BABU BANARASI DAS UNIVERSITY
School of Engineering
(School Code: 04) (University Branch Code: 17)
Department of Computer Science and Engineering
Bachelor of Technology: Computer Science and Engineering
(Generative Artificial Intelligence) with HCL GUVI Collaboration

Evaluation Scheme

SEMESTER I									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
PCC	RGAI5101	Python Programming for AI	3	1	0	40	60	100	4
ESC	RGAI5102	Mathematical Foundations for AI – I (Linear Algebra)	3	0	0	40	60	100	3
PCC	RGAI5151	Python Programming Lab	0	0	2	40	60	100	1
ESC	RGAI5152	Mathematical Foundations Lab	0	0	2	40	60	100	1
GP	RGP5101	General Proficiency	-	-	-	100	-	100	1
Total			**6**	**2**	**4**	**260**	**240**	**500**	**10**
Students need to select either GROUP 'A' or GROUP 'B'									
GROUP'A'									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Totals**	
BSC	RBS5101	Quantum Physics and Advanced Functional Materials	3	1	0	40	60	100	4
ESC	RME5101	Engineering Mechanics and Mechatronics	3	1	0	40	60	100	4
ESC	REC5101	Basic Electronics Engineering	3	0	0	40	60	100	3
BSC	RBSA5103	Environment & Ecological Sustainability	2	1	0	40	60	100	3
ESC	RME5151	Engineering Mechanics and Mechatronics Lab	0	0	2	40	60	100	1
BSC	RBS5151	Quantum Physics and Advanced Functional Materials Lab	0	0	2	40	60	100	1
Total			**11**	**3**	**4**	**240**	**360**	**600**	**16**
GROUP 'B'									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
ESC	REE5101	Electrical Engineering Concepts	3	1	0	40	60	100	4
BSC	RBS5102	Sustainable Chemical Sciences	3	1	0	40	60	100	4
BSC	RHSA5101	Professional and Workplace Communication	2	1	0	40	60	100	3
PCC	RAI5101	AI Fundamentals	2	0	0	40	60	100	2
ESC	REE5151	Electrical Engineering Lab	0	0	2	40	60	100	1
BSC	RBS5152	Sustainable Chemical Sciences Lab	0	0	2	40	60	100	1
ESC	RME5152	Engineering Graphics Lab	0	0	2	40	60	100	1
ESC	RME5153	Workshop Practices	0	0	2	40	60	100	1
Total			**8**	**3**	**8**	**280**	**420**	**700**	**17**

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SEMESTER II									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
PCC	RGAI5201	Data Science and Visualization	3	1	0	40	60	100	4
ESC	RGAI5202	Mathematical Foundations for AI – II (Probability & Statistics)	3	0	0	40	60	100	3
PCC	RGAI5251	Data Science and Visualization Lab	0	0	2	40	60	100	1
ESC	RGAI5252	Mathematical Foundations for AI Lab	0	0	2	40	60	100	1
GP	RGP5201	General Proficiency	-	-	-	100	-	100	1
Total			**6**	**1**	**4**	**260**	**240**	**500**	**10**
Students need to select either GROUP 'A' or GROUP 'B'									
GROUP'A'									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
BSC	RBS5201	Quantum Physics and Advanced Functional Materials	3	1	0	40	60	100	4
ESC	RME5201	Engineering Mechanics and Mechatronics	3	1	0	40	60	100	4
ESC	REC5201	Basic Electronics Engineering	3	0	0	40	60	100	3
BSC	RBSA5203	Environment & Ecological Sustainability	2	1	0	40	60	100	3
ESC	RME5251	Engineering Mechanics and Mechatronics Lab	0	0	2	40	60	100	1
BSC	RBS5251	Quantum Physics and Advanced Functional Materials Lab	0	0	2	40	60	100	1
Total			**11**	**3**	**4**	**240**	**360**	**600**	**16**
GROUP 'B'									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
ESC	REE5201	Electrical Engineering Concepts	3	1	0	40	60	100	4
BSC	RBS5202	Sustainable Chemical Sciences	3	1	0	40	60	100	4
BSC	RHSA5201	Professional and Workplace Communication	2	1	0	40	60	100	3
PCC	RAI5201	AI Fundamentals	2	0	0	40	60	100	2
ESC	REE5251	Electrical Engineering Lab	0	0	2	40	60	100	1
BSC	RBS5252	Sustainable Chemical Sciences Lab	0	0	2	40	60	100	1
ESC	RME5252	Engineering Graphics Lab	0	0	2	40	60	100	1
ESC	RME5253	Workshop Practices	0	0	2	40	60	100	1
Total			**10**	**3**	**8**	**320**	**480**	**800**	**17**

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SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
HSMC	RHS5301 / RHS5302	Work and Organizational Psychology in the Digital Age/Sociology of Work, Technology and Innovation	1	1	0	40	60	100	2
PCC	RCS5301	C Programming	3	1	0	40	60	100	4
PCC	RAI5302	Database Management Systems	3	1	0	40	60	100	4
PCC	RGAI5301	Introduction to Machine Learning	3	1	0	40	60	100	4
ESC	RCS5311	Startup and Innovation	2	0	0	40	60	100	2
PCC	RGAI5302	Foundations of Deep Learning & Neural Networks	2	1	0	40	60	100	3
PCC	RCS5351	C Programming Lab	0	0	2	40	60	100	1
PCC	RAI5352	Database Management Systems Lab	0	0	2	40	60	100	1
PCC	RGAI5351	Machine Learning Lab	0	0	2	40	60	100	1
PCC	RGAI5352	Deep Learning Lab	0	0	2	40	60	100	1
MC	RMC5301	Indian Constitution	1	0	0	40	60	100	1
GP	RGP5301	General Proficiency	-	-	-	100	-	100	1
Total			**15**	**5**	**8**	**540**	**660**	**1200**	**25**

SEMESTER IV									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
HSMC	RHS5402/ RHS5401	Sociology of Work, Technology and Innovation/Work and Organizational Psychology in the Digital Age	1	1	0	40	60	100	2
PCC	RCS5404	Operating Systems	3	1	0	40	60	100	4
PCC	RCS5403	Data Structure using 'C'	3	1	0	40	60	100	4
PCC	RGAI5401	Natural Language Processing Fundamentals	3	1	0	40	60	100	4
PCC	RGAI5402	Introduction to Generative AI Models (GANs, VAEs, Diffusion)	3	1	0	40	60	100	4
MC	RMC5451	YOGA Activities	0	0	2	100	-	100	1
PCC	RCS5454	Operating Systems Lab	0	0	2	40	60	100	1
PCC	RCS5453	Data Structure Using 'C' Lab	0	0	2	40	60	100	1
PCC	RGAI5451	Natural Language Processing Lab	0	0	2	40	60	100	1
PCC	RGAI5452	Generative AI Models Lab	0	0	2	40	60	100	1
GP	RGP5401	General Proficiency	-	-	-	100	-	100	1
Total			**13**	**5**	**10**	**560**	**540**	**1100**	**24**

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SEMESTER V									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
HSMC	RHS5501	AI Economy and Digital Innovation	2	1	0	40	60	100	3
PCC	RCS5501	Automata Theory & Formal Languages	3	1	0	40	60	100	4
PCC	RCS5502	Computer Networks	2	1	0	40	60	100	3
PCC	RGAI5501	Large Language Models & Transformers	3	0	0	40	60	100	3
PCC	RGAI5502	Prompt Engineering & Retrieval Augmented Generation (RAG)	3	0	0	40	60	100	3
MC	RMC5501	Essence of Indian Knowledge Tradition	1	0	0	40	60	100	1
PCC	RCS5552	Computer Networks Lab	0	0	2	40	60	100	1
PCC	RGAI5551	Large Language Models & Transformers Lab	0	0	2	40	60	100	1
PCC	RGAI5552	Prompt Engineering & Retrieval Augmented Generation Lab	0	0	2	40	60	100	1
PSI	RGAI5553	Minor Project-I	0	0	2	100	-	100	1
PSI	RGAI5555	Seminar	0	0	2	100	-	100	1
GP	RGP5501	General Proficiency	-	-	-	100	-	100	1
Total			**14**	**2**	**8**	**660**	**540**	**1200**	**23**

SEMESTER VI									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
HSMC	RHS5601	Industrial Management	2	1	0	40	60	100	3
PEC	-	**Professional Elective Course-I**	2	1	0	40	60	100	3
PEC	-	**Professional Elective Course-II**	2	1	0	40	60	100	3
PCC	RCS5603	Design & Analysis of Algorithms	3	1	0	40	60	100	4
PCC	RGAI5601	Generative Computer Vision & Multimodal AI	2	1	0	40	60	100	3
PCC	RGAI5602	Fine-Tuning, Optimization & Deployment of LLMs	2	1	0	40	60	100	3
PCC	RCS5653	Design and Analysis of Algorithms Lab	0	0	2	40	60	100	1
PCC	RGAI5651	Generative Computer Vision & Multimodal AI Lab	0	0	2	40	60	100	1
PCC	RGAI5652	Fine-Tuning, Optimization & Deployment of LLMs Lab	0	0	2	40	60	100	1
PSI	RGAI5652	Minor Project-II	0	0	2	100	-	100	1
GP	RGP5601	General Proficiency	-	-	-	100	-	100	1
Total			**13**	**5**	**10**	**560**	**540**	**1100**	**24**

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SEMESTER VII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
OE		**Open Elective I***	3	1	0	40	60	100	4
PEC	(RPEC51731-34)	**Professional Elective Course-III**	2	1	0	40	60	100	3
PCC	RGAI5701	LLMOps & Scalable Generative AI Systems	3	0	0	40	60	100	3
PCC	RGAI5702	AI Agents, Tools & Autonomous Systems	3	0	0	40	60	100	3
PCC	RGAI5751	LLMOps& Scalable Generative AI Systems Lab	0	0	2	40	60	100	1
PCC	RGAI5752	AI Agents, Tools & Autonomous Systems Lab	0	0	2	40	60	100	1
PSI	RGAI5753	Major Project-I#	0	0	8	100	-	100	4
PSI	RGAI5754	Industrial Training Evaluation	0	0	2	100	-	100	1
GP	RGP5701	General Proficiency	-	-	-	100	-	100	1
Total			**11**	**2**	**14**	**540**	**360**	**900**	**21**

*Students will opt any one of the open electives from the list of open electives provided by the University.
#Students need to submit an abstract for the project, select a guide and will complete the literature review related to the project.

SEMESTER VIII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
OE		**Open Elective II****	3	1	0	40	60	100	4
PEC	(RPEC51741-44)	**Professional Elective Course IV**	2	1	0	40	60	100	3
PCC	RGAI5801	AI Ethics, Governance & Responsible AI	3	0	0	40	60	100	3
PCC	RGAI5851	AI Ethics, Governance & Responsible AI Lab	0	0	2	40	60	100	1
PSI	RGAI5852	Major Project-II##	0	0	16	160	240	400	8
GP	RGP5801	General Proficiency	-	-	-	100	-	100	1
Total			**8**	**2**	**22**	**420**	**480**	**900**	**20**

**The opted subject should be different from the one selected in VII Semester.
##This is in continuation with the project work started in Semester VII. In this semester the students will formulate the methodology do experimentation and show the results. Finally all project work will be presented in a report i.e. Project Report.

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List of Professional Elective Courses

#	Course Code	Professional Elective Course I	Credit
1	RPEC51711	IoT	3
2	RPEC51712	Cyber Security	3
3	RPEC51713	Big Data Analytics	3
4	RPEC51714	Agentic AI	3
#	**Course Code**	**Professional Elective Course II**	**Credit**
1	RPEC51721	Quantum Computing	3
2	RPEC51722	Softcomputing	3
3	RPEC51723	Cyber Physical Systems	3
4	RPEC51724	Digital Twin Technologies	3
#	**Course Code**	**Professional Elective Course III**	**Credit**
1	RPEC51731	Full Stack Development	3
2	RPEC51732	Knowledge Graph and Context Engineering	3
3	RPEC51733	Essentials of Blockchain	3
4	RPEC51734	AI Copilots and Intelligent Assistants	3
#	**Course Code**	**Professional Elective Course IV**	**Credit**
1	RPEC51741	Augmented and Virtual Reality	3
2	RPEC51742	Explainable and Responsible AI	3
3	RPEC51743	Federated Learning Concepts	3
4	RPEC51744	MLOps	3

List of Open Electives Offered by the Department of Computer Science and Engineering

#	Course Code	Open Elective I	Credit
1	OE53101	Disaster Management	4
2	OE43201	Database Administration	4
3	OE53501	Quality Management	4
4	OE53301	Energy Management	4
#	**Course Code**	**Open Elective II**	**Credit**
1	OE53102	Concepts of Climate Smart Agriculture	4
2	OE53202	Computational Intelligence	4
3	OE53502	Product Development	4
4	OE53302	Non-Conventional Energy Resources	4

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List of Vocational Courses Offered by the Department of Computer Science and Engineering

#	Course Code	Vocational Courses	Credit
1	RVC51711	Programming with Python	2
2	RVC51712	Fundamentals of Artificial Intelligence	2
3	RVC51713	Cyber Crime and Computer Forensics	2
4	RVC51714	Metaverse and Virtual Reality	2

Course Code and Definitions

Code	Definition
L	Lecture
T	Tutorial
P	Practical
CIA	Continuous Internal Assessment
ESE	End Semester Examination
BSC	Basic Science Courses
PCC	Professional Core Courses
ESC	Engineering Science Courses
PEC	Professional Elective Course
GP	General Proficiency
HSMC	Humanities, Social Science, and Management Courses
OE	Open Elective
PSI	Project/Seminar/ Internship
MC	Mandatory Course
VC	Vocational Course

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I		
Course Name	Python Programming for AI				
Code	RGAI5101				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Computer Knowledge	3	1	0	4
Course Objectives	1. Write and execute Python programs using variables, data types, and control structures. 2. Apply functions, modules, and file handling for building reusable AI-oriented scripts. 3. Use Python libraries (NumPy, Pandas) to load, clean, and manipulate datasets. 4. Visualise data using Matplotlib and develop confidence for AI data pipelines.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Write Python programs using variables, data types, operators, and control structures for simple AI tasks.				
CO2	Apply loops, functions, and modules to build clean, reusable code for data processing.				
CO3	Use Pandas and NumPy to load, explore, and clean structured datasets.				
CO4	Create basic visualisations using Matplotlib and connect Python skills to AI workflows.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Python Basics: Introduction to Python, variables, data types, operators, input/output. Conditional statements (if-elif-else). Simple programs and practice exercises. Case Study: Simple calculator for basic arithmetic.	15 Hours	CO1
2	Loops and Lists: while and for loops, list creation and operations, string manipulation, working with tuples and dictionaries. Case Study: Program to manage student names and marks.	15 Hours	CO2
3	Functions and Modules: Defining and calling functions, arguments, return values, scope. Using built-in modules (math, random, os). File handling: reading and writing text files. Case Study: Reusable functions for AI data preprocessing.	15 Hours	CO3
4	Data Handling and Visualisation: Introduction to NumPy arrays, Pandas Data Frames. Reading CSV files, basic exploration, handling missing values. Matplotlib: line plots, bar charts, histograms. Case Study: Plotting and analysing student performance data.	15 Hours	CO4

Suggested Readings:

1. M. Lutz, Learning Python, 5th ed. Sebastopol, CA, USA: O'Reilly Media, 2013.
2. *E.* Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, 3rd ed. San Francisco, CA, USA: No Starch Press, 2023.
3. *W. McKinney,* Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

Online Resources:

1. https://nptel.ac.in/courses/106106145
2. https://www.kaggle.com/learn/python

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	2	2									2	2
CO3	2	2	3									1	2
CO4	2	1	3									1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I		
Course Name	Mathematical Foundations for AI – I (Linear Algebra)				
Code	RGAI5102				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of Mathematics	3	0	0	3
Course Objectives	1. Understand vectors, vector operations, and their role in representing data in AI. 2. Perform matrix operations including multiplication, transpose, and inverse. 3. Apply concepts of eigenvalues, eigenvectors, and linear transformations. 4. Connect linear algebra to AI applications including neural networks and dimensionality reduction.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Perform vector operations (addition, dot product, cosine similarity) and relate them to word embedding's in AI.				
CO2	Execute matrix arithmetic, multiplication, transpose, and inverse and apply them to neural network computations.				
CO3	Apply eigenvalues, eigenvectors, and linear transformations to understand data rotation and scaling in AI.				
CO4	Connect SVD, PCA, and matrix operations to real Generative AI systems such as Stable Diffusion and LLMs.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to Vectors: Scalars vs. Vectors, vector addition, subtraction, scalar multiplication. Dot product, magnitude, unit vectors, cosine similarity. Case Study: Word embedding in ChatGPT — representing word meaning as vectors.	15 Hours	CO1
2	Matrices and Basic Operations: Matrix representation, addition, subtraction, scalar multiplication. Matrix multiplication — step-by-step with examples. Properties of matrix multiplication. Case Study: Images stored and processed as matrices in AI models.	15 Hours	CO2
3	Special Matrices and Transformations: Identity matrix, transpose, matrix inverse. Eigenvalues and eigenvectors (intuitive explanation). Linear transformations — rotation, scaling, reflection. Case Study: How AI models rotate and scale images using transformation matrices. Applications in Generative AI: Vectors and matrices in neural network forward pass. Introduction to dimensionality reduction and PCA. Singular Value Decomposition (SVD) and image compression. Case Study: How Stable Diffusion and LLMs use matrix operations internally.	15 Hours	CO3, CO4

Suggested Readings:

1. Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press. 2023
2. David C. Lay, Linear Algebra and Its Applications, Pearson.2021

Online Resources:

1. https://nptel.ac.in/courses/111108066
2. https://www.coursera.org/learn/linear-algebra-machine-learning

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	1									2	1
CO2	2	3	2									2	2
CO3	2	2	2									2	2
CO4	1	2	3									1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**		I	
Course Name	Python Programming Lab				
Code	RGAI5151				
Course Type	**PCC**	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Computer Knowledge	0	0	2	1
Course Objectives	1. Write and execute Python programs using conditional statements, loops, and functions. 2. Implement string manipulation, list operations, and file handling programs. 3. Use built-in modules (random, math) and external libraries (Pandas, Matplotlib). 4. Build small applications integrating data handling and visualisation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement Python programs using variables, operators, conditionals, and loops.				
CO2	Apply functions, modules, and string operations in reusable Python scripts.				
CO3	Use Pandas to read, analyse, and summarise data from CSV files.				
CO4	Create charts using Matplotlib and build a complete data-driven application.				

S. No.	**List of Experiments**	**Mapped CO**
1	Program to implement a Simple Calculator using conditional statements	CO1
2	Program to calculate Student Marks Average and Grade	CO1
3	Program to print different Number Patterns using Loops	CO1
4	Program for Student Record Management using Lists	CO2
5	Program for String Manipulation and Analysis	CO2
6	Program to implement Reusable Functions for Calculations	CO2
7	Program to create a Number Guessing Game using Random Module	CO2
8	Program to read and analyze data from CSV file using Pandas	CO3
9	Program to create Basic Charts using Matplotlib	CO4
10	Program to build a Personal Budget Tracker Application	CO4
Mini Project	Development of Personal Finance Tracker with Data Visualization	

Suggested Readings:

1. M. Lutz, *Learning Python*, 5th ed. Sebastopol, CA, USA: O'Reilly Media, 2013.
2. E. Matthes, *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*, 3rd ed. San Francisco, CA, USA: No Starch Press, 2023.
3. W. McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

Online Resources:

1. https://nptel.ac.in/courses/106106145
2. https://www.kaggle.com/learn/python

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	2	3									1	2
CO4	2	1	3									1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**		I	
Course Name	Mathematical Foundations Lab				
Code	RGAI5152				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Mathematics (Class XII)	0	0	2	1
Course Objectives	1. Perform vector operations and measure similarity using NumPy. 2. Implement matrix operations including multiplication, transpose, and inverse. 3. Apply eigenvalue decomposition and demonstrate linear transformations. 4. Implement PCA and SVD for dimensionality reduction and image compression.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Perform vector addition, subtraction, dot product, and cosine similarity using NumPy.				
CO2	Execute matrix operations including multiplication, transpose, inverse, and identity verification.				
CO3	Compute eigenvalues, eigenvectors, and demonstrate linear transformations on 2D data.				
CO4	Implement PCA for dimensionality reduction and SVD for image compression.				

S. No.	**List of Experiments**	**Mapped CO**
1	Program to perform Basic Vector Operations using NumPy	CO1
2	Program to calculate Vector Similarity and Distance Measures	CO1
3	Program to implement Matrix Operations	CO2
4	Program to represent Image as Matrix and perform operations	CO2
5	Program to compute Matrix Transpose and Inverse	CO2
6	Program to find Eigenvalues and Eigenvectors	CO3
7	Program to demonstrate Linear Transformations	CO3
8	Program to implement Basic Principal Component Analysis (PCA)	CO4
9	Program for Image Compression using Singular Value Decomposition (SVD)	CO4
10	Program to implement Neural Network Weight Matrix Operations	CO4
Mini Project	Image Compression Tool using SVD	

Online Resources

1. https://nptel.ac.in/courses/111108066
2. https://www.coursera.org/learn/linear-algebra-machine-learning

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	1									2	1
CO2	2	3	2									2	2
CO3	2	2	2									2	2
CO4	1	2	3									1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I/II		
Course Name	Engineering Mechanics and Mechatronics				
Code	RME5101/RME5201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge Physics and Mathematics	3	1	0	4
Course Objectives	1. To understand force systems, equilibrium conditions, and free body diagrams for engineering mechanics analysis. 2. To understand beam mechanics, support reactions, and friction principles in engineering systems. 3. To understand centroid, moment of inertia, stress, strain, and their applications in engineering mechanics. 4. To understand measurement techniques, instrumentation systems, sensors, and mechatronics applications in engineering.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Analyze equilibrium equations to solve engineering mechanics problems.				
CO2	Analyze beams, calculate support reactions, and solve friction-related problems.				
CO3	Determine centroid and moment of inertia of bodies and analyze stress–strain behavior of materials.				
CO4	Use of measurement instruments, analyze errors, and understand sensors and mechatronic systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Force Systems:** Concurrent and Non concurrent forces, laws of motion, principle of transmissibility of forces. Resultant of concurrent force system. Resultant of non-concurrent force system. **Equilibrium of Force Systems:** Free body diagram. Equations of equilibrium and its applications.	15 Hours	CO1
2	**Equilibrium and Beam Mechanics:** Introduction, Types of support, Types of load on beam, Types of beam, Reactions from supports of beam. **Friction:** Introduction, Laws of Coulomb Friction, equilibrium of Bodies involving dry friction, Belt friction and its application.	15 Hours	CO2
3	**Centroid and Moment of Inertia:** Centroid of plane and composite figure, Moment of inertia of plane area, Parallel axes theorem. Perpendicular axes theorem, moment of inertia of composite bodies. **Simple Stress and Strain:** Normal and Shear stresses, Stress-Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members.	15 Hours	CO3
4	**Measurement & Instrumentation:** Concept of measurement. Errors in measurement and calibration. Pressure measurement, temperature measurement, force measurement. Torque measurement. **Mechatronics:** Introduction and evolution of mechatronics, scope, advantages and disadvantages, elements of mechatronic systems, sensors and transducers and their characteristics, actuators, open-loop and closed-loop control	15 Hours	CO4

	systems, industrial automation, robotics, smart manufacturing and applications of mechatronics in modern engineering systems..		

Suggested Reading:

1. S. S. Bhavikatti and K. G. Rajashekarappa, Engineering Mechanics, 6th Ed., New Age International Publishers, New Delhi, 2018.
2. R. K. Bansal, A Textbook of Strength of Materials (In S.I. Units), 6th Ed., Laxmi Publications Pvt. Ltd., New Delhi, 2018.
3. R. K. Rajput, A Textbook of Measurements & Metrology, 1st Ed., S. K. Kataria & Sons, New Delhi, 2012.
4. Beckwith, Marangoni and Lienhard, Mechanical Measurements, 6th Ed., Pearson Education, 2007.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_me27
2. https://nptel.ac.in/courses/112106286?.com

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	-	-	-	1	-	-	1	1
CO2	3	3	2	2	1	-	-	-	1	-	-	1	1
CO3	3	3	2	2	1		-	-	-	-	-	1	1
CO4	3	2	2	2	3		1		1		-	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	I	**Semester**	I/II			
Course Name	Basic Electronics Engineering					
Course Code	REC5101/REC5201					
Course Type	ESC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of Physics and Mathematics	3	0	0	3	
Course Objectives	1. Basic Idea of Semiconductor Physics.					
	2. Comprehensive Idea of Basic Electronic devices like (Diode, BJT and JFET)					
	3. Fundamental Principle of Operational Amplifier and Its Application					
	4. To have an Idea about Digital Electronics.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understanding the Basic concept of semiconductor material (N type and P type), fundamentals of electronic Devices like Diode and its application as Rectifier, Light Emitting Diode, Photo Diode and Varactor Diode.					
CO2	Analyzing the fundamentals of electronic devices like BJT and JFET.					
CO3	Understanding the principles of Operational Amplifier and its application.					
CO4	Evaluate the Number system, Boolean algebra, logic gates.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**DIODES:** Energy Band theory, Semiconductor material, Law of Mass Action, PN junction Diode and its biasing, V-I characteristics of Practical and Ideal Diode, Diode as Rectifier: Half and Full wave Rectifiers, Breakdown Mechanism: Zener and Avalanche breakdown mechanism, Zener Diode and its application, Special purpose Diodes: Light Emitting Diode, Photo Diode, Varactor Diode.	15 Hours	CO1
2	**TRANSISTORS:** Transistor construction, Transistor types and its working, Base-Width modulation (Early Effect), Thermal Runaway, BJT configurations: CE, CB and CC, Input & Output characteristics of CB & CE configuration, Biasing: Fixed bias, Emitter bias, Potential divider bias, Collector feedback bias. Transistor Amplifying Action. **JFET:** Basic construction and working of JFET, Drain and transfer characteristics, Biasing: Self bias, fixed bias and Voltage divider bias.	15 Hours	CO2
3	**OPERATIONAL AMPLIFIER AND DIGITAL ELECTRONICS:** Introduction to OP-AMP, Equivalent Circuit and Pin diagram of Op-amp IC741, Characteristics of ideal OP-AMP, Input Offset Current, Input Bias Current, Configurations: Open loop and closed loop, Applications of OP-AMP: Inverting amplifier, Non-inverting amplifier, Voltage follower, summing amplifier, Difference Amplifier, Integrator and Differentiator. Number System, Complements, Subtraction of binary number using l's and 2's Complements, BCD Code, Excess-3	15 Hours	CO3, CO4

	code, Gray code(Cyclic Code). Boolean Algebra: Basic Theorems, Demorgan's theorem, Standard logic Gates, Universal logic gates. Implementation of Boolean Function using Basic and Universal logic gates.		

Suggested Readings:

1. Robert L. Boylestad and Louis Nashelsky Electronic Devices and Circuit Theory, Pearson India, 11th edition 2013.
2. M. Morris Mano, Digital Logic and Computer Design, PHI, 3rd edition,2004.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee55/preview

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	1	1	1	2								
CO2	1	1	1	1	1								
CO3	1	1	3	3	3								
CO4	1	2	1	1	3								

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I/II		
Course Name	Engineering Mechanics and Mechatronics Lab				
Course Code	RME5151/RME5251				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge Physics and Mathematics	0	0	2	1
Course Objectives	1. Develop practical understanding of friction, force systems, beam behavior, flywheel dynamics, and mechanical power transmission mechanisms through laboratory experimentation. 2. Investigate and evaluate the mechanical properties of engineering materials and machine elements using standard testing methods. 3. Understand principles of engineering measurements, instrumentation, error analysis, and calibration techniques. 4. Familiarize students with basic mechatronics concepts, open-loop and closed-loop control systems, and their engineering applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Perform experiments related to friction, beam deflection, worm gear mechanisms, and flywheel systems and interpret the obtained results.				
CO2	Analyze the mechanical properties of materials under tensile and impact loading using standard testing procedures and compare experimental and theoretical results.				
CO3	Evaluate measurement accuracy, precision, resolution, errors, and apply basic instrumentation concepts in engineering measurements.				
CO4	Differentiate between open-loop and closed-loop control systems and explain their applications in mechatronic engineering systems.				

