BABU BANARASI DAS UNIVERSITY
School of Engineering
(School Code: 04) (University Branch Code: 41)
Department of Computer Science and Engineering
Bachelor of Technology: Computer Science and Engineering
(Artificial Intelligence and Blockchain)-B. Tech CSE (AIBC) (in association with IBM)

Evaluation Scheme

SEMESTER I										
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
BSC	RBS5103	Calculus	3	1	0	40	60	100	4
PCC	RCCML5101	Introduction to Python Programming and Clean Coding	3	0	0	40	60	100	3
PCC	RCCML5151	Python Programming and Clean Coding Lab	0	0	2	40	60	100	1
GP	RGP5101	General Proficiency	-	-	-	100	-	100	1
Total			**6**	**1**	**2**	**220**	**180**	400	9
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**	**Total**	
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
ESC	RME5153	Workshop Practices	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**	**6**	**280**	**420**	**700**	**17**
GROUP 'B'									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course 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
ESC	RCS5102	Basics of Artificial Intelligence	3	0	0	40	60	100	3
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
Total			**11**	**3**	**6**	**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**	**Course Total**	
BSC	RBS5203	Discrete Mathematics	3	1	0	40	60	100	4
PCC	RAIBC5201	Java Fundamental	3	0	0	40	60	100	3
PCC	RAIBC5251	Java Fundamental Lab	0	0	2	40	60	100	1
	RGP5201	General Proficiency				**100**		**100**	**1**
Total			**6**	**1**	**2**	**220**	**180**	**400**	**9**
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**	**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
ESC	RME5253	Workshop Practices	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**	**6**	**280**	**420**	**700**	**17**
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
ESC	RCS5202	Basics of Artificial Intelligence	3	0	0	40	60	100	3
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
Total			**11**	**3**	**6**	**280**	**420**	**700**	**17**

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SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course 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
BSC	RBS5303	Linear Algebra	3	1	0	40	60	100	4
PCC	RAI5302	Database Management Systems	3	1	0	40	60	100	4
ESC	RCS5311	Startup and Innovation	2	0	0	40	60	100	2
PCC	RAIBC5301	Data Visualization with Python	2	1	0	40	60	100	3
PCC	RCS5301	C Programming	3	1	0	40	60	100	4
PCC	RAIBC5351	Data Visualization with Python Lab	0	0	2	40	60	100	1
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
MC	RMC5351	YOGA Activities	0	0	2	100	-	100	1
GP	RGP5301	General Proficiency		-	-	100	-	100	1
Total			**14**	**5**	**8**	**560**	**540**	**1100**	**24**

SEMESTER IV									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course 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
BSC	RBS5403	Probability & Statistics	3	1	0	40	60	100	4
PCC	RAIBC5401	Big Data Analytics & Architecture	3	1	0	40	60	100	4
PCC	RCS5404	Operating Systems	3	1	0	40	60	100	4
PCC	RAIBC5402	Blockchain Essentials	2	1	0	40	60	100	3
PCC	RCS5403	Data Structures Using ‘C’	3	1	0	40	60	100	4
MC	RMC5401	Indian Constitution	1	0	0	40	60	100	1
PCC	RAIBC5451	Blockchain Essentials Lab	0	0	2	40	60	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
GP	RGP5401	General Proficiency	-	-	-	100	-	100	1
Total			**16**	**5**	**6**	**500**	**600**	**1100**	**26**

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SEMESTER V									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
HSMC	RHS5501	AI Economy and Digital Innovation	2	1	0	40	60	100	3
MC	RMC5501	Essence of Indian Knowledge Tradition	1	0	0	40	60	100	1
PCC	RCS5501	Automata Theory & Formal Languages	3	1	0	40	60	100	4
PCC	RAIBC5502	Applications of Blockchain Technology in Business Innovation	3	0	0	40	60	100	3
PCC	RAIBC5501	Concepts of Machine Learning	3	1	0	40	60	100	4
PCC	RCS5502	Computer Networks	2	1	0	40	60	100	3
PCC	RAIBC5551	Concepts of Machine Learning Lab	0	0	2	40	60	100	1
PCC	RCS5552	Computer Networks Lab	0	0	2	40	60	100	1
PSI	RAIBC5555	Seminar	0	0	2	100	-	100	1
PSI	RAIBC5553	Minor Project-I	0	0	2	100	-	100	1
GP	RGP5501	General Proficiency	-	-	-	100	-	100	1
Total			**14**	**4**	**8**	**620**	**480**	**1100**	**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	(RPEC54111-14)	**Professional Elective Course-I**	2	1	0	40	60	100	3
PEC	(RPEC54121-24)	**Professional Elective Course-II**	2	1	0	40	60	100	3
ESC	RCS5604	Compiler Design	3	1	0	40	60	100	4
PCC	RAIBC5601	Deep Learning	3	1	0	40	60	100	4
ESC	RCS5603	Design and Analysis of Algorithms	3	1	0	40	60	100	4
PCC	RAIBC5651	Deep Learning Lab	0	0	2	40	60	100	1
ESC	RCS5653	Design and Algorithms Lab	0	0	2	40	60	100	1
SPIC	RAIBC5652	Minor Project-II	0	0	2	100	-	100	1
GP	RGP5601	General Proficiency	-	-	-	100	-	100	1
Total			**15**	**6**	**6**	**520**	**480**	**1000**	**25**

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SEMESTER VII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
PEC	(RPEC54131-34)	**Professional Elective Course-III**	2	1	0	40	60	100	3
OEC		**Open Elective I***	3	1	0	40	60	100	4
PCC	RCS5703	AI Ethics	2	0	0	40	60	100	2
PCC	RAIBC5701	Generative Artificial Intelligence	3	1	0	40	60	100	4
PCC	RAIBC5751	Generative Artificial Intelligence Lab	0	0	2	40	60	100	1
PSI	RAIBC5751	Major Project I#	0	0	8	100	-	100	4
PSI	RAIBC5752	Industrial Training Evaluation	0	0	2	100	-	100	1
GP	RGP5701	General Proficiency	-	-	-	100	-	100	1
Total			**10**	**3**	**12**	**500**	**300**	**800**	**20**

*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**	**Course Total**	
PEC	(RPEC54141-44)	**Professional Elective Course IV**	2	1	0	40	60	100	3
OEC		**Open Elective II****	3	1	0	40	60	100	4
PCC	RCS5801	Cyber Security and Computer Forensics	3	1	0	40	60	100	4
PSI	RAIBC5851	Major Project II##	0	0	16	160	240	400	8
GP	RGP5801	General Proficiency	-	-	-	100	-	100	1
Total			**8**	**3**	**16**	**380**	**420**	**800**	**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

S. No.	Course Code	Professional Elective Course I	Credits
1	RPEC54111	Blockchain and Distributed Ledger Technology	3
2	RPEC54112	Cloud-Native Application Development	3
3	RPEC54113	Pattern Recognition	3
4	RPEC54114	FinTech and Blockchain	3

S. No.	Course Code	Professional Elective Course II	Credits
1	RPEC54121	Network Security and Cryptography	3
2	RPEC54122	Soft Computing	3
3	RPEC54123	Security Governance and Law	3
4	RPEC54124	Cyber and Digital Forensics	3

S. No.	Course Code	Professional Elective Course III	Credits
1	RPEC54131	Blockchain Architecture: Design and Use Cases	3
2	RPEC54132	Robotics	3
3	RPEC54133	Big Data Security	3
4	RPEC54134	Computer Vision	3

S. No.	Course Code	Professional Elective Course IV	Credits
1	RPEC54141	Distributed Systems	3
2	RPEC54142	Cryptography and Information Security	3
3	RPEC54143	AI For Blockchain	3
4	RPEC54144	Natural Language Processing	

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

S. No.	Course Code	Open Elective I	Credit
1	OE53101	Disaster Management	4
2	OE53201	Database Administration	4
3	OE53501	Quality Management	4
4	OE53301	Energy Management	4
S. No.	**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

S.No.	Course Code	Vocational Courses	Credit
1	NVC53241	Programming with Python	2
2	NVC53242	Fundamentals of Artificial Intelligence	2
3	NVC53243	Cyber Crime and Computer Forensics	2
4	NVC53244	Meta-verse 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 (AIBC)				
Year	I	**Semester**	I		
Course Name	Introduction to Python Programming and Clean Coding				
Code	RCCML5101				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Programming Skills	3	0	0	3
Course Objectives	1. To understand why Python is a useful scripting language for developers. 2. To learn how to design and program Python applications. 3. To learn how to use lists, tuples, and dictionaries in Python programs. 4. To learn how to identify Python object types.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the Writing of loops and decision statements in Python.				
CO2	Analyze and Build package of Python modules for reusability.				
CO3	Students will apply object-oriented principles to develop structured programs and manage data using file operations. They will also handle exceptions gracefully to create robust and error-resilient applications.				
CO4	Students will use Python libraries like Matplotlib to analyze and visualize data, and integrate real-time data using REST APIs. They will apply all concepts in a mini project demonstrating end-to-end application development.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Python:** History and features of Python. Python installation and IDEs: IDLE, VS Code, Jupyter, Basic syntax, keywords, and data types. Variables and constants. Operators: Arithmetic, Relational, Logical, Assignment, Bitwise. Input/output functions. Type conversion and typecasting. Basic programs and debugging.	15 Hours	CO1
2	**Control Structures and Functions:** Conditional statements: if, if-else, if-elif-else, Loops: for, while, break, continue, pass. Range and list comprehension. Functions: definition, calling, arguments, return values. Types of functions: built-in, user-defined, lambda.Variable scope: local, global, *args, **kwargs, Recursion, Modules and packages (introduction).	15 Hours	CO2
3	**Data Structures and File Handling:** Strings and string operations. Lists, Tuples, Sets, Dictionaries: creation, methods, use cases. Iteration over collections. File handling: opening, reading, writing, and appending.Working with text and binary files.Exception handling: try, except, finally, raise.The with statement. **Object-Oriented Programming and Libraries:** OOP concepts: class, object, in it, self, attributes and methods, Inheritance and polymorphism, Method overriding and overloading, Encapsulation and abstraction. Introduction to libraries: math, random, date-time, os, sys. Brief introduction to NumPy, pandas, and matplotlib.	15 Hours	CO3, CO4

Suggested Readings:

1. M. Lutz, Learning Python, Sebastopol, CA, USA: O'Reilly Media,2013(5th Edition).
2. J. Ernesti and P. Kaiser, Python 3: The Comprehensive Guide, Boston, MA, USA: Rheinwerk Publishing (SAP Press), 2022(1st Edition).
3. B. Slatkin, Effective Python: 125 Specific Ways to Write Better Python*, Boston*, MA, USA: Addison-Wesley Professional, Nov. 2024(3rd Edition).
4. R. C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, Upper Saddle River, NJ, USA: Prentice Hall, 2008(1st Edition).

