployment
- Cloud-based AI Development
- Big Data Technologies
- AI Ethics and Responsible AI
- Intelligent Automation and Robotics
- Real-world AI Solution Development and Deployment
- Research, Innovation, and Problem-Solving Skills
- Interdisciplinary Application of AI Technologies
- The B.Tech. Artificial Intelligence program is designed to bridge these skill gaps through industry-oriented curriculum, practical laboratories, internships, live projects, and collaborative learning.

11.4 Employment Opportunities

- Graduates of the B.Tech. Artificial Intelligence program can pursue careers in:
- Artificial Intelligence Engineer
- Machine Learning Engineer
- Deep Learning Engineer
- Data Scientist
- Data Analyst
- Computer Vision Engineer
- NLP Engineer
- Generative AI Engineer
- Prompt Engineer
- AI Research Associate
- MLOps Engineer
- Robotics Engineer

- Intelligent Automation Engineer
- AI Software Developer
- Business Intelligence Analyst
- Big Data Engineer
- AI Consultant
- Cloud AI Engineer
- Product Development Engineer
- Research and Development Engineer
- Technology Entrepreneur
- Employment opportunities exist in IT companies, AI startups, multinational corporations, healthcare organizations, financial institutions, manufacturing industries, research laboratories, government organizations, and innovation centers.

11.5 Industry Support & Collaboration

- The Department of Artificial Intelligence actively collaborates with industries, research organizations, startups, innovation centers, and technology companies to provide students with practical exposure and industry experience. Industry support includes:
- Internships and Industrial Training Programs
- Industry-Sponsored Projects
- Expert Lectures and Technical Workshops
- Hackathons and Innovation Challenges
- Research Collaboration and Consultancy Activities
- Curriculum Development Support
- Skill Development and Certification Programs
- Placement Assistance and Recruitment Drives
- Startup and Entrepreneurship Support
- Collaborative AI Research and Product Development
- These collaborations ensure that students gain hands-on experience with industry-standard tools, technologies, and real-world AI applications.

11.6 Conclusion

- The market survey indicates strong and growing demand for Artificial Intelligence professionals at regional, national, and global levels. Rapid technological advancements, increasing AI adoption across industries, and government support for digital innovation have created substantial employment and entrepreneurship opportunities in the AI domain. The proposed B.Tech. Artificial Intelligence program is strategically aligned with industry needs and future workforce requirements. Through a robust curriculum, industry collaboration, research orientation, and practical learning opportunities, the program will produce highly skilled AI professionals capable of contributing effectively to technological innovation, economic growth, and societal development.

12. Review and Revision of Regulation

The University reserves the right to interpret, modify, revise, amend, or update any provision, rule, regulation, curriculum structure, evaluation pattern, academic requirement, or operational guideline related to the program from time to time in accordance with University regulations, statutory requirements, industry developments, and academic needs.

In case of any ambiguity or dispute regarding interpretation of any provision of this manual, the decision of the University/Competent Authority shall be final and binding on all stakeholders. Any amendments, additions, or revisions approved by the appropriate academic or statutory bodies of the University shall automatically become applicable to the program

Annexure I: Detail Syllabus

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH. 1st SEMESTER
ALL BRANCHES

Subject Code: 10000101	**Subject Title: Engineering Mathematics-I**
Pre-requisite: Nil	

Course Objective:

- To acquaint aspiring engineers with calculus, multivariate analysis and linear algebra techniques.
- To provide students with intermediate to advance level standard ideas and tools that will help them approach more challenging concepts and applications that they will find relevant in their fields.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
03	02	-	05	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Differential Calculus:** Convergent sequence, Bounded sequence, Monotonic sequence, Infinite series, Geometric series, Telescoping series, Convergent, Divergent and Oscillatory Series, Cauchy's Fundamental test for Divergent, p-series, Comparison test, D'Alembert's Ratio test, Raabe's test, Gauss's test, Cauchy's Integral test, Cauchy's root test, Logarithmic test, De Morgan's and Bertrand's test, Cauchy's Condensation test, Alternating series, Leibniz's rule, Power series in X, Absolute and conditional convergence tests, Taylor's & Maclaurin's expansions of single variable, Indeterminate forms, Improper Integrals	12	25

2	**Partial Differentiations:** Limit and Continuity, Partial derivative, Implicit and Explicit functions, Euler's theorem, Geometrical interpretation of partial derivatives **Application of Partial Differentiations**: Tangent plane and Normal line, Maxima and Minima of functions of two variables, Lagrange's multiplier method, Jacobians	10	25
3	**Vector Calculus:** Vector and Scalar Fields, Gradient, curl and divergence, directional derivatives, Conservative fields, Line Integral, Work Done, Circulation and Flux, Green's Theorem	8	20
4	**Multiple Integral:** Double integral, change of order of integration, Application of Double Integral: Transformation of variables by Jacobian only for double integration, Change into polar co-ordinates in double integrals only, Triple integral, Applications of Integral: Change to spherical coordinates, Volume of a solid	8	20
5	**Curve Tracing:** Concavity, Curve Sketching, Relation between Polar Coordinates and Cartesian Coordinates, Graphs in Polar Coordinates	4	10

Course Outcome: After completion of this course, student will be able to

- Use Improper integral as a tool for differential and Integral calculus and understand the basic concepts of Indeterminate forms. Apply the various convergence tests to sequences, series and learning tools for power series in advanced engineering mathematics.
- Understand basic knowledge of partial derivatives and to compute extreme values of functions of several variables via partial derivatives, Tangent planes and Normal lines.
- Learn the basic concepts in vector calculus including gradient, directional derivatives, curl, work done, flux and Green's theorem.
- Gain the knowledge about solving double and triple integration to analyze engineering problems.
- Understand the geometrical terminology of cartesian and polar curves.

List of References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Edition.
2. Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage
3. James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.
4. T. M. Apostol, Calculus, Volumes 1 & 2,, Wiley Eastern.
5. Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014
6. H.K.Dass, Advanced Engineering Mathematics, S. Chand.

Open e-Resource:

1. https://nptel.ac.in/courses/111108098
2. https://nptel.ac.in/courses/111104125
3. https://nptel.ac.in/courses/111105121

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/ICT/CS/AI/EC/EE/R&A
SEMESTER 1ST

Subject Code: 10050101	**Subject Title: Programming for Problem Solving**
Pre-requisite: - Nil	

1 Course Objective:

- To understand the various steps in Program development.
- To understand the basic concepts in C Programming Language.
- To learn how to write modular and readable C Programs
- To learn to write programs (using structured programming approach) in C to solve problems.
- To provide complete knowledge of C language

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

	Subject Contents			
Sr. No	**Topic**	**IEEE BLENDED**	**Total Hours**	**Weight (%)**
1	**Introduction:** Basic block diagram and functions of various components of computer, Concepts of Hardware and software, Types of software, Compiler and interpreter, Concepts of Machine level, Assembly level and high level programming, Flowcharts and Algorithms [CH.1: RB-1 ANSI C Bala Guruswamy]	IEEE	3	5
2	**Fundamentals:** Introduction to C, structure of C Program, comments, header files, data types, constants, variables, declarations, expression statements, arithmetic operations, unary operations, relational and logical, conditional, library functions, single character input and output, entering and writing data, Evaluation of expressions, type conversion, precedence and associativity, I/O functions. [CH.1: RB-1 ANSI C Bala Guruswamy]	IEEE	4	10
3	**Control structure in C:** Simple statements, Decision making statements, Looping statements, Nesting of control structures, break and continue, The Case control structure switch and goto statement. [CH.5: RB-1 ANSI C Bala Guruswamy]	IEEE	5	10
4	**Array & String:** Concepts of array, processing an array, declaration and initialization of arrays, passing arrays to function, multidimensional array. String, string storage, Built-in string functions, command line arguments. [CH.8: RB-1 ANSI C Bala Guruswamy]	IEEE	5	10

5	**Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function: different way of solving problems, recursive program for finding factorial, Fibonacci series etc. [CH.9: RB-1 ANSI C Bala Guruswamy]	IEEE	8	25
6	**Pointers:** Basics of pointers, pointer to pointer, pointer and array, pointer to array, array to pointer, function returning pointer [CH.13: RB-1 ANSI C Bala Guruswamy]	IEEE	6	15
7	**Structure:** Basics of structure, structure members, accessing structure members, nested structures, array of structures, structure and functions, structures and pointers [CH.13: RB-1 ANSI C Bala Guruswamy]	IEEE	6	15
8	**Dynamic memory allocation and File management:** Introduction to Dynamic memory allocation, malloc, calloc. Introduction to file management and its functions [CH.12: RB-1 ANSI C Bala Guruswamy]	IEEE	8	10

Course Outcome(COs): After completion of this course, student will be able to

- Write a C program using correct syntax and execute it.
- Write programs using conditional, branching, iteration, and recursion.
- Write programs using array and strings.
- Decompose a problem into function.
- Develop an application using the concepts of array, pointer,structure, and file management to solve engineering /scientific problems.

2 List of References:

1. Programming in ANSI C, Balagurusamy, 8 Edition 2018 MCGraw Hill
2. Lets C, Y. Kanitkar, BPB
3. Programming with C, Gottafried, Schaum Series
4. C The Complete Reference, Scholdt, TMH
5. Structured Programming Approach Using C, B. Forouzen, Thomas

3 Open e-Resource:

1. NPTEL C Programming: https://nptel.ac.in/courses/106104128
2. NPTEL Problem Solving through C: https://onlinecourses.nptel.ac.in/noc22_cs101/preview

4 List of Suggested Experiments:

1. Write a program that performs as a calculator (addition, multiplication, division, subtraction).
2. Write a C program to interchange two numbers.
3. Write a program to read three numbers from the keyboard and find out the maximum out of these three.
4. Write a program to read marks from keyboard and your program should display equivalent grade according to following table(switch case)
   Marks Grade
   100 - 80 Distinction
   79 - 60 First Class
   59 - 40 Second Class

< 40 Fail

5. a. Write a C program to input an integer number and check if the last digit of the number is even or odd.
   b. Write a C program to find the factorial of a given number.
   c. Write a program to reverse a number.
   d. Write a program to generate the first n number of Fibonacci series.

6. a. Write a C program to find the sum and average of different numbers which are accepted by the user as many as the user wants.
   b. Write a program to check whether the given number is prime or not.
7. Write a C program to find 1+1/2+1/3+1/4+…+1/
8. Write a program to print following patterns:

```
*          *          12345
* *        * *        1234
* * *      * * *      123
* * * *    * * * *    12
* * * * *  * * * * *  1
```

9. Write a program to find maximum element from 1-Dimensional array
10. a. Write a program to find a character from a given string.
    b. Write a program to reverse the string.
    c. Write a program to convert string into upper case.
11. Write a program to find the factorial of a number using recursion.
12. Define a structure called cricket that will describe the following information:
    Team name
    Batting average
    Using cricket, declare an array player with 50 elements and write a C program to read the information about all the 50 players and print team wise list containing names of players with their batting average.
13. Write a C program to swap the two values using pointers.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/ICT/CS/AI/EC/EE/R&A
SEMESTER 1ST /2nd

Subject Code:10010105	**Subject Title: Engineering Foundation**
Pre-requisite:- Zeal to learn the subject	

5 Course Objective:

- Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements.
- Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems
- Improve analytical skills to understand design blueprints
- Learn basic properties of materials and concepts of advanced manufacturing process
- Discover the root cause of a problem or event and fully understand how to fix, compensate or learn from any underlying issues within the root cause
- Provide the engineer a means of ensuring consistent design, quality and operating characteristics with adequate reliability and safety

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Measurements:** Introduction to Measurement, Definition, objectives and concept of Metrology, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement. System of measurement, Material Standard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars, standardization. Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, adjustable slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, problems on building of slip gauges (M87, M112). Measurement of angles- sine bar, sine center, angle gauges, optical instruments for angular measurements	08	19

2.	**Engineering Workshop:** Introduction, Safety slogans and rules in Mechanical workshop, Tools and Equipment used for safety in Mechanical workshop. Types of layouts, Rules and regulations for Workshop layouts and Preparation of actual layout. Introduction, Classification and characteristics of Engineering Materials, Tools and Equipment. *Demonstration of the operation performed on sheet metal for bending operation. Preparation of job in Drilling operation and demonstration on vertical drilling machine. Tools and Equipment for plumbing shop. Preparation of job in Plumbing for joining and threading operation. *Introduction to Arduino, components and working, Electronic circuit drawing, Electronic circuit on breadboard, Demonstration of Arduino for different configuration.	10	24
3.	**Engineering Design:** Introduction to Engineering Drawing and its significance, Drawing instruments and accessories, BIS – SP 46, Types of Lines and their Application, Lettering, Dimensioning Systems, Construction of Regular Polygons, Use of Plane Scales, Diagonal Scales and Representative Fraction.	10	24
4.	Engineering Materials: Types, properties and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer Modeling, Simulation and Conceptual Prototyping: Concept of Modelling and Simulation, Goal of Modelling & simulation, Application of simulations, advantages and disadvantages of simulation, Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems, FDM, SLS, SLA.	06	15
5.	Root Cause Analysis: Introduction, Complete Root Cause Analysis, QM & T Approach to Root Cause Analysis, Practical guide to carry out and RCA, RCA Tools & Techniques, Lookup Table for Completing an RCA, Examples, Hints & Tips, 12 Pitfalls of RCA	04	9
6.	Standards: Introduction, Basic Definitions, Requirements, Guidelines, History of Standards, Modern Examples, Conformity Assessment	04	9

6 * - Topic will be covered during laboratory session

Course Outcome: After completion of this course, student will be able to

1. Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of end bars.
2. Students will learn about taking safety and precautionary measures of self and machines during operations.
3. Interpret engineering drawings using fundamental technical mathematics.
4. Interpret appropriate advanced material processing techniques for different requirement and application
5. Identify the breakdowns in processes and systems that contributed to event and how to prevent future events

7 List of References:

1. Elements of Workshop Technology: Vol- I and Vol - II", K Hajra Choudhury, A K. Hajra, Media Promoters Pvt Ltd
2. Mechanical Measurement and Metrology by R K Jain, Khanna Publisher Mechanical Measurement & Control by D.S. Kumar.
3. A Text Book of Engineering Graphics by P.J.Shah S.Chand & Company Ltd., New Delhi
4. Modern Machining Processes, P. C. Pandey, H. S. Shan, Tata McGraw Hill
5. Root Cause Analysis - Improving Performance for Bottom-line Results, Robert J Latino, Kenneth C Latino, Taylor & Francis Group, CRC Press

8 Open e-Resource:

1. NOC25-AR01 – ARCHITECTURE & PLANNING – Engineering Graphics part-1
2. NOC25-AR02 – ARCHITECTURE & PLANNING – Engineering Graphics part-2
3. NOC25-ME52 – MECHANICAL ENGINEERING – Mechanical Measurement Systems

9 List of Suggested Experiments:

1. Introduction to Engineering workshop: working layout and safety.
2. Demonstration of the sheet metal bending operation and observe safety measures.
3. Demonstration of the drilling operation on vertical drilling machines and observe safety measures.
4. Demonstrate and understand the plumbing operation and tools in detail.
5. Demonstrate Arduino programming for different configurations.
6. Basic understanding of measurements and metrology: concepts, application, advantage and future aspects
7. Performance on linear and angular measurements and check different characteristics of measurements
8. Drawing Practice Sheet (which includes dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil)
9. Problems on Plane Scale.
10. Problems on Diagonal Scale.
11. Demonstration of prototype in FDM 3D Printing

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/ICT/CS/AI/EC/EE/R&A
SEMESTER 1ST /2nd

Subject Code: 10050102	**Subject Title: ICT Fundamental & Workshop**
Pre-requisite: - Nil	

Course Objective:

1. Understand the basics of Information and communication technology.
2. To explain the fundamentals of computers and peripherals.
3. To introduce hardware and software computers basics.
4. To brief the students regarding various operating systems.
5. Understand the basic functions and features of Google Workspace tools and explore emerging trends and technologies.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	1	0	4	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to ICT:** Definition and Scope, Components, Data, Information and Knowledge, Data Collection, Data Storage and Data Transmission, Data Integrity, Information Quality.	03	10
2	**Introduction to computer system:** Introduction to various computer hardware and their application in ICT. Introduction to computer software and its application. Introduction to computer operating systems. What is Operating Systems, ERP, CRM, Service Architecture introduction — Concepts of SaaS, PaaS, IaaS.	05	15
3	**Fundamentals of computer Networks:** Introduction to computer networks, types of networks. Introduction to network devices.	03	15
4	**Storage and Servers:** Primary and Secondary storage, Cloud technology, mail server, data server, Concept of Data centers.	03	10
5	**Microsoft office suite:** Professional Document writing using Word Processing Tool, Data Processing using Spreadsheet, Creating Dynamic and Informative Slide Show using Presentation Software	04	10
6	**G Suite (Google Workspace):** Introduction to Google Workspace, Google Drive Basics, Google Docs, Google Forms, Google Calendar, Google Meet, Google Sites.	05	10
7	**Introduction to the Web:** World Wide Web (WWW): A system of interlinked hypertext documents accessed via the internet. Internet: A global network of interconnected computers that communicate using standard protocols Website, Webpage, Web browser, Web server, Web development tools, web hosting and deployment.	05	10
8	**Cybersecurity Trends:** Emerging Threats, Advanced Security Technologies, Protective Measures, Ethical and Societal Implications.	04	10

9	**Introduction to Emerging Technologies:** Artificial Intelligence, Machine Learning, Big Data Analytics, Block chain, Data Science, Internet of Things (IoT), Virtual reality.	04	10

Course Outcome (COs):

1. Understand the basics of Information and communication technology.
2. Explore the applications of ICT for development.
3. A student can be able to use various G Suite, Microsoft office suite and computer Networks.
4. Students can explore Emerging technologies like IoT, Block chain, Data Science.