S. No.	List of Experiments	Mapped CO
1	Experimental analysis of frictional behavior of a block on inclined plane.	CO1
2	Experimental analysis of frictional behavior in a screw Jack.	CO1
3	Experimental analysis of worm gear mechanism.	CO1
4	Experimental analysis of beam deflection.	CO1
5	Experimental analysis and strength prediction under tensile loading.	CO2
6	Experimental analysis of Impact toughness using Izod testing method.	CO2
7	Experimental analysis of Impact toughness using Charpy method.	CO2
8	Experimental and analytical Method to determine Moment of Inertia of a Flywheel.	CO2
9	Study of errors, accuracy, precision and resolution.	CO3
10	Study of open-loop and closed-loop control systems.	CO4

Reference Books:

1. R. K. Jain, Mechanical and Industrial Measurements, 17th Ed., Khanna Publishers, New Delhi, 2017.
2. V. D. Kodgire and S. V. Kodgire, Material Testing Laboratory Manual, Everest Publishing House, Latest Edition. 2008
3. T. G. Beckwith, R. D. Marangoni, and J. H. Lienhard V, Mechanical Measurements, 6th Ed., Pearson Education, 2007.

Virtual Lab Source:

1. https://www.vlab.ac.in
2. https://nptel.ac.in
3. https://mechlab.iitkgp.ac.in

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	3	2							1	1
CO2	3	3	2	3	1							1	1
CO3	3	2	1	2	3							1	1
CO4	2	2	1	2	3							2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I/II		
Course Name	Electrical Engineering Concepts				
Code	REE5101/REE5201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Physics and Electrical Concepts	3	1	0	4
Course Objectives	1. To provide fundamental knowledge of electrical circuits, network analysis, and AC/DC systems for smart engineering applications. 2. To develop analytical and problem-solving skills using electrical laws, circuit theorems, and modern computational techniques. 3. To introduce electrical measuring instruments, transformers, smart grids, and electrical safety concepts used in modern power systems. 4. To understand the working and applications of electrical machines, electric vehicles, and intelligent energy systems through case studies and simulations.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply electrical circuit laws, network theorems, and analytical techniques to solve electrical engineering problems.				
CO2	Analyze AC/DC circuits, three-phase systems, and power measurements for smart electrical applications.				
CO3	Explain the operation and performance of electrical instruments, transformers, smart grids, and electrical safety systems.				
CO4	Analyze electrical machines, electric vehicle systems, and modern energy applications using simulation and case-study-based approaches.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Smart Electrical Circuits & Network Analysis: Fundamental elements: linear and nonlinear.** The study of various electrical sources and source transformation techniques. Kirchhoff's Law, mesh Law, Star/delta transformation and nodal analysis and their applications based problem/case study simulation. Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer theorem and their application based problem/case study simulation.	15 Hours	CO1 CO2
2	**AC Circuits & Smart Power Systems: F**undamentals of alternating quantities, Peak factor, Form factor, Power factor, Average and RMS values with significance. Phase, phase difference and associated problems. Study of different single phase AC circuits, power triangle (active power, reactive power and apparent power). Need of three phase systems. Measurement of three phase power by two wattmeter method.	15 Hours	CO2
3	**Electrical Measuring Instruments:** Essential components of indicating instruments, Smart permanent magnet moving coil instruments, moving iron instruments, Dynamometer wattmeter and Energy meter.	15 Hours	CO3

	Power System: Single line diagram, Smart grid and case study simulation. Magnetic Circuit, B-H Curve, Eddy Current loses Self and mutual Inductance. Single phase Transformer, EMF Equation, Equivalent circuit diagram, Efficiency, All Day Efficiency and loses. Auto Transformer, Advantages/Disadvantages and comparison with single phase transformer. Simulate a case study regarding cooling of transformer. **Earthing and Electrical Safety:** Earthing/Grounding, Equipment/Building Grounding, Electrical Hazards, Safety rules, Electrical injuries.		
4	**Smart Electrical Machines Applications:** Basic concept of rotating machines, DC Machines (Motor/Generator), Three phase induction motor, Single phase induction motor (Double-field revolving theory, Starting methods), Synchronous generator, three phase Synchronous motor (V Curve and applications), Electric vehicles Vs. hybrid vehicles. **Components of EV:** Batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs, HEV drive train components and advantages.	15 Hours	CO4

Suggested Readings:

1. Charles K. Alexander and Matthew N. O. Sadiku ; Fundamentals of Electric Circuits; McGraw-Hill's 2020.
2. BLaughton, Michael A., and Maurice George Say, eds. Electrical engineer's reference book. Elsevier, 2013.
3. D. P. Kothari, I. J. Nagrath, and A. K. Mittal ; Basic Electrical Technology; McGraw-Hill; 2010.
4. V.K. Maurya, Ritu Raj Jallan, Shasya Shukla; Computer Aided Design of Electrical Machines; S.K. Kataria & Sons; 2014.

Online Resources:

1. NPTEL (SWAYAM) https://nptel.ac.in/courses/108105112
2. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_ec09

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2							1	2
CO2	3	3	3	3	3							1	2
CO3	3	1	2	1	2	3						2	1
CO4	2	2	2	2	1	2						1	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I/II		
Course Name	AI Fundamentals				
Code	RAI5101/RAI5201				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of mathematics, statistics, and computer fundamentals.	2	0	0	2
Course Objectives	1. Introduce the fundamental concepts, history, and applications of Artificial Intelligence (AI). 2. Develop an understanding of data, machine learning, and intelligent systems. 3. Provide hands-on exposure to AI tools, programming environments, and basic model development. 4. Familiarize students with ethical, societal, and legal aspects of AI.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the core concepts, history, and applications of AI.				
CO2	Identify different types of AI systems and machine learning approaches.				
CO3	Apply basic AI techniques using programming tools and datasets.				
CO4	Analyze the role of data in training and evaluating AI models				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Artificial Intelligence:** Definition and scope of AI, History and evolution of AI, Types of AI: Narrow AI, General AI, and Super AI, AI applications in healthcare, education, finance, transportation, agriculture, and industry, Overview of AI technologies: Machine Learning, Deep Learning, Natural Language Processing, Computer Vision, and Robotics. **Data and Problem Solving in AI:** Role of data in AI, Types of data: structured, semi-structured, and unstructured, Data collection, cleaning, and pre-processing, Introduction to problem-solving and search techniques, State-space representation, heuristics, and informed search, Basic knowledge representation concepts.	15 Hours	CO1, CO2
2	**Fundamentals of Machine Learning:** Introduction to machine learning, Supervised, unsupervised, and reinforcement learning, Training and testing datasets, Basic algorithms: Linear Regression, Decision Trees, k-Nearest Neighbours, and Clustering, Model evaluation: accuracy, precision, recall, and confusion matrix, Overfitting and under fitting, Privacy and data protection, AI and employment: opportunities and challenges, AI governance and regulations, Future trends: Generative AI, autonomous systems, and human-AI collaboration.	15 Hours	CO3, CO4

Suggested Readings:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.
2. Ethem Alpaydin, Introduction to Artificial Intelligence, 4th Edition, MIT Press, 2020.
3. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1997.
4. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly, 2022.
5. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ge20/preview

2. https://www.youtube.com/@IITDelhiJuly

Course Articulation Matrix												
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**2**	**2**	**1**								**2**	**2**	
CO2	**2**	**2**	**1**								**2**	**2**	
CO3	**2**	**2**	**1**								**2**	**2**	
CO4	**2**	**2**	**1**								**2**	**2**	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I/II		
Course Name	Electrical Engineering Lab				
Code	REE5151/REE5251				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Physics and Electrical Concepts	0	0	2	1
Course Objectives	1. To understand electrical circuits through practical and simulation methods. 2. To apply network theorems using experiments. 3. To study AC/DC systems and measurements. 4. To analyze electrical machines and their applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Identify and study electrical equipment.				
CO2	Verify electrical circuit laws and theorems.				
CO3	Analyze AC circuits and power measurement.				
CO4	Study performance of electrical machines.				

S. No.	**List of Experiments**	**Mapped CO**
1	Study of Electrical Equipment used in Daily Life	CO1
2	Full Wave Rectifier using Diodes	CO1
3	Verification of KCL & KVL	CO2
4	Verification of Norton's Theorem	CO2
5	Verification of Thevenin's Theorem	CO2
6	Verification of Superposition Theorem	CO2
7	Measurement of 3-Phase Power (Two Wattmeter Method)	CO3
8	DC Shunt Motor Speed Control (Armature & Field)	CO4
9	Load Test on DC Machine & Efficiency Calculation	CO4
10	Transformer O.C. & S.C. Test and Performance Analysis	CO4

Suggested Reading:

1. https://bes-iitr.vlabs.ac.in/exp/electrical-equipments/theory.html
2. https://be-iitkgp.vlabs.ac.in/exp/full-wave-rectification/index.html
3. https://bes-iitr.vlabs.ac.in/exp/kirchhoff-law/
4. https://asnm-iitkgp.vlabs.ac.in/exp/verification-norton-theorem/theory.html
5. https://asnm-iitkgp.vlabs.ac.in/exp/verification-thevenin-theorem/theory.html
6. https://asnm-iitkgp.vlabs.ac.in/exp/verification-superposition-theorem/theory.html
7. https://elms-iitr.vlabs.ac.in/exp/three-phase-power/
8. https://ems-iitr.vlabs.ac.in/exp/dcmotor-field-resistance-control/theory.html
9. https://em-coep.vlabs.ac.in/exp/load-test-dc-motor/theory.html
10. https://ems-iitr.vlabs.ac.in/exp/circuit-parameters-oc-test/theory.html

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	3	3	2							1	
CO2	3	3	3	3	3							1	
CO3	3	2	2	2	2	3						2	
CO4	2	2	2	2	2	2						1	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	Semester	I/II		
Course Name	Engineering Graphics Lab				
Course Code	RME5152/RME5252				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of mathematics and basic geometrical drawing skills	0	0	2	1
Course Objectives	1. To develop a fundamental understanding of engineering graphics principles, scales, projections, and graphical representation techniques used in engineering practice. 2. To enhance visualization and spatial reasoning skills for representing points, lines, planes, solids, and engineering objects in two-dimensional and three-dimensional forms. 3. To impart knowledge of engineering drawing standards, sectional views, development of surfaces and drafting conventions for effective communication of engineering designs. 4. To develop the ability to prepare and interpret engineering drawings using orthographic, isometric, and perspective projection techniques for engineering applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply engineering drawing principles to construct scales and prepare projections of points and lines.				
CO2	Prepare sectional views, surface developments and engineering drawings using drafting conventions.				
CO3	Visualize and represent planes, solids and engineering objects through orthographic and isometric projections.				
CO4	Develop and interpret complete engineering drawings of components and assemblies.				

SN.	List of Experiments	Mapped CO
1	**Scales**: Representative factor, plain scales, diagonal scales, scales of chords.	CO1
2	**Projection**: Types of projection, orthographic projection, first and third angle projection.	CO1
3	**Projection of points:** The principle of orthographic projections of a point on HP and VP, Conventional representation, Projection of a point in all the quadrants.	CO1
4	**Projection of Lines:** Line inclined to one plane, inclined with both the plane, True Length and True Inclination, Traces of straight lines.	CO2
5	**Projection of planes and solids**: Projection of Planes like circle	CO2

	and polygons in different positions; Projection of polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in different positions.	
6	**Section of Solids:** Section of right solids by normal and inclined planes; Intersection of cylinders.	CO2
7	**Isometric Projections:** Isometric scale, Isometric axes, Isometric Projection from orthographic drawing.	CO3
8	**Perspective Projection:** Nomenclature of Perspective Projection, Method of drawing perspective views, Visual Ray Method, using Top and Front, Top and Side views.	CO3
9	**Computer Aided Drafting (CAD)-**I: Introduction, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders.	CO4
10	**Computer Aided Drafting (CAD)-**II: Transformations and editing commands like move, rotate, mirror, array; solution of projection problems on CAD.	CO4

Reference Book:

1. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Ltd., Anand, Gujarat, 2014.
2. K. L. Narayana and P. Kannaiah, Engineering Drawing, 3rd Ed., Scitech Publications (India) Pvt. Ltd., Chennai, 2012.
3. D. A. Jolhe, Engineering Drawing with an Introduction to AutoCAD, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2016..

Virtual Lab Source:

1. https://www.vlab.co.in
2. https://nptel.ac.in
3. https://www.autodesk.com/education/home
4. https://www.autodesk.com/learn
5. https://spoken-tutorial.org

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	-	-	-	-	-	1	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1	1
CO3	2	3	3	1	1	-	-	-	-	-	-	1	1
CO4	3	3	3	2	1	-	-	-	-	-	-	1	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	I/II		
Course Name	Workshop Practices				
Course Code	RME5153/RME5253				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Elementary understanding of engineering materials and manufacturing processes	0	0	2	1
Course Objectives	1. Develop fundamental knowledge of tools, equipment, materials, and processes used in carpentry, fitting, welding, machining, sheet metal, black-smithy, and foundry shops. 2. Impart hands-on skills in performing manufacturing operations such as cutting, shaping, joining, forming, machining, and casting. 3. Enhance safety awareness, precision, workmanship, and professional ethics while working in workshop environments. 4. Develop the ability to fabricate simple engineering components and understand the practical applications of manufacturing processes.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Identify, select, and safely operate workshop tools, equipment, and machines used in various manufacturing processes.				
CO2	Perform basic workshop operations including carpentry, fitting, welding, black-smithy, machining, sheet metal work, and foundry practices with acceptable accuracy.				
CO3	Fabricate simple engineering components, joints, and assemblies by applying appropriate workshop techniques and manufacturing processes.				
CO4	Demonstrate professional work practices, safety procedures, quality consciousness, and teamwork during workshop activities.				

SN.	List of Experiments	Mapped CO
1	**Carpentry Shop-I:** Study of carpentry tools, equipment, safety practices and basic operations.	CO1
2	**Carpentry Shop-II:** Preparation of half-lap corner joint and mortise-tenon joint.	CO1
3	**Fitting Shop:** Study of fitting tools and operations; preparation of male-female fitting joint using drilling and tapping operations.	CO2
4	**Black Smithy Shop:** Study of tools and operations; exercises involving upsetting, drawing down, bending, punching, fullering and swaging.	CO2
5	**Welding Shop:** Study of gas welding and arc welding equipment; preparation of butt and lap joints.	CO3
6	**Sheet Metal Shop:** Study of sheet metal tools and operations; fabrication of funnel with soldering.	CO3
7	**Sheet Metal Shop-II:** Fabrication of tray, tool box or electrical	CO3

	panel box.	
8	**Machine Shop:** Study of machine tools and operations; plane turning, step turning and taper turning.	CO4
9	**Machine Shop-II:** Thread cutting and grinding of cutting tools.	CO4
10	**Foundry Shop:** Study of foundry tools, pattern making, mould preparation, pouring and casting operations.	CO4

Reference Books

1. S. Kalpakjian and S. R. Schmid, Manufacturing Engineering and Technology, 7th Ed., Pearson Education, New York, 2014.
2. H. S. Bawa, Workshop Practice, Tata McGraw-Hill Education, New Delhi, 2009.
3. K. C. John, Engineering Workshop Practice, 2nd Ed., PHI Learning Pvt. Ltd., New Delhi, 2010. Online Resources

Virtual Lab Source:

1. https://www.vlab.co.in
2. https://nptel.ac.in
3. https://spoken-tutorial.org

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	1	3							1	1
CO2	3	2	3	2	3							1	1
CO3	3	3	3	2	2							1	1
CO4	2	1	1	1	2							1	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**		II	
Course Name	Data Science and Visualization				
Code	RGAI5201				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python Programming for AI	3	1	0	4
Course Objectives	1. Strengthen Python programming with OOP, exception handling, and functional programming concepts. 2. Use NumPy and Pandas for numerical computing, data manipulation, and data cleaning. 3. Create effective data visualisations using Matplotlib and Seaborn for insights and reporting. 4. Perform Exploratory Data Analysis (EDA) and build simple ML models using Scikit-learn.				

Course Outcomes: After successful completion of the course, the students will be able to:	
CO1	Write structured and reusable Python code using OOP, exception handling, and functional programming.
CO2	Efficiently load, clean, index, and transform structured data using NumPy and Pandas.
CO3	Create professional data visualisations including line, bar, scatter, histogram, box plot, and heatmap.
CO4	Perform complete EDA, engineer features, and build simple regression and classification models.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Advanced Python for Data Science: Object-Oriented Programming — classes and objects. Exception handling and file handling. List comprehensions, lambda, map, and filter functions. Working with modules and packages. Case Study: Building a Student Data Management System.	15 Hours	CO1
2	NumPy and Pandas Fundamentals: NumPy arrays, operations, indexing, and broadcasting. Pandas Series and DataFrame creation and operations. Data loading, indexing, and selection (loc, iloc). Data cleaning — handling missing values, duplicates, and type conversions. Case Study: Analysing a large student performance dataset.	15 Hours	CO2
3	Data Visualization: Matplotlib basics — line, bar, and scatter plots. Seaborn for statistical visualisations — distribution and relational plots. Advanced plots — histogram, box plot, and heatmap. Customising and saving visualisations. Case Study: Creating insights from sales or student performance data.	15 Hours	CO3
4	Exploratory Data Analysis and Introduction to ML: EDA techniques — descriptive statistics, correlation, and outlier detection. Feature engineering basics — encoding, scaling, and derived features. Introduction to Scikit-learn — preprocessing and model pipeline. Simple regression and classification models. Case Study: End-to-end analysis of a real-world dataset.	15 Hours	CO4

Suggested Readings:

1. W. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, *and* Jupyter, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
2. J. VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data. Sebastopol, CA, USA: O'Reilly Media, 2016.
3. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

Online Resources:

1. https://nptel.ac.in/courses/106106179
2. https://www.kaggle.com/learn/pandas

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2									2	1
CO2	3	3	3									2	2
CO3	2	2	3									1	2
CO4	2	3	3	1								2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	II		
Course Name	Mathematical Foundations for AI – II (Probability & Statistics)				
Code	RGAI5202				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Mathematical Foundations for AI – I	3	0	0	3
Course Objectives	1. Understand fundamental probability concepts including conditional probability and Bayes Theorem. 2. Apply probability distributions (Binomial, Poisson, Normal) to model real data. 3. Summarise and interpret data using descriptive statistical measures. 4. Connect statistical inference and probability theory to Machine Learning and Generative AI models.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Calculate basic and conditional probabilities and apply Bayes Theorem to AI classification problems.				
CO2	Apply Binomial, Poisson, and Normal distributions to model and predict data behaviour in AI.				
CO3	Compute descriptive statistics (mean, variance, standard deviation) and visualise data distributions.				
CO4	Apply correlation, regression, and hypothesis testing concepts to understand AI model evaluation and uncertainty.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Probability: Sample space, events, probability axioms. Addition and multiplication rules. Conditional probability and independence. Bayes Theorem with examples. Case Study: Probability of correct prediction in spam email detection.	15 Hours	CO1
2	Random Variables and Distributions: Discrete and continuous random variables. Binomial and Poisson distributions. Normal distribution — properties, z-score, empirical rule. Central Limit Theorem. Case Study: Normal distribution in AI model error analysis.	15 Hours	CO2
3	Descriptive Statistics: Mean, median, mode — properties and use cases. Variance, standard deviation, interquartile range. Data visualisation: histograms, box plots, scatter plots. Case Study: Statistical analysis of student performance dataset. Statistical Inference and AI Applications: Correlation and simple linear regression. Hypothesis testing — t-test, p-value (basic concepts). Probability in Machine Learning — maximum likelihood estimation. Case Study: How uncertainty is handled in Generative AI and Diffusion Models.	15 Hours	CO3, CO4

Suggested Readings:

1. S. M. Ross, A First Course in Probability, 10th ed. Boston, MA, USA: Pearson, 2018.
2. L. Wasserman, All of Statistics: A Concise Course in Statistical Inference. New York, NY, USA: Springer, 2004.

3. A. B. Downey, Think Stats: Exploratory Data Analysis in Python, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2014. Available online.

Online Resources:

1. https://nptel.ac.in/courses/111105041
2. https://www.coursera.org/learn/probability-statistics-machine-learning

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	1									2	1
CO2	2	3	2									2	2
CO3	2	2	2									1	2
CO4	1	2	3									1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**		II	
Course Name	Data Science and Visualization Lab				
Code	RGAI5251				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python Programming for AI	0	0	2	1
Course Objectives	1. Strengthen Python programming with OOP, exception handling, and functional programming concepts. 2. Use NumPy and Pandas for numerical computing, data manipulation, and data cleaning. 3. Create effective data visualisations using Matplotlib and Seaborn for insights and reporting. 4. Perform Exploratory Data Analysis (EDA) and build simple ML models using Scikit-learn.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Write structured and reusable Python code using OOP, exception handling, and functional programming.				
CO2	Efficiently load, clean, index, and transform structured data using NumPy and Pandas.				
CO3	Create professional data visualisations including line, bar, scatter, histogram, box plot, and heatmap.				
CO4	Perform complete EDA, engineer features, and build simple regression and classification models.				

S. No.	**List of Experiments**	**Mapped CO**
1	Program to implement OOP Concepts for Student Management System	CO1
2	Program for File Handling and Data Storage	CO1
3	Program to perform NumPy Array Operations	CO2
4	Program to create and manipulate Pandas DataFrames	CO2
5	Program for Data Cleaning and Preprocessing	CO2
6	Program to create Basic Plots using Matplotlib	CO3
7	Program for Statistical Visualizations using Seaborn	CO3
8	Program to generate Histogram, Boxplot and Heatmap	CO3
9	Program for Exploratory Data Analysis on Real Dataset	CO4
10	Program to implement Simple Linear Regression using Scikit-learn	CO4
Mini Project	End-to-End Data Analysis and Visualization Dashboard (Real Dataset: Data Cleaning + EDA + Visualization + Simple Predictive Model + Multi-chart Dashboard Report)	

Online Resources

1. https://nptel.ac.in/courses/106106179
2. https://www.kaggle.com/learn/pandas

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2									2	1
CO2	3	3	3									2	2
CO3	2	2	3									1	2
CO4	2	3	3	1								2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	I	**Semester**	II		
Course Name	Mathematical Foundations for AI Lab				
Code	RGAI5252				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Mathematical Foundations for AI – I Lab	0	0	2	1
Course Objectives	1. Simulate probability experiments and compute empirical probabilities. 2. Analyse probability distributions including Binomial and Normal distributions. 3. Compute descriptive statistics and visualise data distributions. 4. Apply correlation, regression, and statistical concepts to AI model evaluation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Simulate dice rolls, card draws, and compute empirical vs theoretical probabilities.				
CO2	Analyse Binomial, Poisson, and Normal distributions using NumPy and SciPy.				
CO3	Compute mean, median, mode, variance, standard deviation, and visualise distributions.				
CO4	Implement correlation, simple linear regression, and evaluate AI model performance statistically.				

S. No.	**List of Experiments**	**Mapped CO**
1	Program to simulate Dice Roll and Probability Calculation	CO1
2	Program to demonstrate Binomial Distribution	CO2
3	Program to analyze Normal Distribution	CO2
4	Program to compute Mean, Median and Mode	CO3
5	Program to calculate Variance and Standard Deviation	CO3
6	Program for Statistical Analysis of Sales Data	CO3
7	Program to compute Correlation between Variables	CO4
8	Program to create Histogram and Box Plot	CO3
9	Program to implement Simple Linear Regression	CO4
10	Program to analyze Performance of AI Model using Statistics	CO4
Mini Project	Student Performance Analysis and Predictor	

Online Resources:

1.https://nptel.ac.in/courses/111105041

2.https://www.coursera.org/learn/probability-statistics-machine-learning

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	1									2	1
CO2	2	3	2									2	2
CO3	2	2	2									1	2
CO4	1	2	3									1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	II	**Semester**	III			
Course Name	C Programming					
Code	RCS5301					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic knowledge of computer systems and operating systems & Fundamental mathematical and logical reasoning skills.	3	1	0	4	
Course Objectives	1. Understand the fundamentals of C programming, data types, operators, and control structures to develop simple programs. 2. Develop modular programs using functions, arrays, strings, and pointers for solving computational problems. 3. Apply structures, unions, file handling, and dynamic memory concepts in real-world programming applications. 4. Design, develop, test, and debug C programs using modern programming practices and problem-solving techniques.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain C programming fundamentals and implement programs using variables, operators, and control statements.					
CO2	Develop programs using functions, arrays, strings, and pointers to solve engineering problems.					
CO3	Implement structures, unions, file operations, and dynamic memory allocation in application-oriented programs.					
CO4	Analyze, design, debug, and evaluate C programs using appropriate programming tools and coding standards.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to C Programming:** History of C, Structure of C Program, Tokens, Data Types, Variables, Constants, Operators, Input/Output Functions, Decision Making Statements, Loops	15 Hours	CO1
2	**Functions, Arrays and Strings:** User Defined Functions, Recursion, Scope of Variables, One-Dimensional and Two-Dimensional Arrays, String Handling Functions	15 Hours	CO2
3	**Pointers and User Defined Data Types:** Pointers, Pointer Arithmetic, Arrays and Pointers, Structures, Unions, Enumerations, Typedef	15 Hours	CO3
4	**File Handling and Dynamic Memory Allocation:** File Operations, Command Line Arguments, Dynamic Memory Allocation (malloc, calloc, realloc, free), Program Testing and Debugging	15 Hours	CO4

Suggested Readings:

1. Van der Linden, Peter. Expert C programming: deep C secrets. Prentice Hall Professional, 1994.
2. Banahan, Mike, Declan Brady, and Mark Doran. The C book. Addison-Wesley Publishing Company, 1988.
3. Oualline, Steve. Practical C programming. " O'Reilly Media, Inc.", 1997.

4. Kernighan, Brian W., and Dennis M. Ritchie. The C programming language. Pearson Educación, 1988.

Online Resources:

1. NPTEL – Programming in C
   https://nptel.ac.in
2. GeeksforGeeks – C Programming
   https://www.geeksforgeeks.org/c-programming-language/
3. TutorialsPoint – C Programming Tutorial
   https://www.tutorialspoint.com/cprogramming/
4. GNU C Documentation
   https://gcc.gnu.org/onlinedocs/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	-	-	1	-	-	-	-	-	1	2	-
CO2	3	3	2	1	2	-	-	-	-	-	1	2	2
CO3	2	2	3	2	3	-	-	-	-	-	1	2	3
CO4	2	3	3	2	3	-	1	1	1	-	2	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	II	Semester	III			
Course Name	Database Management Systems					
Course Code	RAI5302					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic understanding of file systems and data organization	3	1	0	4	
Course Objectives	1. To introduce the basics of Database Management System and architecture. 2. Understanding the fundamental relational system, data model and SQL. 3. Illustrate the concepts of normalization and transaction. 4. Understand the concepts of NoSQL using MongoDB and Cassandra for Big Data					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the architecture of database and management.					
CO2	Constructing conceptual data models and SQL queries.					
CO3	Understand the functional dependencies, normalization and transaction processing techniques.					
CO4	Understand and Compare the work on NoSQL environment and MongoDB and Cassandra.					