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106182/

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

Program	B. Tech. CSE (AIBC)				
Year	I	**Semester**	I		
Course Name	Python Programming and Clean Coding Lab				
Code	RCCML5151 / RCCML5251				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of Python Programming	0	0	2	1
Course Objectives	1. To read and write simple Python programs. 2. To develop Python programs with conditionals and loops. 3. To define Python functions and to use Python data structures – lists, tuples, and dictionaries. 4. To do input/output with files in Python.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the concepts of Python Programming				
CO2	Analyze the syntax and structures of Python Programming.				
CO3	Understanding project-based development.				
CO4	Apply what you've learned to gain a better understanding of Python Programming.				

Sr. No.	Course Contents	Mapped CO
1	Write a Python program that takes two numbers as input from the user and displays the result of all arithmetic operations (addition, subtraction, multiplication, division, modulus, exponent, and floor division).	CO1
2	Write a program that accepts a user's name and age, then prints a message displaying the user's name in uppercase and calculates the year they will turn 100.	CO1
3	Create a program that checks whether an entered number is positive, negative, or zero using conditional statements.	CO2
4	Write a function that returns the factorial of a number using recursion. Ask the user to input a number and call the function.	CO2
5	Write a program that takes a list of integers and returns a new list using list comprehension that contains only the even numbers.	CO2
6	Write a Python script to count the number of vowels, consonants, digits, and special characters in a given string.	CO3
7	Create a dictionary to store student names and their marks. Write a program to display the highest, lowest, and average marks.	CO3
8	Write a program to read a text file, count the number of words, and write the result to a new file. Use exception handling to manage file errors.	CO3
9	Create a class Bank Account with attributes account holder and balance. Add methods to deposit, withdraw, and display the balance. Demonstrate the usage of inheritance by creating a Savings Account subclass that has an additional attribute for interest rate.	CO4
10	Write a Python program using the random, math and datetime libraries to generate: a. A random number between 1 and 100, b. The square root of the number, c. And the current date and time when the operation was performed.	CO4
11	**Project Statement** Design and develop a Python-based console application that manages student academic records. The system should allow users to add student information,	CO4

	record subject-wise marks, compute total and average scores, assign grades, and generate individual report cards. It should also support saving and retrieving data using a file handling technique.	

Suggested Readings:

1. M. Lutz, Learning Python, 5th ed., Sebastopol, CA, USA: O'Reilly Media, 2013.
2. J. Ernesti and P. Kaiser, Python 3: The Comprehensive Guide, 1st ed., Boston, MA, USA: Rheinwerk Publishing (SAP Press), 2022.
3. B. Slatkin, Effective Python: 125 Specific Ways to Write Better Python, 3rd ed., Boston, MA, USA: Addison-Wesley Professional, Nov. 2024.
4. R. C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, 1st ed., Upper Saddle River, NJ, USA: Prentice Hall, 2008.

Virtual Lab Source:

1. https://numpy.org/doc/stable/
2. https://pandas.pydata.org/docs/
3. https://matplotlib.org/stable/tutorials/index.html
4. https://scikit-learn.org/stable/user_guide.html

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

Program	B. Tech. CSE (AIBC)				
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 (AIBC)					
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 (AIBC)					
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

Suggested Readings:

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.

Online Resources:

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 (AIBC)					
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

Suggested Readings:

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:

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 (AIBC)				
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 (AIBC)				
Year	I	**Semester**	I/II		
Course Name	Basics of Artificial Intelligence				
Code	RCS5102/RCS5202				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of computer	3	0	0	3
Course Objectives	1. To study of historical perspectives of AI and its foundations. 2. To understanding the fundamental principles of AI. 3. To study of advanced AI techniques; like soft computing and nature inspired computing. 4. To understanding different AI approaches like problem solving, inference, perception, knowledge representation and learning.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.				
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.				
CO3	Demonstrate advanced AI techniques; like soft computing and nature inspired computing				
CO4	Demonstrate awareness and a fundamental understanding of various applications of AI techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to Artificial Intelligence (AI): definition, foundation and history of AI, types of AI, intelligent agents, structure of intelligent agents, introduction to soft computing, introduction and operations on fuzzy sets, nature inspired computing and algorithms.	15 Hours	CO1
2	AI terminologies & basic concepts, searching for solutions, search strategies: informed and uninformed, local and global search algorithms for optimistic problems, adversarial search, searching techniques for games, Alpha Beta pruning.	15 Hours	CO2
3	Knowledge representation and reasoning, propositional logic, theory of first order logic, inference mechanism in first order logic, forward and backward chaining, probabilistic reasoning, utility theory, Bayesian Networks. Applications and future of Artificial Intelligence, ethical issues, impact of AI on public life: understanding application of AI in Healthcare, Gaming, Finance, Data Security, Social Media, Travel & Transport, Automotive Industry, Robotics, AI in Entertainment, Agriculture, E-commerce and Education.	15 Hours	CO3, CO4

Suggested Readings:

1. Stuart Russell and Peter Norvig, Artifcial Intelligence: A Modern Approach, Pearson Education, Inc., 2010.
2. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, 2003.

4. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.
5. F. O. Karry, C. D. Silva, Soft Computing and Intelligent Systems Design, Pearson, 2009.

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 (AIBC)					
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 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. 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 (AIBC)				
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.				

S.No	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 and polygons in different positions; Projection of polyhedrons like prisms, pyramids and solids of revolutions like cylinder,	CO2

	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

Suggested Readings:

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 Resources:

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 (AIBC)				
Year	I	**Semester**	II		
Course Name	Java Fundamentals				
Code	RAIBC5201				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of object-oriented programming (OOP) concepts.	3	0	0	3
Course Objectives	1. To introduce fundamentals of Java programming and problem-solving techniques. 2. To develop an understanding of object-oriented programming concepts and their implementation using Java 3. To build robust applications using arrays, strings, exception handling and multithreading. 4. To develop Java applications involving collections, file processing and database connectivity.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply Java programming fundamentals, control structures and methods to develop solutions for computational problems.				
CO2	Design and implement object-oriented software solutions using classes, objects, inheritance, polymorphism, abstraction and interfaces.				
CO3	Develop reliable Java applications utilizing arrays, strings, exception handling and multithreading concepts.				
CO4	Build integrated Java applications using collections, file handling and Java Database Connectivity (JDBC), based database operations.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**JAVA fundamentals and Programming Logic:** Introduction to Java programming, features of Java, Java architecture, JDK, JRE and JVM, Java program structure, compilation and execution process, identifiers, variables, constants, data types, operators and expressions, type conversion and casting, input and output operations, control statements including conditional statements (if, if-else, nested if, switch) and iterative statements (for, while, do-while), jump statements (break, continue), methods, parameter passing, scope and lifetime of variables.	15 Hours	CO1

2	**Object Oriented Programming in JAVA:** Introduction to object-oriented programming concepts, classes and objects, constructors, methods, access modifiers, encapsulation, inheritance (single, multilevel and hierarchical inheritance), method overloading, method overriding, polymorphism, abstraction, abstract classes, interfaces, packages, static members, this and super keywords, and design and implementation of object-oriented applications using Java. **Arrays, Strings**: One-dimensional and two-dimensional arrays, array operations and applications, string handling using String, StringBuffer and StringBuilder classes, commonly used string methods, command-line arguments.	15 Hours	CO2
3	**Exception Handling and Multithreading:** Exception handling mechanisms, try-catch-finally blocks, throw and throws keywords, user-defined exceptions, exception propagation, introduction to multithreading, thread life cycle, thread creation using Thread class and Runnable interface, thread priorities, synchronization, inter-thread communication, and concurrent programming concepts. **File Handling and Database connectivity:** File handling using File, FileReader, FileWriter, BufferedReader and BufferedWriter classes, serialization basics, introduction to JDBC architecture, JDBC drivers, establishing database connections, executing SQL statements, PreparedStatement, ResultSet, performing CRUD (Create, Read, Update and Delete) operations, transaction basics, and development of simple database-driven Java applications.	15 Hours	CO3, CO4

Suggested Readings:

1. Naughton, P., and Schildt, H., Java 2: The Complete Reference, TMH, 1999.
2. Venners, B., Inside the Java Virtual Machine, TMH, 2nd Ed.
3. Darnell, R., HTML 4 Unleashed, Techmedia Publications, 2000.
4. Deitel, P., and Deitel, H., Java: How to Program, PHI, 8th Ed., 2010.

Online Resources:

1. https://l1nq.com/vnv35ze

Course Articulation Matrix													
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	2		1										
CO2	2	2	2	1	2							2	2
CO3	2			2									2
CO4	2	2	3	3	2							2	

Program	B. Tech. CSE (AIBC)				
Year	I	**Semester**		II	
Course Name	Java Fundamentals Lab				
Code	RAIBC5251				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of Programming	0	0	2	1
Course Objectives	1. To introduce fundamentals of Java programming and problem-solving techniques. 2. To develop an understanding of object-oriented programming concepts and their implementation using Java 3. To build robust applications using arrays, strings, exception handling and multithreading. 4. To develop Java applications involving collections, file processing and database connectivity.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply Java programming fundamentals, control structures and methods to develop solutions for computational problems.				
CO2	Design and implement object-oriented software solutions using classes, objects, inheritance, polymorphism, abstraction and interfaces.				
CO3	Develop reliable Java applications utilizing arrays, strings, exception handling and multithreading concepts.				
CO4	Build integrated Java applications using collections, file handling and JDBC-based database operations.				

S. No.	List of Experiments	Mapped CO
1	Write a Java program to find the Greatest Common Divisor (GCD) of two numbers.	CO1
2	Write a Java program to demonstrate the creation and use of classes and objects by implementing a Student2 class with methods to initialize and display student details. Create two objects s1 and s2 in a separate test class and invoke the methods to manage and display the information of different students.	CO1
3	Develop an Employee Management application demonstrating inheritance (single, multilevel, and hierarchical inheritance).	CO2
4	Design a Banking System using abstract classes and interfaces to demonstrate abstraction and multiple inheritance through interfaces.	CO2
5	Write a java program in which you will declare an abstract class Vehicle inherits this class from two classes car and truck using the method engine in both display “car has good engine” and “truck has bad engine”.	CO2
6	Develop applications using String, StringBuffer, and StringBuilder classes for text processing and manipulation.	CO3
7	Write a program in java if number is less than 10 and greater than 50 it generates the exception out of range. Else it displays the square of number	CO1, CO3

8	Implement multithreading using Thread class and Runnable interface. Demonstrate thread synchronization using a shared resource scenario.	CO3
9	Create a file-based Employee Record System using file handling classes to perform read, write, append, and search operations.	CO4
10	Develop a database-driven Student Information System using JDBC to perform CRUD (Create, Read, Update, Delete) operations on a MySQL database.	CO4

Suggested Readings:

1. Deitel, P., and Deitel, H., Java: How to Program, Pearson Education, 11th Ed., 2018.
2. Balagurusamy, E., Programming with Java, McGraw-Hill Education, 6th Ed., 2019.