List of Reference Books:

1. "Understanding Computers: Today and Tomorrow" by Deborah Morley and Charles S. Parker
2. "Google Workspace for Dummies" by Blake R. Smith.
3. "Google Workspace: A Complete Guide to Google Workspace Tools" by Dr. Mikhail Kasyanov
4. "Computer Science: An Overview" by J. Glenn Brookshear and Dennis Bylaw
5. "Introduction to Computer Science: A Text-Based Approach" by Jean-Paul Tremblay and Paul G. Sorenson
6. "Practical Malware Analysis handbook dissecting malicious code" by Michael Sikorski and Andrew Hoing
7. "Computer Networking: A Top-Down Approach" by James F. Kurose

Web Resources:

1. https://www.w3schools.com
2. https://www.javatpoint.com
3. https://www.tutorialspoint.com/index.htm
4. https://teacher-network.in/OER/images/9/9a/ICT_student_textbook.pdf

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH. 2nd SEMESTER
ALL BRANCHES

Subject Code: 10000201	**Subject Title: Engineering Mathematics-II**
Pre-requisite: Nil	

Course Objective:

- To familiarize the prospective engineers with techniques in integration, ordinary differential equations and matrices.
- To equip the students to deal with advanced levels of mathematics and applications that are required in their disciplines.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	02	-	05	70	30	-	-	100

	Subject Contents		
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	First order ordinary differential equations • Order and Degree • Solutions of Ordinary Differential Equations • Geometrical Interpretations • Exact and Non-exact equations • Linear and Bernoulli's equations • Euler's equations	6	10%
2	Higher order Ordinary differential equations • Second order linear differential equations with constant coefficients • Second order linear differential equations with variable coefficients • Method of variation of parameters • Cauchy-Euler equation • Series solutions of ordinary differential equations	10	25%
3	Laplace Transformation • Definition and existence of Laplace Transform • Properties of Laplace transforms • Laplace transform of periodic functions • Inverse Laplace transform and properties • Convolution theorem • Applications in solving differential equation	8	20%

4	Fourier Series and Fourier Integral • Dirichlet's Condition • Fourier series of Odd and Even functions • Half range sine and cosine series • Fourier Integral • Fourier Cosine and Sine Integrals • Gamma and Beta functions and their properties	8	20%
5	Matrix Algebra • Definition and types of matrices • Determination of rank • Inverse by Gauss Jordan method • Solution of linear equations • Eigen values and Eigen vectors • Cayley-Hamilton's theorem and applications • Diagonalization	10	25%

Course Outcomes

- Learn the techniques to solve ordinary differential equations for mathematical modelling of real-world problems.
- Apply effective mathematical methods for the solutions of higher order ordinary differential equations.
- Apply Laplace transforms and inverse Laplace transforms to solve ordinary differential equations.
- Utilize Fourier series and Fourier integrals for periodic functions and integration problems.
- Understand matrix algebra and algebraic operations for theoretical problem solving.

List of References

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Edition.
2. Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
3. H.K. Dass, Advanced Engineering Mathematics, S. Chand.
4. H. Anton, Elementary Linear Algebra with Applications (8th Edition), John Wiley, 1995.
5. Fuzhen Zhang, Matrix Theory - Basic Results and Techniques, Springer, 1999.
6. Shanti Narayan, P.K. Mittal, A Textbook of Matrices, S Chand & Company, 2010.

Open e-Resources

- https://nptel.ac.in/courses/111106100
- https://nptel.ac.in/courses/111106139
- https://nptel.ac.in/courses/111105112

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/ICT/CS/AI/EC/EE/R&A
SEMESTER 1ST /2nd

Subject Code: 10000003	**Subject Title: ENGINEERING PHYSICS**
Pre-requisite: Nil	

Course Objective:

- To understand concepts of applications of semiconductor Physics, nanomaterials and non-linear optics in respective engineering branches and measurement techniques to solve problems.
- To educate students for engineering occupations in which Physics concepts may be applied to technological development. Students will be able to find work in engineering after completing this study at the interface of engineering and Physics upon graduation, while also laying a solid basis for graduate school and engineering research.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	-	02	04	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Nanoscience and nanotechnology:** Introduction to Quantum Physics: Particle in a three dimensional box, Introduction – Nanoscale; Nanomaterials: Methods for synthesis of nanomaterials, Properties of nanomaterials, Characterization techniques – X ray Diffraction (XRD) - Single Crystal, Powder and Laue techniques, Low energy Electron Diffraction (LEED), Scanning Electron Microscopy, Tunnelling Electron Microscopy, Nanostructures; Carbon nanotubes, Characteristics and applications, Nanotechnology and environment.	8	19
2	**Classification of Electronic Materials:** Free electron theory, crystal structure and reciprocal lattice, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Brillouin zone, electron in a crystal- Bloch's electron, Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.	8	19
3	**Physics of Semiconductors:** Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction diode, Metal-semiconductor junction (Ohmic and Schottky), Photovoltaic effect, Exciton, Applications with numericals, Lasers and its properties, Spontaneous and stimulated emission, Einstein coefficients, Gas laser	8	19

	(He-Ne Laser), Semiconductor Laser, Applications of Laser.		
4	**(A)Analysis of Errors:** Uncertainties in Measurements: Sources and estimation of errors, accuracy and precision, systematic error, random error, Significant figure and round off, Uncertainties, Parent and Sample Distributions, Mean and Standard Deviation of Distributions, Average error, r.m.s error, probable error and error propagation, **(B) Non-linear Optics:** Introduction to regression analysis and its uses, Basic Principle of Holography, Construction and reconstruction of hologram, Applications of Holography, Introduction to optical fiber, Numerical Aperture of optical fiber, Types of optical fiber, applications of optical fiber **(C)Measurement Techniques:** Four-point probe and Van Der Pauw measurements for carrier density, Resistivity and hall mobility, Hall effect, Hot-point probe measurement, capacitance-voltage measurements, DLTS.	12	29
5	**Physics of Superconductors:** Introduction of Superconductivity, Properties of superconductor, Effect of magnetic field, Meissner effect, Pressure effect, Impurity effect, Isotopic mass effect, Mechanism of Superconductivity: BCS Theory, Penetration depth: Magnetic field, Josephson's junction and its application, Application of superconductors	6	14

Course Outcome: After completion of this course, student will be able to

- Acquire understanding of fundamental physics concepts and link them to engineering science at the conclusion of the course.
- Use physics ideas to solve difficulties in engineering.
- Apply basic Physics concepts to solve new and difficult technological issues.
- The student will gain knowledge of basic theoretical and mathematical concept of nanomaterials and electronic materials.
- Demonstrate understanding of basic principles, properties and applications associated with semiconducting materials.
- Learn how to calculate and find the errors and also characterize diverse semiconducting, electrical, and optoelectrical materials and devices using various measurement techniques and non-linear optics.
- Demonstrate knowledge of superconductivity's fundamental theory, characteristics, and applications.

List of References:

1. T. Pradeep, Nano: The Essentials, New Central book Agency.
2. S. N. Goswami, Elements of Plasma Physics, Tata McGraw Hill publication.
3. B. L. Theraja, Physics for Engineers, S Chand Publication
4. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc.
5. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc.
6. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
7. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
8. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
9. Engineering Physics by Dattu R Joshi, McGraw hill Publications.
10. Resnick, Halliday and Krane, Physics part I and II, 5th Edition John Wiley (2002)

11. Physics for scientists and engineers with modern physics by Jewett & Serwey, Cengage publications.

Open e-Resource:

1. Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL. (URL Link: https://nptel.ac.in/courses/115102026)
2. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL. (URL Link: https://nptel.ac.in/courses/113104012)
3. Online course: “Fiber Optics” by Prof. Vipul Rastogi on NPTEL. (URL link: https://nptel.ac.in/courses/115107095)
4. Online course: “Introduction to Physics of Nanoparticles and Nanostructures” by Prof. G. Mukhopadhyay on NPTEL. (URL Link: https://nptel.ac.in/courses/115101007)
5. Online course: “Introduction to Non-linear optics and its applications” by Prof. Samudra Roy on NPTEL (URL Link: https://nptel.ac.in/courses/115105105)
6. Online course “Superconductivity” by Prof. P. P. Singh and Prof. A. V. Mahajan (URL Link: https://nptel.ac.in/courses/115101012)
7. Online course “A brief course on Superconductivity” by Dr. Saurabh Basu on NPTEL. (URL Link: https://nptel.ac.in/courses/115103108)
8. The Feynman Lectures series on Physics Vol 2, Pearson Education India

List of Suggested Experiments:

1. To find the numerical aperture of an optical fiber.
2. To determine the band gap in a semiconductor using a junction diode.
3. To determine the wavelength of laser using diffraction grating.
4. To find the efficiency of a solar cell.
5. To Study the characteristics of a Zener diode and a LED.
6. To study the “Hall effect” by measuring the voltage and magnetic field, keeping current constant.
7. Determination of radii of curvature of lens using the Newton’s ring formula.
8. Analysis of errors using Least square fitting.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/ICT/CS/AI/EC/EE/R&A
SEMESTER 1ST /2nd

Subject Code: 10050201	**Subject Title: Basic of Python**
Pre-requisite: Basic Programming Knowledge of Computer System	

Course Objective:

1. Leran the syntax and semantic of Python Programming
2.Write Python functions to facilities code reuse and manipulate strings.
3. Ilustrate the process of structuring the data using lists,tuples and dictionaries.
4.Demostrate the use of built-in function to navigate the file system.
5. Appraise the need for networking on File system.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to python programming:** What is python language and its applications, Features of python language, Installing Python packages(Linux, Windows).	04	20
2	**Python Programming:** Data Types, Operators, Control Structures, Iterations, List, Tuple, Dictionary, Functions: Functions and scoping, List Operations, Recursion, Global Variable, modules, I/O operations, In Built Functions and Parameters, Python Library and its uses.	16	40
3	**Modularization and classes:** Classes and Object Oriented Programming- Procedural and Object – Oriented Programming-classes-working with Instances-Techniques for Designing classes, Inheritance-Introduction to inheritance-Polymorphism.	04	10
4	**Input and Output in Python:** Reading and writing text files, writing Text Files, Appending to Files and challenge, writing Binary Files Manually, Using Pickle to Write Binary Files.	07	20
5	Exception Errors in Python: Compile –time Errors, Runtime Errors, Logical Errors, What is Exception, Handling an exception, try…except…else, tryfinally clause, Argument of an Exception, Python Standard Exception, Raising an exceptions, User–defined Exception.	04	10

Course Outcome:

1. Understand concepts of problem solving approach.
2. Able to write basic python code.
3. Understand the basics of Kali Linux & its importance.
4. Understand the security policies & cyber laws.

List of Textbooks:

1. Learn Python Programming Fundamentals: A Beginner's Guide.
2. Introduction to Computation and Programming Using Python, Third Edition by John V. Guttag.
3. Fundamentals of Python: First Programs with MindTap Author(s): Kenneth A. Lambert.

List of Reference Books:

1. Advanced Python Programming by Dr. Gabriele Lanro, Quan nyugen
2. Core Python Programming, By Dr.R Nagaeshwar Rao.
3. Python All-in-One for Dummies by John Sovic.

Open e-Resource:

1. https://www.w3schools.com/python/
2. https://www.javatpoint.com/python-tutorial
3. NPTEL Video lecture on Python Programming
4. Turtle - https://docs.python.org/2/library/turtle.html
5. PyLab - https://scipy.github.io/old-wiki/pages/PyLab Anaconda software

List of Suggested Experiments:

1. Write a program to perform basic mathematical operations.
2. Write a program to find largest element in array.
3. Write a program to use various string functions.
4. Write a program to print addition of 5 elements of an array using looping structure.
5. Write a program to demonstrate the use of conditional structure.
6. Write a program to find sum of all elements in the directory.
7. Write a program to swap to elements in a list.
8. Write a program to sort python directories by key or a value.
9. Write a program to demonstrate the user defined function creation & calling.
10. Demonstrate a program that show the use of python library.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/ICT/CS/AI/EC/EE/R&A
SEMESTER 1ST /2nd

Subject Code: 10030101	**Subject Title:** Basics of Electrical & Electronics Engineering
Pre-requisite: Nil	

Course Objective:

- To Impart the basic knowledge of electrical quantities and to understand the impact of technology in a global and social context.
- To provide knowledge of analog and digital electronics.
- To Introduce the basic knowledge of transformer and electrical machines and electrical safety.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**DC Circuits** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8	20%
2	**AC Circuit:** Representation of sinusoidal waveforms, sinusoidal function-Terminology, Form Factor and Peak Factor, Phase and Phase Difference, Phasor representation of alternating quantities, Phasor addition and subtraction Behavior of purely resistive, inductive and capacitive circuits, Phase relation RL circuit, series RC circuits, series RLC circuit between voltage and current Active, Reactive and Apparent Power, Power Factor and Parallel and series-parallel AC circuits, Resonance in series and parallel circuit. Three-phase balanced circuits, voltage and current relations in star and delta connections.	10	23%
3	**Transformers and Electrical machines** Construction and working principle of single phase and three phase transformers Equation, voltage and current Ideal and practical transformer, autotransformer. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, single phase induction motor	6	14%
4	**Analog Electronics and Applications:**	8	20%

	Semiconductor Diode & its characteristics, Half-Wave, Full-Wave & Bridge Rectifier, Zener Diode, Light-Emitting Diode (LED), Photo diode, Solar cell and Seven Segment Display. Bipolar Junction Transistor, Amplifier, Oscillator and Operational Amplifier.		
5	**Digital Electronics:** Number System, Basic Logic Gates, Building AND, OR & NOT Gate using Diodes and Transistors, Digital logic families, RTL, DTL, TTL.	4	9%
6	**Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	6	14%

Course Outcome: After completion of this course, student will be able to

- Analyze electrical circuits with different elements and describe qualitative comparison between AC and DC systems.
- Understand the construction, working and basic characteristics of transformer and Induction machine
- Learn about the working of Bread-Board, Multimeter, Power Supply, Function Generator, CRO/DSO, GCB/PCB.
- Apply Diodes, Transistors and Logic Gates in different circuits.
- Recognize the importance of protective devices and electrical safety measures.

List of References:

1. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
2. Basic Electrical Engineering - Nagsarkar and Sukhija, Oxford University Press
3. B. L. Theraja, "Electrical Technology – Part I and II", S. Chand and Co. 2012
4. V.N. Mittal, 'Basic Electrical Engineering', Tata Mcgraw-Hill,2nd edition 2006.
5. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
6. A. Chakrabarti, S. Nath, C. Chanda, 'Basic Electrical Engineering', Tata McGrawHill Education India Pvt. Ltd, 2013.
7. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 10th Edition, 2009.
8. Albert Malvino and David Bates, "Electronics Principles" Tata McGraw-Hill, 7th Edition, 2006.
9. Digital Logic and Computer Design By M Morris Mano, Prentice Hall Publication, Fourth Edition.

Open e-Resource:

1. http://vlab.amrita.edu/index.php
2. https://www.facstaff.bucknell.edu/mastascu/eLessonsHTML/EEIndex.html
3. http://www.learnabout-electronics.org
4. http://www.electronics-tutorials.ws
5. https://www.coursera.org/course/eefunlab
6. https://www.coursera.org/course/introtoelectronics
7. http://www.electronicsandyou.com
8. https://onlinecourses.nptel.ac.in/noc21_ee55/preview
9. PSpices and NGSpice (Open Source Software)

List of Suggested Experiments:

1. To verify ohm's law in an electric circuit.

2. To verify KCL and KVL in an electric circuit.
3. To verify the Network theorems
4. To determine power in a single phase circuit using wattmeter.
5. Determination of B-H curve of magnetic material.
6. Analysis series RLC circuit.
7. Demonstration of domestic installations like MCB, ELCB, MCCB
8. To determine power in a three phase circuit using two wattmeter.
9. Demonstration of cut-section models and charts of various machines.
10. Understanding of various electrical bills and calculation for energy consumption.
11. To study and perform the VI characteristics of P-N junction diode
12. To study and perform the VI characteristics of Zener diode.
13. To study and perform about the Half Wave and Full Wave Rectifier.
14. To study and perform the Input and Output characteristics of a Transistor.
15. To study and configure an op-amp as an inverting and non-inverting amplifier.
16. To study and verify digital logic gates.
17. To configure diodes and transistors as logic gates and verify the truth table.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/CS/AI
SEMESTER 3

Subject Code: 10050301	**Subject Title:** Data Structures
Pre-requisite: Programming for Problem Solving	

Course Objective:

1. To impart the basic concepts of data structures and algorithms
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs
4. To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures
5. Ability to sensibly select appropriate data structures and algorithms for problems and to justify that choice.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

	Subject Contents		
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Data Structure:** Data Management concepts, Data types – primitive and non-primitive, Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best and worst case analysis), Types of Data Structures- Linear & Non Linear Data Structures. NPTEL CH-1 RB-1 & TB-1	04	10
2	**Linear Data Structures:** **Array:** Representation of arrays, Applications of arrays, sparse matrix and its representation. **Stack:** Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion, Tower of Hanoi. **Queue:** Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue. **Linked List:** Singly Linked List, Doubly Linked list, Circular linked list, Linked implementation of Stack, Linked implementation of Queue, Applications of linked list. NPTEL CH-4,5,6 RB-1 & TB-1	13	30

3	**Nonlinear Data Structures :** **Tree:** Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Threaded binary tree, Binary search trees, Conversion of General Trees To Binary Trees, Applications Of Trees Some balanced tree mechanism, eg. AVL trees, 2-3 trees, Height Balanced, Weight Balance. **Graph:** Matrix Representation Of Graphs, Elementary Graph operations,(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree). NPTEL CH-7,8 RB-1 & TB-1	13	30
4	**Hashing and File Structure :** **Hashing:** The symbol table, Hashing Functions, Collision Resolution Techniques, **File Structure:** Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure for index files, hashing for direct files, Multi-Key file organization and access methods. NPTEL CH-9 RB-1 & TB-1	06	15
5	**Sorting and Searching:** Bubble Sort, Selection Sort, Quick Sort, Merge Sort, Heap Sort, Sequential Search, Binary Search. NPTEL CH-9 RB-1 & TB-1	06	15

Course Outcome (COs):

1. Define and classify various data structures, storage structures and common operations on them.
2. Create various linear data structures with their representation and perform different operations on them.
3. Create various nonlinear data structures with their representation and perform different operations on them.
4. Apply various searching sorting techniques on data set.
5. Solve the given a problem using an appropriate data structure to achieve optimal performance and compare its performance with other possible data structures

List of Text Books:

1. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill,6th Edition

List of Reference Books:

1. Data Structures using C & C++ 5th Edition -By Ten Baum Publisher – Prenctice-Hall International.
2. Fundamentals of Computer Algorithms 4th Edition by Horowitz, Sahni,Galgotiass
3. Data Structures: A Pseudo-code approach with C,4th Edition -By Gilberg & Forouzan PublisherThomson Learning.

Open e-Resource:

1. https://nptel.ac.in/courses/106102064
2. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

List of Suggested Experiments:

At least 10 practical should be performed by students using programming language.