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Database System Concepts, Architecture, and Cloud Infrastructure:** Introduction to Database System with example, Characteristics of the Database Approach, Users of Database System, Advantages and disadvantages of Using a DBMS, Data Models, Schemas, and Instances, DBMS Architecture and Data Independence, Database Languages and Interfaces. Introduction to Cloud Database Architectures, Database-as-a-Service (DBaaS) models (e.g., Amazon RDS, Google Cloud SQL), Server less Databases, and multi-tenant database architectures.	15 **Hours**	CO1
2	**Data Modeling, and Structured Query Language:** Data Modeling Using the Entity-Relationship Model, mapping constraints, keys, Entity Types, Sets, Attributes, Relationships, Enhanced Entity Relationship Modeling, Subclasses, Super classes, Inheritance, Specialization and Generalization, Structured Query Language (SQL) Basics, Data Definition, Constraints, Schema Changes, Insert/Delete/Update Statements, Queries and Sub queries, Aggregate Functions, Joins.	15 **Hours**	CO2

3	**Database Design and Transaction with Concurrency Control:** Functional Dependencies and Normalization for Relational Databases, Normal Forms Based on Primary Keys (1NF, 2NF, 3NF), Boyce-Codd Normal Form (BCNF), Fourth Normal Form (4NF), and Fifth Normal Form (5NF), Transaction Processing Concepts, Transaction states and State Diagram, Properties of Transactions (ACID), Schedules and Recoverability, Serializability of Schedules, Concurrency Control and Techniques, Database Recovery.	15 **Hours**	CO3
4	**NoSQL Big Data Management, MongoDB and Cassandra:** Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	15 **Hours**	CO4

Suggested Readings:

1. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. Database System Concepts. 7th ed., McGraw-Hill Education, 2020
2. Elmasri, Ramez, and Shamkant B. Navathe. Fundamentals of Database Systems. 8th ed., Pearson, 2022.
3. Ramakrishnan, Raghu, and Johannes Gehrke. Database Management Systems. 3rd ed., McGraw-Hill, 2002.
4. Erl, Thomas, and Eric Barceló Monroy. Cloud Computing: Concepts, Technology, Security & Architecture. 2nd ed., Pearson Education, 2023. .
5. G. Harrison, Next Generation Databases: NoSQL, NewSQL, and Big Data, 1st ed. Berkeley, CA, USA: Apress, 2015.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview
2. https://www.udemy.com/topic/database-management

Course Articulation Matrix

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1							1	1	1
CO2	3	3	3	2	2						2	2	2
CO3	3	3	3	2	2						2	2	2
CO4	3	3	3	2	3						2	2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		III	
Course Name	Introduction to Machine Learning				
Code	RGAI5301				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Mathematical Foundations for AI – I & II	3	1	0	1
Course Objectives	1. Understand the core concepts of Machine Learning and distinguish between supervised, unsupervised, and reinforcement learning. 2. Apply data preprocessing techniques including missing value handling, scaling, and encoding. 3. Implement and evaluate supervised learning algorithms including regression and classification. 4. Apply unsupervised learning techniques and understand model evaluation metrics.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain Machine Learning concepts, types, and real-world applications and differentiate AI, ML, and Deep Learning.				
CO2	Apply data preprocessing steps — cleaning, scaling, encoding, and train-test split — to prepare datasets for ML models.				
CO3	Implement Linear Regression, Logistic Regression, and Decision Trees and evaluate their performance.				
CO4	Apply model evaluation metrics, handle overfitting/underfitting, and implement K-Means clustering.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Machine Learning: What is ML? AI vs ML vs DL. Supervised, unsupervised, reinforcement learning. Real-world ML applications. ML workflow overview. Case Study: How Netflix recommends movies using collaborative filtering.	15 Hours	CO1
2	Data Preprocessing: Importance of data quality. Handling missing values and outliers. Feature scaling (normalisation, standardisation). Encoding categorical variables. Train-test split and cross-validation. Case Study: Preparing a student performance dataset for prediction.	15 Hours	CO2
3	Supervised Learning Algorithms: Linear Regression — equation, cost function, gradient descent. Logistic Regression — sigmoid function, classification. Decision Trees — entropy, information gain, splitting. Algorithm comparison. Case Study: Predicting house prices using Linear Regression.	15 Hours	CO3
4	Model Evaluation and Unsupervised Learning: Accuracy, precision, recall, F1-score, MSE, R^2. Confusion matrix. Overfitting and underfitting — bias-variance trade-off. Regularisation (L1, L2). K-Means Clustering. Case Study: Customer segmentation using K-Means.	15 Hours	CO4

Suggested Readings:

1. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
2. C. M. Bishop, Pattern Recognition and Machine Learning. New York, NY, USA: Springer, 2006.
3. A. Ng, Machine Learning Yearning: Technical Strategy for AI Engineers, in the Era of Deep Learning. Deeplearning.ai, 2018. Available online.

Online Resources:

1. https://nptel.ac.in/courses/106106139
2. https://www.coursera.org/learn/machine-learning

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	3	3	1								2	3
CO4	2	2	3	2								1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	II	**Semester**	III			
Course Name	Startup and Innovation					
Code	RCS5311					
Course Type	ESC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic knowledge of Artificial Intelligence and innovation concepts.	2	0	0	2	
Course Objectives	1. Understand entrepreneurship concepts in the context of Artificial Intelligence. 2. Develop skills to identify AI-based business opportunities and innovative solutions. 3. Learn startup development, business models, and funding mechanisms for AI ventures. 4. Analyze ethical, legal, and societal aspects of AI innovation and commercialization.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the fundamentals of AI entrepreneurship, innovation ecosystems, emerging AI technologies and the startup lifecycle.					
CO2	Analyze market opportunities and develop AI-based products using customer discovery, design thinking, lean startup methodology, and business models.					
CO3	Apply AI startup management principles, including team building, project management, commercialization strategies, intellectual property rights, and regulatory compliance.					
CO4	Evaluate funding options, ethical considerations, sustainability practices, risk management strategies, and prepare effective business pitches for AI ventures.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of AI Entrepreneurship:** Entrepreneurship concepts, innovation ecosystem, AI industry landscape, emerging AI technologies, startup lifecycle, entrepreneurial mindset, opportunity recognition, Enterprise Design Thinking principles, human-centered innovation, empathy mapping, user research, problem framing, stakeholder collaboration. **AI Business Opportunities and Product Development:** Market analysis, customer discovery, problem identification, AI product development lifecycle, value proposition design, lean startup methodology, business model canvas, AI-enabled products and services.	15 Hours	CO1, CO2
2	**AI Startup Management and Commercialization:** Startup formation, team building, project management, AI business strategies, commercialization of AI solutions, intellectual property rights, patents, licensing, AI regulations and compliance. **Funding, Ethics and Innovation:** Venture capital, angel investors, crowdfunding, financial planning, AI ethics, responsible AI, sustainability, risk management, global AI innovation trends, startup case studies and business pitch preparation.	15 Hours	CO3, CO4

Suggested Readings:

1. Burns, Paul. Corporate entrepreneurship and innovation. Bloomsbury Publishing, 2020.
2. Brueggemann, Ralph F., and Charles H. Matthews. Innovation and entrepreneurship: A competency framework. Routledge, 2024.
3. Bessant, John R., and Joe Tidd. Entrepreneurship. John Wiley & Sons, 2018.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg63
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg80

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2	1	-	2	-	-	-	-	1	2	2	2
CO2	2	3	2	1	3	-	-	-	1	2	2	3	2
CO3	2	2	3	1	2	2	-	-	2	2	3	2	3
CO4	1	2	2	-	1	3	3	3	1	2	2	1	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**	III		
Course Name	Foundations of Deep Learning & Neural Networks				
Code	RGAI5302				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Introduction to Machine Learning	2	1	0	3
Course Objectives	1. Understand the biological motivation and mathematical structure of artificial neurons and neural networks. 2. Apply forward propagation, loss functions, and backpropagation to train neural networks. 3. Build and train Multi-Layer Perceptrons (MLPs) and address overfitting using regularisation techniques. 4. Implement deep learning models using PyTorch or TensorFlow frameworks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the structure of artificial neurons, activation functions, and the perceptron learning rule.				
CO2	Implement forward propagation, compute loss, and apply backpropagation with gradient descent to train networks.				
CO3	Build multi-layer neural networks, identify overfitting, and apply dropout and regularisation techniques.				
CO4	Use PyTorch or TensorFlow to build, train, and evaluate deep learning classification models.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Neural Networks: Deep Learning vs Machine Learning. Biological neuron analogy. Artificial neuron, weights, bias. Activation functions — sigmoid, tanh, ReLU, softmax. Perceptron and linear separability. Case Study: How a single neuron classifies spam emails.	15 Hours	CO1
2	Training Neural Networks: Forward propagation — matrix computation of predictions. Loss functions — MSE and binary cross-entropy. Backpropagation — chain rule and gradient computation. Gradient descent and learning rate. Case Study: Training a model to recognise handwritten digits (MNIST).	15 Hours	CO2
3	Deep Neural Networks: Multi-Layer Perceptron (MLP) architecture. Vanishing gradient problem. Overfitting and underfitting in deep networks. Regularisation: L2 weight decay and dropout. Batch normalisation. Case Study: Building a deep image classifier. Introduction to Deep Learning Frameworks: PyTorch / TensorFlow overview. Defining model architecture using Sequential API. Compiling, training, and evaluating models. Saving and loading models. Case Study: Building a digit classifier using PyTorch/Keras.	15 Hours	CO3, CO4

Suggested Readings:

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

2. F. Chollet, Deep Learning with Python, 2nd ed. Shelter Island, NY, USA: Manning Publications, 2021.
3. M. A. Nielsen, Neural Networks and Deep Learning. Determination Press, 2015. Available online.

Online Resources:

1. https://nptel.ac.in/courses/106106184
2. https://www.coursera.org/specializations/deep-learning

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	3	3									2	3
CO4	2	2	3	1								1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**	III		
Course Name	C Programming Lab				
Code	RCS5351				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic understanding of computer systems and operating environments.	0	0	2	1
Course Objectives	1. Understand and implement the fundamental concepts of C programming using variables, operators, input/output, and control structures. 2. Develop modular programs using functions, arrays, and strings for solving computational problems. 3. Apply pointers, structures, and file handling concepts in developing application-oriented programs. 4. Analyze, test, debug, and document C programs using appropriate programming tools and coding standards.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand and implement the fundamental concepts of C programming using variables, operators, input/output, and control structures.				
CO2	Develop modular programs using functions, arrays, and strings for solving computational problems.				
CO3	Apply pointers, structures, and file handling concepts in developing application-oriented programs.				
CO4	Analyze, test, debug, and document C programs using appropriate programming tools and coding standards.				

Module	Course Contents	Mapped CO
1	Write a C program to calculate Simple Interest and Compound Interest.	CO1
2	Write a C program to find the roots of a quadratic equation.	CO1
3	Write a C program to check whether a number is prime or not.	CO1
4	Write a C program to find the factorial of a number using recursion.	CO2
5	Write a C program to perform searching (Linear Search) on an array.	CO2
6	Write a C program to perform sorting (Bubble Sort) on an array.	CO2
7	Write a C program to demonstrate pointer operations and swapping of two numbers using pointers.	CO3
8	Write a C program to maintain student records using structures.	CO3
9	Write a C program to create, write, read, and append data to a file.	CO3
10	Write a C program to implement a menu-driven Student Record Management System using functions and structures.	CO4

Suggested Readings:

1. Oualline, Steve. Practical C programming. " O'Reilly Media, Inc.", 1997.
2. Van der Linden, Peter. Expert C programming: deep C secrets. Prentice Hall Professional, 1994.
3. Seacord, Robert C. Effective C: An Introduction to Professional C Programming. No Starch Press, Inc, 2024.

4. Schildt, Herbert. "C the complete reference." (2021).
5. Kernighan, Brian W., and Dennis M. Ritchie. The C programming language. Pearson Educación, 1988.

Online Resources:

1. NPTEL – Programming in C
   https://nptel.ac.in/courses/106105171
2. GeeksforGeeks – C Programming Language
   https://www.geeksforgeeks.org/c-programming-language/
3. TutorialsPoint – C Programming Tutorial
   https://www.tutorialspoint.com/cprogramming/index.htm
4. GNU GCC Online Documentation
   https://gcc.gnu.org/onlinedocs/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			2						1	2	
CO2	3	3	2	1	3						1	2	2
CO3	2	3	3	2	3						1	2	3
CO4	2	2	3	2	3		1	1	1		2	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	II	Semester	III			
Course Name	Database Management Systems Lab					
Course Code	RAI5352					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic Understanding of File Systems, Data Organization.	0	0	2	1	
Course Objectives	1. Students are able to design, develop databases. 2. Students are able to query a database. 3. Students are able to take backup and rollback databases. 4. Students are able to understand the CRUD operation on MongoDB.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the database language command and also create simple database.					
CO2	Analyze the database using queries to retrieve records.					
CO3	Analyze the retrieve the information using different clauses for processing databases.					
CO4	Understand the different operations on MongoDB and retrieve the record.					

SN.	List of Experiments	Mapped CO
1	Write SQL queries for Data Definition and Data Manipulation Language.	CO1
2	Write SQL queries using logical operations (=, <,>, etc).	CO1
3	Write SQL queries using SQL operators.	CO2
4	Write SQL query using character, number, date and group functions.	CO1
5	Write SQL queries for extracting data from more than one table.	CO4
6	Write SQL queries for sub queries, nested queries.	CO2
7	Write SQL queries for retrieving information from the database using the Group by and Having clause.	CO3
8	Write SQL queries for ROLL BACK, COMMIT.	CO4
9	Create VIEWS and understand its concept.	CO3
10	Write CRUD (Create, Read, Update, and Delete) operations on the databases: MongoDB.	CO4

Suggested Readings:

1. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. Database System Concepts. 7th ed., McGraw-Hill Education, 2020

2. Elmasri, Ramez, and Shamkant B. Navathe. Fundamentals of Database Systems. 8th ed., Pearson, 2022.
3. Ramakrishnan, Raghu, and Johannes Gehrke. *Database Management Systems*. 3rd ed., McGraw-Hill, 2002.
4. Erl, Thomas, and Eric Barceló Monroy. *Cloud Computing: Concepts, Technology, Security & Architecture*. 2nd ed., Pearson Education, 2023. .
5. G. Harrison, *Next Generation Databases: NoSQL, NewSQL, and Big Data*, 1st ed. Berkeley, CA, USA: Apress, 2015.

Online Resources:

1. http://vlabs.iitkgp.ernet.in/se/4/theory
2. https://vlab.iitr.ac.in/assets/explorelabs/Database%20management%20system%20lab/labs/index.html

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	1		2							1	1
CO2	3	2	2	1	1							2	1
CO3	2	3	1	1	2							2	1
CO4	3	3		1	2							3	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		III	
Course Name	Machine Learning Lab				
Code	RGAI5351				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of programming	0	0	2	1
Course Objectives	1. Load, explore, and preprocess datasets for machine learning tasks. 2. Implement supervised learning algorithms including regression and classification. 3. Evaluate ML models using appropriate metrics and visualise results. 4. Apply unsupervised learning and analyse overfitting and underfitting behavior.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Perform exploratory data analysis, handle missing values, and preprocess features.				
CO2	Implement Linear Regression, Logistic Regression, and Decision Tree classifier.				
CO3	Evaluate models using accuracy, precision, recall, F1-score, confusion matrix, and MSE.				
CO4	Implement K-Means clustering and demonstrate overfitting and underfitting with plots.				

S. No.	**List of Experiments**	**Mapped CO**
1	Program for Data Loading and Exploratory Data Analysis	CO1
2	Program to handle Missing Values and Data Cleaning	CO1
3	Program for Feature Scaling and Encoding	CO1
4	Program to implement Linear Regression	CO2
5	Program to implement Logistic Regression	CO2
6	Program to implement Decision Tree Classifier	CO2
7	Program for Train-Test Split and Model Evaluation	CO3
8	Program to implement K-Means Clustering	CO4
9	Program to compute Model Performance Metrics	CO3
10	Program to analyze Overfitting and Underfitting	CO4

Mini Project	House Price Prediction using Machine Learning

Suggested Readings:

1. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
2. C. M. Bishop, Pattern Recognition and Machine Learning. New York, NY, USA: Springer, 2006.
3. A. Ng, Machine Learning Yearning: Technical Strategy for AI Engineers, in the Era of Deep Learning. Deeplearning.ai, 2018. Available online.

Online Resources:

1. https://nptel.ac.in/courses/106106139
2. https://www.coursera.org/learn/machine-learning

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	3	3	1								2	3
CO4	2	2	3	2								1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		III	
Course Name	Deep Learning Lab				
Code	RGAI5352				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of programming	0	0	2	1
Course Objectives	1. Implement perceptron model and understand forward and backward propagation. 2. Build and train multi-layer neural networks using PyTorch. 3. Study activation functions, loss functions, and gradient descent optimisation. 4. Train and evaluate neural network models on standard datasets.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement perceptron model, forward propagation, and backpropagation from scratch.				
CO2	Build multi-layer perceptron using PyTorch with configurable layers and activations.				
CO3	Implement and compare activation functions, loss functions, and gradient descent variants.				
CO4	Train neural networks on MNIST dataset, apply dropout, and build an image classifier.				

S. No.	List of Experiments	Mapped CO
1	Program to implement Perceptron Model	CO1
2	Program to implement Forward Propagation	CO1
3	Program to implement Backpropagation	CO1
4	Program to build Multi-Layer Perceptron using PyTorch	CO2
5	Program to study different Activation Functions	CO3
6	Program to implement Loss Functions	CO3
7	Program for Gradient Descent Optimization	CO3
8	Program to train Neural Network on MNIST Dataset	CO4
9	Program to implement Dropout Regularization	CO4
10	Program to build Image Classifier using Neural Network	CO4

Mini Project	Handwritten Digit Recognition System

Suggested Readings:

1. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. *Cambridge*, MA, USA: MIT Press, 2016.
2. F. Chollet, Deep Learning with Python, 2nd ed. Shelter Island, NY, USA: Manning Publications, 2021.
3. M. A. Nielsen, Neural Networks and Deep Learning. Determination Press, 2015. Available online.

Online Resources:

1. https://nptel.ac.in/courses/106106184
2. https://www.coursera.org/specializations/deep-learning

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	3	3									2	3
CO4	2	2	3	1								1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**	III		
Course Name	Indian Constitution				
Code	RMC5301				
Course Type	MC	**L**	**T**	**P**	**Credit**
Pre-Requisite	The basic knowledge of Indian Constitutions	1	0	0	1
Course Objectives	1. To realize the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution. To Know the need and importance of protecting traditional. 2. To identify the importance of fundamental rights as well as fundamental duties. 3. To understand the functioning of Union, State and Local Governments in Indian federal system. 4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the concept of Indian constitution.				
CO2	Identify the powers and functions of Supreme Court and High court.				
CO3	Analyze the role Governor and Chief Minister.				
CO4	Explain the district administration role and importance.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Indian Constitution:** Constitution meaning of the term - The making of the Indian Constitution - Sources and constitutional history – Philosophy of Constituent Assembly - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy. Union Government and its Administration Structure: President and Vice President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions.	7 Hours	CO1, CO2
2	**The States and The Union Territories:** State Government and its Administration: Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions – Relation between the Union and the States. **Local Administration:** District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative – Panchayati Raj: Functions PRI: Zillah Panchayat, Elected officials and their roles - Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy	8 Hours	CO3, CO4

Suggested Readings:

1. D. D. Basu, Introduction to the Constitution of India, 24th ed. New Delhi, India: Prentice-Hall of India Pvt. Ltd., 2022.
2. S. C. Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law. New Delhi, India: National Book Trust, 2019.
3. J. R. Siwach, Dynamics of Indian Government and Politics. New Delhi, India: Sterling Publishers Pvt. Ltd., 1985.
4. D. C. Gupta, Indian Government and Politics. New Delhi, India: Vikas Publishing House Pvt. Ltd., 2018.
5. H. M. Seervai, Constitutional Law of India, 4th ed. New Delhi, India: Universal Law Publishing Co. Pvt. Ltd., 2015

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_lw03/preview

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		2					2	3	1	2		1	
CO2		3					1	2	3	2		2	
CO3		1					2	2	2	1		1	
CO4		2					1	3	2	2		2	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**	IV		
Course Name	Operating Systems				
Code	RCS5404				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of Computer System.	3	1	0	4
Course Objectives	**1.** Understand the structure and functions of Operating System and analyse Processes, Threads and Scheduling algorithms. **2.** Analyse Operating System concepts that include architecture mutual exclusion algorithms, deadlock detection algorithms and agreement. **3.** Understand the principles of concurrency and Deadlocks. **4.** Analyse various memory management schemes. Study I/O management and File systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understanding of the concepts, structure and design of Operating System and Learning about Processes, Threads and Scheduling algorithms.				
CO2	Understand the principles of concurrency and Deadlock.				
CO3	Evaluate various memory management schemes.				
CO4	Analyse and Implement a prototype file system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Operating System and Process Concept** Operating system and functions, Types of Operating System, Classification of Operating systems, Operating System Structure, Operating System Services, System call and System program, Process concept, Process state, Process control block, Context switching, Operation on process, Threads and their management, Benefits of multithreading, Types of threads, Threading issues, CPU-scheduling, Scheduling criteria, Scheduling Algorithms, Concurrent Processes, Inter Process Communication models and Schemes.	15 Hours	CO1
2	**Process Synchronization and Deadlock** Process synchronization, Producer/Consumer Problem, Critical Section Problem, Peterson's solution, Synchronization of hardware, Semaphore, Classical-problem of synchronization, Deadlock, Deadlock characterization, Deadlock Prevention, Deadlock Avoidance, Resource allocation graph algorithm, Banker's algorithm, Deadlock detection, Recovery from deadlock.	15 Hours	CO2
3	**Memory Management** Memory Management, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing.	15 Hours	CO3
4	**I/O Management and File System** File System Structure, File System Implementation, Directory Implementation and Allocation Methods, Free		

	space Management, Kernel I/O Subsystems, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management.	15 Hours	CO4

Suggested Readings:

1. Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley Publication, 10th Edition, 2018.
2. Sibsankar Halder and Alex A Aravind, "Operating Systems", Pearson Education, 1st Edition, 2013.
3. Harvey M Dietel, "An Introduction to Operating System", Pearson Education, 3rd Edition, 1990.
4. D M Dhamdhere, "Operating Systems: A Concept-based Approach", TMH, 2nd Edition, 2006.
5. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, 9th Edition, 2018.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs72/preview
2. https://www.coursera.org/specializations/codio-introduction-operating-systems

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1	1	2	3							1	
CO2	2	3	2	1	1							1	2
CO3	2	2	1	1	2							2	1
CO4	2	1	2	3	2							1	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**	IV		
Course Name	Data Structure Using 'C'				
Code	RCS5403				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of programming and problem solving techniques.	3	1	0	4
Course Objectives	1. To introduce the basis and advanced data structures 2. To understand various data operations performed on in data structures 3. To understand various sorting and searching techniques in data structures 4. To analyse the performance of data structures algorithms				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching and sorting of each data structure.				
CO2	Apply knowledge of underlying data structures stack and linked list.				
CO3	Understand tree searching, sorting and operations on graph data.				
CO4	Understanding the graph representation and traversal				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Basic Terminology, Data types and its classification, Algorithm complexity notations like big Oh, Time- Space trade-off. Abstract Data Type (ADT). Array: Array , Definition, Representation and Analysis of Arrays, Single and Multidimensional Arrays, Address calculation, Array as Parameters, Sparse Matrices, Recursion- definition and processes, simulating recursion, Backtracking, Recursive algorithms, Tail recursion, Removal of recursion, Tower of Hanoi.	15 Hours	CO1
2	**Stack and Linked List:** Stack, Array Implementation of stack, Linked Representation of Stack, Application of stack: Conversion of Infix to Prefix and Postfix Expressions And Expression evaluation, Queue, Array and linked implementation of queues, Circular queues, D-queues and Priority Queues. Linked list, Implementation of Singly Linked List, Two-way Header List, Doubly linked list, Linked List in Array. Generalized linked list, Application: Garbage collection and compaction.	15 Hours	CO2
3	**Tree, Searching, Sorting and Hashing :** Trees: Basic, terminology, Binary Trees, algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees, Binary Search Tree(BST), AVL Trees, B-trees. Application: Algebraic Expression, Internal and External sorting, Insertion Sort, Bubble Sort, selection sort, Quick Sort, Merge Sort, Heap Sort, Radix sort, Searching Hashing: Sequential search, binary search, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation.	15 Hours	CO3

4	**Graphs:** Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi-list, Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Dijkstra Algorithm and Warshall Algorithm.	15 Hours	CO4

Suggested Readings:

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI, 2000.
2. Horowitz and Sahani, "Fundamentals of Data Structures",Galgotia Publication, 1984.
3. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with Applications", McGraw-Hill, 1984
4. R. Kruse et al, "Data Structures and Program Design in C", Pearson Education, 2006
5. Lipschutz, "Data Structures", Schaum's Outline Series, TMH, 2014
6. GAV Pai, "Data Structures and Algorithms", TMH, 2009

Online Resources:

https://archive.nptel.ac.in/courses/106/102/106102064/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	1	2	1							1	
CO2	1	1	2	2	1							1	
CO3	2	1	2	2	2							1	
CO4	2	2	2	2	2							1	

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	II	Semester	III			
Course Name	Data Structure Using 'C' Lab					
Code	RCS5355					
Course Type	PCC		L	T	P	Credit
Pre-Requisite	Basic Knowledge of programming and problem solving techniques.		0	0	2	1
Course Objectives	**1.** Understand various data representation techniques in the real world. **2.** Implement linear and non-linear data structures. **3.** Analyze various algorithms based on their time and space complexity. **4.** Develop real-time applications using suitable data structure.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the concept of data structures and apply algorithm for solving problems like Sorting, searching, insertion and deletion of data.					
CO2	Explore various operations on dynamic data structures like single linked list, circular linked list and doubly linked list					
CO3	Construct and perform operations on binary trees and binary search trees, including insertion, deletion, and traversal techniques.					
CO4	Implement graph traversal algorithms such as Breadth First Search (BFS) and Depth First Search (DFS) for graph-based problem solving.					

S. No.	List of Experiments	Mapped CO
1	Implementation of Searching and Sorting Algorithms.	CO1
2	Implementation of Singly Linked List	CO2
3	Implementation of Stack using Array.	CO2
4	Implementation of Queue using Array.	CO2
5	Implementation of Circular Queue using Array.	CO2
6	Implementation of Stack using Linked List.	CO2
7	Implementation of Queue using Array.	CO2
8	Implementation of Binary Tree.	CO3
9	Implementation of Binary Search Tree.	CO3
10	Implementation of Graph traversal using BFS & DFS.	CO4

Suggested Readings:

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI, 2000.
2. Horowitz and Sahani, "Fundamentals of Data Structures",Galgotia Publication, 1984.
3. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with Applications", McGraw-Hill, 1984
4. R. Kruse et al, "Data Structures and Program Design in C", Pearson Education, 2006
5. Lipschutz, "Data Structures", Schaum's Outline Series, TMH, 2014
6. GAV Pai, "Data Structures and Algorithms", TMH, 2009

Online Resources:

1. https://cse01-iiith.vlabs.ac.in/
2. https://cse.iitkgp.ac.in/~rkumar/pds-vlab/index1.html

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1	2	2	1							1	
CO2	2	2	1	1	1							1	
CO3	2	2	2	3	2							1	
CO4	2	3	2	2	1							1	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	Semester	IV		
Course Name	Operating Systems Lab				
Course Code	RCS5454				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic C Programming	0	0	2	1
Course Objectives	1. To understand the functionalities of various layers of OSI. 2. To explain the difference between hardware, software; operating systems, programs and files. 3. Simulate deadlock prevention/avoidance strategies and evaluate memory management techniques. 4. Design and compare file organization methods, file allocation strategies, and disk scheduling algorithms.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Ability to implement inter process communication between two processes				
CO2	Ability to design and solve synchronization problems.				
CO3	Ability to simulate and implement operating system concepts such as scheduling, Deadlock management, file management, and memory management.				
CO4	Simulate and evaluate page replacement schemes, file allocation, and disk scheduling.				

SN.	List of Experiments	Mapped CO
1	Study of basic UNIX/Linux commands (ls, cd, mkdir, chmod) and System Calls (fork, exec, wait).	CO1
2	Implement CPU Scheduling Algorithms: First Come First Serve (FCFS) and Shortest Job First (SJF).	CO2
3	Simulate Producer-Consumer problem using Semaphores for process synchronization.	CO3
4	Simulate Deadlock Avoidance using Banker's Algorithm.	CO4
5	Implement Memory Allocation schemes: First Fit, Best Fit, and Worst Fit.	CO2
6	Implement Page Replacement Algorithms: FIFO (First In First Out) and LRU (Least Recently Used).	CO2
7	Simulate File Allocation Strategies: Sequential, Indexed, and Linked.	CO3
8	Simulate Bankers Algorithm for Dead Lock Avoidance	CO4
9	Simulate Bankers Algorithm for Dead Lock Prevention.	CO3
10	Implement Disk Scheduling Algorithms: FCFS, SCAN, and C-SCAN.	CO4

Suggested Readings:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, 10th Edition, John Wiley & Sons, Hoboken, NJ, 2018.