Online Resources:

1. https://java-iitd.vlabs.ac.in/

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

Program	B.Tech CSE(AIBC)					
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(AIBC)				
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(AIBC)				
Year	II	**Semester**	III		
Course Name	Data Visualization with Python				
Code	RAIBC5301				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Python Programming.	2	1	0	3
Course Objectives	1. To understand the Fundamentals of Data Visualization. 2. To apply Python and Matplotlib for Basic Visualizations. 3. To develop Advanced Statistical Visualizations Using Seaborn. 4. To implement Geographic and Exportable Visualizations for Real-World Use.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand basic concepts of python, data visualization and data analysis.				
CO2	Analyze and plot the data visualization by using Matplotlib library.				
CO3	Customize the plot by using Matplotlib library.				
CO4	Analyze and plot the data Visualization by using Seaborn Library.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Visualization:** Introduction to Data Visualization in Data Science, Importance of Visualization in Analytics & Decision Making, Data Types & Mapping to Visualizations, Understanding Human Visual Perception, Exploratory vs Explanatory Visualizations, Overview of Chart Types: Bar, Line, Pie, Scatter, Heatmaps, Choosing the Right Chart Type, Color Theory in Visualization, Typography & Layout Principles, Data-Ink Ratio, Minimal Design and Avoiding Misleading Visuals, Handling Outliers and Missing Data in Visuals, Ethical Considerations in Data Visualization. **Python as tool:** Setting Up Jupyter Notebook, Crash course of Python, Sample. Scripts with Loops in python.	15 Hours	CO1
2	**Matplotlib:** History and Architecture of Matplotlib. Introduction to Matplotlib: Basics and Customizations, Creating Line, Bar, and Pie Charts, Scatter Plots and Histograms, Subplots, axes () function, add_axes () function, ax. Legend () function, ax. plot () function, sine and cosine functions., Annotations, and Grid Layouts **Power BI for Data Visualization:** Introduction to Business Intelligence and Power BI, Power BI Architecture and Components, Data Sources and Data Import, Data Cleaning and Transformation using Power Query, Data Modeling and Relationships, Data Visualization Techniques, Charts and Graphs, Tables and Matrix Visuals, KPI and Card Visuals, Filters and Slicers, Interactive Reports and Dashboards, Introduction to DAX	15 Hours	CO2, CO3

	Functions, Dashboard Design Principles, Report Publishing and Sharing.		
3	**IBM Cognos Analytics and Power BI Project:** Introduction to IBM Cognos Analytics, Cognos Architecture and Components, Data Sources and Data Connectivity, Data Modules and Data Preparation, Data Modeling Concepts, Report Creation and Formatting, Chart-Based Reporting, Dashboard Development, Interactive Filters and Data Exploration, Storytelling with Data, Report Publishing and Collaboration, Security and User Management, Report Scheduling, Sales Performance Dashboard Project using Power BI, Project Documentation and Presentation**.**	15 Hours	CO3, CO4

Suggested Readings:

1. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, John Wiley & Sons, 2015.
2. Srinivasa Rao Poladi, Matplotlib 3.0 Cookbook, Packt Publishing, 2019.
3. David Landup, Data Visualization in Python: A Practical Guide to Creating Visualizations with Python, Stack Abuse, 2020.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/
2. https://onlinecourses.nptel.ac.in/noc21_cs45/

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

Program	B.Tech CSE(AIBC)					
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(AIBC)				
Year	II	**Semester**	III		
Course Name	Data Visualization with Python Lab				
Code	RAIBC5351				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Python Programming.	0	0	2	1
Course Objectives	1. To apply best practices in designing clean, readable, and meaningful graphs. 2. To use Python libraries like Matplotlib and Seaborn for creating visualizations. 3. To use Seaborn for creating advanced charts like heatmaps, boxplots, and regression plots. 4. **4.** To develop skills for building visual dashboards for real-world business problems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the basics of data visualization and select appropriate graph types for different data sets.				
CO2	Create and customize basic charts like line, bar, pie, and scatter plots using Python's Matplotlib library.				
CO3	Build advanced statistical visualizations using Seaborn to analyze data relationships and patterns.				
CO4	Create map-based visualizations using Folium and export graphs as image or PDF files for reporting.				

Sr. No.	List of experiments	
1.	Installation and Setup of Python, Jupyter Notebook, and Required Data Visualization Libraries.	CO1
2.	Develop Python Programs using Variables, Conditional Statements, and Loops for Data Processing.	CO1
3.	Create Basic Line Charts, Bar Charts, and Pie Charts using Matplotlib.	CO2
4.	Design Scatter Plots and Histograms for Visual Analysis of Datasets using Matplotlib.	CO2
5.	Create Multiple Visualizations using Subplots, Legends, and Grid Layouts in Matplotlib.	CO2
6.	Visualize Mathematical Functions such as Sine and Cosine using Matplotlib.	CO2
7.	Import Data from Different Sources into Power BI and Perform Basic Data Transformation using Power Query.	CO3
8.	Create Interactive Charts, Tables, and KPI Visuals in Power BI.	CO3
9.	Design an Interactive Dashboard using Filters, Slicers, and Data Visualizations in Power BI.	CO3
10.	Create Reports and Perform Data Analysis using IBM Cognos Analytics.	CO4
11.	Develop Interactive Dashboards and Data Stories using IBM Cognos Analytics.	CO4

12.	Mini Project: Design and Present a Sales Performance Dashboard using Power BI or IBM Cognos Analytics.	CO4

Online Resources

1. https://python-iitk.vlabs.ac.in/
2. https://learn.microsoft.com/en-us/power-bi/

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

Program	B.Tech CSE(AIBC)				
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(AIBC)					
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. To design, develop databases. 2. To query a database. 3. To take backup and rollback databases. 4. 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(AIBC)				
Year	II	**Semester**		III	
Course Name	YOGA Activities				
Code	RMC5351				
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	7 Hours	CO1, CO2
2	Purification Practice Dhauti/yogic Eneama/Neti/Eye protection Yoga Practices. **AsanasYoga:** Stretching, Suryanamaskar(Warming-up), Standing Asana, SittingAsana, Prone position Asana, Supine position Asana, Meditative Asana, Relaxation Asana **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 **Meditation and Mudras**	8 Hours	CO3, CO4

Suggested Reading

1. Prof. Ramharsh Singh – Yoga Avam Yoga Chikitsa, Chaukhambha Sanskrit Pratishthan, Delhi-07 2.
2. K.S. Joshi - Yoga in Daily Life, Orient Paper Back Publication, New Delhi, 1985
3. Vijnananand Saraswati - Yoga Vigyan, Yoga Niketan Trust, Rishikesh, 1998.

4. Rajkumari Pandey-Bhartiya Yoga Paramparake VividhAyam, Radha Publication, New Delhi, 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(AIBC)					
Year	II	**Semester**	IV			
Course Name	Big Data Analytics & Architecture					
Code	RAIBC5401					
Course Type	PCC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Java, HADOOP frameworks, Clustering techniques, large data sets, PIG and HIVE		3	1	0	4
Course Objectives	1. Optimize business decisions and create a competitive advantage with Big Data analytics 2. Understand several key big data technologies used for storage, analysis and manipulation of data. 3. Recognise the key concepts of the Hadoop framework, MapReduce. 4. To learn Basic methodologies of PIG and HIVE.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Demonstrate an understanding of Big Data, its importance, sources, and the four key characteristics — volume, variety, velocity, and veracity.					
CO2	Analyze frameworks such as Hadoop and NoSQL to efficiently store, manage, and process Big Data for analytics.					
CO3	Design and implement algorithms to solve data-intensive problems using the MapReduce paradigm.					
CO4	Demonstrate and evaluate the use of Pig and Hive frameworks to process Big Data and generate analytics.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**ESSENTIALS OF BIG DATA AND ANALYTICS:** Data, Characteristics of data and Types of digital data, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data; Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.	15 Hours	CO1
2	**HADOOP:** Introducing Hadoop, Need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed computing challenges, History of Hadoop , Hadoop overview, Use case of Hadoop, Hadoop distributors, HDFS (Hadoop Distributed File System), Processing data with Hadoop, Managing resources and applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.	15 Hours	CO2
3	**MAPREDUCE PROGRAMMING:** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real-time applications using MapReduce, Data serialization and working with common serialization formats, Big data serialization formats.	15 Hours	CO3

4	**INTRODUCTION TO PIG and HIVE:** Introducing Pig: Pig architecture, Benefits, Installing Pig, Properties of Pig, Running Pig, and Getting started with Pig Latin, Working with operators in Pig, Working with functions in Pig. Introducing Hive: Getting started with Hive, Hive Services, Data types in Hive, Built-in functions in Hive, Hive DDL.	15 Hours	CO4

Suggested Readings:

1. S. Acharya and S. Chellappan, Big Data and Analytics, Hoboken, NJ, USA: Wiley Publications, 2014,2nd Edition.
2. DT Editorial Services, Big Data, New Delhi, India: Dreamtech Press, 2015.
3. T. White, Hadoop: The Definitive Guide, Sebastopol, CA, USA: O'Reilly Media, 2012.
4. Dreamtech Publications, Black Book: Big Data, New Delhi, India: Dreamtech Press, 2017.

Online Resources:

1. https://nptel.ac.in/courses/106104189

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(AIBC)					
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,	15 Hours	CO4

	Disk Scheduling, Disk Management, Swap-Space Management.		