1. Introduction to pointers. Call by Value and Call by reference.
2. Introduction to Dynamic Memory Allocation. DMA functions malloc(), calloc(), free() etc.
3. Implement a program for stack that performs following operations using array:

(a) PUSH (b) POP (c) PEEP (d) CHANGE (e) DISPLAY

4. Implement a program to convert infix notation to postfix notation using stack.
5. Write a program to implement QUEUE using arrays that performs following operations:
   (a) INSERT (b) DELETE (c) DISPLAY
6. Write a program to implement Circular Queue using arrays that performs following operations:
   (a) INSERT (b) DELETE (c) DISPLAY
7. Write a menu driven program to implement following operations on the singly linked list.
   (a) Insert a node at the front of the linked list.
   (b) Insert a node at the end of the linked list.
   (c) Insert a node such that linked list is in ascending order.(according to info. Field)
   (d) Delete a first node of the linked list.
   (e) Delete a node before specified position.
   (f) Delete a node after specified position.
8. Write a program to implement stack using linked list.
9. Write a program to implement a queue using linked list.
10. Write a program to implement following operations on the doubly linked list.
    (a) Insert a node at the front of the linked list.
    (b) Insert a node at the end of the linked list.
    (c) Delete a last node of the linked list.
    (d) Delete a node before specified position.
11. Write a program to implement following operations on the circular linked list.
    (a) Insert a node at the end of the linked list.
    (b) Insert a node before specified position.
    (c) Delete a first node of the linked list.
    (d) Delete a node after specified position.
12. Write a program which create binary search tree.
13. Implement recursive and non-recursive tree traversing methods inorder, preorder and postorder traversal.
14. Write a program to implement Quick Sort, Merge Sort, Bubble Sort.
15. Write a program to implement Binary Search.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/CS/AI
SEMESTER 3

Subject Code: 10050302	**Subject Title: Database Management Systems**
Pre-requisite: Basic knowledge of Computer Programming	

Course Objective:

1. Understand the fundamental concepts of database management systems (DBMS) and their role in modern information systems.
2. Learn the process of database design, including schema definition, entity-relationship modeling, normalization, and data integrity constraints.
3. Acquire practical skills in using database query languages, such as SQL (Structured Query Language), to retrieve, manipulate, and update data stored in a database.
4. Explore techniques for optimizing database performance, including indexing, query optimization, and transaction management.
5. Understand the principles of data security and privacy in database systems, including access control mechanisms, encryption, and data backup and recovery strategies.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Database system architecture: Purpose of database, File System vs. DBMS, Advantages of a DBMS, Levels of Abstraction in a DBMS, Data Independence. Multi-level architecture, Client/Server architecture, Mapping, Database users and Administrators NPTEL, CH.1: TB1	03	05
2	Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations. NPTEL, CH.6: TB1	04	12

3	Relational query languages: Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, Tuple and domain relational calculus CH.2: TB1	04	08
4	Relational database design: Introduction, data dependency, Armstrong's axioms, Non loss decomposition and functional dependencies, Normalization- 1Nf, 2NF, 3NF, BCNF, Multivalued dependency, 4NF, Join dependency and 5NF. NPTEL, CH.7: TB1	05	10
5	Query processing and optimization: Evaluation of relational algebra expressions, selection operation, sorting, Join strategies, evaluation of expressions, Query optimization NPTEL, CH.15: TB1	04	10
6	Storage strategies: Indices, B-trees, hashing NPTEL, CH.14: TB1	02	05
7	Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery. NPTEL, CH.17: TB1	06	15
8	Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. CH.4: TB1	03	07
9	SQL Concepts : Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, join, Exist, Any, All , view and its types., transaction control commands. SQL3, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. NPTEL, CH.3,4: TB1	06	20
10	PL/SQL Concepts : Cursors, Stored Procedures, Stored Function, Database Triggers CH.5: TB1	02	08

Course Outcome:

1. Design and create a relational database using appropriate data modeling techniques and principles, including entity-relationship diagrams and normalization.
2. Construct and execute complex SQL queries to retrieve, manipulate, and update data in a relational database.
3. Apply optimization techniques to enhance the performance of database operations, such as query optimization, indexing, and transaction management.
4. Demonstrate an understanding of data integrity constraints and enforce them effectively in a database system.
5. Design and implement appropriate security measures to protect data in a database, including access control, authentication, and encryption techniques.
6. Design and implement transactional database systems that adhere to the ACID (Atomicity, Consistency, Isolation, Durability) properties.

List of Text Books:

1. “Database System Concepts”, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. “SQL- PL/SQL”, Ivan bayross

List of Reference Books:

1. “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer Science Press.
2. “Fundamentals of Database Systems”, 7th Edition by R. Elmasri and S. Navathe, Pearson
3. “An introduction to Database Systems”, C J Date, Pearson.
4. “Understanding SQL”, Martin Gruber, BPB
5. "Database Management Systems" by Raghu Ramakrishnan and Johannes Gehrke
6. "Database Design for Mere Mortals: A Hands-On Guide to Relational Database Design" by Michael J. Hernandez
7. "SQL Performance Explained" by Markus Winand
8. "Database Modeling and Design: Logical Design" by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau

Open e-Resource:

1. https://www.tutorialspoint.com/dbms/
2. https://www.w3schools.com/sql/
3. https://www.codecademy.com/learn/learn-sql
4. https://in.udacity.com/

List of Suggested Experiments:

1. To study DDL-create and DML-insert commands
2. Create table and insert sample data in tables.
3. Perform queries involving predicates LIKE, BETWEEN, IN etc.
4. To Perform various data manipulation commands, aggregate functions and sorting concept on all created tables.
5. To study Single-row functions.
6. Displaying data from Multiple Tables (join).
7. To apply the concept of Aggregating Data using Group functions.
8. To solve queries using the concept of sub query.
9. To apply the concept of security and privileges.
10. To study Transaction control commands.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 3

Subject Code: 10300301	**Subject Title:** Fundamentals of Artificial Intelligence
Prerequisite: Basic understanding of logic, mathematics, and programming concepts.	

Course Objective:

1. To understand the basic ideas and goals of Artificial Intelligence.
2. To learn different methods used in AI to solve problems.
3. To explore how AI systems represent and use knowledge.
4. To introduce students to logic, reasoning, and simple learning methods.
5. To introduce students to common real-life applications of AI across various fields.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Basics of Artificial Intelligence: Introduction to AI, history and applications of AI, understanding agents and environments, types of agents, rationality and decision-making, and how intelligent systems solve problems using basic strategies.	09	21
2	Search Techniques in AI: What is searching in AI, types of search – breadth-first, depth-first, and heuristic search (hill climbing, A*, AO*), basics of game playing (minimax), and concepts like alpha-beta pruning and evaluation of moves in games.	09	21
3	Representing Knowledge in AI: Simple ways to store and use knowledge in AI systems, logic-based representation (predicate logic), semantic networks, frames and inheritance, rules-based systems, constraint propagation, and uncertainty in AI reasoning.	08	20
4	Inference and Learning Methods: First-order and propositional logic, simple inference techniques like forward and backward chaining, inductive learning from examples, decision trees, and introduction to basic machine learning techniques including reinforcement learning.	08	19
5	Applications of AI in Everyday Life: Voice assistants, chatbots, facial recognition in mobile phones, AI in smart homes and vehicles, recommendation systems (YouTube, Netflix, shopping apps), AI in healthcare (patient monitoring and diagnosis), AI in education (personalized learning), AI in agriculture (crop monitoring and weather	08	19

	prediction), AI in finance (fraud detection and customer support), and simple real-world examples of AI-based mobile applications.		

Course Outcome:

1. Explain what Artificial Intelligence is and how it works.
2. Use basic search techniques to solve AI problems.
3. Represent knowledge using logical structures and rules.
4. Understand simple AI learning models like decision trees.
5. Identify simple real-life applications of AI in daily life.

List of Textbooks:

1. Elaine Rich & Kevin Knight – Artificial Intelligence, McGraw Hill.
2. Stuart Russell & Peter Norvig – Artificial Intelligence: A Modern Approach, Pearson.

List of Reference Books:

1. Nils J. Nilsson – Principles of Artificial Intelligence.
2. George F. Luger – Artificial Intelligence: Structures and Strategies for Complex Problem Solving
3. Chakraborty & Sharma – Artificial Intelligence (Simplified Text, Katson Publishing)
4. E. Charniak and D. McDermott – Introduction to Artificial Intelligence

List of Suggested Experiments:

10-12 experiments based on the syllabus covered above will be performed and evaluated on a continuous basis

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/CS/AI
SEMESTER 3

Subject Code: 10000302	**Subject Title: Economics and Management**
Pre-requisite: Zeel to learn the subject	

Course Objective:

1. Enrich the knowledge of essential elements of Economics and its application
2. Understand the concepts of Management, Organizational structure & corporate socia responsibility.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	-	3	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	Introduction to Economics; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; law of demand, law of supply, equilibrium between demand & supply Elasticity. elasticity of demand, price elasticity, income elasticity, cross elasticity	05	12
2.	Theory of production; production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis, meaning, explanation, numerical	04	12
3.	Markets; meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP, NDP, Personal income, disposal income.	04	12
4.	Basic economic problems; Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control	04	12
5.	Money; meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR	04	12

6.	Introduction to Management; Definitions, Nature, Management Difference between Management & administration, skill, types and roles of managers Management P r i nc i p l e s; Scientific principles, Administrative , principles, Maslow's Hierarchy of needs theory	05	12
7.	Functions of Management; Planning, Organizing, Staffing, Directing, controlling (meaning, nature and importance) Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization, chain of command, centralization and decentralization	06	12
8.	Organizational culture of Environment concept of culture and its importance, attributes culture, how does culture affect managers and employees.	04	10
9.	Corporate Social Responsibility; meaning, importance Business Ethics; meaning, importance.	03	06

Course Outcome:

1. Understand the concept of elasticity & analyze how it affects revenue.
2. Relate production function and cost function.
3. Analyze different market types and their characteristics for optimal quantity and pricing decisions to achieve profit maximization.
4. Describe basic principles of management: planning, organizing, controlling and directing. **5.** Analyze ethical dilemmas faced by business and managers.

List of Reference Books:

1. Paneerselvam R., Engineering Economics, PHI publication.
2. Robbins S.P. and Decenzo David A, Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
3. Gregory Mankiw N, Economics: Principles of Economics, Cengage Learning.
4. Prasad L.M., Principles and Practices of Management.
5. Tripathy and Reddy., Principles of Management.
6. Dewett K.K. & Navalur M.H., Modern Economic Theory, S.Chand Publication.

Open e-Resource:

1. https://nptel.ac.in/courses/122106031
2. https://nptel.ac.in/courses/109104125

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/CS/AI/ICT
SEMESTER 3

Subject Code: 10000301	**Subject Title: Probability & Statistics**
Pre-requisite: Algebra and Calculus	

Course Objective:

1. The main objective of the course is to provide an understanding of the basic concepts of probability and statistics

2. The focus in this course is to design a statistical hypothesis about real world problems and conduct appropriate tests for drawing valid inference about the population characteristics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	01	-	04	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Basic Statistics:** Measure of Central Tendency: Arithmetic Mean, Median and Mode for Grouped and Ungrouped Data, Standard Deviation, Variance, Coefficient of Variance, Karl Pearson's Coefficients of Skewness, Moments	6	14
2	**Curve Fitting:** Least Square Approximation, Fitting of Linear Curve, Quadratic Curve and Non-linear Curves **Correlation and Regression:** Correlation and its properties, Types of Correlation, Correlation Coefficient, Rank Correlation, Regression, Regression Coefficient, Properties and Expressions of Regression Coefficient	8	19
3	**Basic Probability:** Mathematical & Statistical definition of Probability, Conditional Probability, Baye's Theorem **Random Variables:** Discrete Random Variables, Probability Mass Function, Continuous Random variables, Probability Density Function, Statistical Measures for Two dimensional Random Variables	10	24
4	**Special Probability Distribution:** Binomial Distribution and its properties, Poisson Distribution and its properties, Normal Distribution and its properties, Gamma and Exponential Distributions	8	19
5	**Sampling Theory:** Test of Hypothesis, Level of Significance, Critical Region, One tailed and Two tailed test **Test of Significant for Large Samples:** Means of the samples and test of Significant of means of two large samples, **Test of Significant of Small Samples:** Students *t*-distribution for dependent and independent samples **Chi-Square Test**: Test of Goodness of Fit and Independence of Attributes	10	24

Course Outcome(COs):
After completion of this course, student will be able to:

1. Understand the statistical data using measures of central tendency.
2. Understand the concepts of Least square methods with various curves.
3. Learn the methods of correlation and regression to find relationships between variables and forecast outcomes.
4. Apply the basic principles of probability theory in problem solving situations.
5. Learn about different probability distributions to tackle statistical issues.
6. Learn how to create and evaluate hypotheses, determine the likelihood that hypotheses will be incorrect, and make conclusions using crucial values.

List of Textbooks:
1. R. Singh and M.D. Bhatt, Probability and Statistics, Tata McGraw Hill.
2. R.M. Baphana and T.B. Shah, Probability and Statistics, Tech-Neo Publication.
3. S.S. Patel, N.B. Desai, Probability and Statistics, Atul Prakashan.
4. S.C.Gupta, Fundamentals of Statistics, Himalaya Publishing House.

List of Reference Books:
1. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
4. J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.
5. V.K. Rohatgi and A. K. Md. E. Saleh, An Introduction to Probability and Statistics, Wiley India Pvt. Ltd

Open e-Resources:
1. https://onlinecourses.nptel.ac.in/noc23_ma83/preview
2. https://onlinecourses.nptel.ac.in/noc23_ma77/preview

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/CS/AI
SEMESTER 4

Subject Code: 10050402	**Subject Title: Operating System**
Pre-requisite: Basic Programming Knowledge	

Course Objective:

1. To understand the services provided by and the design of an operating system
2. To understand the structure and organization of the file system
3. To understand what a process is and how processes are synchronized and schedule
4. To understand different approaches to memory management
5. Students should be able to use system calls for managing processes, memory and the file system.
6. Students should understand the data structures and algorithms used to implement an OS.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:** Basics of Operating Systems: Definition – Generations of Operating systems – Types of Operating Systems, OS Service, System Calls, OS structure: Layered, Monolithic, Microkernel Operating, Systems – Concept of Virtual Machine. NPTEL CH-1 TB-1.	3	10
2	**Process Management**: Processes: Definition, Process Relationship, Process states, Process States, Process Control Block, Context switching, Threads– Concept of multithreads, Benefits of threads – Types of threads. NPTEL CH-2 TB-1.	4	7
3	**Process Scheduling:** Definition, Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time (Definition only), Scheduling algorithms: Preemptive and Non preemptive, FCFS – SJF – RR. NPTEL CH-4 TB-1.	4	7
4	**Deadlocks**: Definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery. NPTEL CH-6 TB-1.	4	9
5	**Interprocess Communication:** Race Conditions, Critical Section, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc. CH-2 TB-1.	5	12
6	**Memory Management:** Basic Memory Management: Definition, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition – Internal and External fragmentation and Compaction, Paging: Principle of operation – Page	7	15

	allocation – Disadvantages of paging. NPTEL CH-3 TB-1. **Virtual Memory:** Basics of Virtual Memory, Page fault, Working Set, Dirty page/Dirty bit – Demand paging (Concepts only) – Page Replacement policies: Optimal (OPT), First in First Out (FIFO), Second Chance (SC) and Least Recently used (LRU). NPTEL CH-4 TB-1.		
7	**File Management:** File concept, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping). NPTEL CH-4 TB-1.	5	15
8	**I/O Management:** Principles of I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage, Structure: Disk structure, Disk scheduling algorithm. CH-5 TB-1.	4	8
9	**Security & Protection:** Security Environment, Design Principles Of Security, User Authentication, Protection Mechanism: Protection Domain, Access Control List. CH-9 TB-1.	3	8
10	**Unix/Linux Operating System:** Development of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure. CH-10 TB-1.	3	9

Course Outcome (COs):

1. Understand various generations of Operating System and functions of Operating System.
2. Understand the concept of program, process and thread and Analyze various CPU Scheduling Algorithms and compare their performance.
3. Evaluate the requirements for the process synchronization and co-ordination in contemporary operating system.
4. Analyze various algorithms for memory management, I/O management, File management and security aspects of operating system.
5. Write shell scripts in Unix/Linux O.S and write simple programs using kernel system calls

List of Textbooks:

1. Modern Operating Systems-5th Edition By Andrew S. Tanenbaum (PHI)

List of Reference Books:

1. Operating Systems: Internals & Design Principles, 9th Edition, William Stallings, Pearson Education India
2. Operating System Concepts, 9th edition Peter B. Galvin, Greg Gagne, Abraham Silberschatz, John Wiley & Sons, Inc.
3. The UNIX Programming Environment ,January 2020 by Kernighan & Pike.

Open e-Resource:

1. https://nptel.ac.in/courses/106105214
2. https://www.tutorialspoint.com/operating_system/index.htm

List of Suggested Experiments:

There should be minimum 10 programs/shell scripts.

1. Study of Basic commands of Linux/UNIX.
2. Study of Advance commands and filters of Linux/UNIX.
3. Write a shell script to generate marksheet of a student. Take 3 subjects, calculate and display total marks, percentage and Class obtained by the student.
4. Write a shell script to display multiplication table of given number
5. Write a shell script to find factorial of given number n.
6. Write a shell script which will accept a number b and display first n prime numbers as output.
7. Write a shell script which will generate first n Fibonacci numbers like: 1, 1, 2, 3, 5, 13, …
8. Write a menu driven shell script which will print the following menu and execute the given task.
   a. Display calendar of current month
   b. Display today's date and time
   c. Display usernames those are currently logged in the system.
   d. Display your name at given x, y position.
   e. Display your terminal number.
9. Write a shell script to read n numbers as command arguments and sort them in descending order.
10. Write a shell script to display all executable files, directories and zero sized files from current directory.
11. Write a shell script to check entered string is palindrome or not.
12. Shell programming using filters (including grep, egrep, fgrep)
13. Study of UNIX Shell and Environment Variables.
14. Write a shell script to validate the entered date. (eg. Date format is: dd-mm-yyyy).
15. Write a program using function, which convert each word in a given text into capital.
16. Write a program for process creation using C. (Use of gcc compiler).
17. To write C Programs using the following system calls of UNIX operating system fork, exec,getpid, exit, wait, close, stat, opendir, readdir.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 4

Subject Code: 10300401	**Subject Title:** Machine Learning
Prerequisite: Calculus & Linear Algebra or Programming & Data Structure Course	

Course Objective:

1. To provide an in-depth introduction to supervised, unsupervised
2. To provide an in-depth introduction to reinforcement learning algorithms.
3. To design and implement machine learning solutions to classification, regression,
4. To design and implement machine learning solutions to clustering problems.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Review of linear algebra, optimization and probability: Matrices, Eigenvalues and vectors, gradient, hessian, least squares, optimization; random variables and distributions.	9	22
2	Definitions, goals and history of Machine Learning; Introduction, linear classification; Classification errors; Regression Techniques	8	17
3	Supervised learning: generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines.	9	22
4	Unsupervised learning: clustering, dimensionality reduction, kernel methods; learning theory, bias/variance trade-offs; VC theory; large margins	9	22
5	Reinforcement learning and adaptive control. Applications of machine learning.	8	17

Course Outcome:

1. Develop an appreciation for what is involved in learning from data.
2. Understand a wide variety of learning algorithms.
3. Understand how to apply a variety of learning algorithms to data.
4. Understand how to perform evaluation of learning algorithms and model selection.