2. Sibsankar Halder and Alex A. Aravind, Operating Systems, 1st Edition, Pearson Education India, New Delhi, 2013.
3. Harvey M. Deitel, An Introduction to Operating Systems, 3rd Edition, Pearson Education, New Delhi, 2011.
4. D. M. Dhamdhere, Operating Systems: A Concept-Based Approach, 3rd Edition, McGraw Hill Education (India), New Delhi, 2013.
5. William Stallings, Operating Systems: Internals and Design Principles, 9th Edition, Pearson Education, Boston, 2018.

Online Resources:

1. KodeKloud Free Linux Lab Environment.
2. https://www.vlab.co.in/
3. MIT OpenCourseWare (OCW) System Engineering Page.

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	2	1	2								2
CO2	3	3	2	2	1								1
CO3	3	3	3	2	-								2
CO4	3	3	3	2	1								2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		IV	
Course Name	Natural Language Processing Fundamentals				
Code	RGAI5401				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Foundations of Deep Learning & Neural Networks	3	1	0	4
Course Objectives	1. Understand the core challenges and applications of Natural Language Processing. 2. Apply text pre-processing techniques including tokenisation, stemming, lemmatisation, and TF-IDF. 3. Build basic NLP models for sentiment analysis, text classification, and named entity recognition. 4. Implement sequence models (RNN, LSTM) and word embeddings for language tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain NLP applications, challenges, and the text-as-data paradigm with real-world examples.				
CO2	Apply tokenisation, stop word removal, stemming, lemmatisation, bag-of-words, and TF-IDF pre-processing pipelines.				
CO3	Build and evaluate sentiment analysis, text classification, and NER models using standard NLP libraries.				
CO4	Implement RNN/LSTM-based text models and use Word2Vec embeddings for semantic representation.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to NLP: What is NLP? Challenges in language understanding — ambiguity, context, sarcasm. Applications: chatbots, machine translation, search, sentiment analysis. Basic text pre-processing pipeline overview. Case Study: Spam email detection using text classification.	15 Hours	CO1
2	Text Pre-processing: Tokenisation and lowercasing. Stop word removal and stemming (Porter, Snowball). Lemmatisation. Bag-of-Words model. TF-IDF vectorisation. Case Study: Pre-processing movie reviews for sentiment analysis.	15 Hours	CO2
3	Basic NLP Models: Sentiment analysis — polarity classification. Text classification using Naive Bayes and Logistic Regression. Named Entity Recognition (NER) using spaCy. Rule-based vs learning-based approaches. Case Study: Building a movie review classifier.	15 Hours	CO3
4	Sequence Models and Embeddings: Limitations of bag-of-words. Recurrent Neural Networks (RNNs) — vanishing gradient. Long Short-Term Memory (LSTM) networks. Word2Vec — CBOW and Skip-gram. Text generation basics. Case Study: Simple next-word prediction system.	15 Hours	CO4

Suggested Readings:

1. S. Bird, E. Klein, and E. Loper, Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit. Sebastopol, CA, USA: O'Reilly Media, 2009. Available online.
2. Y. Goldberg, Neural Network Methods for Natural Language Processing. San Rafael, CA, USA: Morgan & Claypool Publishers, 2017.
3. J. Eisenstein, Introduction to Natural Language Processing. Cambridge, MA, USA: MIT Press, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106101007
2. https://www.coursera.org/specializations/natural-language-processing

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	3	3									2	3
CO4	2	2	3	1	2							1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**	IV		
Course Name	Introduction to Generative AI Models (GANs, VAEs, Diffusion)				
Code	RGAI5402				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Foundations of Deep Learning & Neural Networks	2	1	0	3
Course Objectives	1. Understand the distinction between generative and discriminative models and key generative AI applications. 2. Explain the GAN architecture, training process, and practical limitations. 3. Understand Variational Autoencoders (VAEs), latent space representation, and reconstruction. 4. Describe diffusion model fundamentals and compare GANs, VAEs, and diffusion-based generation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Distinguish generative from discriminative models and describe applications of generative AI in image, text, and audio.				
CO2	Explain GAN architecture (generator and discriminator), the adversarial training process, and common failure modes.				
CO3	Understand autoencoder and VAE architectures, latent space concept, and image reconstruction/generation.				
CO4	Describe forward and reverse diffusion processes and compare GANs, VAEs, and diffusion models on quality metrics.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Generative AI: Generative vs discriminative models — intuition and examples. Applications: text-to-image, music generation, drug discovery, deepfakes. Overview of GAN, VAE, and Diffusion architectures. Evaluation metrics: FID, IS, SSIM. Case Study: DALL-E and Midjourney for image generation.	15 Hours	CO1
2	Generative Adversarial Networks (GANs): Generator and Discriminator architecture. Adversarial training — minimax game. Loss functions: binary cross-entropy for GAN. Training instability: mode collapse, vanishing gradients. DCGAN, StyleGAN overview. Case Study: Face generation using StyleGAN.	15 Hours	CO2
3	Variational Autoencoders (VAEs): Encoder-decoder architecture. Variational inference and reparameterisation trick. ELBO loss — reconstruction + KL divergence. Latent space interpolation. Comparison with standard autoencoders and GANs. Case Study: Image reconstruction and controlled generation using VAE.	15 Hours	CO3
4	Diffusion Models: Forward diffusion — adding noise over T steps. Reverse diffusion — denoising with a learned model. DDPM architecture and score matching. Stable Diffusion — latent diffusion model. Comparison: GAN vs VAE vs Diffusion. Case Study: Stable Diffusion for text-to-image generation.	15 Hours	CO4

Suggested Readings:

1. Ian Goodfellow et al., Generative Adversarial Nets (original paper, 2014).
2. Diederik P. Kingma and Max Welling, Auto-Encoding Variational Bayes (original paper, 2013).
3. Denoising Diffusion Probabilistic Models — Ho et al. (2020, NeurIPS).

Online Resources:

1. https://huggingface.co/docs/diffusers
2. https://www.coursera.org/learn/generative-adversarial-networks-gans

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	2	3	2									2	2
CO3	2	3	3									2	3
CO4	2	2	3	1	2							1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		IV	
Course Name	YOGA Activities				
Code	RMC5451				
Course Type	MC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamental Concepts of Yoga	0	0	2	1
Course Objectives	1. To enable the student to have good health. 2. To practice mental hygiene. 3. To possess emotional stability. 4. To integrate moral values. And To attain higher level of consciousness.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	To Understand the Concept of Yoga and its Historical Development.				
CO2	To Analyse the relevance of Yoga in modern age and its scope.				
CO3	To Apply, the Concept of Yoga in different texts.				
CO4	To evaluate the difference between Yogic and non-yogic system of exercises.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	General Introduction of Yoga: Yoga it's Origin, Meaning, Definition & Objectives, Historical Development of Yoga, Relevance of Yoga in modern age and scope, Misconceptions about Yoga and their solutions, Difference between physicalexercise and yogasans system of exercises. Yogasans for male and female	15 Hours	CO1, CO2
2	Purification Practice Dhauti/yogic Eneama/Neti/Eye protection Yoga Practices. 1. AsanasYoga Stretching, Suryanamaskar(Warming-up), Standing Asana, SittingAsana, Prone position Asana, Supine position Asana, Meditative Asana, Relaxation Asana 2. Pranayam- Why pranyam? How to practise of pranyam? a) AnulomaViloma/Surya Bhedana Pranayama Sheetlipranyam/sheetkaripranyam/Brhamaripranyam/ kapalbhati b) Ujjayi Pranayama c) Kumbhaka Pranayama d) Sampoorna Yoga Shwasana (Full Yogic Breathing e) Balance Diet f) Inner silence 3. Meditation and Mudras	15 Hours	CO3, CO4

Suggested Reading:

1. R. Singh, Yoga Avam Yoga Chikitsa. New Delhi, India: Chaukhambha Sanskrit Pratishthan, 2007.
2. K. S. Joshi, Yoga in Daily Life. New Delhi, India: Orient Paperbacks, 1985.

3. V. Saraswati, Yoga Vigyan. Rishikesh, Uttarakhand, India: Yoga Niketan Trust, 1998.
4. R. Pandey, Bhartiya Yoga Parampara ke Vividh Ayam. New Delhi, India: Radha Publications, 2008.

Online Resources:

1. Yoga and Positive Psychology for Managing Career and Life - Course (nptel.ac.in)https://nptel.ac.in/courses/106105218
2. NPTEL :: Management - NOC: Yoga and Positive Psychology for Managing Career and Life.

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1							2	2					2
CO2							2	2					2
CO3							1	2					2
CO4							2	2					2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		IV	
Course Name	Natural Language Processing Lab				
Code	RGAI5451				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Foundations of Deep Learning & Neural Networks Lab	0	0	2	1
Course Objectives	1. Apply text preprocessing techniques including tokenisation, stemming, and lemmatisation. 2. Implement Bag-of-Words and TF-IDF text representations. 3. Build sentiment analysis, text classification, and named entity recognition systems. 4. Implement word embeddings and a basic RNN for text processing tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply tokenisation, stopword removal, stemming, and lemmatisation to raw text data.				
CO2	Implement Bag-of-Words and TF-IDF vectorisation for text representation.				
CO3	Build sentiment analysis, text classification, and NER models using standard NLP libraries.				
CO4	Implement Word2Vec embeddings, basic RNN for text, and a rule-based chatbot.				

S. No.	List of Experiments	Mapped CO
1	Program for Text Preprocessing Techniques	CO1
2	Program to implement Bag of Words Model	CO2
3	Program to implement TF-IDF Vectorization	CO2
4	Program for Sentiment Analysis	CO3
5	Program for Text Classification	CO3
6	Program to implement Word Embeddings	CO4
7	Program for Named Entity Recognition	CO3
8	Program for Stemming and Lemmatization	CO1
9	Program to implement Basic RNN for Text	CO4
10	Program to build Rule-based Chatbot	CO4

Mini Project	Movie Review Sentiment Analysis System

Suggested Readings:

1. S. Bird, E. Klein, and E. *Loper,* Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit. Sebastopol, CA, USA: O'Reilly Media, 2009. Available online.
2. Y. Goldberg, Neural Network Methods for Natural Language Processing. San Rafael, CA, USA: Morgan & Claypool Publishers, 2017.
3. J. Eisenstein, Introduction to Natural Language Processing. Cambridge, MA, USA: MIT Press, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106101007
2. https://www.coursera.org/specializations/natural-language-processing

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	3	3	2									2	2
CO3	2	3	3									2	3
CO4	2	2	3	1	2							1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	II	**Semester**		IV	
Course Name	Generative AI Models Lab				
Code	RGAI5452				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Foundations of Deep Learning & Neural Networks Lab	0	0	2	1
Course Objectives	1. Implement basic autoencoder and variational autoencoder architectures. 2. Build and train a GAN model for image generation. 3. Visualise latent spaces and implement basic diffusion processes. 4. Use pre-trained generative models for image generation and text-to-image tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement autoencoder and VAE for image reconstruction and latent space learning.				
CO2	Build, train, and evaluate a GAN architecture for synthetic image generation.				
CO3	Visualise latent space representations and implement a basic forward diffusion process.				
CO4	Use pre-trained generative models for image generation and text-to-image synthesis.				

S. No.	List of Experiments	Mapped CO
1	Program to implement Basic Autoencoder	CO1
2	Program to implement GAN Architecture	CO2
3	Program for Training Simple GAN Model	CO2
4	Program to implement Variational Autoencoder	CO1
5	Program for Latent Space Visualization	CO3
6	Program to implement Basic Diffusion Process	CO3
7	Program for Image Generation using Pre-trained Model	CO4
8	Program to compare GAN and VAE outputs	CO2
9	Program for Image Denoising using Autoencoder	CO1
10	Program for Text-to-Image Generation using Pre-trained Pipeline	CO4

Mini Project	Basic Generative Image Creation System

Suggested Readings:

1. Ian Goodfellow et al., Generative Adversarial Nets (original paper, 2014).
2. Diederik P. Kingma and Max Welling, Auto-Encoding Variational Bayes (original paper, 2013).
3. Denoising Diffusion Probabilistic Models — Ho et al. (2020, NeurIPS).

Online Resources

1. https://huggingface.co/docs/diffusers

2. https://www.coursera.org/learn/generative-adversarial-networks-gans

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	1
CO2	2	3	2									2	2
CO3	2	3	3									2	3
CO4	2	2	3	1	2							1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	**Semester**	V			
Course Name	Automata Theory and Formal Languages					
Code	RCS5501					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of Discrete Mathematics, Data Structure	3	1	0	4	
Course Objectives	1. To illustrate finite state machines to solve problems in computing 2. To explain the hierarchy of problems arising in the computer sciences. 3. To familiarize Regular grammars, context frees grammar. 4. Understanding the concepts of Push Down Automata, Turing Machine					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Apply the knowledge of automata theory, Finite Automata(NFA & DFA)					
CO2	Analyse the give automata, regular expression & grammar to know the language it represents					
CO3	Design Automata & Grammar for pattern recognition and syntax checking.					
CO4	Identify limitations of some computational models and possible methods of proving them					

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Fundamentals:** Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages. Finite Automata: Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA – Equivalence of NDFAs with and without €-moves, Minimization of finite automata, Equivalence between two DFA's, Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore.	15 Hours	CO1
2	**Regular Languages:** Regular expressions, Identity rules, Conversion of a given regular expression into a finite automaton, Arden's Theorem. Conversion of finite automata into a regular expression, Pumping lemma for regular sets, Closure properties of regular sets. **Context Free Grammars:** Context free grammars and languages, Derivation trees, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion and left factoring in context free grammars, Minimization of context free grammars, Normal forms for context free grammars, Chomsky normal form(CNF), Greibach normal form(GNF), Pumping Lemma for Context free Languages, Closure and decision properties of context free languages.	15 Hours	CO2
3	**Pushdown Automata:** Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence,	15 Hours	CO3

	Types of PDA, Equivalence of context free grammars and pushdown automata, Inter-conversion, Two Stack PDA.		
4	**Turing Machine (TM):** Introduction to Turing machine, Basic Turing Machine Model, Turing Machine Representation, Instantaneous Description of Turing Machine, Turing Machine as Computer of Integer function, Language Acceptability of Turing Machine, Modifications of Turing Machine, Church's Thesis, Recursive and Recursive Enumerable Languages ,Definition of Post's Correspondence Problem, Undecidable Problem that Is RE, Context sensitive languages and Chomsky hierarchy, Halting Problem.	15 Hours	CO4

Suggested Readings:

1. P. Linz, An Introduction to Formal Languages and Automata, 6th ed. Burlington, MA, USA: Jones & Bartlett Learning, 2016.
2. Daniel I. A. Cohen, Introduction to Computer Theory, John Wiley & Sons, 2nd Edition, 1997.
3. J. E. Hopcroft, R. Motwani, and J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd ed. Boston, MA, USA: Pearson/Addison-Wesley, 2006.

Online Resources:

1. NPTEL, Theory of Computation, IIT Kanpur. Available at: https://nptel.ac.in/courses/106104028.
2. Stanford Online, Automata Theory (Self-Paced). Available at: https://www.edx.org/learn/coding/stanford-university-automata-theory.
3. NPTEL, Theory of Automata and Formal Languages, IIT Guwahati. Available at: https://nptel.ac.in/courses/106103070.

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	1						1	2	1
CO2	3	3	2	2	1						2	1	1
CO3	3	3	2	2	2						2	3	1
CO4	3	2	1	1	2						2	2	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	Semester	V			
Course Name	Computer Networks					
Course Code	RCS5502					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of Computer Operations	2	1	0	3	
Course Objectives	1. To understand the organization of computer networks with the concept of layered approach 2. To understand the working of computer networks hardware like LAN, Switch, Hub etc. 3. To understand the concept of data communication 4. To understand the concept of various routing and protocols used in data communication					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain basic concepts of OSI reference model and TCP/IP model and networks devices and transmission media, Analog and digital data transmission					
CO2	Be able to describe the functions of Data link layer and Network layer					
CO3	Be able to describe the functions of Transport, Session Layer					
CO4	Be able to describe the functions of Presentation and Application Layer					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Computer Networks & Physical Layer** **Introduction to Networks:** **Network** objectives and applications, Network structure and architecture, Examples of computer networks **Reference Models:** OSI Reference Model (layer-wise functions), TCP/IP Model and comparison with OSI **Physical Layer Concepts:** Transmission media (guided and unguided), Analog transmission, Digital transmission, Switching techniques (circuit, packet, message switching), ISDN basics, Terminal handling **Broadcast Channels & LAN Basics:** Medium access control principles, LAN protocols overview.	15 Hours	CO1
2	**Data Link Layer & Network Layer:** Design issues, Error detection and correction (CRC, Hamming code, etc.), Elementary data link protocols, Sliding window protocols **MAC & LAN Technologies:** CSMA with Collision Detection (CSMA/CD), Collision-free protocols, IEEE 802 standards for LANs, Comparison of LANs (Ethernet, Token Ring, etc.), Fiber optic networks and FDDI **Network Layer:** Design issues, Routing algorithms (shortest path, distance vector, link state), Congestion control techniques, Internetworking concepts and Examples.	15 Hours	CO2

3	**Transport to Application Layer** **Transport Layer:** Design issues, Connection management (establishment and release), Example of a simple transport protocol **Session Layer:** Design issues, Remote Procedure Call (RPC), Examples **Presentation Layer:** Design issues, Data compression techniques, Encryption basics, Network security and privacy concepts **Application Layer:** Design issues, File transfer and file access (FTP concepts), Electronic mail (Email protocols basics), Virtual terminals, other network applications	15 Hours	CO3, CO4

Suggested Readings:

1. B.A. Frozen "Data Communication and Networking". Tata McGraw Hill.5th edition, 2013.
2. Andrew S. Tanenbaum "Computer Networks" Prentice Hall of India. 5th edition, 2011.
3. William Stallings "Local Networks" Maxwell Macmillan International Edition,3rd edition,1990.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs35

Course Articulation Matrix													
PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1										1	
CO2	2	1	1									1	
CO3	2	1	1									1	
CO4	2	1	1								1	1	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	V		
Course Name	Large Language Models & Transformers				
Code	RGAI5501				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Natural Language Processing Fundamentals	3	0	0	3
Course Objectives	1. Understand the limitations of RNNs and the motivation for the Transformer architecture. 2. Explain self-attention, multi-head attention, and the Transformer encoder-decoder structure. 3. Understand BERT (encoder) and GPT (decoder) pre-training and fine-tuning paradigms. 4. Use the Hugging Face ecosystem to load, run, and apply pre-trained LLMs for practical tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the attention mechanism, scaled dot-product attention, and multi-head attention in Transformers.				
CO2	Describe BERT architecture, masked language modelling, and fine-tuning for downstream NLP tasks.				
CO3	Explain GPT architecture, autoregressive generation, and scaling laws in large language models.				
CO4	Use Hugging Face Transformers library to load pre-trained LLMs and apply them to text generation and Q&A tasks.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Transformer Architecture: Limitations of RNNs — sequential processing and long-range dependencies. Attention mechanism — queries, keys, and values. Scaled dot-product attention. Multi-head attention. Positional encoding. Feed-forward sublayer. Transformer block. Case Study: How Google Translate improved with Transformers.	15 Hours	CO1
2	BERT and Encoder Models: BERT architecture — bidirectional encoder. Pre-training tasks: Masked Language Modelling (MLM) and Next Sentence Prediction (NSP). Fine-tuning BERT for classification, NER, QA. RoBERTa, DistilBERT variants. Case Study: Question answering using BERT on SQuAD.	15 Hours	CO2
3	GPT and Decoder Models: GPT architecture — unidirectional decoder. Autoregressive generation — token prediction. GPT-1, GPT-2, GPT-3, GPT-4 progression. Scaling laws — parameters vs performance. Comparison: BERT (encoder) vs GPT (decoder). Case Study: ChatGPT-like text generation pipeline. Working with LLMs: Hugging Face Transformers and Tokenizers library. Loading pre-trained models: BERT, GPT-2, Mistral, Llama. Inference pipeline — text generation, summarisation, translation. LLM limitations: hallucinations, knowledge cutoff, context window. Case Study: Using open-source LLMs for real tasks.	15 Hours	CO3, CO4

Suggested Readings:

1. A. Vaswani *et al.*, "Attention Is All You Need," in Proc. 31st Int. Conf. Neural Information Processing Systems (NeurIPS), 2017, pp. 6000–6010.
2. L. Tunstall, L. von Werra, and T. Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face. Sebastopol, CA, USA: O'Reilly Media, 2022.
3. Hugging Face Documentation, accessed Jun. 2026.

Online Resources:

1. https://huggingface.co/learn/nlp-course
2. https://www.coursera.org/learn/attention-models-in-nlp

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	1								2	2
CO2	2	3	3	1								2	3
CO3	2	2	3	2								1	3
CO4	3	2	3	1	2							2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	V		
Course Name	Prompt Engineering & Retrieval Augmented Generation (RAG)				
Code	RGAI5502				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Large Language Models & Transformers	3	0	0	3
Course Objectives	1. Master prompt design techniques including zero-shot, few-shot, and chain-of-thought prompting. 2. Apply advanced prompting strategies — role prompting, tree-of-thoughts, and ReAct. 3. Understand the RAG architecture including vector embeddings, vector databases, and retrieval. 4. Build end-to-end RAG pipelines using LangChain for document Q&A and knowledge grounding.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Design effective prompts using zero-shot, few-shot, and chain-of-thought strategies for diverse LLM tasks.				
CO2	Apply advanced prompting techniques including ReAct, role prompting, and tree-of-thoughts for complex tasks.				
CO3	Explain RAG architecture components — embeddings, vector databases (FAISS/Chroma), and retrieval mechanisms.				
CO4	Build functional RAG applications using LangChain and evaluate them using RAGAS metrics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Advanced Prompt Engineering: What is prompt engineering and why it matters. Zero-shot and few-shot prompting. Chain-of-thought prompting — step-by-step reasoning. Instruction following and prompt formatting. Best practices and common pitfalls. Case Study: Improving code generation quality with structured prompts.	15 Hours	CO1
2	Advanced Prompting Techniques: Role prompting — persona assignment. Tree-of-Thoughts (ToT) prompting. ReAct prompting — reason and act. Prompt chaining for multi-step tasks. Prompt evaluation and optimisation. Case Study: Complex problem solving using chained prompts.	15 Hours	CO2
3	Retrieval Augmented Generation (RAG): Limitations of LLMs — hallucination and knowledge cutoff. RAG overview: retrieve → augment → generate. Text chunking strategies. Dense retrieval using sentence embeddings. Vector databases: FAISS, Chroma, Pinecone. Similarity search. Case Study: Building a document Q&A system over PDF files. Building RAG Applications: Lang Chain framework — chains, document loaders, text splitters. Embedding models and vector stores. Retrieval QA chain. Advanced RAG: HyDE, re-ranking, multi-query retrieval. Evaluation using RAGAS — faithfulness, context recall, answer relevance. Case Study: Company knowledge base chatbot with cited sources.	15 Hours	CO3, CO4

Suggested Readings:

1. B. Auffarth, Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs. Sebastopol, CA, USA: O'Reilly Media, 2024.
2. LangChain Documentation, accessed Jun. 2026.
3. P. Lewis *et al*., "Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks," Advances in Neural Information Processing Systems, vol. 33, pp. 9459–9474, 2020.

Online Resources:

1. https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers
2. https://www.langchain.academy

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	2	1	2							2	2
CO2	2	3	3	2	2							2	3
CO3	3	2	3	1	3							2	3
CO4	3	3	3	2	3							2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	**Semester**	V			
Course Name	Essence of Indian Knowledge Tradition					
Course Code	RMC5501					
Course Type	MC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Indian traditional knowledge and understand the importance of roots of knowledge system.	1	0	0	1	
Course Objectives	1. To understand the concept of Traditional knowledge and its importance. 2. To know the need and importance of protecting traditional. 3. To Apply, Know the various enactments related to the protection of traditional knowledge. 4. To understand the concepts of Intellectual property to protect the traditional.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	To Understand and elucidate the basic knowledge of traditional knowledge to develop the physical and social changes in traditional knowledge systems.					
CO2	To Analyse the significance of traditional knowledge protection to communicate the traditional knowledge information					
CO3	To Apply to Recognize the role of government on traditional knowledge to measure its impact on the global economy.					
CO4	To Evaluate and Summarize the strategies of patents and global legal FORA for excel protection of Indian traditional knowledge					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction To Traditional Knowledge:** Understanding the concept and significance of Indian Traditional Knowledge, Historical background, and evolution of traditional knowledge in India. **Intellectual Property Rights (IPR):** Overview of Intellectual Property Rights and its importance in the context of traditional knowledge. **Different types of IPRs:** Copyright, Trademarks, Patents, and Geographical Indications. **Traditional Knowledge and Traditional Cultural Expressions (TCEs):** Introduction to Traditional Cultural Expressions and the challenges in their protection, Examination of international frameworks like the WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge, and Folklore. Traditional Knowledge and Traditional Ecological Knowledge (TEK) Understanding	7 Hours	CO1, CO2

	the relationship between traditional knowledge and traditional ecological knowledge, Analysis of the role of TEK in environmental conservation and sustainable development.		
2	**Traditional Knowledge and IPR Laws In India***:* Study of the legal framework for the protection of traditional knowledge in India, Examination of relevant laws and regulations, such as the Traditional Knowledge Digital Library (TKDL), Traditional Knowledge and Patent Law: Understanding the challenges and issues surrounding the patenting of traditional knowledge, Analysis of case studies highlighting the controversies and debates in the field. **Traditional Knowledge and Copyright Law:** Exploring the relationship between traditional knowledge and copyright law, Discussion on the issues of cultural appropriation and protection of traditional expressions. **Traditional Knowledge and Geographical Indications (GI):** Overview of Geographical Indications and their significance in protecting traditional knowledge, Case studies on the successful registration and protection of traditional products and practices. **Traditional Knowledge, IPR, and the Future:** Analysis of the current trends and future prospects for the protection and preservation of Indian traditional knowledge, Examination of emerging issues such as digital platforms and traditional knowledge dissemination.	8 Hours	CO3, CO4

Suggested Readings:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
4. Sampath, P. G. (2012). Traditional Knowledge Systems and Intellectual Property Rights. Routledge.
5. Sharma, G., & Kumar, V. (Eds.). (2016). Indian Traditional Knowledge and Intellectual Property Rights: Innovations in Traditional Knowledge Preservation. Springer.
6. Ganguli, P. (2010). Indian Traditional Knowledge and Intellectual Property Rights: Indigenous Community Initiatives. Ane Books Pvt Ltd.

Online Resources:

1. https://aec.edu.in/knowledge/
2. https://www.iare.ac.in/?q=node/3745

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1								1	2	2	2		1
CO2								2	2	4	3		2
CO3								1	1	4	2		2
CO4								2	2	3	1		2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	V		
Course Name	Computer Networks Lab				
Code	RCS5552				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic of Networking.	0	0	2	1
Course Objectives	1. Understanding the concepts of Networking. 2. Studying about different Stuffing Concepts. 3. Understanding different network topologies. 4. Applying the various concepts of computer network in the real world.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	1. Understand the concepts of Network Cables and Network Commands.				
CO2	2. Analyze the use of Local Area Networks.				
CO3	3. Evaluate the performance of different programs related to Networking.				
CO4	4. Design and Apply different Topologies through simulation.				

S. No.	List of Experiments	CO Mapping
1	Study of different type of Network cables and practically implement the cross wired cable.	CO1
2	Study and implementation of basic network command and network configuration commands.	CO1
3	Connect the computers in local area network.	CO2
4	To write a socket program for implementation of echo.	CO2
5	Write a program in C to perform character stuffing.	CO3
6	Write a program in C to perform Bit stuffing.	CO3
7	Implement CRC (Cyclic redundancy check) in C.	CO3
8	Write a program in C to implement sliding window protocol.	CO3
9	To create Scenario and Study the performance of Ring topology through simulation.	CO4
10	To create Scenario and Study the performance of Bus topology through simulation.	CO4

Suggested Readings:

1. B.A. Frozen "Data Communication and Networking". Tata McGraw Hill.5th edition, 2013.
2. Andrew S. Tanenbaum "Computer Networks" Prentice Hall of India. 5th edition, 2011.
3. William Stallings "Local Networks" Maxwell Macmillan International Edition,3rd edition,1990.