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(AIBC)				
Year	II	**Semester**		**IV**	
Course Name	Blockchain Essentials				
Code	RAIBC5402				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of Programming (JavaScript), Cryptography and Information Security, Web Technologies, and Basic Concepts of Distributed Systems.	2	1	0	3
Course Objectives	1. Develop a foundational understanding of blockchain technology, its architecture, and core principles. 2. Understand the fundamental concepts and components of blockchain systems required for effective application development. 3. Explore the concepts of cryptocurrencies, their underlying mechanisms, and their role within blockchain ecosystems. 4. Examine Bitcoin and Ethereum platforms and analyze the applications of blockchain technology across various domains and industries.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Develop a comprehensive understanding of the theoretical foundations and practical aspects of blockchain systems and technologies				
CO2	Utilize JavaScript and blockchain interaction libraries such as Web3.js and Ethers.js to communicate with decentralized networks and applications.				
CO3	Design, develop, and deploy secure smart contracts using Solidity, and integrate them with frontend applications for decentralized solutions.				
CO4	Understand cryptoasset management, wallet integration mechanisms, and essential security practices in blockchain environments				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**General Blockchain Knowledge (Basics):-**Definition of blockchain, Components of a blockchain system, Immutable ledger: meaning and importance, Peer-to-peer networks, Role of cryptography in blockchain, Difference between blockchain and traditional databases, Emergence of alternative chains (Polkadot, Solana, Hyperledger), Current trends (Layer-2, DeFi, NFTs, DAOs, Web3) Major use cases: Cryptocurrency, Supply chain management, Identity verification, Healthcare records, What is centralization? Examples (banks, governments, platforms),	15 Hours	CO1

2	**Blockchain Architecture:-**What is decentralization? Examples (Bitcoin, Ethereum, DAOs), Advantages of decentralization (resilience, censorship resistance), Challenges of decentralization (scalability, governance, usability) **Digital Signatures:** asymmetric cryptography, signing, verification, Proof of Work (PoW),Proof of Stake (PoS), Delegated Proof of Stake (DPoS) Blockchain layers: protocol, network, data with web3js.	15 Hours	CO2
3	**Smart Contract Programming:-** What is a smart contract? Why use them? Solidity fundamentals: variables, functions, modifiers, mappings, structs, events, Contract design patterns (Ownable, Pausable, Upgradeable),Unit testing contracts with Hardhat and Truffle, Gas optimization, gas estimation, Smart contract debugging and auditing **Networks and Cryptoasset Management:-** Ethereum networks (mainnet, testnets) Wallets: MetaMask, hardware wallets, custodial vs non-custodial, Managing private keys, mnemonic phrases, and signatures, Handling cryptoassets, tokens, balances, transactions ERC-20 (fungible), ERC-721 (NFT), ERC-1155 standards.	15 Hours	CO3, CO4

Suggested Readings:

1. Andreas M. Antonopoulos and Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, 2018.
2. Ethereum Foundation, Solidity Documentation: The Solidity Programming Language. Available at: Solidity Documentation

Online Resources:

1. IBM, Blockchain Basics. Available at: https://www.ibm.com/topics/blockchain
2. Ethers.js Documentation. Available at: https://docs.ethers.org/v5/
3. Web3.js Documentation. Available at: https://web3js.readthedocs.io/

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		2	1	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2
CO3	2	1	3	2	2		2		2	1		2	2
CO4	2		2		2	2	1		1		1	2	2

Program	B.Tech CSE(AIBC)					
Year	II	**Semester**	III			
Course Name	Data Structures 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:

1. 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(AIBC)				
Year	II	**Semester**	III		
Course Name	Indian Constitution				
Code	RMC5401				
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. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J. A. Siwach, Dynamics of Indian Government & Politics.
4. D. C. Gupta, Indian Government and Politics.
5. H. M. Sreevai, Constitutional Law of India, 4th Edition, Universal Law Publication.

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(AIBC)				
Year	II	**Semester**	IV		
Course Name	Blockchain Essentials Lab				
Code	RAIBC5451				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Networking and cryptography	0	0	2	1
Course Objectives	1. Develop a fundamental understanding of blockchain technology, its concepts, architecture, and underlying principles. 2. Analyze and explain the working mechanisms of blockchain systems, including consensus protocols, transaction processing, and distributed ledger operations. 3. Design, develop, and deploy smart contracts and decentralized applications (DApps) using appropriate blockchain platforms and tools. 4. Apply blockchain concepts and technologies to design innovative solutions and integrate them into real-world projects and applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Develop a strong foundation in JavaScript programming by understanding and implementing core language concepts and programming constructs.				
CO2	Apply JavaScript for blockchain application development and interact with blockchain networks using industry-standard libraries such as Web3.js and Ethers.js.				
CO3	Design, configure, and evaluate a blockchain development environment using the IBM Blockchain Platform Extension and related development tools.				
CO4	Develop, deploy, and test blockchain-based applications by integrating smart contracts, decentralized services, and user interfaces.				

S.no	Lab Experiment	Mapped CO
1	Revision the following Basic Concept from JavaScript:-Variable, Function Scope, Loop and Control Structure	CO1

2	Revision the following Advance Concept from JavaScript: Promise and Async/wait, ES6 Modules, Working with External Libraries (Ether.js / Web3.js)	CO1
3	Write the Program to show the proof of work and proof of stake with Javascript/Python	CO2
4	Building a Small Single-Page App (SPA), with (Ether.js / Web3.js),	CO2
5	"Design and Implementation of a Basic Smart Contract Using Solidity"	CO3
6	Create a simple validator selection program. Proof of Work (PoW), Proof of Stake (PoS) Simulation	CO3
7	DApp Frontend Integration (Connect frontend React app with smart contract using Ether.js/Web3.js.)	CO3
8	Cryptoasset Wallet Integration (integrate MetaMask for signing transactions in a dApp.)	CO4
9	Interacting with Smart Contracts using Ether.js for Read data from deployed contracts.	CO4
10	Decentralized Storage using IPFS for the Upload image / document and retrieve it.	CO4

Online Resources

1. Blockchain Basics (IBM) – https://www.ibm.com/topics/blockchain
2. Solidity Documentation: Syntax and Smart Contract Structure – https://docs.soliditylang.org/en/v0.8.35/

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		2	1	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2
CO3	2	1	3	2	2		2		2	1		2	2
CO4	2		2		2	2	1		1		1	2	2

Program	B.Tech CSE(AIBC)					
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.

Virtual Lab Source

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(AIBC)					
Year	II	Semester	III			
Course Name	Data Structure Using 'C' Lab					
Code	RCS5453					
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(AIBC)					
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						
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(AIBC)					
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 (LMD) and Rightmost (RMD) 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. John C. Martin, Introduction to Languages and Automata Theory, Tata McGraw-Hill, 3rd Edition, 2007.
2. Daniel I. A. Cohen, Introduction to Computer Theory, John Wiley & Sons, 2nd Edition, 1996.
3. Marvin L. Minsky, Computation: Finite and Infinite Machines, Prentice-Hall, Reprint Edition, 1972.

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 (AIBC)				
Year	III	Semester		V	
Course Name	Applications of Blockchain Technology in Business Innovation				
Code	RAIBC5502				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Basic Knowledge of Networking	3	0	0	3
Course Objectives	1. Block chain technology and the key concepts like cryptography and crypto currency concepts. 2. Gain a deep insight into Bitcoin, its network and how Bitcoin transactions are validated by miners. 3. Interpret the prospects of Blockchain and assess your business standards. 4. Explanation of how blockchain, reduces the cost of networking.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand how Blockchain solutions are transforming the Industry landscape.				
CO2	Analyze a deeper understanding of Blockchain Technical topics such as consensus, cryptography, privacy and security.				
CO3	Evaluate better knowledge of Blockchain Technology's potential, allowing them to determine which business challenges it can address.				
CO4	Apply Blockchain-based method for addressing a business problem in their sector.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Blockchain:** Articulate the challenges of predicting technological evolution and its impact on the economy Identify common misconceptions about blockchain technology Compare the emergence of blockchain technology to that of other general-purpose technologies. Evaluate a business application of blockchain through the lens of a strategic framework. Discern the role of entrepreneurial strategy in a time of technological uncertainty **Bitcoin and The Curse of The Double-Spending Problem** Explain the double-spending problem and how it is addressed by Bitcoin Interpret Bitcoin as a medium of exchange, store of value, and unit of account. Review the technical details of the Bitcoin protocol Compare the algorithms used to establish consensus in a blockchain to ensure its integrity Determine from a Bitcoin transaction how the PoW algorithm works. Investigate alternative cryptocurrencies and how they might address the challenges presented by bitcoin Evaluate current issues with scaling the Bitcoin blockchain and how they can be addressed. Investigate the role of mining in bootstrapping Bitcoin's Infrastructure.	15 Hours	CO1
	Costless Verification: Blockchain Technology and The Last Mile Problem: Demonstrate the cost of verifying the attributes of a		

2	transaction Identify situations where settlement and reconciliation are expensive today Determine how to build data integrity with costless verification Compare applications of cheaper settlement and reconciliation across different industries Investigate (online and offline) complements to blockchain technology that may help to solve the last mile problem Recommend feasible solutions to the last mile problem.	15 Hours	CO2
3	**Bootstrapping Network Effects Through Blockchain Technology and Cryptoeconomics:** Deduce how the nature of intermediation may change as a result of blockchain technology Articulate the economic consequences of a reduction in the cost of networking. Analyze the risks associated with smart contracts Discern the role of tokens in incentivizing the growth, operations, and security of a platform. Investigate the conditions under which relational contracts can be automated. Recommend a reward system for an incumbent adding a token to its ecosystem. Assess the ability of case examples to capitalize on the reduction in the cost of networking **Using Tokens to Design New Types of Digital Platforms-** Investigate the value that tokens may bring to a business's ecosystem. Analyze examples of tokens and decide which industry verticals are most promising. Distinguish the role of tokens in funding blockchain innovations and platforms. Evaluate various tokens, ranking them in terms of capital raised and trading performance. Deduce how challenges around securities regulation can affect the successful tokenization of an ecosystem.	15 Hours	CO3

Suggested Readings:

1. IBM, IBM Courseware, IBM Corporation, Latest Edition.
2. Kai Hwang and Min Chen, Big-Data Analytics for Cloud, IoT and Cognitive Computing, Wiley, 2017.
3. Hwaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley, 2017.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs44/preview.
2. https://www.digimat.in/nptel/courses/video/106104220/L01.html

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

Program	B.Tech CSE(AIBC)					
Year	III	**Semester**	V			
Course Name	Concept of Machine Learning					
Course Code	RAIBC5501					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of Python	3	1	0	4	
Course Objectives	1. To provide students with a strong foundation in Machine Learning concepts, techniques, and their applications in solving real-world problems. 2. To develop proficiency in Python programming for data manipulation, preprocessing, visualization, and analytical tasks. 3. To enable students to apply supervised and unsupervised machine learning algorithms for predictive and descriptive data analysis using real-world datasets. 4. To equip learners with the skills to evaluate machine learning models, interpret results, and develop effective data-driven solutions for complex business and societal challenges.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the fundamental concepts of Machine Learning, data preprocessing techniques, and the Python ecosystem used for machine learning applications.					
CO2	Analyze and visualize data using statistical methods and exploratory data analysis techniques to extract meaningful insights.					
CO3	Apply supervised machine learning algorithms such as Regression, Classification, Decision Trees, Random Forests, and Support Vector Machines to solve real-world problems.					
CO4	Implement and evaluate unsupervised learning and neural network techniques, including clustering, dimensionality reduction, and basic artificial neural networks, for data-driven decision making.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Machine Learning Foundations and Python Programming:** Introduction to Artificial Intelligence, Machine Learning and Data Science, Types of Machine Learning (Supervised, Unsupervised and Reinforcement Learning), Applications of Machine Learning, Introduction to Python ecosystem for Machine Learning, NumPy and Pandas basics, Data collection and understanding, Data cleaning and preprocessing, Feature scaling, Normalization and Standardization, Train-Test Split and Cross Validation.	15 Hours	CO1
2	**Exploratory Data Analysis and Statistical Foundations:** Data visualization using Matplotlib and Seaborn, Scatter Plot, Line Chart, Bar Chart, Histogram, Box Plot and Heat Map, Measures of Central Tendency, Variance and Standard Deviation, Correlation and Covariance, Hypothesis Testing, Missing Value	15 Hours	CO2

	Treatment, Outlier Detection, Data Encoding Techniques and Feature Engineering for Machine Learning.		
3	**Supervised Machine Learning Techniques:** Regression and Classification Analysis, Linear Regression, Multiple Linear Regression, Logistic Regression, K-Nearest Neighbour (KNN), Naïve Bayes Classifier, Support Vector Machine (SVM), Decision Trees, Random Forest, Model Evaluation Techniques including Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC-AUC Curve, MAE, MSE and RMSE.	15 Hours	CO3
4	**Unsupervised Learning and Neural Networks:** Clustering Techniques, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering (DBSCAN), Principal Component Analysis (PCA), Association Rule Mining and Apriori Algorithm, Introduction to Artificial Neural Networks, Perceptron Model, Backpropagation Algorithm, Real-world Applications of Machine Learning, Case Studies and Mini Project Development using Python.	15 Hours	CO4

Suggested Readings:

1. IBM, Machine Learning Courseware, IBM Corporation, Latest Edition.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022.
3. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly Media, 2016.
4. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2020.