List of Textbooks:

1. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997.
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.

List of Reference Books:

1. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
2. Hastie, T., R. Tibshirani, and J. H. Friedman. The Elements of Statistical Learning: Data Mining, Inference and Prediction, Second Edition, Springer, 2009.
3. MacKay, David. Information Theory, Inference, and Learning Algorithms. Cambridge, UK: Cambridge University Press, 2003.

List of Suggested Experiments:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on a continuous basis.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 4

Subject Code: 10300403	**Subject Title: Reinforcement Learning**
Pre-requisite: Probability, statistics, linear algebra, and programming, machine learning concepts	

Course Objective:

1. Develop a strong understanding of the fundamental principles of Reinforcement Learning, including the agent–environment interaction, state–action–reward dynamics, and different environment types.
2. To enable students to model sequential decision-making problems using the Markov Decision Process (MDP) framework and understand associated solution techniques.
3. To develop the ability to apply and compare major RL methods: Dynamic Programming, Monte Carlo, and Temporal Difference algorithms for prediction and control in model-based and model-free settings.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

1	**Introduction:** Basics of Machine Learning, The Agent Environment Interface, Components of RL: Agent, Environment, State, Action, Reward, Applications of RL (e.g., robotics, gaming, recommendation systems), Fundamental concepts of RL: Action space, Policy, Episode , Horizon, 1 Return and discount factor, The value function, Model-based and Model-free learning, Different types of environments :Deterministic and stochastic environments, Discrete and continuous environments, Episodic and non-episodic environments, Single and multi-agent environments	9	22
2	**Markov Decision Process (MDP):** Multi-armed Bandit Problem, Exploration vs. Exploitation, epsilon-greedy algorithm, Markov property, Markov Chain, Markov Reward Processes (MRPs), Markov Decision Processes (MDPs)	9	22
3	**The Bellman Equation and Dynamic Programming (DP):** Bellman equation of the value function, Bellman equation of the Q function, Dynamic programming: Value iteration, Dynamic programming: Policy Iteration	9	18

4	**Monte Carlo (MC) Methods:** Introduction to Monte Carlo Method, Monte Carlo Prediction: First-visit Monte Carlo, Monte Carlo Prediction: Every-visit Monte Carlo, Monte Carlo Control: On-Policy control, Monte Carlo Control: Off-Policy control	9	10
5	**Temporal Difference Methods:** Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.	9	10

Course Outcomes:

On completion of this course, the students will be able to:

1. Explain fundamental concepts of Reinforcement Learning
2. Apply Markov Decision Processes to solve RL Problems.
3. Apply the Bellman Equation and Dynamic Programming (DP) Methods to solve RL Problems
4. Apply Monte Carlo (MC) Methods for solving RL Problems.
5. Select the appropriate method between DP, MC, TD to solve the RL problem.

List of Textbooks:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019

List of Reference Books:

1. Keng, Wah Loon, Graesser, Laura, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison Wesley Data & Analytics Series, 2020.
2. Marco Wiering, Martijn van Otterlo (Ed), Reinforcement Learning, State-of-the-Art, Adaptation, Learning, and Optimization book series, ALO, volume 12, Springer, 2012.

Open e-Resource:

http://cse.iitkgp.ac.in/~adas/courses/rl_aut2021/syllabus.html
https://swayam.gov.in/search_courses?searchText=RL

https://www.youtube.com/playlist?

Lists of Experiments:

1. Set up an RL environment.
2. Explore OpenAI Gym to be used for RL Problems
3. Implementing a Markov Chain in Python.
4. Implement the Markov Property in a simple Gym environment.
5. Implement Bellman Expectation Equation.
6. Write a python program using OpenAI Gym to solve the Frozen Lake problem using Value Iteration.
7. Implement Python program using OpenAI Gym to solve the Frozen Lake problem using Dynamic programming Policy Iteration.

8. Implement Python program using OpenAI Gym to implement First-visit MC prediction 9. Implement First-visit MC prediction using python and OpenAI Gym.
10. Using TD prediction algorithm solve the problem of Predicting the value of states in the Frozen Lake environment
11. Micro Projects (Suggestions):

    a. In this OpenAI Gym environment, an agent learns to drive a car up a hill.

    b. Utilize OpenAI Gym to create an environment where an agent learns to balance a pole on a moving cart. Implement algorithms like Q-learning or policy gradients to train the agent.

    c. Tic-Tac-Toe Game: Develop an RL agent that learns to play Tic-Tac-Toe, focusing on state representation and reward shaping

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/IT/CSE/CS/AI
SEMESTER 4

Subject Code: 103000406	**Subject Title: Statistical Methods**
Pre-requisite: Basic knowledge of Mathematics and Probability, Basic knowledge of computer applications for statistical computation.	

Course Objective:

1. To introduce fundamental concepts and applications of statistical methods.
2. To develop analytical skills for organizing, presenting, and interpreting data.
3. To understand measures of central tendency, dispersion, correlation, and regression analysis.
4. To apply statistical techniques for data analysis, sampling, and decision-making.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	1	0	4	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Statistical Methods:** Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.	10	25
2	**Measures of Central Tendency:** Mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.	08	20
3	**Bivariate data:** Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.	08	15

4	**Index Numbers:** Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth- Marshall and Fisher's Ideal Index numbers. Errors in Index numbers. Chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers. Uses and limitations of index numbers	10	20
5	**Sampling methods & sampling distributions:** Population and sample, Probability and non-probability sampling methods, determination of sample size, Chi square, t and F distributions-definition, properties and tables of distribution	08	20

Course Outcome:

After completing this course, students will be able to:

1. Understand statistical concepts, data classification, and graphical representation methods.
2. Apply measures of central tendency and dispersion for data analysis.
3. Analyze relationships between variables using correlation and regression techniques.
4. Apply statistical distributions and hypothesis-related concepts in practical problems.
5. Use statistical methods for engineering, research, and real-world data analysis applications.

List of Text Books:

1. Fundamentals of Mathematical Statistics — S. C. Gupta and V. K. Kapoor, Sultan Chand Publications
2. Higher Engineering Mathematics — B. S. Grewal, Khanna Publishers
3. Applied Statistics and Probability for Engineers — Douglas C. Montgomery & George C. Runger, Wiley

List of Reference Books:

1. Probability and Statistics for Engineers and Scientists — Ronald E. Walpole, Pearson
2. Statistical Methods — N. G. Das, McGraw Hill Education
3. Fundamentals of Statistics — S. C. Gupta, Himalaya Publishing House

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CSE/AI
SEMESTER 5

Subject Code: 10270501	**Subject Title: Computer Communication and Network**
Pre-requisite: Basic Knowledge of hardware, software and operating system	

Course Objective:

1. To understand the concepts behind computer networks and data communication.
2. To learn the different types of networks, network topologies and their characteristics.
3. To learn the working of protocols used at various layers.
4. To understand the utility of different networking devices.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introductory Concepts:** Network hardware, Network software, topologies, Protocols and standards, OSI model, TCP model, TCP/IP model, Physical Layer: Digital and Analog Signals, Periodic Analog Signals, Signal Transmission, Limitations of Data Rate, Digital Data Transmission, Performance Measures, Line Coding, Digital Modulation, Media and Digital Transmission System	9	19
2	**Data Link Layer:** Error Detection and Correction, Types of Errors, Two dimensional parity check, Detection verses correction, Block Coding, Linear Block Coding, Cyclic Codes, Checksum, Standardized Polynomial Code, Error Correction Methods, Forward Error Correction, Protocols: Stop and wait, Go-back-N ARQ, Selective Repeat ARQ, Sliding window, Piggy backing, Pure ALOHA, Slotted ALOHA, CSMA/CD, CSMA/CA	10	21
3	**Network Layer:** Design issues, IP addressing, sub netting, Super netting (CIDR), IPV4, IPV6, Routing and Forwarding, Routing algorithms: Static and dynamic routing, Unicast and Multicast Routing, Distance-Vector Routing, Link-State Routing, Shortest path computation-Dijkstra's algorithm, Address mapping-ARP, RARP, BOOTP, DHCP, Address mapping: ARQ, RARQ, Congestion control, Quality of Service, Internetworking	10	21
4	**Transport Layer:** Services, UDP and TCP segment formats, connection establishment and termination, Expert Lecture from Industry, Congestion control, Congestion control: Open Loop and closed loop, Quality of	10	21

	service, Flow characteristics, Techniques to improve QoS , Leaky Bucket and Token Bucket algorithm.		
5	**Application Layer:** Services, DNS, SIP, RTP, Telnet/SSH, HTTP, HTTPS, Remote login, Electronic mail, SMTP, FTP Commands and Replies, WWW, SNMP, Addressing Schemes, Uniform Resource Identifiers, Introduction to network security.	8	17

Course Outcomes (COs):

On completion of this course, the students will be able to:

1. Differentiate between various types of computer networks and their topologies.
2. Understand the difference between the OSI and TCP/IP protocol suit.
3. Explain the design and functions of the Network Layer.
4. Demonstrate how traffic shaping algorithms work to regulate data flow and enforce QoS.
5. Demonstrate the use of application layer tools and utilities.

List of Textbooks:

1. William Stallings, Data and Computer Communications, Edition: 10th, Pearson.
2. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Edition: 5th, Pearson.
3. Behrouz A. Forouzan, Data Communications and Networking, Edition: 5th, McGraw-Hill.

List of Reference Books:

1. Gary A. Donahue, Network Warrior for a practical, hands-on perspective.
2. W. Richard Stevens, TCP/IP Illustrated (Volume 1), for protocol-level understanding.
3. Ames Kurose, Keith Ross, Computer Networking: A Top - Down Approach.

Open e-Resource:

1. **https://onlinecourses.nptel.ac.in/noc22_cs19/preview**
2. **http://www.redbooks.ibm.com/abstracts/gg243376.html**
3. **http://www.tcpipguide.com/**
4. **https://ieeexplore.ieee.org/document/6535799**

List of Experiments:

1. Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.
2. Study of Network Devices in Detail.
3. Study of network IP.
4. Connect the computers in Local Area Network.
5. Study of basic network command and Network configuration commands.
6. Demonstrate the simple network configuration with a router that connects two local area network (LAN) segments using cisco packet tracer.
7. Configure a Network topology using packet tracer software.
8. Configure a Network using Distance Vector Routing protocol.
9. Configure Network using Link State Vector Routing protocol.
10. Configure a network by having one scenario.
11. Network troubleshooting, analysis, software, and communications protocol development by Wireshark.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 5

Subject Code: 10300501	**Subject Title:** Neural Networks and Deep Learning
Prerequisite: Basic knowledge of linear algebra, calculus, probability, and programming fundamentals.	

Course Objective:

1. Introduce the fundamental concepts of neural networks, neuron models, and network architectures, drawing parallels with the human brain.
2. Explain various learning paradigms, including supervised, unsupervised, and reinforcement learning, and the mathematical principles behind them.
3. Develop proficiency in single-layer and multilayer perceptron models, focusing on training algorithms such as least mean square and backpropagation.
4. Implement deep learning models using frameworks like TensorFlow or PyTorch.
5. Analyze and evaluate the performance of deep learning systems in AI applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction**: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks **Learning Process**: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process	10	23
2	**Single Layer Perceptrons**: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment. **Multilayer Perceptron**: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.	12	27
3	**Back Propagation**: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning	8	18
4	**Data Augmentation Techniques**: Cropping, Flipping, Rotation, Brightness, Contrast, Color Augmentation, Saturation; Convolutional Neural Networks (CNNs): Convolution, Striding, Padding, Pooling, AlexNet Architecture, Image Classification (ImageNet Challenge); Well-	6	14

	Known CNN Architectures: VGG16, VGG19; Advanced CNN Concepts: Residual Block, ResNet50, 1x1 Convolution, XceptionNet, EfficientNet; Transfer Learning.		
5	**Generative Learning:** Variational Auto-Encoders (VAEs), Generative Adversarial Neural Networks (GANs), Generative Learning Applications: Image Generation, Font Generation, Video Generation, Anime Face/Celebrity Face Generation; Deep Reinforcement Learning: Markov Decision Process (MDP), Deep Q Learning, Exploration vs. Exploitation, Value Iteration vs. Policy Iteration; Reinforcement Learning Applications: Robotics, Gaming, Ad Targeting, Recommendation Systems, Decision Making.	8	18

Course Outcome:

1. Understand the Fundamentals of Neural Networks and Brain-Inspired Computation
2. Analyze Learning Processes in Neural Networks
3. Apply and Evaluate Single Layer Perceptron Models.
4. Implementation and Enhancement of Deep Learning Solutions.
5. Application of Deep Various Domains with Ethical Learning in Considerations.

List of Textbooks:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 2018.

List of Reference Books:

1. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILL EDUCATION 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. François Chollet, Deep Learning with Python, Manning Publications, Second Edition, 2021.

List of Suggested Experiments:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on a continuous basis.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CSE/AI
SEMESTER 5

Subject Code: 10270504	**Subject Title: Data Analysis and Visualization**
Pre-requisite: Familiarity with at least one programming language, preferably Python including basic syntax, variables, loops, and functions.	

Course Objective:

This course is designed to introduce the students to real-world data analysis problems, their analysis and interpretation of results in the field of exploratory data science using Python.

1. Develop a foundational understanding of data types, data collection methods, and data cleaning techniques.
2. Learn to summarize and explore data patterns using statistical methods and descriptive analytics.
3. Gain proficiency in tools and programming languages such as Python (Pandas, NumPy) for analyzing data.
4. Learn to design clear, insightful visual representations of data using tools like Matplotlib, Seaborn, Tableau, or Power BI.
5. Develop the ability to draw actionable insights from data and effectively communicate findings to stakeholders through reports and dashboards.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to basic statistics and analysis:** Fundamentals of Data Analysis,Types of data, Statistical foundations for Data Analysis, Types of Data Analysis, Correlation and Covariance.	10	22
2	**Array manipulation using Numpy:** Numpy array: Creating numpy arrays, various data types of numpy arrays, indexing and slicing, swapping axes, transposing arrays, data processing using Numpy arrays.	8	18
3	**Data Manipulation using Pandas:** Data Structures in Pandas: Series, Dataframe, Index objects, loading data into Panda's data frame, Working with Dataframe: Arithmetic's, Statistics, Binning, Indexing, Reindexing, Filtering, handling missing data, Hierarchical indexing, Data wrangling: Data cleaning, transforming, merging and reshaping.	10	22
4	**Data Visualization and Reporting with Supervised learning** Linear Regression, Classification, clustering and decision tree. Statistical Hypothesis Generation and Testing Understanding Data Visualization and Reporting, Key Principles for Data Visualization and Reporting, Techniques of Effective Data Visualization, Techniques for Effective	8	18

	Reporting, Importance of Data Visualization and Reporting.		
5	**Plotting and Visualization:** Using matplotlib to plot data: figures, subplots, markings, color and line styles, labels and legends, plotting functions in Pandas: Line bar, Scatter plots, histograms, stacked bars, Heatmap	9	20

Course Outcomes:

On completion of this course, the students will be able to:

1. Apply descriptive statistics to obtain a deterministic view of data
2. Perform data handling using Numpy arrays
3. Load, clean, transform, merge and reshape data using Pandas
4. Demonstrate knowledge of core design principles such as clarity, accuracy, simplicity, and audience-centric communication.
5. Visualize data using Pandas and matplotlib libraries.

List of Textbooks

1. McKinney W. Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media, 2018.
2. Molin S. Hands-On Data Analysis with Pandas, Packt Publishing, 2019.
3. Gupta S.C., Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2020.

List of Reference Books

1. Chen D. Y, Pandas for Everyone: Python Data Analysis, Pearson, 2018.
2. Miller J.D. Statistics for Data Science, Packt Publishing, 2017.

Open e-Resource:

1. https://ieeexplore.ieee.org/document/7583967
2. https://onlinecourses.nptel.ac.in/noc21_cs45/preview
3. https://www.tutorialspoint.com/excel_data_analysis/data_analysis_overview.htm

Lists of Experiments:

Use data set of your choice from Open Data Portal (https:// data.gov.in/, UCI repository) or load from scikit, seaborn library for the following exercises to practice the concepts learnt.

1. Load a Pandas dataframe with a selected dataset. Identify and count the missing values in a dataframe. Clean the data after removing noise as follows

a. Drop duplicate rows.

b. Detect the outliers and remove the rows having outliers

c. Identify the most correlated positively correlated attributes and negatively correlated attributes

2. Import iris data using sklearn library or (Download IRIS data from: https://archive.ics.uci.edu/ml/datasets/iris or import it from sklearn.datasets)

a. Compute mean, mode, median, standard deviation, confidence interval and standard error for each feature.

b. Compute correlation coefficients between each pair of features and plot heatmap.

c. Find covariance between length of sepal and petal d. Build contingency table for class feature.

3. Load Titanic data from sklearn library, plot the following with proper legend and axis labels:

a. Plot bar chart to show the frequency of survivors and non-survivors for male and female passengers separately
b. Draw a scatter plot for any two selected features
c. Compare density distribution for features age and passenger fare
d. Use a pair plot to show pairwise bivariate distribution
4. Using Titanic dataset, do the following
a. Find total number of passengers with age less than 30
b. Find total fare paid by passengers of first class
c. Compare number of survivors of each passenger class

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 5

Subject Code: 10300504	**Subject Title:** Computer Vision
Prerequisite: Basic knowledge of Machine Learning, Linear Algebra, Probability, and Python programming.	