Online Resources:

1. http://vlabs.iitkgp.ac.in/ant/1/

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	1	2						1	2	1
CO2	2	3	2	2	1						1	2	3
CO3	3	2	2	1	3						1	3	2
CO4	3	2	2	1	2						2	3	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	V		
Course Name	Large Language Models & Transformers Lab				
Code	RGAI5551				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Natural Language Processing Fundamentals Lab	0	0	2	1
Course Objectives	1. Implement self-attention mechanism and build a basic Transformer block. 2. Load and use pre-trained models from Hugging Face for text tasks. 3. Fine-tune small language models and compare BERT and GPT architectures. 4. Apply tokenisation, masked language modelling, and prompt-based generation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement scaled dot-product attention and build a basic Transformer encoder block.				
CO2	Load pre-trained BERT and GPT models from Hugging Face and run inference.				
CO3	Apply BERT for text classification and GPT for text generation tasks.				
CO4	Fine-tune a small language model and compare BERT vs GPT output behaviours.				

S. No.	List of Experiments	Mapped CO
1	Program to implement Self-Attention Mechanism	CO1
2	Program to build Basic Transformer Block	CO1
3	Program to load Pre-trained Models from Hugging Face	CO2
4	Program for Text Classification using BERT	CO3
5	Program for Text Generation using GPT	CO3
6	Program to implement Masked Language Modeling	CO2
7	Program for Tokenization Techniques	CO2
8	Program for Fine-tuning Small Language Model	CO4
9	Program for Prompt-based Text Generation	CO3
10	Program to compare BERT and GPT Models	CO4
Mini Project	Text Summarization using Large Language Model	

Online Resources:

1. https://huggingface.co/learn/nlp-course
2. https://www.coursera.org/learn/attention-models-in-nlp

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	1								2	2
CO2	2	3	3	1								2	3
CO3	2	2	3	2								1	3
CO4	3	2	3	1	2							2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	V		
Course Name	Prompt Engineering & Retrieval Augmented Generation Lab				
Code	RGAI5552				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Large Language Models & Transformers Lab	0	0	2	1
Course Objectives	1. Design and evaluate basic and advanced prompts for LLM tasks. 2. Apply chain-of-thought, few-shot, zero-shot, and ReAct prompting techniques. 3. Set up a vector database and build a document embedding and retrieval pipeline. 4. Build and evaluate a complete RAG pipeline using LangChain.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Design and evaluate zero-shot, few-shot, and chain-of-thought prompts for LLM tasks.				
CO2	Apply ReAct prompting and structured prompt patterns for multi-step reasoning.				
CO3	Set up a vector database, chunk documents, and create embedding-based retrieval.				
CO4	Build a complete RAG pipeline and a LangChain agent with document Q&A capability.				

S. No.	**List of Experiments**	**Mapped CO**
1	Program for Basic and Advanced Prompt Engineering	CO1
2	Program to implement Chain-of-Thought Prompting	CO1
3	Program for Few-Shot and Zero-Shot Prompting	CO1
4	Program to implement ReAct Prompting	CO2
5	Program to setup Vector Database using FAISS or Chroma	CO3
6	Program for Document Chunking and Embedding	CO3
7	Program to build Basic RAG Pipeline	CO4
8	Program for Advanced RAG Techniques (HyDE and Re-ranking)	CO4
9	Program for RAG System Evaluation using RAGAS Metrics	CO4
10	Program to build LangChain Agent with Tools	CO4
Mini Project	Document Question-Answering System using RAG	

Online Resources

1. https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers

2. https://www.langchain.academy

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	2	1	2							2	2
CO2	2	3	3	2	2							2	3
CO3	3	2	3	1	3							2	3
CO4	3	3	3	2	3							2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III			**Semester**	VI
Course Name	Design & Analysis of Algorithms				
Code	RCS5603				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Data Structure	3	1	0	4
Course Objectives	1. Analyse the asymptotic performance of algorithms. 2. Proving correctness of algorithms. 3. Demonstrate a familiarity with major algorithms and data structures. 4. Apply important algorithmic design paradigms and methods of analysis.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understanding fundamentals of algorithms and advanced data structure.				
CO2	Understanding and use divide and conquer approach along with greedy methods				
CO3	Implements dynamic programming and backtracking.				
CO4	Understanding branch and bound, string, and advanced topics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction and Analysis of Algorithms:** Algorithm and its characteristics, Asymptotic Notations and Basic Efficiency Classes, Recurrence Relations, Solving Recurrence Relations using Master's Theorem, Time-Space Trade-off in algorithms. Analysis of Sorting Algorithms: Bubble Sort, Selection Sort and Insertion Sort **Advanced Data Structures:** Red-Black Trees, Binomial Heaps, and Fibonacci Heaps.	15 Hours	CO1
2	**Divide and conquer approach:** Binary Search, Merge sort, Quick Sort, Strassen's Matrix Multiplication. **Greedy Methods:** Knapsack problem, Job sequencing with deadlines, Huffman Coding, Minimum Spanning Trees: Prim's and Kruskal's Algorithms.	15 Hours	CO2
3	**Dynamic Programming**: 0/1 Knapsack, All Pair Shortest Paths- Floyd's Warshal's Algorithms, Matrix chain multiplication, Longest common subsequence, Single Source Shortest Paths - Dijkstra's and Bellman Ford Algorithms. **Backtracking**: Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	15 Hours	CO3
4	**Branch and Bound:** Travelling Salesman Problem. **String Matching:** The naive method, Rabin- Karp method, Boyer-Moore, Knuth-Morris-Pratta (KMP). **Advanced topics:** Theory of NP-Completeness, Approximation Algorithms and Randomized Algorithms.	15 Hours	CO4

Suggested Readings:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India, 2022.
2. Horowitz, E., Sahni, S., and Rajasekaran, S., Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2008.

3. Aho, Hopcraft, Ullman, “The Design and Analysis of Computer Algorithms” Pearson Education, 2008.
4. R. C. T. Lee, S. S. Tseng, R. C. Chang, and Y. T. Tsai, Introduction to the Design and Analysis of Algorithms: A Strategic Approach. New York: McGraw-Hill, 2005

Online Resources:

1. https://nptel.ac.in/courses/106106131

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	3	3	1	3							1	
CO2	1	1	1	2	3							1	
CO3	2	2	1	2	2							2	
CO4	1	2	1	3	1							1	

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	VI		
Course Name	Generative Computer Vision & Multimodal AI				
Code	RGAI5601				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Introduction to Generative AI Models	2	1	0	3
Course Objectives	1. Understand CNN-based image processing and apply transfer learning for computer vision tasks. 2. Implement and use GAN and diffusion-based models for image generation and transformation. 3. Understand CLIP, vision-language models, and multimodal architectures. 4. Explore advanced multimodal systems combining vision, text, and audio.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply CNN-based feature extraction and transfer learning to build image classification systems.				
CO2	Use GAN and diffusion models (Stable Diffusion) for text-to-image, image-to-image, and inpainting tasks.				
CO3	Explain CLIP architecture, zero-shot image classification, and vision-language model applications.				
CO4	Describe multimodal AI systems combining text, image, and audio and apply industry tools like GPT-4o and Gemini.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Computer Vision Fundamentals: Image representation — pixels, channels, resolution. CNN architecture — convolution, pooling, fully connected layers. Transfer learning — ResNet, VGG, EfficientNet. Object detection — YOLO overview. Case Study: Fine-tuning ResNet for custom image classification.	15 Hours	CO1
2	Generative Models for Vision: DCGAN and StyleGAN for image generation. Diffusion models for images — DDPM and latent diffusion. Stable Diffusion architecture — VAE + U-Net + CLIP. Image-to-image and inpainting with ControlNet. Case Study: Text-to-image generation with Stable Diffusion.	15 Hours	CO2
3	Multimodal AI: What is multimodal AI? CLIP — contrastive learning of image-text pairs. Zero-shot image classification using text prompts. BLIP and BLIP-2 for image captioning. Visual Question Answering (VQA). Multimodal embedding spaces. Case Study: Image captioning and visual QA systems. Advanced Multimodal Systems: Audio + text + vision — unified multimodal models. Video generation — Sora, Gen-2 overview. LLaVA, GPT-4o, Gemini multimodal APIs. Industry use cases — medical imaging, autonomous vehicles, content creation. Future trends in multimodal AI. Case Study: GPT-4o multimodal capabilities.	15 Hours	CO3, CO4

Suggested Readings:

1. R. Szeliski, *Computer Vision: Algorithms and Applications*, 2nd ed. Cham, Switzerland: Springer Nature, 2022.
2. Hugging Face Diffusers Documentation, accessed Jun. 2026.
3. A. Radford *et al*., "Learning Transferable Visual Models From Natural Language Supervision," in *Proc. 38th Int. Conf. Machine Learning (ICML)*, 2021, pp. 8748–8763.

Online Resources:

1. https://huggingface.co/learn/computer-vision-course
2. https://www.fast.ai (Practical Deep Learning for Coders)

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	1	2							2	2
CO2	2	3	3	1	3							2	3
CO3	3	3	3	2	3							2	3
CO4	2	2	2	1	3							1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III		**Semester**	VI	
Course Name	Fine-Tuning, Optimization & Deployment of LLMs				
Code	RGAI5602				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Large Language Models & Transformers	2	1	0	3
Course Objectives	1. Understand fine-tuning paradigms including full fine-tuning, PEFT, LoRA, and QLoRA. 2. Apply model optimisation techniques including quantisation, pruning, and knowledge distillation. 3. Deploy LLM-based applications using FastAPI, Gradio, and cloud platforms. 4. Implement production-grade LLM deployment with API management, security, and cost optimisation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply LoRA and QLoRA for parameter-efficient fine-tuning of LLMs on domain-specific datasets.				
CO2	Implement model quantisation (INT4/INT8), pruning, and distillation to reduce model size and inference cost.				
CO3	Deploy fine-tuned LLM applications using FastAPI and Gradio locally and on cloud platforms.				
CO4	Apply API management, security, rate limiting, and cost optimisation for production LLM services.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Fine-Tuning LLMs: Why fine-tune? Full fine-tuning vs parameter-efficient fine-tuning (PEFT). LoRA — low-rank adaptation: concept, rank selection. QLoRA — quantised LoRA for memory-efficient training. Instruction tuning and RLHF (conceptual overview). Hugging Face PEFT library. Case Study: Fine-tuning Mistral-7B for a domain-specific chatbot.	15 Hours	CO1
2	Model Optimisation: Quantisation — FP16, INT8, INT4 using bitsandbytes and GGUF format. Structured and unstructured pruning. Knowledge distillation — teacher-student framework. Model compression techniques. Benchmarking: quality vs speed vs memory trade-offs. Case Study: Running a 7B model on 8GB RAM using 4-bit quantisation.	15 Hours	CO2
3	LLM Deployment: Deployment strategies — cloud, on-premises, edge. Serving with FastAPI — REST API endpoint design. Gradio for rapid UI prototyping. Streaming responses with server-sent events. Deploying to Hugging Face Spaces and AWS Lambda. Case Study: Deploying a fine-tuned chatbot as a public REST API. Advanced Deployment Topics: API gateway design and rate limiting. JWT authentication and API key management. Prompt injection prevention and content filtering. Cost optimisation — batching, caching, model selection. SLA management and scaling strategies. Case Study: Enterprise LLM deployment with monitoring.	15 Hours	CO3, CO4

Suggested Readings:

1. Hugging Face PEFT Documentation, accessed Jun. 2026.
2. T. Dettmers, A. Pagnoni, A. Holtzman, and L. Zettlemoyer, "QLoRA: Efficient Finetuning of Quantized LLMs," Advances in Neural Information Processing Systems, vol. 36, 2023.
3. FastAPI Documentation, accessed Jun. 2026.

Online Resources:

1. https://www.deeplearning.ai/short-courses/finetuning-large-language-models
2. https://huggingface.co/learn/llm-course

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	3	1	3							2	3
CO2	2	3	3	2	3							2	3
CO3	3	2	3	1	3	1						2	3
CO4	3	2	2	1	2	1						1	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	Semester	VI			
Course Name	Design & Analysis of Algorithms Lab					
Code	RCS5653					
Course Type	PCC	L	T	P	Credit	
Pre-Requisite	Strong Knowledge of Programming Language	0	0	2	1	
Course Objectives	1. To analyze the asymptotic performance of algorithms. 2. To calculate rigorous correctness proofs for algorithms. 3. To demonstrate a familiarity with major algorithms and data structures. 4. To apply important algorithmic design paradigms and methods of analysis.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Implement various search techniques					
CO2	Implement various sorting techniques.					
CO3	Implement backtracking strategy.					
CO4	Implement various greedy and dynamic programming techniques.					

S. No.	List of Experiments	Mapped
1	Program for Recursive Binary & Linear Search.	CO1
2	Implement Merge Sort.	CO2
3	Implement Quick Sort (Divide & Conquer).	CO2
4	Implement Heap Sort.	CO2
5	Implement Knapsack problem (Greedy algorithms.).	CO4
6	Implement Insertion Sort.	CO2
7	Implement Shortest path by Dijkstra Algorithm.	CO1
8	Implement 8- Queen problem (Back Tracking).	CO3
9	Implement Prim's Algorithms.	CO1
10	Implement Kruskal's Algorithm.	CO2, CO4

Suggested Readings:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India, 2022.
2. Horowitz, E., Sahni, S., and Rajasekaran, S., Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2008.
3. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.
4. R. C. T. Lee, S. S. Tseng, R. C. Chang, and Y. T. Tsai, Introduction to the Design and Analysis of Algorithms: A Strategic Approach. New York: McGraw-Hill, 2005

Online Resources:

https://cse01-iiith.vlabs.ac.in/exp/sorting/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	3	1						1	2	3
CO2	3	2	3	1	1						1	2	3
CO3	1	3	2	2	1							1	
CO4	1	2	3	1	2						2	2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**		VI	
Course Name	Generative Computer Vision & Multimodal AI Lab				
Code	RGAI5651				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Introduction to Generative AI Models Lab	0	0	2	1
Course Objectives	1. Apply CNN-based transfer learning to build image classification models. 2. Use Stable Diffusion for text-to-image and image-to-image generation tasks. 3. Implement CLIP-based zero-shot image classification and image captioning. 4. Build multimodal pipelines combining image, text, and audio inputs.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Fine-tune a pre-trained CNN (ResNet or Efficient Net) for custom image classification.				
CO2	Use Stable Diffusion pipeline for text-to-image, image-to-image, and in painting.				
CO3	Implement CLIP zero-shot classification and BLIP image captioning.				
CO4	Build a multimodal pipeline combining vision and language models for real-world tasks.				

S. No.	List of Experiments	Mapped CO
1	Program to implement CNN-based Image Classification using Transfer Learning	CO1
2	Program for Text-to-Image Generation using Stable Diffusion	CO2
3	Program for Image-to-Image Translation using Diffusion Pipeline	CO2
4	Program to implement CLIP for Zero-Shot Image Classification	CO3
5	Program for Image Captioning using BLIP Model	CO3
6	Program for Visual Question Answering using BLIP-2 or LLaVA	CO3
7	Program for Inpainting using ControlNet and Stable Diffusion	CO2
8	Program to build Image Search Engine using CLIP Embeddings	CO3
9	Program for Audio Transcription and Summarization using Whisper and LLM	CO4
10	Program to build Multimodal Product Description Generator	CO4

Mini Project	Multimodal Visual Story Generator (Image to Caption to Story)

Suggested Readings:

1. R. Szeliski, *Computer Vision: Algorithms and Applications*, 2nd ed. Cham, Switzerland: Springer Nature, 2022.
2. Hugging Face Diffusers Documentation, accessed Jun. 2026.
3. A. Radford *et al*., "Learning Transferable Visual Models From Natural Language Supervision," in *Proc. 38th Int. Conf. Machine Learning (ICML)*, 2021, pp. 8748–8763.

Online Resources:

1. https://huggingface.co/learn/computer-vision-course
2. https://www.fast.ai

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	1	2							2	2
CO2	2	3	3	1	3							2	3
CO3	3	3	3	2	3							2	3
CO4	2	2	2	1	3							1	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**		VI	
Course Name	Fine-Tuning, Optimization & Deployment of LLMs Lab				
Code	RGAI5652				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Large Language Models & Transformers Lab	0	0	2	1
Course Objectives	1. Fine-tune a pre-trained language model using full fine-tuning and LoRA (PEFT). 2. Apply quantisation and knowledge distillation to reduce model size and inference cost. 3. Deploy fine-tuned models as REST APIs using FastAPI and Gradio. 4. Implement streaming responses, rate limiting, and cost optimisation for LLM services.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Fine-tune GPT-2 and apply LoRA using the PEFT library on a domain dataset.				
CO2	Quantise a language model to INT4/INT8 and implement knowledge distillation.				
CO3	Deploy a fine-tuned LLM as a FastAPI endpoint and Gradio web application.				
CO4	Implement streaming responses, API security, and evaluate deployed LLM cost vs quality.				

S. No.	List of Experiments	Mapped CO
1	Program to Fine-tune GPT-2 on Custom Text Corpus using Hugging Face Trainer	CO1
2	Program to apply LoRA Fine-tuning using PEFT Library	CO1
3	Program to Quantize LLM to 4-bit using bitsandbytes	CO2
4	Program for Knowledge Distillation of BERT (Teacher-Student Framework)	CO2
5	Program to Deploy Fine-tuned Model as FastAPI REST Endpoint	CO3
6	Program to Build Gradio Chatbot UI for Fine-tuned LLM	CO3
7	Program to Deploy LLM Application on Hugging Face Spaces	CO3
8	Program for Load Testing LLM API using Locust	CO4
9	Program to Implement Streaming Response for LLM API	CO4
10	Program for End-to-End Fine-tune, Quantize and Deploy Pipeline	CO4

Mini Project	Fine-tuned Domain Chatbot: LoRA Fine-tuning, Quantization and Gradio Deployment

Online Resources:

1. https://www.deeplearning.ai/short-courses/finetuning-large-language-models
2. https://huggingface.co/docs/peft

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	3	1	3							2	3
CO2	2	3	3	2	3							2	3
CO3	3	2	3	1	3	1						2	3
CO4	3	2	2	1	2	1						1	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**	VII		
Course Name	LLMOps & Scalable Generative AI Systems				
Code	RGAI5701				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fine-Tuning, Optimization & Deployment of LLMs	3	0	0	3
Course Objectives	1. Understand the LLMOps lifecycle and the challenges of managing LLMs in production. 2. Apply monitoring and evaluation frameworks for LLM quality, hallucinations, and drift. 3. Design scalable Generative AI systems using distributed inference, caching, and vector stores. 4. Implement CI/CD pipelines, security, and A/B testing for production LLM systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Describe the LLMOps lifecycle and identify key tools for managing, versioning, and monitoring LLM systems.				
CO2	Set up evaluation and monitoring pipelines to track LLM output quality, hallucination rate, and latency.				
CO3	Apply scaling techniques including semantic caching, vector database optimisation, and inference batching.				
CO4	Implement CI/CD for LLM applications with automated testing, A/B experiments, and security controls.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to LLMOps: What is LLMOps? LLM lifecycle — develop, evaluate, deploy, monitor. MLflow and LangSmith for experiment tracking. Versioning prompts and models. Challenges: model drift, hallucination, latency. Case Study: Managing multiple LLMs in a production enterprise environment.	15 Hours	CO1
2	Monitoring and Evaluation: LLM evaluation metrics — BLEU, ROUGE, BERTScore, G-Eval. Monitoring hallucination and factual drift using NLI. Logging with Prometheus and Grafana. LangSmith for tracing LangChain pipelines. Alerting on quality degradation. Case Study: Monitoring a customer support LLM post-deployment.	15 Hours	CO2
3	Scaling Generative AI Systems: Distributed inference — tensor parallelism and pipeline parallelism. Semantic caching with Redis. Vector database scaling — Pinecone, Weaviate at millions of documents. Inference cost management. Auto-scaling LLM APIs on Kubernetes. Case Study: Scaling a RAG system to 10,000 concurrent users. Production Best Practices: CI/CD for LLMs using GitHub Actions — lint, test, deploy pipeline. A/B testing LLM outputs — statistical significance. Prompt injection and jailbreak defences. Security — PII redaction, output filtering. Compliance and audit logging. Case Study: Enterprise GenAI deployment with full CI/CD.	15 Hours	CO3, CO4

Suggested Readings:

1. C. Huyen, Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications. Sebastopol, CA, USA: O'Reilly Media, 2022.
2. LangSmith Documentation, accessed Jun. 2026.
3. Prometheus Documentation, accessed Jun. 2026.

Online Resources:

1. https://www.deeplearning.ai/short-courses/llmops
2. https://mlflow.org/docs/latest/index.html

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	1	3	1				1		2	2
CO2	2	3	3	2	3	1				1		2	3
CO3	3	2	3	2	3	1				1		2	3
CO4	3	3	2	1	3	2				1		2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**		VII	
Course Name	AI Agents, Tools & Autonomous Systems				
Code	RGAI5702				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Prompt Engineering & RAG	3	0	0	3
Course Objectives	1. Understand AI agent concepts, architectures, and the role of tool use in extending LLM capabilities. 2. Build LLM agents with tool-calling, memory, and multi-step reasoning using LangChain. 3. Design and implement autonomous multi-step planning agents and multi-agent collaborative systems. 4. Build practical agent applications using LangGraph or CrewAI for real-world tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain AI agent architectures, reactive vs cognitive agents, and the tool-calling mechanism in LLMs.				
CO2	Build LangChain agents with custom tools, function calling, and short-term and long-term memory.				
CO3	Implement ReAct and Plan-and-Execute agents and design multi-agent collaborative systems.				
CO4	Build practical AI agent applications using LangGraph or CrewAI for autonomous multi-step workflows.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to AI Agents: What are AI agents? Agent vs chatbot. Agent loop: perceive → reason → act. Reactive vs deliberative vs cognitive agents. ReAct pattern: reason-then-act. Tool use in LLMs — OpenAI function calling. Use cases: research assistants, coding agents, autonomous workflows. Case Study: Simple virtual assistant with web search capability.	15 Hours	CO1
2	Tool Use in Agents: LLM function calling — schema design and JSON output. LangChain Tools and Agents — built-in tools and custom tool creation. Tool integration: search, calculator, code executor, database, APIs. Handling tool errors and retries. Case Study: Agent that searches the web, executes Python, and queries a SQL database.	15 Hours	CO2
3	Autonomous Agents: ReAct agent implementation. Plan-and-Execute agent — task decomposition. Short-term memory (conversation buffer) and long-term memory (vector store). Multi-agent systems — roles, collaboration, and communication. Evaluating agent performance. Case Study: Research assistant agent reading and summarising papers. Building Practical Agents: LangGraph — stateful agent workflows with conditional branching. CrewAI — role-based multi-agent collaboration. Agentic RAG — dynamic retrieval decisions. Human-in-the-loop patterns. Industry applications — customer support, data analysis, code review. Case Study: Multi-agent content creation pipeline.	15 Hours	CO3, CO4

Suggested Readings:

1. LangChain Agents Documentation, accessed Jun. 2026.
2. A. Ng, AI Agentic Design Patterns. DeepLearning.AI Blog, 2024. Available online.
3. CrewAI Documentation, accessed Jun. 2026.

Online Resources:

1. https://www.deeplearning.ai/short-courses/ai-agents-in-langgraph
2. https://www.langchain.academy

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	2	3	1				1		2	2
CO2	3	3	3	2	3	1				1		2	3
CO3	2	3	3	3	3	1				1		2	3
CO4	3	3	3	2	3	1				1		2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**		VII	
Course Name	LLMOps & Scalable Generative AI Systems Lab				
Code	RGAI5751				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fine-Tuning, Optimization & Deployment of LLMs Lab	0	0	2	1
Course Objectives	1. Set up experiment tracking and tracing for LLM pipelines using LangSmith and MLflow. 2. Build evaluation and monitoring dashboards for LLM quality and hallucination detection. 3. Implement semantic caching and vector database optimisation for scalable GenAI systems. 4. Build CI/CD pipelines, A/B testing, and security controls for production LLM services.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Set up LangSmith tracing and MLflow experiment tracking for LLM pipelines.				
CO2	Build automated evaluation harness and hallucination detection for LLM outputs.				
CO3	Implement semantic caching with Redis and benchmark vector database query performance.				
CO4	Build CI/CD pipeline using GitHub Actions and implement A/B testing for LLM prompts.				

S. No.	List of Experiments	Mapped CO
1	Program to Setup LangSmith Tracing on LangChain RAG Pipeline	CO1
2	Program to Build LLM Evaluation Harness with G-Eval Scoring	CO2
3	Program to Implement Hallucination Detection using NLI Model	CO2
4	Program to Setup Prometheus and Grafana Dashboard for LLM API Monitoring	CO2
5	Program to Implement Semantic Caching with Redis for LLM Responses	CO3
6	Program to Build CI/CD Pipeline for LangChain App using GitHub Actions	CO4
7	Program to Benchmark Vector Database Query Latency at Different Index Sizes	CO3
8	Program to Implement A/B Testing for Two Prompt Templates	CO4
9	Program to Implement Rate Limiting and API Key Management for FastAPI LLM Service	CO4
10	Program to Compare LLM Cost and Quality across GPT-4o, GPT-4o-mini and Mistral-7B	CO3

Mini Project	Production LLMOps Dashboard: Tracing, Monitoring, Caching and CI/CD for RAG Chatbot

Suggested Readings:

1. C. Huyen, Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications. Sebastopol, CA, USA: O'Reilly Media, 2022.
2. LangSmith Documentation, accessed Jun. 2026.
3. Prometheus Documentation, accessed Jun. 2026.

Online Resources:

1. https://www.deeplearning.ai/short-courses/llmops

2. https://docs.smith.langchain.com

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	1	3	1				1		2	2
CO2	2	3	3	2	3	1				1		2	3
CO3	3	2	3	2	3	1				1		2	3
CO4	3	3	2	1	3	2				1		2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**		VII	
Course Name	AI Agents, Tools & Autonomous Systems Lab				
Code	RGAI5752				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Prompt Engineering & RAG Lab	0	0	2	1
Course Objectives	1. Build ReAct agents with tool-calling using Lang Chain and OpenAI function calling. 2. Implement agents with short-term and long-term memory and custom tool integration. 3. Design autonomous multi-step agents using LangGraph stateful workflows. 4. Build multi-agent collaborative systems using CrewAI for real-world tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Build a ReAct agent using LangChain with search, calculator, and custom tools.				
CO2	Implement OpenAI function calling with multiple tools and conversation memory.				
CO3	Build LangGraph stateful agent with conditional branching and human-in-the-loop.				
CO4	Build a multi-agent system using CrewAI with specialised role-based agents.				

S. No.	List of Experiments	Mapped CO
1	Program to Build ReAct Agent with Search and Calculator Tools using LangChain	CO1
2	Program to Implement OpenAI Function Calling with Multiple Custom Tools	CO2
3	Program to Build Code Execution Agent (LLM writes and runs Python code)	CO1
4	Program to Implement Short-term and Long-term Memory in LLM Agent	CO2
5	Program to Build Agentic RAG System with Dynamic Retrieval Decisions	CO3
6	Program to Build Multi-Agent System using CrewAI (Researcher, Writer, Editor)	CO4
7	Program to Build Lang Graph Stateful Agent with Conditional Branching	CO3
8	Program to Build Autonomous Data Analysis Agent for CSV Files	CO3
9	Program to Evaluate Agent Performance on Task Success Rate and Tool Accuracy	CO4
10	Program to Build Personal Study Assistant Agent with Quiz and Progress Tracking	CO4

Mini Project	Multi-Agent Research Assistant: Web Search, Summarize, Synthesize and Export to PDF

Suggested Readings:

1. LangChain Agents Documentation, accessed Jun. 2026.
2. A. Ng, AI Agentic Design Patterns. DeepLearning.AI Blog, 2024. Available online.