Online Resources:

1. Scikit-learn Documentation – Official documentation and tutorials for machine learning using Python
2. TensorFlow Tutorials – Official hands-on tutorials for building and training machine learning models.

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		2	1	2	2	2
CO2	2	2	2	3	2	1	2		2	1	1	2	2
CO3	2	1	3	2	2		2		2	1		2	2
CO4	2		2		2	2	1		1		1	2	2

Program	B.Tech CSE(AIBC)				
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. To understanding the concepts of Networking. 2. To studying about different Stuffing Concepts. 3. To understanding different network topologies. 4. To 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	Understand the concepts of Network Cables and Network Commands.				
CO2	Analyze the use of Local Area Networks.				
CO3	Evaluate the performance of different programs related to Networking.				
CO4	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 (AIBC)					
Year	III	Semester	V			
Course Name	Concept of Machine Learning Lab					
Course Code	RAIBC5551					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of Python Programming Language.	0	0	2	1	
Course Objectives	1. To provide hands-on experience in data collection, preprocessing, and transformation using Python-based tools and libraries. 2. To develop skills in data visualization and exploratory data analysis for extracting meaningful insights from datasets. 3. To enable students to implement supervised and unsupervised machine learning algorithms on real-world datasets. 4. To equip learners with the ability to evaluate machine learning models and develop practical data-driven solutions for real-world applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Apply Python libraries for data manipulation, preprocessing, and visualization.					
CO2	Implement and evaluate supervised machine learning algorithms on real-world datasets.					
CO3	Apply unsupervised learning techniques for clustering and dimensionality reduction.					
CO4	Design and develop machine learning solutions for practical applications using industry-standard tools.					

S. No.	List of Experiments	Mapped CO
1.	Perform data acquisition, preprocessing, handling missing values, and feature scaling on a real-world dataset using Python libraries such as Pandas and NumPy.	CO1
2.	Develop programs to visualize and analyze datasets using various plotting techniques including scatter plots, histograms, box plots, and heat maps using Matplotlib and Seaborn	CO1
3.	Implement Linear Regression on a given dataset and evaluate the performance of the model using appropriate error metrics.	CO2
4.	Implement Logistic Regression for classification problems and analze the prediction results using confusion matrix and classification metrics.	CO2
5.	Develop and evaluate a K-Nearest Neighbour (KNN) classifier using a standard dataset and compare actual and predicted outputs.	CO2
6.	Implement the Naïve Bayes classification algorithm on a real-world dataset and evaluate its performance using suitable evaluation measures.	CO3

7.	Implement Support Vector Machine (SVM) algorithms for classification tasks and compare the results with other classification techniques.	CO3
8.	Implement a Decision Tree classifiers on real world dataset and analyze feature importance, tree structure, and classification performance.	CO3
9.	Implement Random Forest classifiers and analyze the improvement in prediction accuracy over individual decision trees.	CO4
10.	Apply model evaluation techniques including Accuracy, Precision, Recall, F1-Score, ROC Curve, and Confusion Matrix for performance assessment of machine learning models.	CO4
11.	Implement the K-Means clustering algorithm on a real-world dataset and analyze the quality of clusters formed.	CO4
12.	Develop a mini machine learning project involving data preprocessing, model building, evaluation, and interpretation using a real-world dataset from domains such as healthcare, finance, education, or retail.	CO4

Suggested Readings:

1. IBM, Machine Learning Courseware, IBM Corporation, Latest Edition.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022.
3. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly Media, 2016.
4. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2020.

Virtual Lab Source:

1. Virtual Labs (Ministry of Education, Government of India)
   https://www.vlab.co.in
2. IIT Kharagpur Virtual Labs – Data Analytics and Machine Learning Experiments
   https://cse20-iiith.vlabs.ac.in

Course Articulation Matrix

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

Program	B. Tech. CSE (AIBC)					
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 (AIBC)				
Year	III	**Semester**	VI		
Course Name	Compiler Design				
Code	RCS5604				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Automata Theory	3	1	0	4
Course Objectives	**1.** To apply the theory of language translation to build compilers and interpreters. **2.** Building of translators both from scratch and using compiler generators. **3.** Identifies and explores the main issues of the design of translators. **4.** The construction of a compiler/interpreter for a small language				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand different phases and passes of the compiler and use the compiler tools like LEX, YACC, etc.				
CO2	Analyse the concepts of parser and its types.				
CO3	Understanding translation and applying it.				
CO4	Applying code generation and optimization on target machine				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Compiler:** Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG. **Basic Parsing Techniques:** Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers.	15 Hours	CO1
2	**Automatic Construction of efficient Parsers:** LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables. Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser.	15 Hours	CO2, CO3
3	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation. **More about translation:** Array references in arithmetic expressions, procedures call, declarations and case statements. **Symbol Tables:** Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, storage	15 Hours	CO3

	allocation in block structured language.		
4	**Error Detection & Recovery:** Lexical Phase errors, syntactic phase errors semantic errors. **Code Generation:** Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	15 Hours	CO4

Suggested Readings:

1. A. V. Aho, R. Sethi, and J. D. *Ullman,* Compilers: Principles, Techniques, and Tools. Reading, MA, USA: Addison-Wesley, 1986.
2. K. Muneeswaran, Compiler Design, 1st ed. New Delhi, India: Oxford University Press, 2012.
3. J. P. Bennet, Introduction to Compiler Techniques, 2nd ed. New York, NY, USA: McGraw-Hill, 2003.
4. H. Alblas and A. Nymeyer, Practice and Principles of Compiler Building with C. New Delhi, India: Prentice Hall of India, 2001.
5. V. Raghavan, Principles of Compiler Design. New Delhi, India: Tata McGraw-Hill, 2010.
6. K. C. Louden, Compiler Construction: Principles and Practice. Boston, MA, USA: Cengage Learning, 1997.
7. C. N. Fischer and R. J. LeBlanc Jr., Crafting a Compiler with C. Boston, MA, USA: Pearson Education, 1991.

.**Online Resources:**

1. https://nptel.ac.in/courses/106104123
2. https://nptel.ac.in/courses/106105190

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	2	
CO2	3	3	2	1	2						2	1	
CO3	3	3	2	2	3						2	2	
CO4	3	2	1	1	1						1	1	

Program	B. Tech. CSE (AIBC)				
Year	III	**Semester**	VI		
Course Name	Deep Learning				
Code	RAIBC5601				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre -Requisite	Knowledge of Machine Learning	3	1	0	4
Course Objectives	1. To introduce students to the fundamental concepts and architectures of deep learning. 2. To provide hands-on experience in implementing and training deep neural networks using Python libraries. 3. To enable students to apply deep learning models to solve problems in computer vision, natural language processing, and reinforcement learning. 4. To develop the ability to evaluate and optimize deep learning models, and understand the ethical considerations of AI systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Identify foundational concepts and current applications of deep learning in vision, language, and decision-making domains.				
CO2	Develop and train neural networks using Python libraries for image and text data.				
CO3	Apply optimization strategies and advanced architectures (CNNs, RNNs, Transformers) to real-world tasks.				
CO4	Design and implement deep learning projects using appropriate evaluation metrics and deployment tools, considering ethical implications.				

Module	**Course Contents**	Contact Hrs	**Mapped CO**
1	**Neural Network Fundamentals and Optimization** Overview and evolution of Deep Learning, Applications in vision, NLP, reinforcement learning, Setting up Python environment (Anaconda, Jupyter, TensorFlow, PyTorch), Basics of Neural Networks: structure and working of ANNs, Deep Learning Fundamentals: Gradient Descent, Optimization Algorithms (SGD, Adam), Activation Functions: sigmoid, tanh, ReLU and variants, Model Evaluation Metrics: accuracy, precision, recall, F1-score, Implementing feedforward networks from scratch using NumPy, Backpropagation and weight updates, Visualization of activation functions and loss surfaces	15 Hours	CO1
2	**CNNs, RNNs and NLP Applications** CNN Architecture and components: convolution, pooling, padding, Image Classification using CNN with MNIST/CIFAR-10, Transfer Learning: using ResNet/VGG models, Fine-tuning Pre-trained CNNs and Data Augmentation, Sequence Modeling with RNNs and LSTMs, Vanishing Gradient Problem and	15 Hours	CO2

	solution via LSTM/GRU, Sentiment Analysis with LSTM using IMDB dataset, Text Generation with LSTM, Introduction to Attention Mechanism, Project Work: Build and fine-tune a CNN or RNN-based model.		
3	**GANs, Reinforcement Learning** Introduction and Architecture of GANs: Generator and Discriminator, Training GANs and use cases: synthetic image generation, data augmentation, Conditional GANs and Style Transfer, Introduction to Reinforcement Learning and MDPs, Q-Learning and Deep Q-Networks (DQN), Implementing DQN for CartPole and Atari Games	15 Hours	CO3
4	**Advanced Topics in AI** Introduction to Transformers and Self-Attention, Hugging Face Transformers: use for text classification, Capsule Networks: overview and comparison, Ethics in AI: bias, fairness, privacy, responsible AI, Capstone Project: End-to-end DL application with model training, evaluation, and deployment	15 Hours	CO4

Suggested Reading:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. François Chollet, Deep Learning with Python, Manning Publications, 2021 (2nd Edition).
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022 (3rd Edition).
4. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press, 2018 (2nd Edition).