Course Objective:

1. Understand the fundamental concepts of neural networks and deep learning architectures.
2. Explore and apply optimization techniques and regularization methods for training deep models.
3. Analyze and implement Convolutional Neural Networks (CNNs) and their advanced variants.
4. Study generative and reinforcement learning models and their real-world applications.
5. Learn model evaluation, tuning, and deployment strategies for deep learning applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Overview of Computer Vision, Definitions, History of Computer Vision and its application, Geometric primitives in image processing, Image transformations, Image restoration, linear filtering, Homogeneous co-ordinates, Camera projection and its models, Basic image processing techniques: filtering, edge detection, frequency domain analysis, Interest point detection, Blob and ridge detection.	09	21
2	Scale-invariant feature transform (SIFT), Applications of SIFT, Histogram of oriented gradients and its parameters, Bag of words and histogram of oriented gradients (HOG), Feature representation using HOG, Gaussian and Hough transform, Difference of Gaussian and Hough transform for feature detection, Feature extraction, Corner detection using Harris operator, Random sample consensus (RANSAC), RANSAC for robust estimation.	09	21
3	Optical flow and its application in motion tracking, Pyramids and motion models for multi-resolution analysis, Global motion estimation, Kanade-Lucas-Tomasi (KLT) feature tracking, Introduction to motion models in video, motion segmentation.	08	19
4	Fundamental matrix, Epipolar geometry for stereo vision, Camera models, Calibration and structure from motion, What is Stereo Vision?, Structure from motion, Stereo vision and reconstruction techniques, 3D image formation pipeline.	08	19
5	Object detection and recognition methods from traditional to deep learning approaches, Introduction to machine learning and deep learning algorithms, Application of machine learning and deep learning, Object detection and recognition, Advanced topics in computer vision, Semantic segmentation, Instance segmentation, Applications of Generative AI.	08	19

Course Outcome:

1. Understand the fundamental concepts and theories of computer vision.
2. Implement basic image processing techniques for feature extraction and analysis.
3. Apply advanced methods such as scale-invariant feature detection and optical flow for object tracking and motion analysis.
4. Comprehend the principles of machine learning and deep learning algorithms in computer vision.
5. Design and develop computer vision systems for object detection, recognition, and 3D reconstruction.

List of Textbooks:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. François Chollet, Deep Learning with Python, Manning Publications, 2nd Edition, 2021.

List of Reference Books:

1. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
2. Aurelien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 3rd Edition, 2022.
3. Nikhil Buduma and Nicholas Locascio, Fundamentals of Deep Learning, O'Reilly Media, 2017
4. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 2018.

List of Suggested Experiments:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on a continuous basis.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 5
Professional Elective - I

Subject Code: 10300503	**Subject Title:** Foundations of AI, Robotics and Drones
Prerequisite: Basic knowledge of programming, electronics, and artificial intelligence concepts.	

Course Objective:

1. To introduce basic concepts of AI, robotics, and drones.
2. To understand sensors, actuators, and control systems in intelligent machines.
3. To learn design, kinematics, and programming of robots and drones.
4. To apply AI techniques for perception, navigation, and automation.
5. To explore applications, ethics, and future trends in robotics and drones.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Introduction to Artificial Intelligence and Robotics:- Definition and evolution of AI and Robotics; Relationship between AI, ML, and Robotics; Components and structure of an intelligent robot; Role of AI in automation; Overview of real-world AI robots and drones.	08	20
2	Sensors, Actuators, and Control Systems:- Types and working principles of sensors (vision, proximity, ultrasonic, GPS); Actuators (electrical, hydraulic, pneumatic); Control systems and feedback loops; Motion control and precision; Robot and drone navigation basics.	09	20
3	Robot and Drone Kinematics, Programming & Simulation:- Forward and inverse kinematics; Path planning and trajectory generation; Drone dynamics and flight control; Robot programming languages; Simulation tools (e.g., Gazebo, MATLAB, ROS); Integration of control and AI logic.	08	20
4	AI and Perception Systems:- Role of AI in robotic perception; Image processing and computer vision; Machine learning for autonomous navigation; SLAM (Simultaneous Localization and Mapping); Cognitive architectures and decision-making in drones.	09	20
5	Applications, Ethics, and Future Trends:- Applications of robotics and drones in industry, healthcare, agriculture, defense, and logistics; Ethical and social issues; Regulatory frameworks for drones; Emerging technologies – Swarm robotics, Edge AI, and Sustainable robotics.	08	20

Course Outcome:

1. Understand the basic concepts and structure of AI, robotics, and drones.
2. Describe sensors, actuators, and control systems used in intelligent autonomous machines.
3. Apply kinematics and programming concepts to simulate and control robot and drone movements.
4. Evaluate the applications, challenges, and ethical aspects of robotics and drone technologies.

List of Textbooks:

1. Introduction to Robotics: Mechanics and Control" – John J. Craig, Pearson Education.
2. Drone Technology in AI Applications" – Rishabh Jaiswal, CRC Press.

List of Reference Books:

1. Unmanned Aircraft Systems: UAVS Design, Development and Deployment" – Reg Austin, Wiley.
2. Principles of Robot Motion: Theory, Algorithms, and Implementations" – Howie Choset et al., MIT Press.

List of Suggested Experiments:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on a continuous basis.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 5
Professional Elective - I

Subject Code: 10300505	**Subject Title:** Society and Artificial Intelligence
Prerequisite: Basic understanding of Artificial Intelligence concepts and applications	

Course Objective:

1. To introduce the fundamentals of Artificial Intelligence and its societal relevance.
2. To explore the ethical, cultural, and economic impacts of AI across various domains.
3. To examine real-world case studies demonstrating both positive and negative effects of AI.
4. To develop critical thinking on responsible AI development and governance.
5. To understand emerging trends, spiritual implications, and philosophical debates surrounding AI.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	0	3	70	30	0	0	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Overview of Artificial Intelligence: Definitions, history, Basic Concepts; AI Techniques: Machine learning, neural networks, and deep learning; AI Applications in Society: Healthcare (diagnosis, treatment, mental healthcare), Education (personalized learning, adaptive assessments, virtual tutors).	06	13
2	Ethical Frameworks: Utilitarianism, deontology, virtue ethics in AI; Bias and Fairness: Understanding algorithmic bias, mitigating algorithmic bias; Privacy and Security: Surveillance, data protection, and encryption in AI systems; Designing Ethical AI: Principles of ethical design and development; Transparency and Accountability: Explainability, auditing, and responsibility in AI systems; Regulatory Landscape: International standards, policies, and governance frameworks for AI.	10	22
3	Employment Trends: Automation, job displacement, future workforce; Economic Implications: Market disruption, wealth inequality, policy responses; Social Challenges: Digital divide, misinformation, and AI-driven polarization; AI in Art and Creativity: Generative art, music compositions, storytelling; AI in Media: Content generation, recommendation systems, deepfake technology; AI and Human Identity: Philosophical perspectives on AI's impact on human identity.	11	24
4	Case Studies: Analysis of real-world applications and controversies surrounding AI; Debate: Students engage in structured debates on controversial AI topics; AI and the Future of Work: Augmented intelligence, human-AI collaboration, new job opportunities; Emerging Trends: Quantum AI, swarm intelligence, and other cutting-edge	12	26

	developments; Speculative Futures: Scenarios for the evolution of AI and its societal impacts.		
5	Historical overview of intersections between AI and religion; Technological spirituality: Examining AI-driven meditation apps, virtual pilgrimages, and religious rituals; Digital immortality: Concepts of eternal life through AI, such as uploading consciousness; How AI might challenge traditional religious hierarchies and structures; Religious responses to AI: Different religious perspectives on the ethical use and development of AI; Transhumanism and spirituality: Debates on the convergence of technology and spirituality.	07	15

Course Outcome:

1. To examine the historical and current applications of AI in society.
2. To analyse the ethical implications of AI technologies.
3. To explore the impact of AI on employment, economy, and societal structures.
4. To investigate AI's influence on culture, media, and human behaviour.
5. To foster critical thinking and informed discourse on AI-related issues

List of Textbooks:

1. Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, 2019..
2. Wendell Wallach & Colin Allen, Moral Machines: Teaching Robots Right from Wrong, Oxford University Press, 2009.

List of Reference Books:

1. Shalini S. & S. Balaji, Artificial Intelligence and Society, Wiley India, 2021.
2. Nick Bostrom, Superintelligence: Paths, Dangers, Strategies, Oxford University Press, 2014.
3. Kate Crawford, Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence, Yale University Press, 2021.
4. Kevin Kelly, The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future, Penguin Books, 2016.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CE/AI
SEMESTER 6

Subject Code: 10050703	**Subject Title:** Image Processing
Pre-requisite: Physics and fundamentals of signal processing	

10 Course Objective:

1. To become familiar with digital image fundamentals
2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
3. To learn image restoration, interpolation, and filtering operations.
4. To learn various image processing operations like edge detection, segmentation; color-based processing, region and boundary detection, morphological operations.
5. To become familiar with image compression and recognition methods
6. To get exposure to digital image processing in detail with enhanced knowledge in various application areas.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Digital image fundamentals: Light and Electromagnetic spectrum, Components of Image processing system, Image formation and digitization concepts, Neighbors of pixel adjacency connectivity, regions and boundaries, Distance measures, Applications. NPTEL, CH.1,2: R1	05	20
2	Image Enhancements: In spatial domain: Basic gray level transformations, Histogram processing, Using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters. In Frequency domain: Introduction to the Fourier transform and frequency domain concepts, smoothing frequency-domain filters, Sharpening frequency domain filters. NPTEL, CH.2: R1	15	30
3	Image Restoration: Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering. NPTEL, CH.5: R1	5	20
4	Colour Image processing: Colour fundamentals, Colour models, Colour transformation, Smoothing and Sharpening, Colour segmentation. NPTEL, CH.6: R1	3	5

5	Wavelet and Multi-resolution processing: Image pyramids, Multi-resolution expansion, wavelet transform. NPTEL, CH.7: R1	3	10
6	Image compression: Introduction, Image compression model, Error-free compression, Lossy compression. NPTEL, CH.8: R1	3	5
7	Image segmentation: Detection of discontinuities, Edge linking and boundary detection, thresholding. NPTEL, CH.10: R1	3	10

11 Course Outcome:

1. Understand the basic image enhancement techniques in spatial & frequency domains
2. Apply various tools and techniques for digital image quality enhancement in spatial/frequency domain
3. Analyse image to evaluate quality of the digital image
4. Design real time application using digital image processing concepts

12 \List of References:

1. Digital Image Processing, by Rafel C. Gonzalez and Richard E. Woods, Pearson Education, latest edition.
2. Digital Image Processing by Bhabatosh Chanda and Dwijesh Majumder, PHI
3. Fundamentals of Digital Image Processing by Anil K Jain, PHI
4. Digital Image Processing Using Matlab, Rafel C. Gonzalez and Richard E. Woods, Pearson Education

13 Open e-Resource:

14

1. MATLAB with image processing toolbox.
2. Scilab (SIP)

15 List of Suggested Experiments:

1. MATLAB program to extract different Attributes of an Image.
2. MATLAB program for Image Negation.
3. MATLAB program for Power Law Transformation.
4. MATLAB program for Histogram Mapping and Equalization.
5. MATLAB program for Image Smoothening and Sharpening.
6. MATLAB program for Edge Detection using Sobel, Prewitt and Roberts Operators.
7. MATLAB program for Morphological Operations on Binary Images.
8. MATLAB program for Pseudo Coloring.
9. MATLAB program for Chain Coding.
10. MATLAB program for DCT/IDCT Computation.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH CSE/CE/IT/AI/CS
SEMESTER 6

Subject Code: 10060603	**Subject Title: Software Engineering**
Pre-requisite: Object Oriented Programming fundamental, UML	

Course Objective:

1. To study Software Development Life Cycle, Development models and Agile Software development.
2. To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
3. To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
4. To learn the process of improving the quality of software work products.
5. To gain the techniques and skills on how to use modern software testing tools to support software testing projects
6. To expose Software Process Improvement and Reengineering.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous assessment**	**University Assessment**	**Continuous assessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Software and Software Engineering The Evolving Role of Software, Software:** A Crisis on the Horizon and Software Myths, Software Engineering: A Layered Technology, Software Process Models, The Linear Sequential Model, The Prototyping Model, The RAD Model, Evolutionary Process Models, Agile Process Model, Component-Based Development, Process, Product and Process. [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-1]	3	10
2	**Agile Development**: Agility and Agile Process model, Extreme Programming, Other process models of Agile Development and Tools. [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-2]	4	7
3	**Managing Software Project:** Software Metrics (Process, Product and Project Metrics), Software Project Estimations, Software Project Planning (MS Project Tool), Project Scheduling & Tracking, Risk Analysis &Management (Risk Identification, Risk Projection, Risk Refinement , Risk Mitigation). [R.B Roger S.Pressman, Software Engineering- A practitioner's	4	7

	Approach CH-2,28]		
4	**Requirement Analysis and Specification:** Understanding the Requirement, Requirement Modeling, Requirement Specification (SRS), Requirement Analysis and Requirement Elicitation, Requirement Engineering [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-5]	4	9
5	**Software Design:** Design Concepts and Design Principal, Architectural Design, Component Level Design (Function Oriented Design, Object Oriented Design), User Interface Design, Web Application Design. [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-8,9]	5	12
6	**Software Coding & Testing:** Coding Standard and coding Guidelines, Code Review, Software Documentation, Testing Strategies, Testing Techniques and Test Case, Test Suites Design, Testing Conventional Applications, Testing Object Oriented Applications, Testing Web and Mobile Applications, Testing Tools (Win runner, Load runner). [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-17]	7	15
7	**Quality Assurance and Management:** Quality Concepts and Software Quality Assurance, Software Reviews (Formal Technical Reviews), Software Reliability, The Quality Standards: ISO 9000, CMM, Six Sigma for SE, SQA Plan [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-14,16]	5	15
8	**Software Maintenance and Configuration Management:** Types of Software Maintenance, Re-Engineering, Reverse Engineering, Forward Engineering, The SCM Process, Identification of Objects in the Software Configuration, Version Control and Change Control [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-22,29]	4	8
9	**DevOps:** Overview, Problem Case Definition, Benefits of Fixing Application Development Challenges, DevOps Adoption Approach through Assessment, Solution Dimensions, What is DevOps?, DevOps Importance and Benefits, DevOps Principles and Practices, 7 C's of DevOps Lifecycle for Business Agility, DevOps and Continuous Testing, How to Choose Right DevOps Tools, Challenges with DevOps Implementation, Must Do Things for DevOps, Mapping My App to DevOps - Assessment, Definition, Implementation, Measure and Feedback [R.B Roger S.Pressman, Software Engineering- A practitioner's Approach CH-29]	3	8
10	**Advanced Topics in Software Engineering:** Component-Based Software Engineering, Client/Server Software Engineering, Web Engineering, Reengineering, Computer-Aided Software Engineering, Software Process Improvement, Emerging Trends in software Engineering. [R.B Roger S.Pressman, Software Engineering- A practitioner's	3	9

	Approach CH-31]		

Course Outcome:

1. Prepare SRS (Software Requirement Specification) document and SPMP (Software Project Management Plan) document.
2. Apply the concept of Functional Oriented and Object Oriented Approach for Software Design.
3. Recognize how to ensure the quality of software product, different quality standards and software review techniques.
4. Apply various testing techniques and test plan in.
5. Able to understand modern Agile Development

List of Reference Books:

1. Roger S.Pressman, Software Engineering- A practitioner's Approach, McGraw-Hill International Editions
2. Ian Sommerville, Software engineering, Pearson education Asia
3. Pankaj Jalote, Software Engineering – A Precise Approach Wiley
4. Behhforoz & Frederick Hudson, Software Engineering Fundamentals, OXFORD
5. Rajib Mall, Fundamentals of software Engineering, Prentice Hall of India.
6. Deepak Gaikwad, Viral Thakkar, DevOps Tools from Practitioner's ViewPoint, Wiley
7. Merlin Dorfman (Editor), Richard H. Thayer (Editor) ,Software Engineering
8. Robert C. "Uncle Bob" Martin , Clean Architecture: A Craftsman's Guide to Software Structure and Design

Open e-Resource:

1. https://www.javatpoint.com/software/engineering
2. https://www.geeksforgeeks.org/software/engineering/introduction/to/software/engineering/

List of Suggested Experiments:

There should be minimum 10 programs/shell scripts.

1. Select any application for which software development process can be defined and find out which process model will be more suitable for application. Justify the selection of model.
2. Create a SRS document for selected application.
3. Draw E/R diagram and class diagram for your selected application.
4. Write the scenario and draw Use case Diagram for selected application.
5. Draw Activity diagram for selected application.
6. Draw Sequence diagram for selected application.
7. Draw Data Flow Diagrams for selected application.
8. Apply FP oriented estimation model for selected application.
9. Prepare Test Cases for your application.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 6

Subject Code: 10300606	**Subject Title: LLM Engineering**
Pre-requisite: Basic Knowledge of Python Programming, Machine Learning and Natural Language Processing.	

Course Objective:

1. Understand the architecture and working principles of Large Language Models (LLMs).
2. Learn prompt engineering techniques for interacting with LLMs effectively.
3. Explore fine-tuning and optimization techniques for customizing language models.
4. Develop real-world AI applications using LLM frameworks and APIs.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**ContinuousAssessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Large Language Models:** Basics of Artificial Intelligence, Natural Language Processing and Generative AI. Evolution of Language Models from N-grams, RNN, LSTM to Transformer models. Architecture of Transformer including self-attention and encoder-decoder structure. Overview of popular LLMs such as GPT, BERT, LLaMA and Gemini. Applications of LLMs in various domains.	8	19
2	**Prompt Engineering:** Fundamentals of prompt design. Types of prompting techniques including Zero-shot, One-shot and Few-shot prompting. Chain-of-Thought prompting. Prompt optimization and evaluation techniques. Prompt templates and structured prompting for different tasks such as text generation, summarization and question answering.	10	24
3	**LLM Fine-Tuning and Customization:** Pre-training vs Fine-tuning. Transfer learning in language models. Dataset preparation for LLM training. Parameter Efficient Fine-Tuning (PEFT). Techniques such as LoRA and adapters. Evaluation metrics for LLM performance including perplexity, accuracy and BLEU score.	10	24
4	**LLM Frameworks and Tools:** Introduction to HuggingFace Transformers, LangChain and OpenAI APIs. Working with tokenizers and	7	17

	embeddings. Building simple LLM applications. Integration of LLMs with databases and external tools. Development of conversational AI systems and chatbots.		
5	**Advanced LLM Applications and Deployment:** Retrieval Augmented Generation (RAG). LLMs for code generation, summarization and knowledge assistants. Ethical considerations, bias, hallucination and security issues in LLMs. Deployment of LLM applications using cloud platforms and APIs.	7	16

Course Outcomes:
On completion of this course, the students will be able to:

1. Understand the architecture and working principles of Large Language Models.
2. Apply prompt engineering techniques to interact effectively with LLMs.
3. Perform fine-tuning and customization of language models for specific tasks.
4. Develop applications using LLM frameworks and APIs.
5. Analyze ethical, security and deployment issues related to LLM systems.