3. CrewAI Documentation, accessed Jun. 2026.

Online Resources:

1. https://www.deeplearning.ai/short-courses/ai-agents-in-langgraph

2. https://docs.crewai.com

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	2	3	1				1		2	2
CO2	3	3	3	2	3	1				1		2	3
CO3	2	3	3	3	3	1				1		2	3
CO4	3	3	3	2	3	1				1		2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**		VIII	
Course Name	AI Ethics, Governance & Responsible AI				
Code	RGAI5801				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Large Language Models & Transformers	3	0	0	3
Course Objectives	1. Identify and analyse ethical issues including bias, fairness, and privacy in AI systems. 2. Apply responsible AI practices including explainability, transparency, and accountability. 3. Understand AI governance frameworks, global regulations, and India's AI policy. 4. Evaluate emerging ethical challenges including deepfakes, misinformation, and sustainable AI.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Identify bias, fairness, and privacy risks in AI systems and propose mitigation strategies.				
CO2	Apply XAI techniques (SHAP, LIME) and responsible AI frameworks to improve transparency and accountability.				
CO3	Describe EU AI Act, India's DPDP Act, and global AI governance frameworks and their compliance requirements.				
CO4	Evaluate societal impacts of deepfakes, AI-driven unemployment, and environmental costs of large AI models.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to AI Ethics: Why AI ethics matters — high-stakes decisions. Types of bias: data bias, algorithmic bias, societal bias. Fairness metrics: demographic parity, equal opportunity. Privacy concerns — data collection, surveillance. AI harm taxonomy. Case Study: Biased facial recognition leading to wrongful outcomes.	15 Hours	CO1
2	Responsible AI Practices: Explainability and interpretability — SHAP and LIME. Transparency in model design and documentation. Accountability — model cards, datasheets for datasets. Safety and alignment — RLHF and constitutional AI. Responsible AI guidelines: Google PAIR, Microsoft RAI, EU Ethics Guidelines. Case Study: Building safe and explainable LLMs for healthcare.	15 Hours	CO2
3	AI Governance and Regulation: EU AI Act — risk classification (prohibited, high-risk, limited, minimal). India's AI Policy and Digital Personal Data Protection (DPDP) Act 2023. Intellectual property in AI-generated content. Compliance and certification requirements. Sector-specific regulations — healthcare, finance, autonomous vehicles. Case Study: Impact of EU AI Act on Indian technology companies.	15 Hours	CO3
4	Future of Ethical AI: Deepfakes — detection, legal implications, and platform responsibility. AI and employment — automation impact and reskilling. Environmental cost — energy and carbon footprint of training LLMs (Green AI). Career paths in Responsible AI and AI governance. Case Study: Ethical dilemmas in Generative AI deployment.	15 Hours	CO4

Suggested Readings:

1. K. Crawford, Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence. New Haven, CT, USA: Yale University Press, 2021.
2. V. Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way. Cham, Switzerland: Springer Nature, 2019.
3. EU AI Act Portal, accessed Jun. 2026.

Online Resources:

1. https://www.coursera.org/learn/ai-ethics
2. https://www.deeplearning.ai/short-courses/building-evaluating-advanced-rag

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1						1	2	3	2	1	1	2	1
CO2						1	3	2	2	2	1	2	2
CO3						1	3	1	2	3	2	2	1
CO4						1	2	1	1	2	3	1	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**		VIII	
Course Name	AI Ethics, Governance & Responsible Lab				
Code	RGAI5851				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Large Language Models & Transformers Lab	0	0	2	1
Course Objectives	1. Measure and mitigate bias in classification models using fairness metrics. 2. Apply SHAP and LIME explainability techniques to model predictions. 3. Implement privacy-preserving ML and deepfake detection systems. 4. Profile AI model carbon footprint and conduct responsible AI red-teaming.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Audit classification models for demographic bias using fairness metrics.				
CO2	Apply SHAP and LIME to explain model predictions for tabular and text data.				
CO3	Implement differential privacy, deepfake detection, and content safety filters.				
CO4	Profile AI carbon footprint, red-team an LLM, and write an AI impact assessment.				

S. No.	List of Experiments	Mapped CO
1	Program to Audit Classification Model for Bias using Fairness Metrics	CO1
2	Program to Apply SHAP Explainability on Random Forest Model	CO2
3	Program to Apply LIME for Explaining NLP Model Predictions	CO2
4	Program to Implement Differential Privacy using TF Privacy on MNIST	CO3
5	Program to Detect Deepfake Images using Pre-trained Detector	CO3
6	Program to Evaluate LLM Hallucination Rate using TruthfulQA Benchmark	CO2
7	Program to Implement Prompt Classification Filter for Harmful Content Detection	CO3
8	Program to Profile AI Model Energy Consumption using CodeCarbon	CO4
9	Program to Red-team an LLM and Document Jailbreak Attempts and Mitigations	CO4
10	Program to Write AI Impact Assessment Report following EU AI Act Template	CO4

Mini Project	Responsible AI Audit: Bias, Explainability, Carbon Footprint and Impact Assessment

Suggested Readings:

1. K. Crawford, Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence. New Haven, CT, USA: Yale University Press, 2021.
2. V. Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way. Cham, Switzerland: Springer Nature, 2019.
3. EU AI Act Portal, accessed Jun. 2026.

Online Resources:

1. https://www.coursera.org/learn/ai-ethics
2. https://artificialintelligenceact.eu

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1						1	2	3	2	1	1	2	1
CO2						1	3	2	2	2	1	2	2
CO3						1	3	1	2	3	2	2	1
CO4						1	2	1	1	2	3	1	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	**Semester**	VI			
Course Name	Internet of Things					
Code	RPEC51711					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of AI and Computer Network		2	1	0	3
Course Objectives	1. Understand the fundamentals of IoT, including its vision, architecture, design principles, and M2M communication concepts. 2. Gain knowledge of IoT hardware and embedded platforms, such as sensors, actuators, RFID, wireless sensor networks, Arduino, and Raspberry Pi. 3. Learn IoT networking and programming techniques, including communication protocols, data handling, and Arduino-based application development. 4. Apply IoT technologies to develop smart solutions for real-world applications such as healthcare, home automation, smart metering, automotive systems, and smart cities.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Demonstrate basic concepts, principles and challenges in IoT.					
CO2	Illustrate functioning of hardware devices and sensors used for IoT.					
CO3	Analyze network communication aspects and protocols used in IoT.					
CO4	Apply IoT for developing real life applications using Ardunio programming.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Internet of Things (IoT)**: Vision, Definition, Conceptual Framework, Architectural view, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.	15 Hours	CO1
2	**Hardware for IoT**: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks. **Embedded Platforms for IoT:** Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino and Raspberry pi.	15 Hours	CO2
3	**Network & Communication aspects in IoT:** Wireless Medium access issues, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination. **Programming the Ardunio:** Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT. **IoT Applications:** Smart Metering, E-health, City Automation, Automotive Applications, home automation	15 Hours	CO3, CO4

Suggested Readings:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, VPT, 2014
2. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.
3. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs53
2. https://onlinecourses.swayam2.ac.in/arp19_ap52/preview

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1	1		1							2	1
CO2	3	2	1	2	2							1	2
CO3		3	2	1	2							2	1
CO4	1		2	1	1							2	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	VI		
Course Name	Cyber Security				
Code	RPEC51712				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Computer Security	2	1	0	3
Course Objectives	1. To introduce the basics of information and web security and computer communication. 2. To familiarize students Security policies and Cryptography. 3. To exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization. 4. To monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the information systems, its types, threats, security issues related to it and also about cyber security and risk associated to it.				
CO2	Analyze about Application security, Data security and types of security Threats in network.				
CO3	Understand the importance of secure information system and risk management issues indifferent applications.				
CO4	Understand modern copyright, patent law, skills of ethics, cyber-crime and IT ACT so that they can protect their inventions by making use of these Laws.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis. Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing, Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations.Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data.	15 Hours	CO1
2	Security Technology-Firewall and VPNs, Security Threats-Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attacks, Security Threats to E-Commerce-Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, Public Key Cryptography. Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security	15 Hours	CO2
3	Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures. Laws, Investigation and Ethics, Cyber Crime , Information Security and Law ,Types & overview of Cyber Crimes, Cyber Law, Issues in E-Business Management Overview of	15 Hours	CO3, CO4

	Indian IT Act, Ethical Issues in Intellectual property rights, Copy Right, Patents, Data privacy and protection, Domain Name, Software piracy, Plagiarism, Issues in ethical hacking.		

Suggested Readings:

1. Godbole, *"* Information Systems Security*"*, Willey,2008
2. Merkov, Breithaupt, *"* Information Security*"*, Pearson Education,2014
3. Yadav, *"*Foundations of Information Technology*"*, New Age,Delhi, 2006
4. Schou, Shoemaker, *"* Information Assurance for the Enterprise*"*, Tata McGraw Hill,2006

Online Resources:

1. https://nptel.ac.in/courses/106106129
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1									2	1
CO2	2	2	1	2	2							1	2
CO3	1	1	2	2	2							2	2
CO4	2	1	2	2	2							2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	Semester	VI		
Course Name	Big Data Analytics				
Course Code	RPEC51713				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine Learning, Statistics, Probability	2	1	0	3
Course Objectives	1. To introduce the fundamental concepts and techniques of big data analytics. 2. To understand Hadoop architecture and its ecosystem components such as HDFS, MapReduce, MongoDB. 3. To implement big data storage and processing using modern tools. 4. To perform real-time analytics using R, Spark, and other frameworks, to explore NoSQL databases for handling semi-structured and unstructured data.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the architecture and ecosystem of Big Data platforms and their use cases.				
CO2	Apply HDFS and MapReduce paradigms to process large-scale datasets.				
CO3	Design and query semi-structured data using MongoDB tools.				
CO4	To Learn knowledge of NoSql and MongoDB.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Big Data :**Types of digital data, Evolution and history of Big Data, Big Data architecture and ecosystem, Characteristics of Big Data ,Drivers and applications of Big Data, Big Data analytics lifecycle, Challenges of traditional data processing systems, Intelligent data analysis and analytic processes, Modern analytics tools and platforms, Security, privacy, ethics, compliance in Big Data.	15 Hours	CO1
2	**Hadoop and Distributed Storage :** Introduction to Hadoop and its evolution ,Hadoop ecosystem overview **HDFS (Hadoop Distributed File System):** Architecture and design principles, Data blocks, replication, and fault tolerance, Read/write mechanisms, Command line and Java interfaces, Hadoop I/O: Compression, Serialization, Avro, Data ingestion: Flume and Sqoop, Hadoop cluster setup and configuration, Monitoring, maintenance, and security, Hadoop deployment in cloud environments. **MapReduce and YARN Framework :** Map Reduce programming model, Working of MapReduce, Job lifecycle, scheduling, and execution, Input and output formats, Shuffle and sort phase, Handling failures in distributed systems, Introduction to YARN	15 Hours	CO2

	architecture, Writing and testing MapReduce programs.		
3	**NoSQL Databases and MongoDB *:*** Introduction to NoSQL databases,Types of NoSQL databases (Key-value, Document, Column, Graph),MongoDB architecture and features, CRUD operations (Create, Read, Update, Delete),Indexing and aggregation, Data modelling in MongoDB, Handling semi-structured and unstructured data. **Apache Spark and Real-Time Analytics *:***Introduction to Apache Spark, Spark architecture and components, RDD (Resilient Distributed Datasets),Spark execution model (Jobs, Stages, Tasks),Spark vs Map Reduce, Spark applications (Batch & Real-time processing),Introduction to Spark Streaming, Use cases of real-time analytics	15 Hours	CO3

Suggested Readings:

1. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publications, 2nd Edition, 2014;
2. Tom White, “Hadoop: The Definitive Guide”, O’Reilly, 3rd Edition, 2012.
3. “Black Book Big Data”, DreamTech Publications, 1st Edition, 2017.

Online Resources:

1. https://nptel.ac.in/courses/106104189
2. https://www.books.google.co.in/books?id=rkWPojgfeM8C&printsec=frontcover&dq=HIGH+PE
3. http://www.datameer.com/pdf/big-data-analytics-ebook.pdf?mkt_tok.

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1		1							1	3	2
CO2	3	2		2							1	2	3
CO3	3	1	3	2	2						1	3	3
CO4	3		3	2	1							3	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	Semester	VI			
Course Name	Agentic AI					
Course Code	RPEC51714					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of AI	2	1	0	3	
Course Objectives	1. Understand the foundations, architecture, and evolution of Agentic AI systems. 2. Develop intelligent agents capable of reasoning, planning, tool usage, and autonomous decision-making. 3. Apply Agentic AI frameworks to real-world applications while addressing safety, ethics, and governance concerns. 4. Analyze, evaluate, and deploy Agentic AI solutions by incorporating ethical principles, safety mechanisms, governance frameworks, and industry best practices.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the concepts, architectures, and components of Agentic AI systems					
CO2	Design and implement autonomous agents using planning, reasoning, memory, and tool integration.					
CO3	Evaluate Agentic AI applications with respect to performance, safety, ethics, and real-world deployment.					
CO4	Develop and deploy Agentic AI applications by integrating governance, safety, explainability, ethical considerations, and security measures for real-world problem solving.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of Agentic AI and LLM Architectures:** Introduction to Agentic AI: Evolution of AI Agents, Characteristics of Autonomous Agents, Reactive vs Deliberative Agents, Multi-Agent Systems, Agent Architectures, Agent Lifecycle, Applications of Agentic AI.	15 Hours	CO1
2	**Memory, Tools, and Agent Frameworks**-Agnostic Reasoning, Planning and Tool Use: Knowledge Representation, Goal Formulation, Planning Algorithms, Memory Systems, Retrieval-Augmented Generation (RAG), Tool Calling, Agent Workflows, Human-Agent Collaboration, Multi-Agent Coordination.	15 Hours	CO2
3	**Multi-Agent Systems and Deployment:** Agentic AI Development and Governance: Agent Frameworks, Evaluation Metrics, Safety and Alignment, Explainability, Ethical AI, Security Risks, Autonomous Decision-Making, Industry Case Studies, Future Trends in Agentic AI.	15 Hours	CO3, CO4

Suggested Readings:

1. "Designing Autonomous Agents: Theory and Practice from Biology to Engineering and Back" – Pattie Maes. 2. "Multi-Agent Systems: Algorithmic, Game-Theoretic, and Logical Foundations" – YoavShoham and Kevin Leyton-Brown
2. Artificial Intelligence: A Modern Approach Stuart Russell and Peter Norvig, Pearson Education, 2020. Comprehensive coverage of intelligent agents, reasoning, planning, and decision-making systems.
3. Multiagent Systems YoavShoham and Kevin Leyton-Brown, Cambridge University Press, 2009. Covers multi-agent collaboration, coordination, negotiation, and distributed intelligence.
4. Reinforcement Learning: An Introduction MIT Press, 2018. Fundamental concepts of learning agents, rewards, policies, and autonomous decision-making.

Online Resource:

1. https://docs.crewai.com Pydantic Documentation – https://docs.pydantic.dev OpenAI Agent Swarms Overview
2. https://platform.openai.com/docs/agent-swarms N8N Workflow Automation – https://n8n.io
3. Prompt Engineering Guide – https://www.promptingguide.ai/ Coursera: Generative AI Prompt Engineering for Everyone – https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyon

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	-	-	-	-	2		3	3
CO3	3	3	3	3	2	2	2	3	2	3	3	3	3
CO4	3	3	3	2	3	1	1	1	1	2	2	3	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	**Semester**	VI			
Course Name	Quantum Computing					
Code	RPEC51721					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Engineering Mathematics, Data Structures and Algorithms, Python Programming		2	1	0	3
Course Objectives	1. To understand the basics of quantum computing. 2. To understand the mathematics required for quantum computing. 3. To understand the building blocks of quantum computing and design algorithms. 4. To understand quantum hardware principles and tools for quantum computing.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand basic concepts of quantum computing. Appraise various mathematical models required for quantum computing.					
CO2	Analyse various quantum hardware-building principles.					
CO3	Apply various quantum hardware-building principles.					
CO4	Evaluate the various quantum algorithms.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Quantum Computing & Mathematical Foundations for Quantum Computing** Motivation for studying Quantum Computing Origin of Quantum Computing Quantum Computer vs. Classical Computer Introduction to Quantum mechanics Overview of major concepts in Quantum Computing Qubits and multi-qubits states Bloch Sphere representation Quantum Superposition Quantum Entanglement. **Matrix Algebra:** basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.	15 Hours	CO1
2	**Building Blocks for Quantum Program** Architecture of a Quantum Computing platform Details of q-bit system of information representation: Block Sphere Multi-qubits States Quantum superposition of qubits (valid and invalid superposition) Quantum Entanglement Useful states from quantum algorithmic perceptive e.g. Bell State Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit No Cloning Theorem and Teleportation.	15 Hours	CO2
3	**Quantum Algorithms and Error correction** Quantum Algorithms, Shor's Algorithm, Grover's Algorithm. Deutsch's Algorithm, Deutsch -Jozsa Algorithm.Quantum error correction using repetition codes 3 qubit codes, Shor's 9 qubit error correction Code.	15 Hours	CO3, CO4

Suggested Readings:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University Press.
2. David McMahon, “Quantum Computing Explained”, Wiley ,2008.
3. Vladimir Silva, Practical Quantum Computing for Developers,2018.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview
2. https://www.coursera.org/courses?query=quantum%20computing
3. https://www.cl.cam.ac.uk/teaching/1617/QuantComp/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	2	2	3							1	2
CO2	3	3	1	2	1							2	1
CO3	2	1	2	1	1							2	2
CO4	1	2	1	3	2							1	2

Program	B. Tech CSE-AI					
Year	IV	**Semester**	VIII			
Course Name	Soft Computing					
Code	RPEC51722					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Mathematics, Probability, Statistics, and Programming Fundamentals.		2	1	0	3
Course Objectives	1. To understand the fundamental concepts, principles, and significance of soft computing techniques for handling uncertainty, imprecision, and complex decision-making problems. 2. To apply fuzzy logic, artificial neural networks, and evolutionary computing methods to model and solve real-world computational problems. 3. To analyze and evaluate the performance of intelligent systems developed using soft computing approaches in diverse application domains. 4. To design and develop hybrid soft computing solutions by integrating multiple intelligent techniques for optimization, prediction, classification, and decision-support applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the fundamental concepts and principles of soft computing and fuzzy logic.					
CO2	Apply artificial neural network models for solving classification and prediction problems.					
CO3	Analyze and implement evolutionary algorithms for optimization tasks.					
CO4	Design hybrid soft computing solutions for real-world intelligent systems.					

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Soft Computing and Fuzzy Logic:** Introduction to Soft Computing: Concepts, Characteristics, and Applications, Hard Computing vs. Soft Computing, Fundamentals of Fuzzy Sets and Fuzzy Logic ,Membership Functions and Fuzzy Set Operations ,Fuzzy Relations and Fuzzy Reasoning ,Fuzzy Inference Systems (Mamdani and Sugeno Models) , Applications of Fuzzy Logic **Artificial Neural Networks (ANN):** Biological Inspiration and Neural Network Fundamentals, Architecture of Artificial Neural Networks ,Learning Methods: Supervised, Unsupervised, and Reinforcement Learning ,Single Layer and Multi-Layer Perceptron,	15 Hours	CO1, CO2
2	**Backpropagation:** Backpropagation Learning Algorithm ,Radial Basis Function Networks ,Applications of Neural Networks in Pattern Recognition and Prediction. **Evolutionary Computing and Optimization:** Introduction to Evolutionary Computing, Genetic Algorithms: Principles and Operators, Selection, Crossover, and Mutation Techniques, Fitness Evaluation and Constraint Handling , Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO),Applications of Evolutionary Algorithms in Optimization Problems.	15 Hours	CO2, CO3

3	**Hybrid Soft Computing Systems and Applications:** Neuro-Fuzzy Systems and Adaptive Neuro-Fuzzy Inference System (ANFIS), Hybrid Intelligent Systems, Soft Computing for Data Mining and Machine Learning, Case Studies in Pattern Recognition, Classification, and Forecasting, Soft Computing Applications in Healthcare, Agriculture, Robotics, and IoT, Recent Trends and Research Directions in Soft Computing	15 Hours	CO4

Suggested Readings:

1. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, 3rd Edition, Wiley India, 2018.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 4th Edition, Wiley, 2016.
3. J. S. R. Jang, C. T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Pearson Education, 2015.
4. Rajasekaran, S. and Vijayalakshmi Pai, G. A., Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, PHI Learning, 2017.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ma54
2. https://www.iiitdmj.ac.in/ict.iiitdmj.ac.in/downloads/scpser_course-m/Lect1-AO-IntroSoftComputing.pdf

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3						1	2	2
CO2	3	2	1	2	2						3	1	2
CO3	3	1	2	3	1						2	2	1
CO4	2	2	3	1	1						1	2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	III	**Semester**	VI			
Course Name	Cyber Physical System					
Code	RPEC51723					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of hardware platforms	2	1	0	3	
Course Objectives	1. Understand the fundamental concepts, architecture, design principles, and applications of Cyber-Physical Systems (CPS) in modern industrial environments. 2. Analyze CPS hardware platforms, communication networks, embedded controllers, and real-time scheduling techniques used in Industry 4.0 and Industrial IoT systems. 3. Apply principles of dynamical systems, control theory, and software-hardware integration for the design and implementation of CPS solutions. 4. Evaluate CPS performance under real-time constraints and develop intelligent CPS applications using advanced control and machine learning techniques.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the architecture, characteristics, design principles, and real-world applications of Cyber-Physical Systems in domains such as manufacturing, healthcare, transportation, and building automation.					
CO2	Apply CPS hardware components, communication protocols, and real-time scheduling techniques for designing reliable and efficient cyber-physical systems.					
CO3	Analyze dynamical system behavior and design appropriate control strategies for CPS considering stability, network delays, packet losses, and environmental uncertainties.					
CO4	Evaluate the performance of CPS under scheduling, communication, and fault conditions and propose suitable optimization approaches.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Cyber-Physical Systems:** Cyber-Physical Systems (CPS) in the real world; basic principles of design and validation of CPS; Industry 4.0; AUTOSAR; Industrial Internet of Things (IIoT) implications; Building Automation; and Medical CPS. CPS hardware platforms, including processors, sensors, and actuators. WirelessHART, CAN, and Automotive Ethernet. Table-driven schedulers, event-driven schedulers, and hybrid schedulers.	15 Hours	CO1
2	**Principles of Dynamical Systems:** Dynamical Systems and Stability. Controller Design Techniques and Performance under Packet Drop and Noise. From Features to Automotive Software Components and Mapping Software Components to ECUs (Electronic Control Units).	15 Hours	CO2
3	**CPS implementation issues:** CPS Performance Analysis: Effect of scheduling, bus latency, Sense and actuation faults on control performance, network congestion, Building real-time networks for CPS. **Intelligent CPS:** Safe Reinforcement Learning: Robot motion control Autonomous Vehicle control, Gaussian Process Smart Grid Demand Response. Building Automation	15 Hours	CO3, CO4

Suggested Readings:

1. Suh, Sang C., U. John Tanik, John Carbone, and Abdullah Eroglu, eds. Applied cyber-physical systems. Springer New York, 2014
2. Alur, Rajeev. Principles of cyber-physical systems, MIT Press, 2015
3. Colombo, Armando W., Thomas Bangemann, Statmatis Karnouskos, Jerker Delsing, Petr Stluka, Robert Harrison, Francois Jammes and Joes L. Lastra. "Industrial cloud-based cyber physical system." The Imc-aesop Approach 22(2014):4-5.

Online Resources:

1. MIT OpenCourseWare – Cyber-Physical Systems **https://ocw.mit.edu**
2. NPTEL – Cyber Physical Systems **https://nptel.ac.in**

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			1		1					3	1
CO2	3	3	2	1	3						1	3	2
CO3	2	3	3	2	2						1	2	3
CO4	2	3	2	3	2	1					1	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	III	**Semester**	VI		
Course Name	Digital Twins				
Code	RPEC53233				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Internet of Things (IoT)	2	1	0	3
Course Objectives	1. Understand the concepts, architecture, lifecycle, and development methodology of Digital Twins. 2. Analyze industrial applications of Digital Twins and evaluate frameworks for implementing Digital Twin solutions in various domains. 3. Develop and deploy Digital Twin models using Azure Digital Twins and Digital Twin Definition Language (DTDL). 4. Apply Digital Twin technologies to solve real-world manufacturing, smart city, and industrial automation problems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the concepts, lifecycle, characteristics, and development process of Digital Twin technology.				
CO2	Analyze Digital Twin implementation requirements and identify suitable Digital Twin candidates in industrial environments.				
CO3	Apply Digital Twin frameworks and project planning methodologies for developing Digital Twin solutions.				
CO4	Develop Digital Twin models using Azure Digital Twins platform and configure Digital Twin services.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to digital twin:**Origin of the Digital Twin concept, what is a Digital Twin, Entity life cycle and Digital Twin development life cycle. Types of Digital Twins- Discrete versus composite, Product versus facility. Simulation versus operational, Analytics versus physics-based, Characteristics of a Digital Twin. **Digital twin model development plan:**Key criteria, Expected business outcomes- The manufacturing industry-Discrete manufacturing. Process manufacturing, Smart manufacturing. Supply chain management. Prerequisites for the Digital Twin, Technological needs.	15 Hours	CO1
2	**Identifying the first digital twin:** Evaluating Digital Twin candidates, Industrial conglomerates, Digital twin at digital competency, Digital twin at the LOB, Large enterprises in a single industry sector, public sector, Software and public cloud providers. **Work with digital twin**: Project Planning framework, Solution planning framework, Validating the problem statement and outcomes, Exploring the business process for Digital Twin development, Factoring in technology considerations.	15 Hours	CO2
3	**Azure digital twin:** Technical Requirements, Azure Digital Twin service, MS visual studio, The Window Azure, CLI with windows		

	powershell, Node.JS, Azure digital twin explorer, Creating first Digital twin **Digital Twin Definition Language:** Digital Twin Definition Language, DT Interface, interface content, schemas, primitive schemas, complex schemas, geospatial schema.	15 Hours	CO3, CO4

Suggested Readings

1. Digital Twin Driven Smart Manufacturing, Academic Press, 2019.
2. Digital Twin Technologies and Smart Cities, Springer, 2020.
3. Digital Twin: Mitigating Unpredictable, Undesirable Emergent Behavior in Complex Systems, Springer, 2022.

Online Resources

1. NPTEL – Internet of Things and Industry 4.0 Courses- https://nptel.ac.in/courses/106105195

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2					1					3	1
CO2	2	3	2	1	2						1	3	2
CO3	2	3	3	3	2						1	2	3
CO4	2	2	2	3	2	1					1	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**	VII		
Course Name	Full Stack Development				
Code	RPEC51731				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	HTML DBMS	2	1	0	3
Course Objectives	**1.** Understanding the fundamentals of web development tools to become and industry-ready engineer who can readily deploy in a project. **2.** Apply basic programming principles to the construction of websites **3.** Design user interactions on web pages **4.** Create servers and databases for functionality.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand basics of HTTP, HTML, CSS, Web Sockets, JSON, DOM, AJAX basics JavaScript, and jQuery.				
CO2	Apply frontend and backend scenarios to read, write and update data stored in MongoDB.				
CO3	Analyze AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters.				
CO4	Evaluate strong expertise to develop front end application using Angular JS.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basic Concepts:** Basics of Hyper Text Transfer Protocol (HTTP), Some Basics of Hyper Text Mark-up Language (HTML), Some Basics of Cascading Style Sheets (CSS), Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Basics of Web Sockets, Opening Handshake, Sending and Receiving Data, Closing the Connections, Object Oriented Design, JSON, DOM, AJAX.	15 Hours	CO1
2	**JavaScript:** JavaScript Objects, JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM, JavaScript BOM. **jQuery:** Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX, Introduction to jQuery Mobile	15 Hours	CO2, CO4
3	**Angular JS:** Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API, AngularJS Animations, AngularJS i18n, and i10n; **Node.js:** Introduction to Express Framework, Node Core, Node Modules, File System, Debugger, Automation	15 Hours	CO3, CO4

	and Deployment; Introduction to React**.** **MongoDB:** Introduction to MongoDB, Environment, Create Database, Drop Database, Create Collection, Drop Collection, Read Operations, Write Operations, Data Modelling, Administration, Security, Aggregation, Indexes, Storage, Replication		

Suggested Readings:

1. Northwood, Chris. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer. Apress, 2018.
2. Zammetti, Frank. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker. Apress, 2020.