Online Resources:

1. Hugging Face Documentation. Available at: https://huggingface.co/docs
2. PyTorch Tutorials. Available at: https://pytorch.org/tutorials/
3. TensorFlow Guides. Available at: https://www.tensorflow.org/learn

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	1
CO2	3	3	1	2	1							2	1
CO3	2	1	2	1	1							2	2
CO4	1	2	1	3	2							1	1

Program	B. Tech. CSE (AIBC)				
Year	III			**Semester**	VI
Course Name	Design and 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 (AIBC)				
Year	III	**Semester**	VI		
Course Name	Deep Learning Lab				
Course Code	RAIBC5651				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic of Python Programming	0	0	2	1
Course Objective	1. To provide practical exposure to the implementation of machine learning and deep learning algorithms using Python and modern AI frameworks. 2. To develop the ability to design, train, evaluate, and optimize deep learning models for solving real-world classification, prediction, and pattern recognition problems. 3. To familiarize students with advanced deep learning architectures such as CNNs, RNNs, LSTMs, transfer learning models, and probabilistic graphical models. 4. To enable students to apply deep learning techniques and tools for developing innovative AI-based solutions in research and industry applications.				
Course Outcomes After successful completion of the course, the students will be able to:					
CO1	Implement and evaluate fundamental machine learning and deep learning algorithms using Python and relevant libraries.				
CO2	Develop predictive and classification models using deep learning techniques and assess their performance using appropriate evaluation metrics.				
CO3	Apply advanced deep learning architectures such as CNNs, LSTMs, transfer learning models, and Bayesian Networks to solve domain-specific problems.				
CO4	Design and implement AI-based projects by integrating deep learning frameworks and tools for real-world applications and research-oriented solutions.				

S. No.	List of Experiments	Mapped CO
1.	Write a program to implement k-Nearest Neighbour algorithm to classify the Iris dataset. Print both correct and wrong predictions	CO1
2.	Build a Logistic Regression model that answers the question: “What sorts of people were more likely to survive?” using passenger data in the Titanic dataset.	CO2
3.	Build a model for digit recognition on the MNIST dataset using Support Vector Machine. Also print the confusion matrix.	CO1
4.	Write a program to implement the Naïve Bayes classifier for a sample training data set stored as a CSV file. Compute the accuracy using test data sets.	CO2
5.	Use the “airline-passengers.csv” dataset to implement an LSTM model that predicts the number of international airline passengers from Jan 1949 to Dec 1960 (144 observations).	CO2
6.	Construct a Bayesian Network considering medical data. Use this model to diagnose heart patients using the Heart Disease dataset.	CO3
7.	Write a program to classify retinal damage from the OCT Scan dataset using a pre-	CO4

S. No.	List of Experiments	Mapped CO
	trained VGG16 model.	
8.	Build a CNN model to identify images from the CIFAR-10 dataset. Calculate the accuracy, precision, and recall.	CO3
9.	Construct a Bayesian Network using medical data to demonstrate diagnosis of heart patients. (Repeat for deeper understanding).	CO4
10.	**Project Title**: *Stock Market Prediction* — Use time series analysis and sentiment analysis (from online news/blogs) to build a hybrid neural network model that predicts stock prices.	CO3, CO4

Suggested Reading :

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. François Chollet, Deep Learning with Python, Manning Publications, 2021 (2nd Edition).
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022 (3rd Edition).
4. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press, 2018 (2nd Edition).

Online Resources:

1. https://vlab.spit.ac.in/ai/

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

Program	B. Tech. CSE (AIBC)					
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(AIBC)				
Year	IV	Semester	VII		
Course Name	AI Ethics				
Course Code	RCS5703				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamental Knowledge of AI,ML Models and Data Science	2	0	0	2
Course Objectives	1. To introduce the ethical, social, legal, and governance issues arising from Artificial Intelligence technologies. 2. To develop understanding of fairness, transparency, accountability, privacy, and responsible AI principles. 3. To analyse the societal impact of AI on individuals, organizations, and communities. 4. To apply ethical frameworks and regulatory guidelines to real-world AI applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain fundamental concepts, ethical theories, and principles related to AI systems.				
CO2	Identify and evaluate ethical issues such as bias, discrimination, privacy violations, and accountability in AI applications.				
CO3	Analyse the societal, legal, and economic impacts of AI deployment through case studies.				
CO4	Apply ethical frameworks, governance principles, and regulatory guidelines to assess AI systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to AI Ethics**: Evolution of Artificial Intelligence , Need for AI Ethics , Ethical Foundations: Utilitarianism, Deontology, Virtue Ethics, Human-Cantered AI, AI Ethics Frameworks and Global Perspectives, Ethics vs. Morality, AI Lifecycle and Ethical Challenges, Human Rights and AI, UNESCO Recommendations on AI Ethics	7 Hours	CO1
2	**Fairness, Bias and Accountability in AI**: Sources of Bias in Data and Algorithms, Algorithmic Fairness, Explainability and Interpretability, Accountability and Responsibility ,AI Auditing and Risk Assessment, Data Bias, Sampling Bias, Discrimination in AI Systems , Fairness Metrics , Explainable AI (XAI).	8 Hours	CO2
3	**Privacy, Security and Legal Issues**: Data Privacy and Protection , Consent and Data Ownership , AI Security Risks, Intellectual Property Rights and AI, Cyber security and AI, Emerging AI Regulations. Privacy-Preserving AI, Surveillance Technologies, Data Governance, GDPR Overview, AI Act and Regulatory Approaches. **Governance, Responsible AI:** AI Governance Frameworks, Ethical AI Development Lifecycle, Responsible Innovation, Sustainability and AI, Ethical Failures and Successes, AI Risk Management, AI Ethics Assessment Tools, Industry Best Practices	15 Hours	CO3, CO4

Suggested Readings:

1. Mark Coeckelbergh, AI Ethics, The MIT Press, 1st Edition, 2020.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux, 1st Edition, 2019.
3. Markus D. Dubber, Frank Pasquale, and Sunit Das (Eds.), The Oxford Handbook of Ethics of AI, Oxford University Press, 1st Edition, 2020.

Online Resources:

1. https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_INTEL_02

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

Program	B.Tech CSE(AIBC)				
Year	IV	Semester	VII		
Course Name	Generative Artificial Intelligence				
Course Code	RAIBC5701				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of Artificial Intelligence, Basic Knowledge of Deep Learning and Neural Networks	3	1	0	4
Course Objectives	1. To understand the basic concepts and applications of Generative Artificial Intelligence. 2. To learn the working principles of generative models such as GANs, VAEs, and Transformers. 3. To develop AI solutions for generating text, images, and other digital content using modern Generative AI tools. 4. To understand the ethical, responsible, and secure use of Generative AI technologies.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the fundamental concepts				
CO2	Apply generative models and AI tools to create text				
CO3	Develop solutions using Transformer-based models				
CO4	Evaluate the performance				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Foundations of Generative Artificial Intelligence: Introduction to Artificial Intelligence, Introduction to Generative AI, Evolution of Generative AI, Applications of Generative AI, Discriminative Models, Generative Models, Fundamentals of Deep Learning, Neural Networks, Representation Learning, Probability Concepts for Generative Modeling, Generative AI Tools, Generative AI Platforms.	15 Hours	CO1
2	Generative Models: Autoencoders, Variational Autoencoders (VAEs), Latent Space Representation, Generative Adversarial Networks (GANs), GAN Architecture, GAN Training Process, Conditional GANs, StyleGAN, Evaluation Metrics for Generative Models, Deep Learning Frameworks for Generative AI, Implementation of Generative Models.	15 Hours	CO2
3	Large Language Models and Prompt Engineering: Transformer Architecture, Attention Mechanism, Self-Attention, Large Language Models (LLMs), GPT Models, BERT Models, Prompt Engineering Techniques, Fine-Tuning of LLMs, Transfer Learning, Retrieval-Augmented Generation (RAG), Conversational AI Systems, Text Generation, Text Summarization, Machine Translation, Chatbot Development.	15 Hours	CO3
	Multimodal and Responsible Generative AI:		

4	Diffusion Models, Text-to-Image Generation, Text-to-Video Generation, Multimodal AI Systems, AI Agents, AI Copilots, Model Evaluation, Model Benchmarking, Ethical AI Practices, Responsible AI, Bias and Fairness, Privacy in Generative AI, Security Challenges, Explainable AI, Future Trends in Generative AI, Emerging Applications of Generative AI.	15 Hours	CO4

Suggested Readings:

1. Foster, David. Generative deep learning. " O'Reilly Media, Inc.", 2022.
2. Alammar, Jay, and Maarten Grootendorst. Hands-on large language models: language understanding and generation. " O'Reilly Media, Inc.", 2024.
3. Poornima, R., et al. Generative AI: Foundations & Concepts. BR Publications, 2026.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs137
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs104

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
CO2	3	2	3	1	3				1			2	2
CO3	2	3	3	2	3						1	2	2
CO4	1	2	1	2	1	3	1				1	1	1

Program	B.Tech CSE(AIBC)				
Year	IV	**Semester**	VII		
Course Name	Generative Artificial Intelligence Lab				
Code	RAIBC5751				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic concepts of AI and Deep Learning	0	0	2	1
Course Objectives	1. To provide hands-on experience in Generative Artificial Intelligence tools and frameworks. 2. To implement basic generative models such as GANs, VAEs, and Transformers. 3. To develop skills in prompt engineering and large language model applications. 4. To enable students to build simple AI applications like text, image, and content generation systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Apply Python and deep learning tools for Generative AI programming.				
CO2	Implement basic generative models such as GANs and VAEs.				
CO3	Develop applications using LLMs and prompt engineering techniques.				
CO4	Build simple Generative AI-based applications for real-world problems.				

S. No.	List of Experiments	Mapped CO
1	Write a program to use Python libraries such as NumPy, Pandas, and Matplotlib for data loading, preprocessing, and visualization for AI applications.	CO1
2	Write a program to perform basic deep learning operations using TensorFlow or PyTorch including tensor creation, forward propagation, and model evaluation.	CO1
3	Write a program to preprocess text data for Generative AI applications using tokenization, stopword removal, and encoding techniques.	CO1
4	Write a program to build and train a basic Autoencoder for data compression and reconstruction.	CO2
5	Write a program to implement a simple Variational Autoencoder (VAE) for generating new synthetic data samples.	CO2
6	Write a program to design and train a basic Generative Adversarial Network (GAN) for image or data generation.	CO2
7	Write a program to generate text using a pre-trained Large Language Model (LLM) such as GPT for text completion tasks.	CO3
8	Write a program to perform prompt engineering experiments using LLM APIs to improve response quality and accuracy.	CO3
9	Write a program to build a chatbot using a transformer-based model for conversational AI applications.	CO3
10	Write a program to develop a simple real-world Generative AI application such as text summarization, image generation, or Q&A system using pre-trained models.	CO4

Suggested Readings:

1. Foster, David. Generative deep learning. " O'Reilly Media, Inc.", 2022.
2. Alammar, Jay, and Maarten Grootendorst. Hands-on large language models: language understanding and generation. " O'Reilly Media, Inc.", 2024.
3. Poornima, R., et al. Generative AI: Foundations & Concepts. BR Publications, 2026.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs137
2. https://www.youtube.com/watch?v=adtCAEdTT2c