List of Textbooks:
1. Denis Rothman, Transformers for Natural Language Processing, Packt Publishing.
2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, Natural Language Processing with Transformers, O'Reilly.

List of Reference Books:
1. Jurafsky & Martin, Speech and Language Processing, Pearson.
2. Yoav Goldberg, Neural Network Methods for Natural Language Processing, Morgan & Claypool.

Open e-Resource:
1. https://huggingface.co/learn
2. https://platform.openai.com/docs
3. https://developers.google.com/machine-learning

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 6

Subject Code: 10300602	**Subject Title:** Privacy, Ethics and Regulations of Artificial Intelligence
Prerequisite: Basic understanding of AI concepts, data handling, and machine learning fundamentals.	

Course Objective:

1. To introduce students to the ethical challenges and responsibilities in the development and deployment of AI systems.
2. To develop an understanding of privacy issues related to AI and data usage.
3. To explore frameworks and global standards for AI governance and regulation.
4. To analyze the societal and legal implications of AI technologies.
5. To promote responsible AI practices for fairness, transparency, and accountability.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	0	3	70	30	0	0	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Foundations of AI Ethics: Meaning of ethics, moral philosophy in AI, ethical dilemmas, role of ethics in automation, value alignment, AI ethics frameworks	08	17
2	Fairness, Accountability & Transparency: Algorithmic bias, discrimination, fairness metrics, explainability of AI models (XAI), black-box vs. interpretable AI	10	22
3	Privacy & Data Protection in AI: Data privacy concepts, anonymization, de-identification, consent, surveillance, data protection by design, privacy-preserving ML	10	21
4	Global and National AI Regulations: Overview of GDPR, EU AI Act, OECD AI Principles, Indian Digital Personal Data Protection Act, ethical AI by NITI Aayog	09	22
5	Case Studies and Emerging Trends: Real-world cases (e.g., facial recognition, credit scoring), deepfakes, misinformation, ethical risks of generative AI, future of responsible A	08	18

Course Outcome:

1. Identify and describe ethical issues and risks in AI systems.
2. Analyze privacy threats arising from data-driven AI applications.
3. Apply ethical principles like fairness, transparency, and explainability in AI models.
4. Understand major AI regulations and standards like GDPR, AI Act, and Indian frameworks.
5. Evaluate real-world case studies to recognize the need for ethical AI development.

List of Textbooks:

1. Mark Coeckelbergh, AI Ethics, The MIT Press, 2020.
2. Virginia Dignum, Responsible Artificial Intelligence, Springer, 2019.

List of Reference Books:

1. Cathy O'Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, Crown Publishing, 2016.
2. Shalini S. Sharma & S. B. Mishra, Artificial Intelligence: Ethics, Governance, and Society, CRC Press, 2022.
3. Wendell Wallach and Colin Allen, Moral Machines: Teaching Robots Right from Wrong, Oxford University Press, 2009.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 6
Professional Elective - II

Subject Code: 10300603	**Subject Title: Industrial Automation & AI**
Pre-requisite: Basics of AI/ML, Control Systems, Industrial Automation, Sensors, Python Programming	

Course Objective:

1. To provide an understanding of the integration of Artificial Intelligence in industrial automation systems.
2. To enable students to develop AI-based models for predictive maintenance, quality inspection, and intelligent control.
3. To introduce smart manufacturing concepts such as digital twins, Industry 4.0, and IoT-driven automation.
4. To equip students with hands-on experience in computer vision, ML, and AI-enabled PLC/SCADA s ystems.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to AI in Industrial Automation:** Evolution of automation: Industry 1.0 to 5.0, Concept of Intelligent Automation, Role of AI in manufacturing, logistics, and process industries, AI-based industrial decision-making, Case studies: Siemens MindSphere, ABB Ability, Bosch Nexeed	06	10
2	**Industrial Data Acquisition and IoT Integration:** Industrial sensors (vision, vibration, temperature, proximity, pressure), IIoT architecture: Edge layer, Fog layer, Cloud layer, Data acquisition systems (DAQ), OPC-UA, MQTT, Feature extraction from sensor and machine data, Industrial data lakes and real-time streaming	10	25
3	**Machine Learning for Industrial Systems:** Linear & nonlinear ML models for automation, Predictive maintenance using ML (bearing faults, vibration analysis), Equipment health monitoring and degradation modeling, Production forecasting and resource optimization using ML, ML pipelines for industrial data (scaling, PCA, anomaly detection)	08	20
4	**Computer Vision & Deep Learning for Automation**: Industrial vision systems fundamentals, CNN architectures for defect detection, Object detection: YOLO, SSD, Faster R-CNN, Visual inspection of assembly lines, Vision-based robot guidance and positioning	06	15
5	**AI Integration with PLC, SCADA, and Robotics:** AI-driven PLC logic	06	15

	optimization, SCADA data analytics using AI, Reinforcement Learning in industrial control, Robotic automation: Collaborative robots, adaptive control, Real-time systems and challenges for AI integration		
6	**Digital Twins, Smart Manufacturing & Industrial Safety:** Concept of Digital Twin and Virtual Commissioning, AI-powered simulation and optimization, Smart factories: Autonomous production lines, AI-enabled safety systems, cybersecurity in automation, ISO standards for industrial safety (ISO 10218, IEC 61508, ISO 13849)	04	15

Course Outcome:

After completing this course, students will be able to:

1. Explain AI applications and architectures in modern industrial automation.
2. Collect and analyze industrial data using IIoT technologies.
3. Build ML models for predictive maintenance, process optimization, and quality control.
4. Apply computer vision and deep learning techniques for industrial inspection.
5. Integrate AI models with PLC, SCADA, and robotic systems.
6. Evaluate digital twin systems and apply AI for smart factory operations.

List of Text Books:

1. Artificial Intelligence for Industry 4.0, Parag Kulkarni, Springer
2. Industrial Automation and Robotics, Mikell Groover, Pearson
3. Machine Learning for Industrial Applications, Jay Lee, Springer

List of Reference Books:

1. AI & IoT in Manufacturing, Ovidiu Vermesan, River Publishers
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press
3. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer

Open e-Resource:

1. NPTEL – Industrial IoT / Machine Learning
2. Siemens MindSphere Documentation
3. TensorFlow & PyTorch official websites
4. Intel AI for Industrial Applications
5. https://www.automationworld.com
6. https://www.analyticsvidhya.com

List of Suggested Experiments:

1. Acquisition of industrial sensor data (temperature, vibration, etc.).
2. Performing feature extraction and preprocessing techniques on industrial datasets.
3. Development of predictive maintenance ML model using Python.
4. Time-series forecasting (ARIMA/LSTM) for machine performance prediction.
5. Implementing defect detection using CNN and OpenCV.
6. Object detection using YOLO for automated inspection.
7. Integration of AI model with virtual PLC (Codesys/Factory I/O).
8. SCADA system data analytics using AI (simulation).
9. Robot path optimization using Reinforcement Learning (simulation).
10. Mini Project: AI-enabled automation system (Smart conveyor, Fault classifier, Vision inspection system).

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 6
Professional Elective - II

Subject Code: 10300604	**Subject Title: AI for Healthcare**
Pre-requisite: Fundamentals of AI/ML, Python programming, Basic Biomedical Engineering, Signal/Image Processing	

Course Objective:

1. To introduce AI applications, opportunities, and challenges in the healthcare domain.
2. To enable students to build ML/DL models for disease prediction, diagnosis, and treatment planning.
3. To understand medical imaging, electronic health records (EHR), and physiological signal analysis.
4. To develop AI-based solutions ensuring safety, ethics, privacy, and clinical reliability.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to AI in Healthcare:** Overview of healthcare systems and digital transformation, Role of AI in diagnostics, prognosis, therapy, and hospital automation, Healthcare data types: Images, signals, EHR, genomics, Challenges: Data scarcity, privacy, explainability, Case studies: IBM Watson Health, Google DeepMind, Siemens Healthineers	06	10
2	**Medical Data Acquisition & Preprocessing:** Medical image formats: DICOM, NifTI, EHR data structure: ICD codes, lab records, prescriptions, Physiological signals: ECG, EEG, EMG, Noise removal, normalization, segmentation, Handling imbalance, missing values & multi-modal healthcare data	10	25
3	**ML for Disease Prediction & Risk Assessment:** Classification, regression, clustering for healthcare datasets Chronic disease prediction: Diabetes, heart disease, cancer, Survival analysis and risk stratification, Clinical decision support systems (CDSS), Explainability methods: SHAP, LIME, Grad-CAM	08	20
4	**Deep Learning for Medical Imaging**: Convolutional Neural Networks (CNN) for medical diagnosis, Organ segmentation (U-Net, SegNet), Detection of tumors, lesions, fractures, Radiology AI: X-ray, CT, MRI, Ultrasound analysis, Evaluation metrics specific to healthcare: Dice Score, AUC, Sensitivity	06	15
5	**AI for Biomedical Signals & Wearable Devices:** ECG/EEG/PPG processing using AI, Arrhythmia detection using ML, Human activity recognition from wearable sensors, Real-time patient monitoring and alert systems, IoT and remote health monitoring (Telemedicine + AI)	06	15
6	**Ethics, Privacy & Regulations in AI Healthcare:** Confidentiality,	04	15

	anonymization, HIPAA/GDPR compliance, Bias, fairness, transparency in medical AI, Safety considerations & human oversight, Clinical trials for AI systems, FDA/CE approval pathways for medical AI devices		

Course Outcome:

After completing this course, students will be able to:

1. Understand the role and scope of AI in modern healthcare systems.
2. Process and analyze medical images, signals, and EHR data.
3. Develop ML models for disease prediction and risk assessment.
4. Apply deep learning methods for medical imaging and diagnostics.
5. Implement AI solutions using wearable and IoT healthcare devices.
6. Evaluate ethical, regulatory, and safety aspects of AI in clinical practice.

List of Text Books:

1. Artificial Intelligence in Healthcare, Parag Kulkarni, Springer
2. Deep Learning for Medical Image Analysis, Zhou, Greenspan & Shah, Academic Press
3. Machine Learning and AI in Healthcare, Arjun Panesar, Apress

List of Reference Books:

1. Bioinformatics & Medical Data Analysis, Cecil Lynch, Elsevier
2. Healthcare Analytics Using ML, V. K. Jain, Wiley
3. Biomedical Signal Processing, Rangayyan, CRC Press
4. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer

Open e-Resource:

1. NIH Medical Data Repository
2. Kaggle Medical Imaging & EHR Datasets
3. Physionet (ECG/EEG data)
4. NPTEL – Biomedical Signal Processing / AI in Healthcare
5. TensorFlow Medical Add-ons (TF-Med)
6. https://www.mitacs.ca/healthcare-ai

List of Suggested Experiments:

1. Preprocessing and visualization of healthcare datasets (EHR/Image/Signal).
2. ECG signal classification using ML models.
3. Building a diabetes or heart disease prediction model using Python.
4. Medical image segmentation using U-Net.
5. Tumor detection using CNN (X-ray/CT/MRI).
6. Development of a wearable-based health monitoring model.
7. Explainability analysis using LIME/SHAP on clinical predictions.
8. Real-time health monitoring dashboard using IoT sensors.
9. Creation of a clinical decision support system prototype.
10. Mini Project: End-to-end AI solution for healthcare problem (diagnosis, monitoring, triage).Mini Project: AI-enabled automation system (Smart conveyor, Fault classifier, Vision inspection system).

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 6
Professional Elective - II

Subject Code: 10300605	**Subject Title: AI for IOT**
Pre-requisite: IoT fundamentals, Python programming, Basics of AI/ML, Sensors & Embedded Systems	

Course Objective:

1. To integrate Artificial Intelligence techniques with IoT systems for intelligent connected environments.
2. To develop ML/DL models for IoT data analytics and smart automation.
3. To understand edge AI, embedded intelligence, and cloud–edge computing systems.
4. To apply AI-driven solutions in domains such as smart homes, smart cities, healthcare, and industrial IoT.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to AI-Enabled IoT Systems:** IoT architecture: Perception, Network, Middleware, Application, Role of AI in enhancing IoT systems, Smart IoT-based applications: Home automation, Wearables, Smart Agriculture, Types of IoT data: Sensor, time-series, multimedia, event-driven, Case studies: Google Nest, Amazon IoT, Azure IoT Hub	06	10
2	**IoT Sensors, Data Acquisition & Communication:** Sensor types: Environmental, motion, biometric, industrial, IoT communication protocols: MQTT, CoAP, AMQP, BLE, Zigbee, LoRaWAN, Edge data acquisition, microcontroller interfaces (ESP32, Arduino, STM32), Data preprocessing: Filtering, smoothing, normalization, compression, Real-time streaming using Apache Kafka / MQTT	10	25
3	**Machine Learning for IoT Data Analytics:** Supervised and unsupervised models for IoT data, Anomaly detection in sensor networks, Predictive analytics and forecasting (temperature, humidity, energy usage), Clustering for pattern recognition in IoT devices, Deployment of ML models on cloud platforms (AWS, Azure, GCP IoT services)	08	20
4	**Deep Learning & Computer Vision for IoT**: CNN, RNN, LSTM for IoT applications, Vision-based IoT: Smart CCTV, object tracking, gesture recognition, Speech recognition for IoT voice-enabled devices, Lightweight deep learning models for IoT (MobileNet, TinyML), Multimedia IoT data handling: Audio, image, video streams	06	15
5	**Edge AI & Embedded Intelligence:** Edge vs Fog vs Cloud computing, AI model compression: Quantization, pruning, distillation, Running AI on microcontrollers (TinyML, TensorFlow Lite), Edge devices: NVIDIA	06	15

	Jetson Nano, Google Coral, Raspberry Pi 4, Latency, energy efficiency, and optimization in edge AI systems		
6	**AI-Enabled Smart Applications & Security:** Smart city solutions: Traffic prediction, pollution monitoring, Smart industry: Predictive maintenance & automation, Intelligent home systems: Energy optimization, voice control, IoT security: Device authentication, data encryption, attack detection using AI, Ethical considerations for AI-enabled IoT systems	04	15

Course Outcome:

After completing this course, students will be able to:

1. Explain AI-enabled IoT architectures and applications.
2. Acquire and preprocess IoT sensor data for intelligent applications.
3. Build ML models for IoT analytics such as anomaly detection and forecasting.
4. Apply DL techniques for IoT-based vision, speech, and multimodal systems.
5. Deploy AI models on edge devices for real-time IoT intelligence.
6. Evaluate IoT security and apply AI to enhance robustness.

List of Text Books:

1. Artificial Intelligence for IoT, John Soldatos, Artech House
2. Internet of Things, A Hands-on Approach, Arshdeep Bahga, Vijay Madisetti, Universities Press
3. Machine Learning and AI for IoT, Jaydip Sen, CRC Press

List of Reference Books:

1. Hands-On Machine Learning with Scikit, Learn, Keras & TensorFlow, Aurélien Géron, O'Reilly
2. Deep Learning, Ian Goodfellow, MIT Press
3. TinyML: Machine Learning with TensorFlow Lite on Microcontrollers, Pete Warden, Daniel Situnayake, O'Reilly

Open e-Resource:

1. Google TensorFlow Lite Micro
2. AWS IoT Documentation
3. Microsoft Azure IoT Edge
4. OpenCV & PyTorch Tutorials
5. NPTEL: IoT, Machine Learning, Edge AI
6. https://thingsboard.io/(IoT Platform)

List of Suggested Experiments:

1. Interfacing sensors with ESP32/Raspberry Pi and data acquisition.
2. Real-time data publishing using MQTT protocol.
3. ML-based anomaly detection on IoT sensor datasets.
4. LSTM-based forecasting for IoT time-series data.
5. Face/object detection using lightweight CNN (MobileNet).
6. Deploying AI models on Raspberry Pi or Jetson Nano.
7. TinyML model deployment on Arduino/ESP32.
8. IoT dashboard creation using ThingsBoard/AWS IoT.
9. Implementing IoT security anomaly detection using ML.
10. Mini Project: AI-enabled IoT system (Smart home, smart industry, smart agriculture, etc.).

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7

Subject Code: 10300701	**Subject Title: Prompt Engineering**
Pre-requisite: Familiarity with at least one programming language, preferably Python including basic syntax, variables, loops, and functions and machine learning.	