Online Resources:

1. https://nptel.ac.in/courses/106106156

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	1								1	2	1
CO2	1	2	1		1						2	2	**1**
CO3	1	2	1		1						1	2	**2**
CO4	1	3	2		1						2	2	**2**

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	Semester	VII		
Course Name	Knowledge Graph and Context Engineering				
Course Code	RPEC51732				
Course Type	PEC	L	T	P	Credit
Pre-Requisite	Knowledge of the fundamentals of Artificial Intelligence, Machine Learning basics, Python programming	2	1	0	3
Course Objectives	1. Understand the principles of Knowledge Graphs, Semantic Web technologies, ontology engineering, and graph databases for knowledge representation. 2. Develop the ability to construct, manage, and analyze Knowledge Graphs from structured and unstructured data sources. 3. Apply Context Engineering techniques, Retrieval-Augmented Generation (RAG), and GraphRAG frameworks for intelligent information retrieval and reasoning. 4. Design AI-driven applications using Knowledge Graphs, Large Language Models (LLMs), and context-aware systems for real-world domains.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the concepts of Knowledge Graphs, graph databases, Semantic Web technologies, RDF, OWL, and ontology engineering.				
CO2	Construct and manage Knowledge Graphs using entity extraction, relationship modeling, ontology design, graph databases, and graph analytics techniques.				
CO3	Apply Context Engineering principles, vector databases, embedding models, Retrieval-Augmented Generation (RAG), and GraphRAG frameworks to build intelligent AI systems.				
CO4	Design and evaluate context-aware AI applications integrating Knowledge Graphs and Large Language Models for domains such as healthcare, finance, recommendation systems, and intelligent agents.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Knowledge Graphs:** Fundamentals of Knowledge Representation, Knowledge Graph Architecture, Semantic Web Concepts, RDF, OWL, Taxonomies and Ontologies, Property Graph Model, Graph Databases, Introduction to Neo4j, Cypher Query Language, Applications of Knowledge Graphs in Industry.	15 Hours	CO1

2	**Knowledge Graph Construction and Management:** Data Sources and Integration, Structured and Unstructured Data Processing, Entity Recognition, Entity Linking, Relationship Extraction, Ontology Design, Knowledge Base Development, Graph Embeddings, Knowledge Graph Storage and Query Processing, Graph Analytics.	15 Hours	CO2
3	**Context Engineering and Retrieval-Augmented Generation (RAG):** Introduction to Context Engineering, Context Window Management, Prompt Engineering Fundamentals, Embedding Models, Vector Databases, RAG Architecture, Hybrid Search Techniques, GraphRAG Framework, Multi-Hop Reasoning, Context Ranking and Retrieval Optimization.	15 Hours	CO3
4	**Advanced Applications and Industry Use Cases:** Knowledge Graphs with Large Language Models, Semantic Search Systems, Context-Aware AI Agents, Recommendation Systems, Healthcare Knowledge Graphs, Financial Intelligence Systems, AI Ethics, Security and Privacy Considerations, Future Trends in GraphRAG and Agentic AI.	15 Hours	CO4

Suggested Readings:

1. Knowledge Graphs – Jesse Anderson, O'Reilly Publications.
2. Designing Machine Learning Systems, O'Reilly Media.
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig.
4. Graph Databases, Ian Robinson, Jim Webber and Emil Eifrem.
5. Natural Language Processing with Transformers.

Online Resources:

1. https://www.coursera.org/specializations/explainable-artificial-intelligence-xai
2. https://onlinecourses.nptel.ac.in/noc25_lw12/preview

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	1	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	-	-	-	-	-	2	3	3
CO3	3	3	3	3	3	-	-	-	-	2	2	3	3
CO4	3	3	3	3	3					2	2	3	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**	VII		
Course Name	Essentials of Blockchain				
Code	RPEC51733				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Distributed Systems, Computer Networking, Cryptography.	3	0	0	3
Course Objectives	**1.** Understand the fundamentals of blockchain technology, distributed ledger systems, cryptocurrencies, and blockchain architecture. **2.** Analyze blockchain networks, consensus mechanisms, transaction processing, security challenges, and governance models. **3.** Explore Bitcoin, Ethereum, smart contracts, interoperability solutions, and emerging blockchain ecosystems. **4.** Evaluate blockchain applications, regulatory aspects, and the integration of blockchain with emerging technologies such as Generative AI.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the fundamentals of blockchain technology, cryptocurrencies, distributed ledger technology, and blockchain applications.				
CO2	Analyze blockchain architecture, transaction lifecycle, consensus mechanisms, governance models, and security challenges.				
CO3	Evaluate Bitcoin and Ethereum ecosystems, mining strategies, smart contracts, interoperability mechanisms, and blockchain security.				
CO4	Assess blockchain applications, legal and regulatory frameworks, and the role of Generative AI in blockchain-based solutions.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	History and Evolution of Cryptocurrency, Distributed Ledger Technology (DLT), Roots of Bitcoin, Bitcoin and Alternative Cryptocurrencies, Bitcoin Protocol, Ethereum Architecture, DAO (Decentralized Autonomous Organization), GHOST protocol, Sidechains and Interoperability, Namecoin and Early Altcoins; Blockchain Vulnerabilities, Common Attacks, Security Enhancements; Regulation and Legal Framework: Stakeholders in the Cryptocurrency Ecosystem, Legal and Regulatory Aspects, Cryptocurrency and the Global Economy, Black Markets and Illicit Use, Applications of Blockchain Technology: Internet of Things (IoT); Medical Record Management Systems; Domain Name Services (DNS); Supply Chain and Logistics; Digital Identity and Authentication, Future of Blockchain.	15 Hours	CO1
2	Introduction to Blockchain, Comparison with conventional distributed databases , Trust models and elimination of intermediaries, Blockchain Network Architecture, Data Structures in Blockchain, Transaction Lifecycle, Gas and Fee Mechanisms, Mempool structure and transaction prioritization strategies, Mining, Rewards, and Economic Incentives, Need for Consensus in Decentralized Systems, Consensus Algorithms, Difficulty and Finality, Forking Mechanisms, Security Threats, Network and Protocol Vulnerabilities, Energy Utilization and Alternatives, Anonymity and Privacy, Chain Policy and Governance, Types of Blockchain, Lifecycle of a Blockchain Application.	15 Hours	CO2, CO3

3	Distributed Ledger Technology (DLT), Roots of Bitcoin, Bitcoin Network Architecture, Mining Strategy and Rewards, Transaction Verification Process, Ethereum Architecture, Smart Contracts, DAO (Decentralized Autonomous Organization), GHOST Protocol, Security Threats, Sidechains and Interoperability, Namecoin and Early Altcoins, Stakeholders in Cryptocurrency Ecosystem, Legal and Regulatory Aspects, Cryptocurrency and the Global Economy, Role of Generative AI in Smart Contract.	15 Hours	CO4

Suggested Readings:

1. Antonopoulos, A. M. Mastering Bitcoin: Unlocking Digital Cryptocurrencies. O'Reilly Media, Inc., 2014
2. Wood, G. Ethereum: A Secure Decentralized Transaction Ledger (Ethereum Yellow Paper)., 2014
3. Lewis, A. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology That Powers Them (2nd ed.). Mango Publishing., 2021
4. Bambara, J. J., Allen, P. R., Iyer, K., Madsen, R., Lederer, S., & Wuehler, M.. Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions. McGraw-Hill Education., 2018

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs44

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2	-	-	-	-	1	-	2	2
CO2	3	3	2	3	2	-	-	-	-	1	-	3	2
CO3	3	3	3	2	3	-	-	-	-	1	-	3	3
CO4	3	3	2	3	2	1	1	-	-	1	-	3	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	Semester	VII			
Course Name	AI Copilots and Intelligent Assistant					
Course Code	RPEC51734					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic Knowledge of Computer	2	1	0	3	
Course Objectives	1. To provide an understanding of AI Copilots, Intelligent Assistants, Generative AI, Large Language Models (LLMs), Transformer architecture, and prompt engineering concepts. 2. To develop knowledge of Natural Language Processing techniques and Conversational AI systems for language understanding, content generation, chatbots, and virtual assistants. 3. To explore AI Copilot applications, Responsible AI practices, AI agents, RAG systems, and emerging trends in intelligent assistance technologies. 4. To enable students to design, develop, and evaluate AI-powered copilot and intelligent assistant solutions using modern AI frameworks, prompt engineering techniques, and responsible AI practices for real-world applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the fundamentals of AI Copilots and Intelligent Assistants, including Generative AI, LLMs, Transformers, Prompt Engineering, and AI collaboration tools.					
CO2	Apply NLP and Conversational AI techniques for language understanding, content generation, chatbots, virtual assistants, and AI-assisted decision support.					
CO3	Analyze AI Copilot applications, Responsible AI principles, RAG, AI agents, security concerns, and emerging trends in intelligent assistance.					
CO4	Design and implement AI Copilot and Intelligent Assistant solutions using LLMs, prompt engineering, NLP techniques, AI frameworks, and responsible AI principles to address real-world problems.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of AI Copilots and Intelligent Assistants:** Introduction to AI Copilots and Intelligent Assistants, Evolution of AI Assistants, Human-AI Collaboration, Generative AI Fundamentals, Large Language Models (LLMs), Transformer Architecture, Attention Mechanism, Prompt Engineering Basics, AI Copilot Frameworks and Tools.	15 Hours	CO1
2	**Natural Language Processing and Conversational AI**: Natural Language Processing (NLP), Text and Language Understanding, Tokenization, Named Entity Recognition		CO2

	(NER), Sentiment Analysis, Text Summarization, Machine Translation, Conversational AI, Chatbots and Virtual Assistants, Context Management, Question Answering Systems, Content Generation, Code Generation, AI-assisted Decision Support.	15 Hours	
3	**Applications, Ethics and Future Trends**:Applications of AI Copilots in Education, Business and Software Development, Retrieval-Augmented Generation (RAG), AI Agents and Autonomous Workflows, Responsible AI, AI Ethics and Bias, Privacy and Security Issues, Evaluation of AI Assistants, Multimodal AI, Future Trends in Intelligent Assistance.	15 Hours	CO3, CO4

Suggested Readings:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020**.**
2. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, 3rd Edition, Tata McGraw-Hill, 2009**.**
3. M. Sridhar, Abhijeet Chavan*,* Responsible AI: Implementing AI with Trustworthiness and Fairness*,* Wiley, 2023. – Covers fairness, accountability, transparency, safety, and real-world applications.
4. Sandra Wachter, Brent Mittelstadt, The Ethics of Artificial Intelligence, Oxford University Press (Forthcoming). – Preprint articles available online; focuses on ELSI, legal frameworks, and AI governance.
5. Jacob Eisenstein, Introduction to Natural Language Processing, 1st Edition, The MIT Press*,* 2019**.**

Online Resources:

1. https://www.coursera.org/specializations/microsoft-copilot-your-everyday-ai-companion
2. https://onlinecourses.nptel.ac.in/noc25_lw12/preview

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	-	3	-	-	-	-	-	-	3	2
CO2	2	3	2	2	3	-	-	-	-	-	-	3	3
CO3	2	2	2	1	2	-	-	-	-	-	-	2	3
CO4	3	3	3	3	3							3	**3**

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**	VIII		
Course Name	Augmented and Virtual Reality				
Code	RPEC51741				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of AI and 3D Visualization.	2	1	0	3
Course Objectives	**1**. To provide students with a solid background of 3D compositing techniques. **2**. Applications in interactive interfaces augmented reality interfaces **3**. Provide students with a comprehensive knowledge in 3D vision. **4.** Develop skills in the design of interactive augmented reality games.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand interactive augmented reality applications.				
CO2	Analyze about some Software Technologies used in Visualization.				
CO3	Evaluate the 3D interaction techniques.				
CO4	Apply knowledge of the research literature in Augmented Reality.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**VIRTUALREALITYANDVIRTUAL ENVIRONMENT:** The historical development of VR: Scientific landmarks Computer Graphics, Real- time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. Visual Displays Auditory Displays, Haptic Displays, And Choosing Output Devices for 3DUser Interfaces. Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home Brewed Input Devices, and Choosing Input Devices for 3D Interfaces.	15 Hours	CO1
2	**Database:** World Space, World Coordinate System, World Environment, Objects—Geometry, Position/Orientation, Hierarchy, Bounding Volume, Scripts, and other attributes. **VR Environment:** VR Database, Tessellated Data, Levels of Detail (LODs), Lights and Cameras, Scripts, Interaction—Simple Interaction, Feedback, Graphical User Interface (GUI), Control Panel, 2D Controls, Hardware Controls, Room/Stage/Area Descriptions, World Authoring and Playback, and VR Toolkits.	15 Hours	CO2
3	**3D INTERACTION TECHNIQUES:** 3D Manipulation Tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, and Design Guidelines. 3D Travel Tasks, Travel Techniques, and Design Guidelines. Theoretical Foundations of Way finding, User-Centered Way finding Support, Environment-Centered Way finding Support, Evaluating Way finding Aids, and Design Guidelines. Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Multimodal System Control Techniques, Design Guidelines, and Case Study: Mixing System Control Methods. Symbolic Input Tasks, Symbolic Input Techniques, and Design Guidelines	15 Hours	CO3, CO4

Suggested Readings:

1. Craig, A. B., Sherman, W. R., & Will, J. D. Developing Virtual Reality Applications: Foundations of Effective Design. Morgan Kaufmann Publishers, 2009.
2. Kim, G. J. Designing Virtual Systems: The Structured Approach. Springer, 2005.
3. Bimber, O., & Raskar, R. Spatial Augmented Reality: Merging Real and Virtual Worlds. A K Peters Ltd., 2005.
4. Burdea, G. C., & Coiffet, P. Virtual Reality Technology (2nd ed.). Wiley-Interscience, 2003.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106138

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	2		2							2	2
CO2	1	3	2	1								2	2
CO3	2	1		1	2							2	2
CO4	2	2	1		1							2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	Semester	VIII			
Course Name	Explainable and Responsible AI					
Course Code	RPEC51742					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of Artificial Intelligence.		2	1	0	3
Course Objectives	1. Understand the methods and terminologies involved in Explainable AI,, including its Taxonomy of XAI methods for Machine Learning.					
	2. Differentiate the methods used in XAI and apply suitable XAI Models or approaches for given application.					
	3. Design and develop XAI use cases for real time applications.					
	4. Understand the ethical, social, and responsible use of AI systems in real-world applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the fundamental concepts of Explainable & Responsible AI. Describe key principles and challenges of Responsible AI, including fairness and safety.					
CO2	Analyze various problem-solving strategies in AI and implement searching algorithms. Detect and mitigate bias using fairness metrics and tools. Apply visual explanation techniques such as PDP and ICE.					
CO3	Apply knowledge-based systems and logical reasoning. Apply explainability and interpretability techniques in AI models.					
CO4	Apply Explainable and Responsible AI techniques to develop trustworthy AI solutions for real-world problems.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Explainable & Responsible AI:** Definitions and Goals of Explainable AI (XAI), Challenges and Limitations of XAI, Types of Explainability and Taxonomy of XAI Methods, Explainability in the Model Development Process, Human-Centered AI and Responsible AI, Interpretable and Non-Interpretable Models, Black-Box vs. White-Box Models, Foundations of Responsible AI, Key Principles of Responsible AI, Challenges in Implementing Responsible AI, ELSI (Ethical, Legal and Social Implications) Framework, AI Safety and Alignment, Fairness and Privacy in AI Systems.	15 Hours	CO1
2	**Taxonomy of Explainable AI Methods, Fairness and Bias:** Model-Agnostic Explanation Methods – LIME, SHAP, Integrated Gradients, Partial Dependence Plots (PDP), Individual Conditional Expectation (ICE); Model-Specific Explanation Methods – Rule-Based Explanations and Decision Trees. Human Bias and Algorithmic Bias, Types and Sources of Bias, Effects of Bias on Different Demographics, Bias vs. Fairness, Exploratory Data Analysis for Bias Detection, Bias Mitigation Techniques –	15 Hours	CO2

	Pre-processing, In-processing and Post-processing Approaches, Fairness Metrics and Bias Detection Tools.		
3	**Evaluation of XAI Techniques and Responsible AI Applications:** Importance of Explainability and Interpretability, Challenges in Explainable AI, Interpretability through Simplification and Visualization, Intrinsic Interpretable Methods, Post-hoc Interpretability Techniques, Model-Agnostic Interpretation Methods, Explainability through Causality, Explainability Metrics and Evaluation Methods, Human-Centered Evaluation of Explanations, Trade-offs between Model Performance and Explainability, Transparency, Accountability and Trustworthiness in AI Systems, Ethical Considerations in Explainable AI and Real-World Applications of Explainable and Responsible AI in Healthcare, Finance, Security and Smart Systems.	15 Hours	CO3, CO4

Suggested Readings:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
2. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, 3rd Edition, Tata McGraw-Hill, 2009.
3. M.Sridhar,Abhijeet,Chavan,"ResponsibleAI:ImplementingAIwith Trustworthiness and Fairness", Wiley, 2023. – Covers fairness, accountability, transparency, safety, and real-world applications
4. SandraWachter, Brent Mittestadt, "The Ethics of Artificial Intelligence", Oxford University Press (Forthcoming), Preprint articles available online. – Deep dive into ELSI, legal frameworks, and AI governance.

Online Resources:

1. https://www.coursera.org/specializations/explainable-artificial-intelligence-xai
2. https://onlinecourses.nptel.ac.in/noc25_lw12/preview

Course Articulation Matrix

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	2	2	-	-	-	-	3	2
CO2	2	3	2	1	3	-	2	-	-	-	-	2	3
CO3	2	3	3	2	3	-	1	-	-	-	1	2	3
CO4	1	2	3	2	2	3	3	1	1	-	2	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**	VIII		
Course Name	Federated Learning Concepts				
Code	RPEC51743				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic understanding of Machine Learning	2	1	0	3
Course Objectives	1. To understand the fundamental principles, architecture, and workflow of Federated Learning for privacy-preserving distributed machine learning. 2. To analyze various Federated Learning algorithms, communication protocols, and model aggregation techniques used in decentralized environments. 3. To apply Federated Learning concepts for developing secure, scalable, and efficient AI solutions across distributed data sources. 4. To understand the challenges, security issues, and real-world applications of Federated Learning in distributed AI systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the fundamentals, architecture, and key concepts of Federated Learning and distributed machine learning systems.				
CO2	Analyze Federated Learning algorithms, aggregation methods, privacy-preserving techniques, and communication challenges in decentralized environments.				
CO3	Design and implement basic Federated Learning models for real-world applications while evaluating their performance, security, and scalability.				
CO4	Develop Federated Learning-based solutions addressing privacy, security, and efficiency challenges in distributed AI systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Federated Learning:** Introduction to Federated Learning, Motivation and Need for Federated Learning, Definition and Categories of Federated Learning, Current Developments and Research Challenges, Open-Source Projects and Standardization Efforts, Federated AI Ecosystem. Privacy-Preserving Machine Learning (PPML), Threat and Security Models, Privacy Threat Models, Privacy Preservation Techniques, Secure Multi-Party Computation (SMPC), Homomorphic Encryption, Differential Privacy. Introduction to Distributed Machine Learning (DML), DML Platforms, Large-Scale Machine Learning, Scalability-Oriented DML Schemes, Privacy-Preserving DML Schemes, Privacy-Preserving Decision Trees, Privacy-Preserving Gradient Descent, Vanilla Federated Learning and Privacy-Preserving Methods.	15 Hours	CO1
2	**Federated Learning Architectures and Optimization:** Horizontal Federated Learning (HFL), Architecture of HFL, Client–Server and Peer-to-Peer Architectures, Global Model Evaluation, Federated Averaging (FedAvg) Algorithm, Secured FedAvg Algorithm, Federated Optimization, Communication Efficiency and Client Selection. Vertical Federated Learning (VFL), Architecture and Algorithms of	15 Hours	CO2

	VFL, Secure Federated Linear Regression, Secure Federated Tree-Boosting. Heterogeneous Federated Learning, Federated Transfer Learning (FTL), FTL Framework, Additively Homomorphic Encryption, FTL Training and Prediction Processes, Security Analysis, Secret Sharing-Based FTL.		
3	**Advanced Applications of Federated Learning:** Incentive Mechanism Design for Federated Learning, Paying for Contributions, Profit-Sharing Games, Reverse Auctions, Fairness-Aware Profit Sharing Framework, Modeling Contribution, Cost and Regret, Policy Orchestrator and Payoff Weightage Computation. Federated Learning for Computer Vision, Natural Language Processing (NLP), and Recommendation Systems, Federated Recommendation Models. Introduction to Reinforcement Learning, Policy, Reward, Value Function and Environment Model, Reinforcement Learning Algorithms, Distributed Reinforcement Learning, Asynchronous and Synchronous Distributed Reinforcement Learning, Federated Reinforcement Learning, Background and Categorization. Performance Evaluation, Scalability Analysis, Security Challenges, Trustworthy Federated Learning.	15 Hours	CO3, CO4

Suggested Readings:

1. Federated Learning, Cambridge University Press, 2023.
2. Advances and Open Problems in Federated Learning, Foundations and Trends® in Machine Learning, Now Publishers, 2021.
3. Machine Learning: A Probabilistic Perspective, MIT Press, 2012. (Provides foundational concepts relevant to Federated Learning.)

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	-	2	2	-	-	-	-	-	-	2	3
CO3	2	2	3	2	3	1	-	-	-	-	-	2	3
CO4	2	-	3	-	3	1	-	-	-	-	-	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VIII			
Course Name	MLOps					
Code	RPEC51744					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of Machine Learning, Python Programming, Data Analytics, Cloud Computing Basics		2	1	0	3
Course Objectives	1. Understand the principles, practices, and lifecycle of MLOps for deploying and managing machine learning systems. 2. Apply tools and techniques for continuous integration, continuous deployment, and automation of ML workflows. 3. Design scalable and reproducible machine learning pipelines using modern MLOps frameworks. 4. Monitor, govern, and maintain machine learning models in production environments.					

Course Outcomes: After successful completion of the course, the students will be able to:	
CO1	Explain the concepts, lifecycle, architecture, and tools involved in MLOps.
CO2	Apply version control, experiment tracking, CI/CD, and pipeline automation techniques for ML systems.
CO3	Develop and deploy scalable machine learning models using containerization and orchestration technologies.
CO4	Analyze model performance, drift, governance, security, and monitoring requirements in production environments.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to MLOps and ML Lifecycle:** Introduction to MLOps, Need and Benefits of MLOps, Machine Learning Lifecycle, Challenges in Production ML Systems, Data Engineering for ML, Data Versioning, Data Validation, Experiment Tracking, Reproducibility, Model Development Workflow, Git and Version Control for ML Projects, Workflow Automation, Overview of MLOps Platforms and Tools (MLflow, DVC, Kubeflow, TFX).	15 Hours	CO1
2	**CI/CD and Machine Learning Deployment:** Continuous Integration and Continuous Delivery for ML, Automated Testing of Data and Models, Pipeline Design and Automation, Docker Fundamentals, Containerization of ML Applications, Kubernetes Fundamentals, Model Packaging and Serving, Batch and Real-Time Inference, REST APIs for Model Deployment, Infrastructure as Code, Cloud-based MLOps Platforms, Deployment using MLflow and Kubeflow Pipelines.	15 Hours	CO2, CO3
3	**Monitoring, Governance and Advanced MLOps:** Model Monitoring and Logging, Data Drift and Concept Drift Detection, Performance Monitoring Metrics, Model Retraining Strategies, Feature Stores, Model Registry, Explainable AI in Production, Responsible AI and Fairness, Security and Privacy in MLOps, Governance and Compliance, MLOps Best Practices, Industry Case Studies and End-to-End MLOps Workflow Implementation.	15 Hours	CO4

Suggested Readings:

1. Treveil, M., Omont, N., Stengelin, C., et al. (2020). *Introducing MLOps: How to Scale Machine Learning in the Enterprise*. O'Reilly Media.
2. Burkov, A. (2020). *Machine Learning Engineering*. True Positive Technologies.
3. Huyen, C. (2022). *Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications*. O'Reilly Media.
4. Kleppmann, M. (2017). *Designing Data-Intensive Applications*. O'Reilly Media.
5. Burns, B., Beda, J., & Hightower, K. (2022). *Kubernetes: Up and Running* (3rd Edition). O'Reilly Media.
6. Turnbull, J. (2014). *The Docker Book*. James Turnbull.
7. Amershi, S., Begel, A., Bird, C., et al. (2019). "Software Engineering for Machine Learning: A Case Study." IEEE/ACM ICSE.

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	2	2	-	-	-	-	-	-	3	2
CO2	2	3	3	2	3	-	-	-	1	-	-	3	3
CO3	2	3	3	2	3	-	-	-	1	-	1	3	3
CO4	2	3	2	3	2	1	1	2	1	1	2	2	3

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**	VII		
Course Name	Disaster Management				
Course Code	OE53101				
Course Type	OEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Environmental Studies, Chemistry, Basic Statistics and Data Analysis	3	1	0	4
Course Objectives	1. To understand the fundamentals of disasters and hazards. 2. To learn the causes and impacts of natural and man-made disasters. 3. To develop knowledge of disaster preparedness, mitigation, and response. 4. To understand disaster management strategies & community resilience.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the concepts of disasters, hazards, vulnerability, and disaster management systems.				
CO2	Analyze disaster-related data and identify the role of information and communication technologies in disaster management.				
CO3	Apply emerging technologies for disaster preparedness and response.				
CO4	Develop technology-enabled solutions for disaster risk reduction and resilience.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Disaster Management:** Introduction to Disaster Management, Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Types of Environmental hazards & Disasters: Natural hazards and Man-made, Volcanic Hazards- Causes and distribution of Volcanoes, Hazardous effects of volcanic eruptions, Environmental impacts of volcanic eruptions ,Earthquakes- Effects, Measures, Distribution of earthquakes, Floods- Control measures Human adjustment, Perception & Mitigation, Cyclones, Droughts- Impacts, Drought hazards in India, Drought -Control measures. Landslides, Wildfires, Biological hazards, Disaster Risk Assessment and Vulnerability Analysis	15 Hours	CO1
2	**Mechanics and forms of Soil Erosion:** Factors & Causes of Soil Erosion, Conservation measures of Soil Erosion, Sedimentation processes, Global and Regional Sedimentation problems, Sedimentation & Environmental problems, Corrective measures of Erosion & Sedimentation, Chemical hazards-Release of toxic chemicals, Geographic Information Systems (GIS) in Disaster Management, Big Data Analytics for Disaster Monitoring.	15 Hours	CO2
3	**Pre and Post-Stages:** Pre- disaster stage (preparedness)- Preparing hazard zonation maps, Predictability-forecasting & Early Warning Systems **,**Artificial Intelligence and Machine		CO3

	Learning in Disaster Prediction Preparing disaster preparedness plan, Land use zoning, Pre-disaster stage (mitigation) Disaster resistant house construction, Population reduction in vulnerable areas, Awareness . Emergency Stage- Rescue training for search & operation at national & regional level, Immediate relief, and Assessment surveys. Post Disaster stage, Rehabilitation- Political Administrative Aspect, Drone Technology and Robotics in Disaster Response.	15 Hours	
4	**Relief Measures:** Disaster Preparedness and Emergency Planning, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards, Mitigation methods, Meteorological observatory, Seismological observatory, Hydrology Laboratory, Industrial Safety inspectorate, Institution of urban & regional planners, Chambers of Architects, Engineering Council, National Standards Committee, Integrated Planning Contingency management Preparedness Education on disasters, Community involvement, The adjustment of Human Population to Natural hazards & disasters, Population Explosion, Post-Disaster Recovery and Rehabilitation.	15 Hours	CO4

Suggested Readings:

1. S. Singh, Environmental Geography. Allahabad, India: Prayag Pustak Bhawan, 2014.
2. V. K. Sharma, Ed., Disaster Management. New Delhi, India: Indian Institute of Public Administration (IIPA), 2011.
3. National Disaster Management Authority, Guidelines and Publications on Disaster Management. New Delhi, India: Government of India.
4. K. N. Tripathi and B. Siddiqui, Environmental Pollution and Human Health. New Delhi, India: Academic Guru Publishing House, 2010.