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

Program	B. Tech CSE(AIBC)					
Year	IV	**Semester**	VIII			
Course Name	Cyber Security and Computer Forensics					
Code	RCS5801					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Computer Networks & Fundamentals of Information Security	3	1	0	4	
Course Objectives	1. Understand the fundamental concepts, threats, vulnerabilities, and defense mechanisms in cyber security. 2. Apply security technologies and tools to protect computing systems, networks, and digital assets. 3. Analyze cyber incidents and perform digital forensic investigations using standard methodologies. 4. Develop skills in evidence collection, preservation, analysis, reporting, and ethical/legal aspects of cyber forensics.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain cyber security principles, cyber threats, attacks, vulnerabilities, and security controls.					
CO2	Apply network, system, and application security mechanisms to secure digital infrastructures.					
CO3	Perform digital forensic investigation including evidence acquisition, preservation, analysis, and reporting.					
CO4	Evaluate legal, ethical, and professional issues associated with cybercrime investigation and cyber security management.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Cyber Security**: Introduction to Cyber Security, Cyber Space and Security Challenges, Information Security Concepts, CIA Triad, Threats, Vulnerabilities and Risks, Types of Cyber Attacks, Malware, Phishing, Social Engineering, Password Attacks, Denial of Service (DoS/DDoS), Security Policies and Standards, Risk Assessment and Risk Management**.**	15 Hours	CO1
2	**Network and System Security:** Network Security Fundamentals, Firewalls and Intrusion Detection Systems, Intrusion Prevention Systems, Virtual Private Networks (VPN) and Secure Communication, Authentication and Access Control, Cryptography Fundamentals, Symmetric Encryption, Asymmetric Encryption, Hash Functions, Digital Signatures, Wireless Security, Cloud Security Basics.	15 Hours	CO2
3	**Digital Forensics**: Introduction to Digital Forensics, Digital Forensic Process, Evidence Identification and Preservation, Disk Forensics, File System Analysis, Data Recovery Techniques, Memory Forensics, Email and Browser Forensics, Mobile Device Forensics, Forensic Tools and Utilities.	15 Hours	CO3
4	**Cyber Crime Investigation and Legal Issues**: Cyber Crimes and Classification, Cyber Crime Investigation Process, Incident Response and Handling, Chain of Custody, Digital Evidence Management, Cyber Laws and Regulations,	15 Hours	CO4

	Information Technology (IT) Act and Legal Framework, Ethical Issues in Cyber Security, Professional Responsibilities, Emerging Trends in Cyber Security and Digital Forensics.		

Suggested Readings

1. DeFranco, Joanna F., and Bob Maley. What every engineer should know about cyber security and digital forensics. CRC Press, 2022.
2. Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
3. Ghonge, Mangesh M., et al., eds. Cyber security and digital forensics: Challenges and future trends. John Wiley & Sons, 2022.

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	3	2	-	-	1	-	-	-	-	-	1	3	1
CO2	3	3	2	1	3	-	-	-	-	-	1	3	3
CO3	2	3	2	3	3	-	-	1	1	-	1	2	3
CO4	1	2	-	1	-	2	3	1	2	1	1	1	2

Program	B.Tech CSE (AIBC)				
Year	III	**Semester**		VI	
Course Name	Blockchain and Distributed Ledger Technology				
Code	RPEC54111				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Computer Networks and Distributed Systems	2	1	0	3
Course Objectives	**1.** Blockchain technology and the key concepts like cryptography and cryptocurrency concepts **2.** Gain a deep insight into Bitcoin, its network and how Bitcoin transactions are validated by miners **3.** Interpret the prospects of Blockchain and assess how Blockchain can improve your business standards **4.** Design, build, and deploy smart contracts and distributed applications,				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand how blockchain solutions are transforming the industry landscape.				
CO2	Develop a deeper understanding of blockchain technical topics such as consensus, cryptography, privacy and security.				
CO3	Explain design principles of Bitcoin and Ethereum.				
CO4	Understand the Cryptocurrency and research activities on blockchain network.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basic:** Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof. **Blockchain:** Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.	15 Hours	CO1
2	**Distributed Consensus:** Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. **Cryptocurrency:** History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.	15 Hours	CO2, CO3
3	**Cryptocurrency Regulation:** Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain. **PROJECT:** Research Activities on Blockchain network.	15 Hours	CO4

Suggested Readings:

1. IBM, IBM Blockchain Courseware, IBM Corporation, Latest Edition.
2. Nitin Gaur, Luc Desrosiers, Petr Novotny, Siddhartha Baset, Salman A. Baset, and Venkatraman Ramakrishna, Hands-On Blockchain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer, Packt Publishing, 2018.

Online Resources:

1. NPTEL: Computer Science and Engineering - NOC: Blockchain and its Applications.

   https://onlinecourses.nptel.ac.in/noc26_cs34

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

Program	B.Tech CSE (AIBC)				
Year	III	**Semester**	VI		
Course Name	Cloud-Native Application Development				
Code	RPEC54112				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Hybrid Cloud	2	1	0	3
Course Objectives	**1.** Describe the characteristics of cloud-native applications. **2.** Understand hybrid cloud concepts and benefits. **3.** Explain application modernization with hybrid cloud. **4.** Explain the concepts and use of container technology and containerized applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the vision of Cloud native application development from a global context.				
CO2	Applying and analyzing RedHat OpenShift architecture and APIs with application development.				
CO3	To evaluate the application of DevOps with Redhat Open Shift architecture in industrial Automation.				
CO4	Creating projects and research activities based on application development with Redhat OpenShift.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Hybrid Clouds:** Definition of Cloud native applications, Understand concepts of hybrid cloud and its connectivity, Understand application modernization with hybrid cloud, Concept of security architecture in hybrid cloud, Definition of Multi-Cloud **Foundations of Cloud Native Application Development:** Understand twelve-factor app methodology, Linux containers, Introduction to Microservices architecture and its integration Architecture of IBM Kubernetes Service, Virtual machines and Containers isolation, Rapid security patching by using container image layering, DevOps	15 Hours	CO1
2	**Architecture overview of IBM Kubernetes Service (IKS):** Technical architecture of Kubernetes Container Platform, Pods, Role of master nodes, and worker nodes, Role of scheduler, Services and Routes with working, Persistent storage and list its benefits with Kubernetes, external routing into Kubernetes applications and the router‘s role, Internal routing within Kubernetes, Workflow of a pod deployment in Kubernetes **Introduction to Red Hat OpenShift on IBM Cloud:** Introduction Red Hat OpenShift on IBM Cloud architecture, Key features of Red Hat OpenShift, Understand namespaces, users, and resource quota limits, application creation and auto scaling processes.	15 Hours	CO2

3	**Configuring applications on Red Hat OpenShift:** Understand application configuration concepts, Role of volumes in cloud native application development, Concept of persistent volumes, What are environment variables, Concept of secrets, what are ConfigMap, Articulate downward API. **DevOps for Red Hat Open Shift applications on IBM Cloud:** Challenges of application integration, Features of continuous integration (CI) and its best practices, Understand workflows, their benefits, and their tools, Introduction to DevOps Practices, Continues Delivery, Understand deployment pipeline process, Explain DevSecOps and why it is important, Understand tool chains on IBM Cloud.	15 Hours	CO3, CO4

Suggested Readings:

1. Graham Dumpleton, Deploying to OpenShift: A Guide for Busy Developers, Red Hat, 2016.
2. Cornelia Davis, Cloud Native Patterns: Designing Change-Tolerant Software, Manning Publications, 2019.
3. Michael Hausenblas and Stefan Schimanski, Programming Kubernetes: Developing Cloud-Native Applications, O'Reilly Media, 2019.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs42/preview

Course Articulation Matrix													
PO- PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**
CO 1	2	2			2								
CO 2	2	2			3							2	2
CO 3	2	2	3									2	1
CO 4	2	2	2		2							2	2

Program	B. Tech CSE (AIBC)				
Year	III	**Semester**	VI		
Course Name	Pattern Recognition				
Course Code	RPEC54113				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Probability, Linear algebra, ML, Python	2	1	0	3
Course Objectives	1. Learn the fundamental concepts and applications of pattern recognition. 2. Understand the fundamental concepts of Pattern Recognition. 3. Evaluate the learning of the Models. 4. Develop some applications of pattern recognition.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the fundamental pattern recognition and machine learning theories.				
CO2	Analyze certain important pattern recognition techniques.				
CO3	Evaluate systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns.				
CO4	Applying the pattern recognition theories to applications of interest.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Pattern Recognition, Basics of pattern recognition and application, Design principles of pattern recognition system, Learning and adaptation, Types of learning in pattern recognition. Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.	15 Hours	CO1
2	**Statistical Pattern Recognition:** Bayesian Decision Theory, Classifiers, Normal density, Discriminant functions. Parameter Estimation Methods: Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods, Principal Component Analysis (PCA), Fisher Linear discriminate analysis, Expectation maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.	15 Hours	CO2
3	**Nonparametric Techniques and Unsupervised Learning:** Introduction to nonparametric models, decision boundaries in non-parametric method. Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification, Clustering, Criterion functions for clustering, Clustering Techniques, Iterative square - error partitioned clustering – K means, Agglomerative hierarchical clustering, Cluster validation.	15 Hours	CO3

Suggested Readings:

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, 2nd Edition, John Wiley, 2006.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.
3. S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, 4th Edition, Academic Press, 2009.

Online Resources:

1. https://nptel.ac.in/courses/106106046
2. https://nptel.ac.in/courses/106108057
3. https://nptel.ac.in/courses/117106100
4. https://nptel.ac.in/courses/117108048

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

Program	B.Tech CSE (AIBC)				
Year	III	**Semester**		VI	
Course Name	Fintech and Blockchain				
Code	RPEC54114				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Computer Science and Finance (optional)	2	1	0	3
Course Objectives	1. To introduce students to the emerging field of financial technologies (Fintech). 2. To provide foundational knowledge of blockchain and its applications. 3. To explore real-world use cases in banking, insurance, payments, and investment. 4. To develop hands-on skills through tools, platforms, and mini-projects				

Course Outcomes: After successful completion of the course, the students will be able to:	
CO1	Understand the components and services in the Fintech ecosystem. Gain awareness of regulatory frameworks and recent trends in India.
CO2	Gain foundational knowledge of how blockchain works. Learn basic programming with smart contracts using Solidity.
CO3	Understand how blockchain is transforming financial services. Analyze key applications and ongoing initiatives in India (e.g., RBI's CBDC pilot).
CO4	Recognize and critically assess challenges in adoption. Apply learning to a practical project simulating real-world fintech/blockchain solutions.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Fintech:** Evolution of Fintech: Traditional Finance vs Fintech, Fintech Ecosystem: Stakeholders, Startups, and Regulators Digital Banking: Neo-banks, Core Banking System Payments: UPI, Mobile Wallets, QR Codes, RTGS, IMPS Fintech Regulations in India: RBI, SEBI Guidelines	15 Hours	CO1
2	**Fundamentals of Blockchain:** Blockchain Basics: Blocks, Hashes, Nodes, Consensus, Types of Blockchains: Public, Private, Consortium, Distributed Ledger Technologies (DLT), Cryptographic Foundations: SHA-256, Merkle Trees, Digital Signatures, Smart Contracts: Introduction using Ethereum,Blockchain Platforms: Bitcoin, Ethereum, Hyperledger	15 Hours	CO2

3	**Blockchain in Fintech Applications:** Blockchain in Payments: Crypto Payments, Cross-border Transactions DeFi (Decentralized Finance): Lending, Borrowing, Yield Farming, Tokenization of Assets (NFTs, Digital Gold, Real Estate) Blockchain in Insurance: Claims, Underwriting, Fraud **Prevention Central Bank Digital Currency (CBDC):** e-Rupee and Global Trends Emerging Trends, Challenges, and Capstone Project Regulatory Challenges and Ethical Concerns Cybersecurity in Fintech and Blockchain Artificial Intelligence in Fintech (Robo-Advisors, Fraud Detection) Capstone Project: Build a basic DApp or Fintech use case prototype, Industry Tools: MetaMask, Remix IDE, Polygon, Firebase	15 Hours	CO3, CO4

Suggested Readings:

1. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, Apress, 2017.
2. Pranay Gupta and T. Mandy Tham, Fintech: The New DNA of Financial Services, De Gruyter, 2019.
3. Reserve Bank of India (RBI) and Securities and Exchange Board of India (SEBI), Official Circulars and Guidelines on FinTech Regulations, Government of India, Latest Edition.
4. Ethereum Foundation, Ethereum Documentation, Latest Edition. Hyperledger Foundation, Hyperledger Documentation, Latest Edition.