Course Objective:

1. Understand the principles and techniques of prompt engineering, including the designs of effective prompts
2. Explore the capabilities of large language models for text and image generations and to leverage the creation of engaging content.
3. Gain practical experience in crafting prompts and generating text and images using AI tools and platforms.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Prompt Engineering:** Large Language Model, Working of LLM, Prompt Engineering, importance of Prompt Engineering, Types of prompts: security threats, system failures, performance bottlenecks, Benefits and limitations of Prompt Engineering, Benefits and limitations of Prompt Engineering, Case studies highlighting the impact of prompts on computing systems Real-world applications across various domains	9	22
2	**Foundations of NLP and Generative Models:** Overview of NLP tasks and applications, Preprocessing techniques for text data, Basic NLP tools and libraries (NLTK, SpaCy), Text Representation and Feature Engineering - Bag-of-Words model, Word embeddings (Word2Vec, GloVe), Deep learning-based text representations (BERT, Transformer). Generative Models - Overview of generative modeling, Probabilistic generative models, Autoencoders and variational inference.	9	22
3	**Prompt Types and Techniques:** Zero-shot vs. Few-shot learning with prompts, Task-specific prompt design strategies, Advanced techniques like Chain-of-Thought prompting, Introduction to prompt engineering tools and resources, Prompt Detection Techniques- Anomaly detection methods, Threshold-based approaches, Machine learning techniques for prompt detection	9	18
4	**Prompt Development and Evaluation:** Exercises - case studies in crafting prompts for various tasks (e.g., text generation, question answering), Techniques for evaluating prompt effectiveness and factual accuracy, Refining and iterating on prompts based on results, bias	9	10

	detection and mitigation in prompts.		
5	**Current trends and case studies of Prompt Engineering:** Emerging trends and advancements in prompt engineering Ethical considerations and potential societal impacts Discussion on the future of human-AI collaboration through prompts, Case Studies: Analysis of real-world prompt events, Design and implementation of prompt-resistant solutions, Evaluation of prompt engineering techniques in practice.	9	10

Course Outcomes:
On completion of this course, the students will be able to:

1. Understand the role in interacting with LLM
2. Explore the fundamental concepts of NLP and generative models
3. Explore the different prompt types and their applications.
4. Apply various prompt engineering techniques.
5. Evaluate ethical consideration of Prompt Engineering

List of Textbooks:

1. Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, Published by O'Reilly Media, Inc. in 2024, ISBN: 9781098153434

List of Reference Books:

1. Prompt Engineering: The Art of Asking Hardcover by Yaswanth Sai Palaghat in 2023.
2. Gilbert Mizrahi, "Unlocking the Secrets of Prompt Engineering: Master the Art of Creative Language Generation to Accelerate Your Journey from Novice to Pro", January 2024 https://www.packtpub.com/en-in/product/unlocking-the-secrets-of-prompt-engineering9781835083833
3. "Prompt Engineering", OpenAI, https://platform.openai.com/docs/guides/promptengineering/strategy-test-changes-systematically
4. Michael Ferguson, "Prompt Engineering: The Future of Language Generation", January 2023

Open e-Resource:

https://youtu.be/_ZvnD73m40o
https://www.youtube.com/watch?v=6eul1pfGKwk
https://www.youtube.com/watch?v=QZosTTcg7F8

Lists of Experiments:

1. Perform basic NLP preprocessing on text data.
2. Convert text into numeric representations with different text representation techniques.
3. Introduction to Generative Models, generate text using simple generative models.
4. Experiment with different prompting strategies on LLMs, zero-shot and few-shot prompting
5. Role-Based and Instruction Prompts
6. Chain-of-Thought (CoT) Prompting
7. Identify unsafe or suspicious prompt patterns.
8. Study biases in LLM-generated text.
9. Build a small prompt-engineered

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7

Subject Code: 10300702	**Subject Title: Generative AI**
Pre-requisite: Basic Knowledge of Python Programming, Machine Learning and Deep Learning.	

Course Objective:

1. Understand the fundamental concepts and working principles of Generative Artificial Intelligence.
2. Learn different deep learning based generative models such as GANs, VAEs and Transformers.
3. Explore the use of Large Language Models for text generation and intelligent applications.
4. Study image generation techniques and multimodal AI systems.
5. Analyze ethical issues, challenges and deployment strategies for Generative AI applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	**-**	**2**	**4**	**70**	**30**	**30**	**20**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Generative Artificial Intelligence:** Overview of Artificial Intelligence, Machine Learning and Deep Learning. Concept of generative modeling and probabilistic learning. Difference between generative and discriminative models. Applications of Generative AI in text generation, image synthesis, speech generation and creative content production.	8	19
2	**Deep Generative Models:** Autoencoders and Variational Autoencoders (VAE). Generative Adversarial Networks (GAN) architecture, training mechanism and optimization issues. Different types of GAN models and their applications in image generation and style transfer.	9	21
3	**Transformers and Large Language Models:** Transformer architecture, self-attention mechanism and encoder-decoder models. Pre-training and fine-tuning of language models. Overview of models such as GPT, BERT and LLaMA. Prompt engineering techniques and applications in chatbots, summarization and question answering.	10	24
4	**Diffusion Models and Multimodal AI:** Concept of diffusion models and latent diffusion. Image generation models such as DALL·E and Stable Diffusion. Multimodal AI integrating text, images and audio generation.	7	17

	Applications in design, entertainment and content creation.		
5	**Ethics and Deployment of Generative AI:** Ethical challenges, bias and hallucination in generative systems. Data privacy and copyright concerns. Responsible AI practices. Deployment of generative AI applications using APIs, cloud platforms and AI frameworks.	8	19

Course Outcomes:
On completion of this course, the students will be able to:

1. Understand the basic principles and architectures of generative AI models.
2. Analyze different deep generative models including GANs and VAEs.
3. Apply transformer-based models and large language models for text generation tasks.
4. Develop applications using generative AI frameworks and tools.
5. Evaluate ethical issues and challenges in generative AI deployment.

List of Textbooks:
1. David Foster – Generative Deep Learning, O'Reilly Media.
2. Denis Rothman – Transformers for Natural Language Processing, Packt Publishing.

List of Reference Books:
1. Ian Goodfellow, Yoshua Bengio & Aaron Courville – Deep Learning, MIT Press.
2. Stuart Russell & Peter Norvig – Artificial Intelligence: A Modern Approach, Pearson.

Open e-Resource:
1. https://huggingface.co/learn
2. https://platform.openai.com/docs
3. https://www.deeplearning.ai

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7
Professional Elective - III

Subject Code: 10300703	**Subject Title: Agentic AI**
Prerequisite: Python Programming, Artificial Intelligence, Machine Learning, Deep Learning, Natural Language Processing	

Course Objective:

1. To understand the concepts and architecture of Agentic AI systems.
2. To design intelligent autonomous agents capable of reasoning and decision-making.
3. To integrate LLMs, tools, APIs, and memory into AI agents.
4. To develop AI agents for task automation, planning, and problem-solving.
5. To explore multi-agent systems and real-world agentic AI applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Introduction to Agentic AI Systems: Concept of AI agents, reactive vs. deliberative agents, Agent architecture, Autonomous systems, intelligent decision-making, Goal-based and utility-based agents, Agentic AI workflow, Real-world applications of Agentic AI	06	10
2	Large Language Models & AI Agents: Fundamentals of LLMs, Prompt engineering, Role of LLMs in autonomous agents, Retrieval-Augmented Generation (RAG), Memory systems, Context management, tool usage, and API integration in agents	10	20
3	Planning, Reasoning & Task Execution: AI planning techniques, Chain-of-thought reasoning, Task decomposition, Sequential and parallel task execution, ReAct framework, Function calling, Autonomous workflow automation	08	20

4	Multi-Agent Systems & Collaboration: Multi-agent communication, Cooperative and competitive agents, Agent coordination, Swarm intelligence basics, Distributed AI systems, collaborative problem-solving, Human-AI collaboration LangChain, CrewAI, AutoGen, Semantic Kernel basics, Building AI assistants and chatbots, Agent deployment, monitoring, and optimization of agents, Cloud integration	10	20
5	Applications, Ethics & Security in Agentic AI: AI copilots, Autonomous customer support, AI research assistants, Security risks in autonomous agents, AI hallucination and bias, Ethical AI systems, Responsible Agentic AI development	08	15

Course Outcome:

1. Explain the architecture and working of Agentic AI systems.
2. Develop intelligent AI agents using LLMs and AI frameworks.
3. Implement reasoning, planning, and memory-enabled autonomous systems.
4. Design collaborative multi-agent systems for complex tasks.
5. Evaluate ethical, secure, and responsible deployment of Agentic AI.

List of Textbooks:

1. Building LLM-Powered Applications – Valentina Alto
2. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig
3. Generative AI with LangChain – Ben Auffarth

List of Reference Books:

1. Designing Autonomous AI Agents – Kevin Jolly
2. Hands-On Large Language Models – Jay Alammar & Maarten Grootendorst
3. Deep Learning – Ian Goodfellow

Open e-Resource:

1. OpenAI Documentation
2. Lang Chain Documentation
3. CrewAI Documentation
4. Microsoft AutoGen Tutorials
5. Hugging Face Transformers
6. NPTEL: Artificial Intelligence & NLP

List of Suggested Experiments:

1. Prompt engineering and chatbot creation using LLMs.
2. Building an AI assistant with LangChain.
3. Implementing memory-enabled conversational agents.
4. Creating a Retrieval-Augmented Generation (RAG) system.
5. Developing tool-calling AI agents using APIs.
6. Task automation using autonomous agents.

7. Multi-agent collaboration using CrewAI or AutoGen.
8. Building AI research assistant applications.
9. Deployment of AI agents on cloud platforms.
10. Mini Project: Autonomous Agentic AI System.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7
Professional Elective - III

Subject Code: 10300704	**Subject Title:Information Retrieval**
Pre-requisite: Basic Knowledge of Data Structures, Database Systems and Probability.	

Course Objective:

1. Understand the basic concepts and models used in Information Retrieval systems.
2. Learn techniques for indexing, searching and ranking large collections of documents.
3. Study text processing, query processing and retrieval evaluation methods.
4. Explore modern search technologies including web search and recommender systems.
5. Analyze applications of information retrieval in search engines and digital libraries.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Information Retrieval:** Basic concepts of Information Retrieval. Difference between Data Retrieval and Information Retrieval. Components of IR systems. Applications of Information Retrieval. Boolean Retrieval model and basic search techniques.	8	19
2	**Text Processing and Indexing:** Document preprocessing techniques including tokenization, stop word removal and stemming. Inverted index structure. Dictionary and posting lists. Index construction and storage techniques.	10	24
3	**Retrieval Models:** Vector Space Model. Term Frequency (TF) and Inverse Document Frequency (IDF). Similarity measures such as cosine similarity. Probabilistic retrieval models. Language models for information retrieval.	9	21
4	**Web Search and Ranking Algorithms:** Web search engines architecture. Crawling and indexing of web pages. Link analysis algorithms such as PageRank and HITS. Ranking methods used in search engines.	7	17
5	**Evaluation and Advanced Topics:** Evaluation metrics such as precision, recall and F-measure. Relevance feedback techniques. Introduction to multimedia retrieval, recommender systems and modern AI-based search systems.	8	19

Course Outcomes:
On completion of this course, the students will be able to:

1. Understand the basic architecture and components of information retrieval systems.
2. Apply text preprocessing and indexing techniques for document collections.
3. Implement different retrieval models for searching information.
4. Analyze ranking algorithms used in modern web search engines.
5. Evaluate the performance of information retrieval systems using standard metrics.

List of Textbooks:

1. Christopher D. Manning, Prabhakar Raghavan & Hinrich Schütze – Introduction to Information Retrieval, Cambridge University Press.
2. Ricardo Baeza-Yates & Berthier Ribeiro-Neto – Modern Information Retrieval, Addison-Wesley.

List of Reference Books:

1. Stefan Büttcher, Charles Clarke & Gordon Cormack – Information Retrieval: Implementing and Evaluating Search Engines.
2. Bruce Croft, Donald Metzler & Trevor Strohman – Search Engines: Information Retrieval in Practice.

Open e-Resource:

1. https://nlp.stanford.edu/IR-book
2. https://nptel.ac.in
3. https://www.coursera.org

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7
Professional Elective - III

Subject Code: 10050604	**Subject Title: Distributed Computing**
Pre-requisite: A strong foundation in data structures, algorithms, computer networks, and programming is essential for studying distributed computing.	

Course Objective:

1. Understand the fundamental concepts and challenges of distributed computing.
2. Gain practical experience in designing and implementing distributed systems.
3. Analyze and evaluate different distributed algorithms and architectures.
4. Develop skills in designing fault-tolerant and scalable distributed applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Distributed Systems:** Definition and characteristics of distributed systems**,** Motivation and challenges of distributed computing**,** Types of distributed systems, Examples of distributed systems in real-world applications. [T.B-1:Distributed Systems: Principles and Paradigms- CH-1,2]	3	10
2	**Distributed System Models:** Client-server architecture, Peer-to-peer architecture, Middleware-based architectures, Comparison of different distributed system models. [T.B-1:Distributed Systems: Principles and Paradigms- CH-4]	4	10
3	**Communication in Distributed Systems:** Remote Procedure Call (RPC), SUN RPC operation, example - SUN RPC LRPC, Example: DCE RPC Remote object invocation ,The General Architecture, Steps for Developing an RMI system, Remote Interfaces and Classes, example, Message passing, Synchronous vs. asynchronous communication. [T.B-1:Distributed Systems: Principles and Paradigms- CH-6]	4	15
4	**Concurrency Control:** Mutual exclusion and synchronization**,** Distributed mutual exclusion algorithms**,** Deadlock detection and prevention [T.B-1:Distributed Systems: Principles and Paradigms- CH-8]	4	12
5	**Distributed Algorithms:** Leader election**,** Distributed consensus algorithms (e.g., Paxos, Raft)**,** Distributed termination detection, Distributed graph algorithms [T.B-2:Distributed Algorithms- CH-1,2]	5	12

6	**Fault Tolerance:** Types of faults in distributed systems**,** Replication and consistency models**,** Fault tolerance techniques (e.g., replication, check pointing, recovery) [T.B-1:Distributed Systems: Principles and Paradigms- CH-9]	7	15
7	**Scalability and Performance:** Scalability metrics**,** Techniques for achieving scalability (e.g., load balancing, caching)**,** Performance modeling and analysis Case studies of scalable distributed systems [T.B-1:Distributed Systems: Principles and Paradigms- CH-11]	5	15
8	**Case Studies and Applications:** Case studies of distributed systems (e.g., Google File System, Amazon Dynamo DB) Applications of distributed computing (e.g., cloud computing, Iot) [T.B-4:Distributed Systems: Principles and Paradigms- CH-13]	4	11

Course Outcome:

1. To gain experience in the design and development of distributed systems and distributed systems applications.
2. To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
3. To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.
4. Understand distributed system techniques and methodologies.

List of Textbooks:

1. Distributed Systems: Principles and Paradigms" by Andrew S. Tanenbaum and Maarten Van Steen.
2. Distributed Algorithms" by Nancy A. Lynch.
3. Tributed Computing: Principles, Algorithms, and Systems" by Ajay D. Kshemkalyani and Mukesh Singhal.
4. Principles of Distributed Database Systems" by M. Tamer Özsu and Patrick Valduriez.

List of Reference Books:

1. Building Microservices" by Sam Newman - While primarily focusing on microservices architecture, this book discusses the principles and challenges of building distributed systems, including communication patterns, service discovery, resilience, and deployment strategies.
2. Cloud Computing: Principles and Paradigms" edited by Rajkumar Buyya, James Broberg, and Andrzej Goscinski - This book provides comprehensive coverage of cloud computing concepts, architectures, deployment models, and technologies, which are essential for understanding modern distributed computing infrastructures.
3. Distributed Systems for Fun and Profit" by Mikito Takada - This online book provides practical insights into designing and implementing distributed systems, covering topics such as network protocols, concurrency models, fault tolerance, and scalability techniques.

Open e-Resource:

1. https://ieeexplore.ieee.org/search/distributedcomputing
2. https://nptel.ac.in/courses/106106168
3. https://github.com/topics/distributed-systems
4. https://www.coursera.org/courses/distributedsystems

List of Suggested Experiments:

1. Set up a simple client-server architecture using sockets or a higher-level framework like Apache Thrift. Experiment with different communication protocols and message formats.
2. Implement a basic distributed file system where files are stored across multiple servers.
3. Experiment with file replication, fault tolerance, and consistency models.
4. Implement a distributed key-value store like Dynamo or Cassandra.
5. Experiment with data partitioning, replication strategies, and consistency levels.
6. Implement a distributed task execution framework like Apache Spark or Hadoop.
7. Experiment with task scheduling, data partitioning, and fault tolerance.
8. 8-Program to implement termination detection
9. 8-Program to implement termination detection
10. 8-Program to implement termination detection
11. Implement concurrent echo client-server application.
12. Implement concurrent day-time client-server application.
13. Configure following options on server socket and tests them: SO_KEEPALIVE, SO_LINGER, SO_SNDBUF, SO_RCVBUF, and TCP_NODELAY.
14. Incrementing a counter in shared memory.
15. Create CORBA based server-client application.

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7
Professional Elective – IV

Subject Code: 10300705	**Subject Title:** Virtual and Augmented Reality
Pre-requisite: Basic programming (Python/C#), fundamentals of Computer Graphics, and understanding of Linear Algebra and AI concepts.	

Course Objective:

1. Introduce the concepts, evolution, and applications of VR and AR.
2. Explain VR/AR hardware, software, sensors, and tracking systems.
3. Train students in building 3D virtual environments and AR experiences.
4. Provide hands-on practice using Unity, Unreal Engine, ARCore, ARKit, and related frameworks.
5. Integrate AI techniques into immersive computing applications.
6. Prepare students for industry use-cases such as gaming, robotics, healthcare, and simulation.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Extended Reality (XR) :** VR, AR, MR overview, evolution of immersive technologies, key characteristics, applications in AI, industry use-cases	6	10
2	**VR/AR Hardware & Software Ecosystem:** HMDs, smart glasses, sensors, IMUs, cameras, controllers; VR engines, AR SDKs; Unity, Unreal Engine, APIs & toolkits	10	20
3	**3D Graphics & Virtual Environment Development:** Coordinate systems, 3D transformations, modeling, rendering pipeline, shading, lighting, physics simulation, spatial sound	12	25
4	**Interaction Design for VR/AR:** Gesture recognition, gaze-based interaction, hand tracking, haptic feedback, locomotion techniques, UI/UX for immersive applications	10	20

5	**Building VR/AR Applications:** Unity AR Foundation, ARCore/ARKit, Vuforia, marker & markerless AR, WebXR basics, AI-based interactions, VR training simulations, case studies	10	25

Course Outcome:

1. Understand and differentiate VR, AR, MR, and XR technologies.
2. Identify and use VR/AR hardware, sensors, and engines effectively.
3. Apply 3D graphics and physics concepts to develop virtual environments.
4. Design intuitive and natural immersive interactions for VR/AR systems.
5. Develop VR/AR applications using Unity, ARCore, ARKit, or Vuforia.
6. Integrate AI-driven models into VR/AR experiences.