Online Resources:

1. https://nptel.ac.in/courses/124107010
2. https://store.agphbooks.com/product/environmental-pollution-and-human-health

Course Articulation Matrix

O/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	2	-	2	2	-	-	-	2	-	-
CO2	3	2	-	2	-	2	2	-	-	-	2	-	-
CO3	3	2	-	2	-	2	2	-	-	-	2	-	-
CO4	3	2	-	2	-	2	2	-	-	-	2	-	-

Program	B.Tech.(CSE- Generative Artificial Intelligence)				
Year	IV	**Semester**		VII	
Course Name	Database Administration				
Code	OE53201				
Course Type	OEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Database Management Systems (DBMS) and SQL.	3	1	0	4
Course Objectives	1. To understand the concepts of Database Management Systems (DBMS). 2. To introduce students to database administration concepts and practices in an Oracle environment. 3. To explain Database Management Systems, their components, architectures, and models. 4. To understand and apply user roles, privileges, and database security mechanisms.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the database approach and the file-system approach, and explain DBMS components and models.				
CO2	Apply database security mechanisms, user management, storage structures, and backup and recovery techniques.				
CO3	Analyse and implement transaction management, concurrency control, and performance-tuning techniques.				
CO4	Evaluate database administration practices, automation techniques, NoSQL databases, and emerging cloud/distributed database trends.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	DBMS and RDBMS concepts, database architecture (centralized, client-server, distributed systems), ER modeling, normalization and schema design, database installation and configuration (Oracle, MySQL/PostgreSQL), database instances and network environment, introduction to cloud databases (AWS RDS, Azure SQL).	15 Hours	CO1
2	Storage structures (tablespaces, data files), indexing and partitioning, user management and authentication, roles and privileges, database security mechanisms, encryption techniques, database backup and recovery methods (RMAN, snapshots), database maintenance, auditing, data privacy and compliance basics.	15 Hours	CO2
3	Transaction management, ACID properties, concurrency control, locking mechanisms, deadlocks, crash recovery, query processing, query optimization, execution plans, performance tuning techniques, database monitoring tools.	15 Hours	CO3
4	DBA roles and responsibilities, database monitoring and scaling, automation using scripts and scheduling, introduction to NoSQL databases (MongoDB), DevOps concepts for databases, containerization basics, distributed databases, big data integration, cloud-native database systems.	15 Hours	CO4

Suggested Readings:

1. Teorey, T. J., Lightstone, S. S., & Nadeau, TPhysical Database Design: The Database Professional's Guide to Exploiting Indexes, Views, Storage, and More. Morgan Kaufmann (Elsevier), 2007.
2. Sciore, E. Database Design and Implementation (2nd Edition). Wiley, 2008.
3. Lewis, P. M., Bernstein, A., & Kifer, M. Databases and Transaction Processing: An Application-Oriented Approach. Addison-Wesley, 2001.

Online Resources:

1. https://nptel.ac.in/courses/106105175

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2	2	2	2							3	2
CO2	2	2	2	2	2							2	2
CO3	2	2	3	2	2							3	2
CO4	2	2	2	2	2							3	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VIII			
Course Name	Quality Management					
Code	OE53501					
Course Type	OEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic knowledge of management principles, statistics, and engineering processes.	3	1	0	4	
Course Objectives	1. To develop fundamental understanding of quality concepts, evolution of quality control, TQM, and quality in design and procurement processes. 2. To impart knowledge of quality management systems, organizational structure, and the role of human factors in achieving quality improvement. 3. To equip students with statistical tools such as control charts for monitoring, analyzing, and improving manufacturing processes. 4. To enable students to understand defect diagnosis, reliability concepts, ISO standards, and modern quality improvement techniques like Taguchi and JIT.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain quality concepts, TQM principles, and evaluate procurement and manufacturing quality practices.					
CO2	Analyze the role of organizational structure and human factors in effective quality management systems.					
CO3	Apply statistical quality control techniques such as control charts to analyze process performance and capability.					
CO4	Evaluate defects, reliability, and implement quality improvement methodologies including ISO standards, Taguchi methods, and JIT.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Quality Concepts:** Evolution of Quality control, Concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of prototype. **Control on Purchased Product:** Procurement of various products, Evaluation of supplies, Capacity verification, Development of sources, Procurement procedure. **Manufacturing Quality:** Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.	15 Hours	CO1
2	**Quality Management:** Organization structure and design, Quality function, Decentralization, Designing and fitting organization for different types products, Economics of quality value and contribution, Quality cost, Optimizing quality cost. **Human Factor in Quality:** Attitude of top management, Co-operation, of groups, Operators attitude, responsibility, Causes of operator's error and corrective methods.	15 Hours	CO2

3	**Control Charts:** Theory of control charts, Measurement range, Construction and analysis of R charts, Process capability study, Use of control charts. **Attributes of Control Charts:** Defects, Construction and analysis off-chart, Improvement by control chart, Variable sample size, Construction and analysis of C-chart.	15 Hours	CO3
4	**Defects Diagnosis and Prevention:** Defect study, Identification and analysis of defects, Corrective measure, Factors affecting reliability, MTTF, Calculation of reliability, Building reliability in the product, Evaluation of reliability, Interpretation of test results, Reliability control, Maintainability, Zero defects, quality circle. **IS0-9000 and its concept of Quality Management:** ISO9000 series, Taguchi method, JIT in some details.	15 Hours	CO4

Suggested Readings:

1. Kusiak, Andrew (Ed.), Concurrent Engineering: Automation, Tools, and Techniques, John Wiley & Sons, New York, 1993.
2. Menon, Uday V., Concurrent Engineering, Chapman & Hall, London, 1992.
3. B. Singh, Quality Control and Reliability Analysis, 3rd ed. New Delhi, India: Khanna Publishers, 1997

Online Resources:

1. https://archive.nptel.ac.in/courses/110/104/110104080/
2. https://nptel.ac.in/courses/110104085

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	0	1							1	1
CO2	2	3	2	0	1							1	1
CO3	3	3	2	3	3							1	1
CO4	2	3	3	2	2							1	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VII			
Course Name	Energy Management					
Code	OE53301					
Course Type	OEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Engineering Mathematics		3	1	0	4
Course Objectives	1. To understand the fundamentals of energy sources, conservation, and energy management practices. 2. To learn the principles and techniques of energy auditing and performance analysis. 3. To analyze and improve the energy efficiency of electrical, lighting, HVAC, and industrial systems. 4. To evaluate energy management solutions using economic and environmental considerations.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand energy sources, demand–supply, energy conservation, and basic measurement techniques.					
CO2	Apply energy management and auditing principles for data analysis and performance improvement.					
CO3	Analyze and optimize electrical, lighting, and HVAC systems for energy efficiency and comfort.					
CO4	Evaluate process and building energy systems with economic analysis for decision-making.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Energy sources, Energy demand and supply, Energy crisis, Future scenario, Energy system efficiency, Energy conservation aspects, Instrumentation and measurements. **Principles of Energy Management and Energy Audit:** General principles, Planning and program, Introduction to energy audit, General methodology, Site surveys, and Energy systems survey, Energy audit, Instrumentation, Analysis of data and results.	15 Hours	CO1
2	**Electrical Load and Lighting Management:** General principles, Illumination and human comfort, Lighting systems, Equipment's, Electrical systems, Electrical load analysis, Peak load controls. **Heating and Cooling Management:** General principles of energy managements in HVAC systems, Human comforts and health requirements, HVAC systems, Boiler and heat sources, Chillers, fans, pumps, cooling towers, Modeling of heating and cooling loads in buildings, Energy management opportunities.	15 Hours	CO2

3	**Process Energy Management:** Principles, Process heat, Combustion, Automatic fuel controls, Steam generation and distribution, Hot water and pumping, Furnaces and ovens, Process electricity, Compressed air, Manufacturing process, Energy storage for process industries, Process control. **Integrated Building systems:** General principles, Environment conformation, Passive design considerations, Building envelope design consideration, Integration of building system, Energy storage-cold storage techniques, Economic analysis.	15 Hours	CO3
4	**Economic Aspects of Energy Management:** General considerations, Economic analysis methods, Life-cycle costing, Break even analysis, Benefit cost analysis, Payback period analysis, Present worth analysis, Equivalent annual cost analysis, Use of computers, Management of energy with environment aspects.	15 Hours	CO4

Suggested Readings

1. S Kaushik, T Verma ; Rural Energy Management; Deep and Deep Publishers; 2004.
2. W R Murphy, G Mckay, B.S. ; Energy Management; Publications; 2009.
3. S. C. Patra, B.C Kurse, R. Kataki ; Renewable Energy and Energy Management; International Book Co; 2007.
4. J Piper ; Operations and Maintenance Manual for Energy Management; Standard Publishers; 1999.

Online Resources:

1. https://nptel.ac.in/courses/108106022
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee84

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	1									2
CO2	3	3	2	2	2	3						2	2
CO3	3	3	3	2	2	2						2	2
CO4	3	3	2	2	2	2						3	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VIII			
Course Name	Concepts of Climate Smart Agriculture					
Course Code	OE53102					
Course Type	OEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Environmental Studies, Disaster Management	3	1	0	4	
Course Objectives	1. To introduce the fundamentals of meteorology, atmospheric processes, and the principles of Climate-Smart Agriculture (CSA). 2. To develop an understanding of soil formation, soil properties, and their role in sustainable crop production. 3. To examine climate change, its impacts on agricultural systems, and adaptation strategies for resilient farming. 4. To explore climate-related agricultural challenges and modern approaches to water resource management and precision agriculture.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the concepts of meteorology, atmospheric composition, and Climate-Smart Agriculture and their relevance to sustainable agriculture.					
CO2	Analyse soil formation processes, physicochemical properties, and their influence on soil fertility and crop productivity.					
CO3	Assess the impacts of climate change on agricultural systems and evaluate climate-resilient crop production strategies.					
CO4	Apply water management techniques, precision agriculture tools, and climate-smart practices to address agricultural challenges under changing climatic conditions.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Meteorology and Climate Smart Agriculture**: Meteorology and atmosphere, structure and composition of atmosphere, atmospheric inputs (acid rain, dust), water-soil-plant relations, pollution in the environment and its effects on humans, plants and soil, climate smart agriculture and greenhouse gases.	15 Hours	CO1
2	**Soil Formation and its Physicochemical Properties:** Soil forming rocks and minerals, their classification and composition, important soil physical properties and their importance, soil particle distribution, soil organic matter including its composition and decomposition, effect on soil fertility, soil reaction (acidic, saline and sodic soils), soil nutrients, influence of physicochemical properties on plant health, effects of macro and micronutrients on plant growth.	15 Hours	CO2
3	**Climate Change and its Possible Impacts:** Historical examples of crop failure, reasons and social consequences, need and strategy for development of climate smart crops, successful		CO3

	examples of climate smart crops, effects of climate on crops, crop growth and development in relation to environmental stress (water and temperature stress), nutrient stress and resistance mechanisms.	15 Hours	
4	**Climate Challenges and Water Management:** Challenges arising due to climate change and case studies (e.g., cultivating durum wheat in Ethiopia and its mitigation), advances in crop water management for climate smart crop farming, and use of high-quality crop varieties. Precision agriculture using IoT for climate-smart farming.	15 Hours	CO4

Suggested Readings:

1. Manohar, K. R., and Thinathane, C. Iga, Green House Technology and Management, B.S. Publications, Hyderabad, 2004.
2. Benkeblia, Noureddine (Ed.), Climate Change and Crop Production: Foundations for Agroecosystem Resilience, CRC Press, Boca Raton, 2020.
3. Hebbar, K. B., Kumar, S. Naresh, and Chowdappa, P. (Eds.), Impact of Climate Change on Plantation Crops, Astrel International–Daya Publishing House, New Delhi, ISBN: 9789351248330, 2017.

Online Resources:

1. U.M. Sainju, R. Dris and B. Singh, Mineral Nutrition of Tomato, 2003. Available: www.aseanfood.info/Articles/11019991.pdf
2. Making climate-smart agriculture work for the poor Available: www.worldagroforestry.org/publication/making-climate-smart-agriculture-work-poor

Course Articulation Matrix

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	2		-	-	-	2	-	-
CO2	3	2	2	2	-	2		-	-	-	2	-	-
CO3	3	2	2	2	-	2		-	-	-	2	-	-
CO4	3	2	2	2	-	2		-	-	-	2	-	-

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VIII			
Course Name	Computational Intelligence					
Code	OE53202					
Course Type	OEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of Artificial Intelligence, Probability & Statistics, and Basic Programming Concepts.		3	1	0	4
Course Objectives	1. To introduce the fundamental concepts, techniques, and applications of Computational Intelligence in solving complex real-world problems. 2. To develop an understanding of knowledge representation, reasoning mechanisms, fuzzy systems, and neural network models. 3. To explore learning paradigms, probabilistic reasoning, evolutionary computation, and intelligent decision-making techniques. 4. To enable students to apply Computational Intelligence methods in areas such as machine learning, natural language processing, and intelligent systems.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the fundamental concepts of Computational Intelligence, including search strategies, expert systems, and heuristic problem-solving techniques.					
CO2	Analyze knowledge representation, reasoning mechanisms, fuzzy inference systems, and neural network models for intelligent decision-making.					
CO3	Evaluate machine learning approaches, probabilistic reasoning models, evolutionary algorithms, and neural network learning techniques for solving computational problems.					
CO4	Apply Computational Intelligence techniques to develop intelligent solutions in domains such as natural language processing, information retrieval, and machine learning applications.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Artificial Intelligence-Search-Heuristic Search-A* algorithm-Game Playing- Alpha-Beta Pruning-Expert systems-Inference-Rules-Forward Chaining and Backward Chaining- Genetic Algorithms.	15 Hours	CO1
2	**Knowledge Representation And Reasoning:** Proposition Logic, First Order Predicate Logic, Unification Algorithm, Forward Chaining, Backward Chaining. Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, Prolog Programming. **Uncertainty:** Non monotonic reasoning-Fuzzy Logic, Fuzzy rules, fuzzy inference, Temporal Logic, Temporal Reasoning, Neural Networks, Neuro-fuzzy Inference.	15 Hours	CO2
3	**Learning:** Probability basics, Bayes Rule and its Applications, Bayesian Networks, Exact and Approximate Inference in Bayesian Networks, Hidden Markov Models, Forms of Learning, Supervised Learning, Learning Decision Trees, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Support Vector Machines, Statistical Learning, Learning with Complete Data, Learning with Hidden Variables, The EM Algorithm,	15 Hours	CO3

	Reinforcement Learning.		
4	**Intelligence And Applications:** Natural language processing, Morphological Analysis, Syntax analysis, Semantic Analysis, Language Models, Information Retrieval, Information Extraction, Machine Translation, Machine Learning.	15 Hours	CO4

Suggested Readings:

1. A. P. Engelbrecht, Computational Intelligence: An Introduction, 2nd ed. Hoboken, NJ, USA: Wiley-Blackwell, 2007.
2. R. C. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementations. Amsterdam, Netherlands: Elsevier, 2007.
3. A. Konar, Computational Intelligence: Principles, Techniques and Applications. Berlin, Germany: Springer-Verlag, 2005.

Online Resources:

1. https://www.udemy.com/course/cipython/
2. https://nptel.ac.in/courses/106102220
3. https://nptel.ac.in/courses/106105077

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3						1	2	2
CO2	1	3	2	3	2						2	2	2
CO3	3	3	3	2	3						1	1	1
CO4	3	3	1	2	3						1	2	2

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VIII			
Course Name	Product Development					
Code	OE53502					
Course Type	OEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic engineering knowledge and problem-solving skills		3	1	0	4
Course Objectives	1. To understand the fundamentals of product development, product planning, customer needs, and market analysis. 2. To learn product architecture, system-level design, product platforms, and requirement engineering principles. 3. To apply industrial design principles, DFMA, robust design, prototyping, and additive manufacturing techniques. 4. To develop skills in product management, value engineering, innovation, intellectual property, and product.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Analyze product development processes, customer requirements, and market needs for successful product planning.					
CO2	Design product architectures and system-level solutions based on engineering specifications and market requirements.					
CO3	Apply industrial design, DFMA, prototyping, and additive manufacturing techniques in product development.					
CO4	Evaluate product cost, value, innovation, intellectual property, and commercialization strategies for product success.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Product Development Fundamentals:** Challenges of Product Development, Successful Product Development, Product Planning Process, Product Life Cycle Management (PLM) **Customer and Market Analysis:** Market Research, Survey Techniques, Identifying Customer Needs, Customer Journey Mapping and User Personas	15 Hours	CO1
2	**Product Architecture Fundamentals**: Product Architecture, Implications of Architecture, Establishing the Architecture **System Design and Product Platforms**: Related System-Level Design Issues, Modular and Platform-Based Product Design, Requirement Engineering and Specifications	15 Hours	CO2
3	**Industrial Design and Product Optimization**: Industrial Design overview, Design for Manufacturing and Assembly (DFMA), Robust Design **Prototyping and Advanced Manufacturing Technologies**: Prototyping, Rapid Prototyping Tools and CAD/CAM Integration, Additive Manufacturing (3D Printing)	15 Hours	CO3
4	**Product Management and Cost Optimization**: Concurrent Engineering, Product Costing, Value Engineering, Product Data Management (PDM) **Product Innovation**: Innovation and Creativity in Product Design. **Emerging Trends and Commercialization**: Intellectual Property Rights (Patents, Copyrights, Trademarks), AI and Data Analytics in Product Development, Start-up Product Development and Commercialization Strategies.	15 Hours	CO4

Suggested Readings:

1. K. T. Ulrich and S. D. Eppinger, Product Design and Development, 6th ed. New York, NY, USA: McGraw-Hill Education, 2015.
2. A. K. Chitale and R. C. Gupta, Product Design and Manufacturing, 5th ed. New Delhi, India: PHI Learning Pvt. Ltd., 2014.
3. P. N. Rao, Product Design and Manufacturing. New Delhi, India: Tata McGraw-Hill Education, 2013.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_me81
2. https://onlinecourses-archive.nptel.ac.in/noc18_me04

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	2	1		1					1	1
CO2	3	3	3	2	2		1					1	1
CO3	2	2	3	2	3		2					1	1
CO4	2	3	2	2	2		1	1	1		3	1	1

Program	B.Tech.(CSE- Generative Artificial Intelligence)					
Year	IV	**Semester**	VIII			
Course Name	Non-Conventional Energy Resources					
Course Code	OE53302					
Course Type	OEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic understanding of energy concepts, physics, and environmental studies.	3	1	0	4	
Course Objectives	1. To understand the fundamentals of non-conventional and renewable energy resources. 2. To study solar energy systems, biomass energy, and their applications. 3. To learn the principles and operation of wind, tidal, hydrogen, and fuel cell technologies. 4. To explore geothermal, ocean, and other emerging renewable energy systems for sustainable power generation.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	To understand about Non –Conventional energy resources.					
CO2	Evaluate solar energy, make use of it, and understand the principals involved in gathering solar energy and converting it into electricity					
CO3	Study the components, kinds and performance of the wind energy conversion system to gain an understanding of the topics involved					
CO4	To understand about examples of ocean energy and describe the practical ways to use it.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Indian and global energy sources, Energy exploited, Energy planning, Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy. Solar radiations: Extraterrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, Zenith angle, solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length.	15 Hours	CO1
2	**Solar energy:** Solar thermal power and its conversion, Solar collectors, Flat plat, Concentric collectors, Cylindrical collectors, Thermal analysis of solar		

	collectors. Solar energy storage, Different systems, solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants. **Biogas:** Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Energy plantation, Fuel properties.	15 Hours	CO2
3	**Wind energy:** Properties of wind, Availability of wind energy in India, wind Velocity, win machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Economic issues, Recent development. **Electrochemical effects and fuel cells:** Revisable cells, Ideal fuel cells, other types of fuel cells, Efficiency of cells, Thermions systems. **Tidal power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. **Hydrogen Energy:** Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel.	15 Hours	CO3
4	**Thermoelectric systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators. **Geothermal energy:** Hot springs, Steam ejection, Principal of working, types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts Problems associated with geothermal conversion. **Ocean energy:** Principal of ocean thermal energy conversion, Power plants based on ocean energy, problems associated with ocean thermal energy conversion systems.	15 Hours	CO4

Suggested Readings:

1. Bansal Keemann, Meliss ; Renewable energy sources and conversion technology; McGraw Hill; 2018.
2. Rai G.D. ; Non-Conventional energy Sources; Khanna Publishers; 1988.
3. Ashok V. Desai ; Non-conventional Energy; New Age International Private Limited; 2022.

Online Resources:

1. NPTEL(SWAYAM): https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge38
2. IEEE Papers**:** https://ieeexplore.ieee.org/document/5596088

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	3	2	3						2	2
CO2	3	3	2	3	3	3						1	2
CO3	2	2	3	2	3	2						2	1
CO4	3	2	3	2	3	2						2	1

Program	Vocational Course offered by CSE Department				
Year		**Semester**			
Course Name	Programming with Python				
Code	NVC53241				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	C Programming	2	0	0	2
Course Objectives	1. To develop a strong foundation in Python programming. 2. To develop analytical and problem-solving skills for real-world applications 3. Easy mapping and respective conversion of real world problems to python programs. 4. To develop the ability to work with large amounts of data for analytical purposes using Python.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply fundamental programming concepts using Python to solve basic computational problems.				
CO2	Utilize Python data structures and functions for efficient program development				
CO3	Develop object-oriented Python programs incorporating exception handling and modular programming.				
CO4	Implement Python-based solutions for simple data analysis and real-world applications.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Python and Programming Fundamentals**: Overview of programming languages and Python, installation and Python development environment, Python syntax and program structure, variables and data types, type conversion, input and output operations, operators and expressions, decision-making statements including if, if-else and nested if, iterative statements including for and while loops, control statements such as break, continue and pass. **Python Data Structures and Functions:** Strings and string manipulation, lists and list operations, tuples, sets and dictionaries, indexing and slicing, user-defined functions, function arguments and return values, variable scope, recursive functions, file handling concepts, reading from and writing to text files. Python Data Structure: Tuples, Lists, List Comprehension, Sets and Dictionaries, Mutable Sequences, Unpacking Sequences,	15 Hours	CO1, CO2
2	**Object-Oriented Programming and Python Applications:** Introduction to object-oriented programming, classes and objects, constructors and methods, inheritance and polymorphism, exception handling techniques, modules and packages, introduction to NumPy and Pandas libraries, basic data analysis and visualization concepts, development of simple Python applications and mini projects.	15 Hours	CO3, CO4

Suggested Readings:

1. John M. Zelle, Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates, 2017.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist (2nd Edition), O'Reilly Media, 2015.
3. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming (3rd Edition), No Starch Press, 2023.

Online Resources:

1. https://nptel.ac.in/courses/106106182
2. https://swayam.gov.in/explorer?searchText=python+programming

Course Articulation Matrix													
PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	1	2						1	1	1
CO2	3	3	2	2	2						2	2	2
CO3	3	3	3	2	3						2	2	2
CO4	3	3	3	2	3						2	2	2

Program	Vocational Course offered by CSE Department.				
Year		**Semester**			
Course Name	Fundamentals of Artificial Intelligence				
Code	NVC53242				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Data Structures & Algorithms, Fundamentals of Mathematics	2	0	0	2
Course Objectives	1. Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents. 2. The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications 3. Study the concept behind genetic algorithm and its various operations. 4. Learn the basic concept of fuzzy set theory.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the evolution and various approaches of AI.				
CO2	Implementation of data stoarage,processing,visualization, and its use in regression, clustering etc.				
CO3	Analyze the concepts of neural networks.				
CO4	Apply the concepts of face, object, speech recognition and robots.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**An overview to AI:** The evolution of AI to the present, various approaches to AI, what should all engineers know about AI? Other emerging technologies, AI and ethical concerns, Existing sets of principles for AI, AI in the Organization Structure. **Data & Algorithm:** History of Data, Data storage and importance of and its acquisition, the stages of data processing, data visualization, regression, prediction & classification, clustering & recommender systems.	15 Hours	CO1, CO2
2	**Artificial Neural Networks:** Deep learning, Recurrent Neural Networks, Convolutional Neural Networks, The Universal Approximation Theorem, Generative Adversarial Networks, Speech recognition, Natural language understanding, Natural language generation, Chatbots, Machine Translation. **Applications:** Image and face recognition, Object recognition, Speech Recognition besides Computer Vision, Robots, Applications, Investments in AI and AI in start-ups, AI Strategy and Governance (agenda).	15 Hours	CO3, CO4

Suggested Readings:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko,-Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones,-Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008.

4. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
5. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
6. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.
7. David L. Poole and Alan K. Mackworth,-Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

Online Resources:

1. https://nptel.ac.in/courses/109106184
2. https://onlinecourses.nptel.ac.in/noc22_cs83/preview

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	1	2	2						2	2	1
CO2	2	1	2	3	2						2	1	2
CO3	2	2	2	2	2						1	1	2
CO4	2	2	2	2	2						1	1	2

Program	Vocational Course offered by CSE Department				
Year	II	**Semester**	IV		
Course Name	Cyber Crime and Computer Forensics				
Code	NVC53243				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of Cyber Laws	2	0	0	2
Course Objectives	1. To understand the fundamentals of cybercrime, cyber laws, and challenges associated with cyber security and internet governance. 2. To develop knowledge of cybercrime investigation techniques, digital evidence collection, preservation, and analysis procedures. 3. To analyze computer forensic tools, technologies, and methodologies used in cybercrime detection and investigation. 4. To apply digital forensic techniques and security mechanisms to investigate cyber incidents and support legal proceedings.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the concepts, types, and characteristics of cybercrimes, cyber threats, and cyber laws.				
CO2	Analyze cyber-attacks, malware, hacking techniques, and cybercrime investigation methodologies				
CO3	Evaluate various computer forensic tools, forensic procedures, and evidence acquisition techniques used in digital investigations				
CO4	Apply digital forensic methods, evidence handling procedures, and security mechanisms to investigate cyber incidents and support forensic analysis				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Definition of Cyber Crime:** Introduction of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime, Social Engineering, Categories of Cyber Crime, Property Cyber Crime. Introduction to internet crimes: hacking and cracking, credit card and ATM frauds, emerging digital crimes and modules. Introduction to Cyber Crime Investigation, Investigation Tools, Discovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery.	15 Hours	CO1, CO2
2	**Computer forensics analysis and Tools:** Introduction to Computer Forensics Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics. **Email Security And Firewalls**: PGP ,S/MIME, Internet Firewalls for Trusted System- Roles of Firewalls, Firewall related terminology, Types of Firewalls, Firewall designs SET for E-Commerce Transactions.	15 Hours	CO3, CO4

Suggested Readings:

1. Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008**.**
2. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004. "Understanding Forensics in IT ", NIIT Ltd, 2005.
3. Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009**.**

Online Resources:

1**.** https://onlinecourses.swayam2.ac.in/cec20_lb06
2**.** https://nptel.ac.in/courses/106106178

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2		1							1	2	2
CO2	1	2	2	1							1	2	2
CO3	2	1	2	2	2						2	2	2
CO4	1	1	1	2	2						2	2	2

Program	Vocational course offered by CSE Department				
Year		**Semester**			
Course Name	Meta-Verse and Virtual Reality				
Code	NVC53244				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic computer knowledge and VR hardware.	2	0	0	2
Course Objectives	1. To understand how Augmented Reality/Virtual Reality (AR/VR) interfaces are used to interact in the Meta-verse. 2. To create AR/VR interfaces using free software tools. 3. To Use AR/VR interfaces as part of a business solution to enable potential customers to interact with a company's products and services in the Meta-verse. 4. To understand how all these fit into the Meta-verse as a whole, so as to create viable business solutions in the Meta-verse.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Define Meta-verse & the interplay between Web 3.0 and Blockchain				
CO2	Use of NFTs in Meta-verse & Industries using the Meta-verse technology				
CO3	Describe how VR systems work and list the applications of VR.				
CO4	Explain the concepts of motion and tracking in VR systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction and class policies, What is the Meta-verse? Demo of the Meta-verse ,The Meta-verse vs. Web 3.0 AR/VR and the Meta-verse Applications of the Meta-verse advantages and Challenges of the Meta-verse Types of the Meta-verse Block chain and the Meta-verse Crypto currency and the Meta-verse NFTs and the Meta-verse	15 Hours	CO1, CO2
2	Introduction to Virtual Reality, Representing the Virtual World ,The Geometry of Virtual Worlds & The Physiology of Human Vision, Visual Perception & Rendering ,Motion & Tracking.	15 Hours	CO3, CO4

Suggested Readings:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.

Online Resources:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/metaverse/
2. https://archive.nptel.ac.in/courses/106/106/106106138/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	2	1	1							1	1	1
CO2	1	2	2	2	1							2	2	2
CO3	1	1	2	2	1							2	2	2
CO4	1	2	2	2	1							2	2	2