List of Textbooks:

1. Understanding Virtual Reality, William R. Sherman & Alan B. Craig
2. Augmented Reality: Principles and Practice ,Schmalstieg & Hollerer
3. Learning Virtual Reality ,Tony Parisi

List of Reference Books:

1. Unity Virtual Reality Projects, Jonathan Linowes
2. Prototyping Augmented Reality ,Tony Mullen
3. Augmented Reality for Developers, Jonathan Linowes & Krystian Babilinski

Open e-Resources:

1. https://learn.unity.com/
2. https://developer.oculus.com/
3. https://developer.vuforia.com/
4. https://developers.google.com/ar
5. https://developer.apple.com/augmented-reality
6. https://webxr.io/

List of Suggested Experiments:

1. Introduction to Unity/Unreal Engine interface
2. Creating a basic 3D world and virtual objects
3. Implementing VR camera and player controller
4. Gesture and gaze-based interaction in VR
5. Developing a marker-based AR app using Vuforia
6. Surface detection using ARCore/ARKit
7. Hand tracking & object manipulation
8. Implementing physics-based interaction in VR
9. Integrating AI (object detection/pose estimation) in AR
10. Mini project: VR/AR application for gaming, e

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7
Professional Elective - IV

Subject Code: 10300706	**Subject Title: Remote Sensing and AI**
Pre-requisite: Familiarity with Programming, Mathematics, knowledge of machine learning	

Course Objective:

1. Understand the fundamentals of Remote Sensing, sensors, satellite datasets, and basic AI concepts.
2. Learn Machine Learning and Deep Learning techniques used for RS-based classification, segmentation, and object detection.
3. Apply AI methods for advanced RS tasks such as change detection, LULC mapping, data fusion, and hyperspectral/LiDAR analysis.
4. Gain awareness of emerging technologies like Generative AI, Explainable AI, and Quantum AI in Remote Sensing.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:**Basics of RS: Electromagnetic spectrum, atmospheric windows, Types of sensors: Passive vs Active, Types of resolutions (spatial, spectral, temporal, radiometric), Satellites and popular RS datasets (Landsat, Sentinel, MODIS, LIDAR, UAV imagery), Applications: Agriculture, environment, urban planning, disaster management. Overview of Artificial Intelligence: What is AI? Evolution and scope, AI vs ML vs DL, AI workflow for RS tasks, Real-world AI applications in Earth observation	6	15
2	**Machine Learning Techniques for RS:** Supervised learning for RS, Algorithms: SVM, Random Forest, KNN, Decision Trees, Feature extraction from RS images, Accuracy metrics for RS classification.	6	15
3	**Deep Learning Models for RS:** CNN fundamentals, Architectures: U-Net, ResNet,EfficientNet,Semantic segmentation vs classification, Object detection architectures (YOLO, Faster R-CNN), Challenges: limited labeled data, imbalanced datasets, domain shift	8	25
4	**Advanced RS Tasks:** Classification and Object Detection in RS, Change Detection and Monitoring, Multi-sensor Data Fusion	5	12
5	**Cutting-edge AI in Remote Sensing:** Land Use Land Cover (LULC) using AI, Generative AI for Remote Sensing, Explainable AI (XAI) in RS, Quantum AI in RS	5	12
6	**Specialized RS Data & Applications:** Hyperspectral data characteristics, ML/DL for hyperspectral classification, LiDAR point cloud processing, Applications: forestry, mining, terrain modelling,building end-to-end RS	6	21

	pipelines, Deployment of AI models for real-time RS tasks, Integrating AI outputs with GIS systems, Case studies: crop health monitoring, disaster early warning system		

Course Outcomes:
On completion of this course, the students will be able to:

1. Explain the basic principles of Remote Sensing and AI.
2. Apply ML and DL algorithms to classify and analyze RS imagery.
3. Perform advanced RS tasks such as change detection, LULC mapping, and multi-sensor data fusion.
4. Process specialized data such as hyperspectral and LiDAR using AI techniques.
5. Use modern AI approaches (GANs, XAI, Quantum AI) to enhance RS workflows and interpretation.

List of Textbooks:
1. Remote Sensing and Image Interpretation, Authors: Thomas M. Lillesand, Ralph W. Kiefer, Jonathan Chipman, Publisher: Wiley
2. Fundamentals of Remote Sensing, Authors: George Joseph, Publisher: Universities Press
3. Deep Learning, Authors: Ian Goodfellow, Yoshua Bengio, Aaron Courville
   Publisher: MIT Press
4. Pattern Recognition and Machine Learning, Author: Christopher M. Bishop, Publisher: Springer

List of Reference Books:
1. Object-Based Image Analysis, Authors: Thomas Blaschke, Minghini, Hay, Publisher: Springer
2. Remote Sensing with LiDAR, Author: Paul E. Gessler & Others, Publisher: CRC Press
3. Machine Learning for Remote Sensing, Author: João P. A. Maia, Publisher: CRC Press
4. Deep Learning for Remote Sensing Data, Authors: Gui-Song Xia et al., Publisher: Springer

Open e-Resource:
https://www.mdpi.com/1424-8220/25/19/5965

https://ieeexplore.ieee.org/document/9756442/

Lists of Experiments:

1. Introduction to Satellite Imagery
2. Preprocessing of RS Data
3. Feature Extraction from RS Images
4. ML-based Classification (SVM / Random Forest / KNN)
5. Deep Learning – Basic CNN for Image Classification
6. Semantic Segmentation using U-Net
7. Object Detection on RS Data (YOLO / Faster R-CNN)
8. Apply image differencing/post-classification comparison and generate change map.
9. LiDAR Point Cloud Processing
10. Generative AI for Remote Sensing

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH AI
SEMESTER 7
Professional Elective - IV

Subject Code: 10060606	**Subject Title: Cloud Infrastructure and Services**
Pre-requisite: Fundamentals of Distributed Computing	

Course Objective:

This course aims students to understand the hardware, software concepts and architecture of cloud computing. Students realize the importance of Cloud Virtualization, Abstractions and Enabling Technologies.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:** Cloud Computing, Layers and Types of Clouds, Cloud Infrastructure Management, Challenges and Applications. Virtualization: Virtualization of Computing, Storage and Resources. Cloud Services: Introduction to Cloud Services IaaS, PaaS and SaaS [T.B-1: "The Basics of Cloud Computing" - CH-1]	4	10
2	**Software as a Service (SaaS):** Evolution of SaaS, Challenges of SaaS Paradigm, SaaS Integration Services, SaaS Integration of Products and Platforms. Infrastructure As a Services (IaaS): Introduction, Background & Related Work, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, VM Provisioning and Migration in Action. Platform As a service (PaaS):Integration of Private and Public Cloud, Technologies and Tools for Cloud Computing, Resource Provisioning services [T.B-1: "The Basics of Cloud Computing" - CH-2]	8	20
3	**Abstraction and Virtualization:** Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Understanding Machine Imaging, Porting Applications, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Center Automation [T.B-2: "Cloud Computing: Methodology, Systems, and Applications " - CH-4]	8	20
4	**Cloud Infrastructure and Cloud Resource Management:**	8	20

	Architectural Design of Compute and Storage Clouds, Layered Cloud Architecture Development, Design Challenges, Inter Cloud Resource Management, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources. Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards [R.B-3: "Cloud Application Architectures" - CH-2]		
5	**Security:** Security Overview, Cloud Security Challenges and Risks, Software-as-a Service Security, Cloud computing security architecture: Architectural Considerations, General Issues Securing the Cloud, Securing Data, Data Security, Application Security, Virtual Machine Security, Identity and Presence, Identity Management and Access Control, Autonomic Security Establishing Trusted Cloud computing, Secure Execution Environments and Communications, , Identity Management and Access control Identity management, Access control, Autonomic Security Storage Area Networks, Disaster Recovery in Clouds. [T.B-3: "Cloud Computing: Concepts, Technology & Architecture" - CH-5]	7	14
6	**Cloud Middleware:** OpenStack, Eucalyptus, Windows Azure, CloudSim, EyeOs, Aneka, Google App Engine [T.B-3: "Cloud Computing: Concepts, Technology & Architecture" - CH-6]	5	8
7	**Cloud Based Case-Studies:** Overview of Cloud services, Designing Solutions for the Cloud, Implement & Integrate Solutions, Emerging Markets and the Cloud, Tools for Building Private Cloud: IaaS using Eucalyptus, PaaS on IaaS - AppScale	5	8

Course Outcome:

1. Compare the strengths and limitations of cloud computing
2. Identify the architecture, infrastructure and delivery models of cloud computing
3. Apply suitable virtualization concept.
4. Choose the appropriate cloud player, Programming models and approach
5. Address the core issues of cloud computing such as security, privacy and interoperability

List of Text Books:

1. The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice.
2. Cloud Computing: Methodology, Systems, and Applications
3. Cloud Computing: Concepts, Technology & Architecture

List of Reference Books:

1. Rajkumar Buyya, James Broberg, Andrzej M Goscinski, Cloud Computing: Principles and Paradigms, Wiley publication.
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.

3. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication
4. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

List of Experiments:

1. BASICS OF CLOUD COMPUTING
2. STUDY OF CLOUD COMPUTING ARCHITECTURE AND SERVICE MODEL
3. STUDY VIRTUALIZATION OF CLOUD THROUGH ANY HYPERVISON
4. STUDY OF GOOGLE APP ENGINE (GAE)
5. STUDY OF AMAZON WEB SERVICES (AWS)
6. STUDY OF APACHE HADOOP
7. STUDY OF MICROSOFT AZURE
8. STUDY ABOUT CLOUD COMPUTING SECURITY ISSUE

Open e-Resource:

1. technolamp.blogspot.com
2. http://www.intelligentedu.com/
3. NITTR Instructional Resources Videos

B.TECH AI
SEMESTER 8

Subject Code: 10300801	**Subject Title: Project/Internship**
Prerequisite: - Computer Engineering courses (Basic science, Engineering Science and core courses), Effective Technical Communication and Design Engineering	

Course Objective:

1. To create competent professionals for the industry.
2. To provide possible opportunities to learn, understand and sharpen the real time technical /managerial skills required at the job
3. To work on a problem assigned by a mentor at industry, prepare action plan and complete within time limit
4. To learn, create/prepare a report for Project/Framework/research as used in industry with productive (Data in a concise form) and efficient way (with action resolution).
5. To explore possibilities of patent or research paper publications.
6. Expose students to the engineer's responsibilities and ethics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
-	-	24	12	0	0	100	100	200

Course Outcomes (COs):

On completion of this course, the students will be able to:

CO1: Undertake problem identification, formulation and solution.
CO2: Design engineering solutions to complex problems utilising a systematic approach and team work
CO3: Communicate with engineers and the community at large in written and oral forms
CO4: Demonstrate the knowledge and understanding of engineering and management principles and apply it to the assigned project.

General Guidelines for Internship/Project:

Industrial Training guidelines :

1. A student shall submit a brief proposal about the work to be carried out in the internship, to a committee formed by the head of department within 3 weeks, after starting the internship.
2. The internship shall be full time for the whole duration.
3. A detailed daily diary is supposed to be maintained by students. It shall be signed duly by the concerned supervisor of industry. It shall be submitted to the department.
4. A comprehensive report is required to be prepared and submitted to the department at the end of the semester. A certificate shall be attached with this report duly signed by the competent authority of the industry for the successful completion of the internship. An attendance report shall also be attached with this report.
5. The internal evaluation shall be done at the start of the semester, at the mid of the semester and at the end of the semester. The internal marks shall be divided as decided by the head.

6. A plan for the whole internship duration shall be prepared after joining the industry after consultation with the supervisor/mentor/guide of industry. It shall contain the activities/ visits to different sections etc with appropriate timelines.
7. The project report shall be submitted to the institute which may include the objective of training,about the industry, process, product line, equipment/machineries involved, divisions/sections in the industry, any competitor, scope of some improvement in the process/product/efficiency, benefit by the training etc.
8. The industry supervisor may be invited at the time of external examination of the internship, if possible. It can be an online presence.
9. The evaluation by an external examiner shall be made considering all guidelines.

Project guidelines :

1. To provide detailed and extensive explanation of the purpose and need of the project
2. A Significant review of the previous work published in the literature pertaining to the topic of the investigation.
3. Perform proper analysis of technical, operational and economic aspects of the proposed work.
4. Identify methodology for the proposed work.
5. Decide implementation method and list components or parts required.
6. Point out practical difficulties faced during implementations and devise mechanisms to solve them.
7. Iterate design if feasible to obtain better results.
8. Optimize the project design in terms of cost, area, power, computation complexity etc.
9. Compare results of projects with other similar design specifications.
10. Prepare a project report and do a presentation before the department project committee.
11.Conclude the project work and suggest future work.
12. Intermediate and final seminar in presence of department project committee for review of the work done.
13. To explore possibilities of patent or research paper publications.

A. Ability Enhancement Courses (AEC)

Sl. No	Course Name	Tick (Any 05)
1	Business Communication – Blended with ICSI	AEC001
2	Communication and Presentation for Technical Professionals (IEEE)	AEC002
3	Conversational Hindi (Modern Indian Language)	AEC003
4	Corporate Grooming and Business Etiquettes	AEC004
5	Digital Privacy: Understanding and Operational Framework (IEEE)	AEC005
6	Digital Transformation: Game Changing Opportunities (IEEE)	AEC006
7	Economics & Business Environment Blended with ICSI	AEC007
8	Freelancing and Content Writing	AEC008
9	French	AEC009
10	Functional Grammar and Composition	AEC010
11	German	AEC011
12	Gujarati	AEC012
13	Marathi	AEC013
14	Mass Communication and Journalistic Writing	AEC014
15	Personality Development for Effective Leadership	AEC015
16	Practical English	AEC016
17	Punjabi	AEC017
18	Spanish	AEC018
19	Radio Jocky	AEC019

B.Skill Enhancement Courses (SEC)

Sl. No	Course Name	Tick (Any 05)
1	Animation & Graphics Design	SEC001
2	Aptitude and Logical Reasoning Blended with ICSI	SEC002
3	AutoCAD and Basic Drafting	SEC003
4	Business Administration	SEC004
5	Current Affairs and Quantitative Aptitude Blended with ICSI	SEC005
6	Data Analysis using Spreadsheet	SEC006
7	Digital Marketing	SEC007
8	Eco-Engineering: Designing for the Future	SEC008
9	Engineering Mastery: Tools and Techniques	SEC009
10	Event Management	SEC010
11	ICT Skills for Leadership	SEC011
12	Innovation & Entrepreneurship	SEC012
13	Interpersonal Skills – Blended with ICSI	SEC013
14	Introduction of Cyber Security (IEEE)	SEC014
15	Office Automation Tools	SEC015
16	Performing Arts (Dance, Music, Drama)	SEC016
17	Personal Financial Planning	SEC017
18	Practical Workshop Training	SEC018
19	Social Media Management	SEC019
20	Tally Accounting	SEC020
21	Visual Arts	SEC021
22	Public Speaking	SEC022

C. Value Addition Courses (VAC)

Sl. No.	Course Name	Tick (Any 05)
1	Anti-ragging – Blended with IEEE	VAC001
2	Art of Living for Wellness	VAC002
3	Awareness of Cyber Crime and Ethical Hacking	VAC003
4	Basic Life Support (BLS)	VAC004
5	Community Development	VAC005
6	Economics & Social Development	VAC006
7	Emotional Intelligence	VAC007
8	Environmental Studies	VAC008
9	Ethics and Values in Ancient Indian Tradition	VAC009
10	Gandhian Studies	VAC010
11	Indian Economy and Planning	VAC011
12	Indian Geography and Environmental Ecology	VAC012
13	Indian History and Cultural Heritage	VAC013
14	Integrated Personality Development Course	VAC014
15	Life Lessons from Bhagvad Gita	VAC015
16	Life Skills	VAC016
17	National Cadet Corps (NCC)	VAC017
18	National Service Scheme (NSS)	VAC018
19	Prevention of Sexual Harassment	VAC019
20	Psychology	VAC020
21	Stress and Time Management	VAC021
22	Sustainable Development and Environmental Studies	VAC022
23	Universal Human Values	VAC023
24	Yoga and Meditation for Wellness	VAC024

Annexure II: Developer Survey Analysis

Sample Size	Survey Period	Region
Industry Experts / Technology Professionals	**April 2026**	**Gujarat**

1. Summary:

A structured market survey was conducted among 20 industry professionals, technology leaders, AI practitioners, startup founders, HR managers, and senior executives from AI, IT, Data Science, and emerging technology organizations across Gujarat, including Ahmedabad and Gandhinagar, to assess the demand for Artificial Intelligence professionals and validate the need for the proposed B.Tech. in Artificial Intelligence program.

The survey findings strongly support the introduction of the program. Industry representatives highlighted a growing demand for professionals with expertise in Artificial Intelligence, Machine Learning, Data Science, Deep Learning, Computer Vision, and Generative AI. Most respondents indicated that the current talent pool lacks sufficient practical exposure and industry-ready AI skills. A significant majority expressed willingness to recruit graduates from a specialized AI program and collaborate with the university through internships, projects, training programs, and research initiatives.

Confirm critical talent gap in Gujarat market	90%
Would actively recruit UG graduates	90%
Open to formal industry partnership with the University	80%
Average rating — recommend program launch	4.4/5

2. Respondent Profile

The 20 respondents were drawn from leading IT companies, AI startups, software development organizations, data analytics firms, research institutions, technology consulting companies, and innovation centers located in Ahmedabad and Gandhinagar.

Respondent designations included:

- Chief Technology Officers (CTOs)
- AI/ML Engineers
- Data Science Managers
- Technology Directors
- Research Scientists
- Software Development Managers
- Human Resource Managers
- Startup Founders
- Innovation Leads
- Technical Consultants

These respondents represent both technical and managerial perspectives, ensuring comprehensive industry feedback regarding workforce requirements and future technology trends.

3. Findings Q1: Skill Gap in Fresh Graduates

Respondents were asked to identify the most significant skill gaps observed while hiring fresh graduates for AI and technology-related roles. Multiple responses were permitted.

The findings indicate that while graduates possess theoretical knowledge, many lack practical experience in developing, deploying, and managing AI solutions. Industry professionals identified the following major gaps:

- Insufficient hands-on experience in Artificial Intelligence and Machine Learning projects.
- Limited understanding of Deep Learning frameworks and model deployment.
- Inadequate exposure to Data Science tools and real-world datasets.
- Lack of practical skills in Computer Vision and Natural Language Processing.
- Limited knowledge of Generative AI and Large Language Models (LLMs).

- Weak problem-solving and analytical thinking abilities.
- Lack of experience with cloud-based AI platforms and MLOps practices.
- Insufficient industry exposure through internships and live projects.
- Gaps in communication, teamwork, and professional skills.
- Limited awareness of AI ethics, responsible AI, and emerging technologies.

The survey findings clearly indicate a strong need for an industry-oriented B.Tech. Artificial Intelligence program that combines theoretical knowledge with practical training, industry collaboration, internships, research activities, and hands-on project experience to produce job-ready AI professionals.