Online Resources:

1. https://nptel.ac.in/courses/106105235

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

Program	B.Tech CSE (AIBC)				
Year	III	**Semester**	VI		
Course Name	Network Security and Cryptography				
Code	RPEC54121				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Security Services and Mechanism	2	1	0	3
Course Objectives	1. Have a fundamental understanding of the objectives of cryptography and network security. 2. Getting familiar with the cryptographic techniques that provide information and network security. 3. To know the different types of algorithms for exchanging information in a secret way. 4. To know the possible threats which can break the secure communication.				

Course Outcomes: After successful completion of the course, the students will be able to:	
CO1	Understanding cryptography and network security concepts and applications.
CO2	Apply security principals to system design and real-time scenarios.
CO3	To evaluate the application of security with Digital Signature.
CO4	Analysis of network traffic and security threats.

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cryptography and Symmetric Ciphers** Security Attacks: Security Services and mechanism; Classical encryption techniques: Substitution ciphers and Transposition ciphers, Steganography, Cryptanalysis; Modern Block Ciphers: Stream and Block Cipher, Block Cipher Principles, Block Cipher Modes of Operations; Shannon's theory of Confusion and Diffusion; Feistel structure; Data Encryption Standard (DES); Strength of DES; Idea of differential cryptanalysis; Triple DES; Symmetric Key Distribution; Finite Fields: Introduction to groups, rings and fields, Modular Arithmetic, Euclidean Algorithm, Finite Fields of the form GF(p).	15 Hours	CO1
2	**Basics of Number Theory and Public Key Cryptography** Introduction to Number Theory: Prime and Relative Prime Numbers, Fermat's and Euler's theorem, Testing for Primality, Chinese Remainder Theorem, Discrete Logarithms. **Public Key Cryptography:** Principles of Public-Key Cryptography, RSA Algorithm, Security of RSA, Key Management, Diffie-Hellman Key Exchange, Elliptic curve cryptography.	15 Hours	CO2
3	**Hash Functions and Digital Signatures**: Message Authentication; Hash Functions; Secure Hash Functions; Security of Hash Functions and MACs; Digital Signatures; Digital Signature Standards (DSS); Proof of Digital Signature Algorithm; Advanced Encryption Standard (AES) encryption and decryption.	15 Hours	CO3, CO 4

	Network and System Security: Authentication : pplications: Kerberos, X.509 Certificates; Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME; IP Security: IP Security Architecture, Authentication Header (AH), IP security overview, IP security policy, Encapsulating Security Payload (ESP), Combining Security Associations. **Web Security:** Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET);Intruders; Viruses; Firewalls.		

Suggested Readings:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education, 2017.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, Tata McGraw-Hill Education, 2011.
3. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, John Wiley & Sons, 1996.

Online Resources:

1. http://swayam.gov.in/
2. https://nptel.ac.in/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO12**	**PSO1**	**PSO2**
CO1	2	2									1		
CO2	2	2									1	2	
CO3	2	2	3								1	3	2
CO4	2	2	2		2						1	3	2

Program	B. Tech CSE(AIBC)					
Year	IV	**Semester**	VI			
Course Name	Soft Computing					
Code	RPEC54122					
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. Understand the fundamental concepts, principles, and significance of soft computing techniques for handling uncertainty, imprecision, and complex decision-making problems. 2. Apply fuzzy logic, artificial neural networks, and evolutionary computing methods to model and solve real-world computational problems. 3. Analyze and evaluate the performance of intelligent systems developed using soft computing approaches in diverse application domains. 4. 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, Backpropagation Learning Algorithm ,Radial Basis Function Networks ,Applications of Neural Networks in Pattern Recognition and Prediction.	15 Hours	CO1, CO2
2	**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	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 (AIBC)				
Year	III	**Semester**		VI	
Course Name	Security Governance and Law				
Code	RPEC54123				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Security mechanism.	2	1	0	3
Course Objectives	1. Recognize and differentiate information security policies and strategies to guide the development of standards and procedures, in alignment with organizational goals and objectives. 2. Identify and analyze risk management processes and procedures to ensure compliance with applicable security, privacy laws and regulations 3. Identify incident response processes for detecting and responding to security risks 4. Determine the proper steps to implement comprehensive business continuity, disaster recovery, and incident response plans.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the concept of cyber security law and types.				
CO2	Analyze the misuses of electronics and international security for cyber fraud.				
CO3	To evaluate the application of IT Act 2000 & IT Amendment Act 2008.				
CO4	Copyright Infringe Remedies of Infringement Multimedia, Copyright issues Software Piracy.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Overview Security Types and Laws** Designing Trusted Operating Systems, Security Policies Methods of security, Trusted operating system design, Database Security, Multilevel databases, Proposals for Multilevel security, Administrating Security, Security planning, Risk analysis, Organization and security Policies, Legal, Privacy and Ethical Issues in Computer Security, International Cyber crimes	15 Hours	CO1
2	**Cyber Fraud and Electronic Misuse** Characteristics Cyber Fraud Offence, fraud related Offenses, Encryption in Crime and Terrorism- Law Enforcement Options, Data protection for system designers, Evaluation criteria and security testing **International standards** Analysis and Logging, Recovery and data backs, Security policy development, Security Models: Frameworks, Standards, Security Certification ISO 17799/ ISO 27001, System Security Engineering Capacity Maturity Model, Laws and Legal Framework for Information Security, Recovery and risk analysis, Operating system and application specific auditing.	15 Hours	CO2, CO3
3	**IT Act 2000 & IT Amendment Act 2008**: Introduction, Digital Signature, Secure Electronic records and secure digital signatures, Digital Signature Certificates, Offences covered under IT Act 2000, Major Amendments in IT Act, Understanding Copy Right in Information Technology: Understanding the technology of Software software-copyright vs Patent debate Authorship **Copy right and Legal Issues** Software Copyright Jurisdiction Issues, Copyright Infringe Remedies of Infringement Multimedia, Copyright issues	15 Hours	CO4

	Software Piracy, Patents understanding and Data Privacy laws: GDPR. **PROJECT:**Research Activities on Security Governance with projects and research letters. (POC on dataset).		

Suggested Readings:

1. Information Security Governance: A Practical Development and Implementation Approach (Wiley Series in Systems Engineering and Management Book 92) by Krag Brot Phillip. A. Laplante, ―Real-Time Systems Design and Analysis‖, second edition, PHI, 2005.
2. Information Security Governance Simplified: From the Boardroom to the Keyboard by Todd Fitzgerald
3. Handbook of Governance and Security Edited by James Sperling, Professor of Political Science, University of Akron, US Publication Date: 2014 ISBN: 978 1 78195 316 7 Extent: 752.

Online Resources:

1. https://nptel.ac.in/courses/106106129

Course Articulation Matrix													
PO- PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**
CO 1	2	2			2								1
CO 2	2	2			1								
CO 3	2	2	1									1	1
CO 4	2	2	2		2							1	2

Program	B.Tech CSE (AIBC)				
Year	III	**Semester**		VI	
Course Name	Cyber and Digital Forensics				
Code	RPEC54124				
Course Type	PEC	L	T	P	Credit
Pre-Requisite	Basic knowledge of Cyber Security	2	1	0	3
Course Objectives	1. Learn the security issues network layer and transport layer. 2. Be exposed to security issues of the application layer. 3. Learn computer forensics, tools and to analyse and validate forensics data. 4. Will gain the knowledge to implement various security attacks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand to the get the ideas in various ways to trace an attacker.				
CO2	Analyse and validate forensics data to satisfy.				
CO3	Evaluate the security in different layers.				
CO4	Apply the security tools to provide the security in Cyber.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to IT laws & Cyber Crimes** – Internet, Hacking, Cracking, Viruses, Virus Attacks, Pornography, Software Piracy, Intellectual property, Legal System of Information Technology, Social Engineering, Mail Bombs, Bug Exploits, and Cyber Security. **Legal and Ethical Principles:** Introduction to Forensics – The Investigative Process – Code of Ethics, Ethics of Investigations, Evidence Management – Collection, Transport, Storage, access control, disposition	15 Hours	CO1
2	**Forensic Science:** Principles and Methods – Scientific approach to Forensics, Identification and Classification of Evidence, Location of Evidence, Recovering Data, Media File Forensic Steps, Forensic Analysis – Planning, Case Notes and Reports, Quality Control	15 Hours	CO2
3	**Digital Forensics:** Hardware Forensics – Hidden File and Anti- forensics - Network Forensics – Virtual Systems - Mobile Forensics Digital Watermarking Protocols: A Buyer-Seller Watermarking Protocol, an Efficient and Anonymous Buyer- Seller Watermarking Protocol, Extensions of Watermarking Protocols, Protocols for Secure Computation **Application Forensics, Tools and Report Writing** – Application Forensics, Email and Social Media Investigations, Cloud Forensics, Current Digital Forensic Tools, Report Writing for Investigations.	15 Hours	CO3, CO4

Suggested Readings:

1. Bill Nelson, Christopher Steuart, Amelia Philips, ―Computer Forensics and Investigations‖, Delmar Cengage Learning; 5th edition January 2015
2. Chuck Eastom, ―Certified Cyber Forensics Professional Certification:, McGraw Hill, July

2017.
3. Nilakshi Jain, Dhananjay Kalbande, Digital Forensic : The fascinating world of Digital Evidences‖ Wiley India Pvt Ltd 2017.
4. John R.Vacca, Computer Forensics: Computer Crime Scene Investigation‖, Laxmi Publications, 2015.
5. MarjieT.Britz, Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
6. Clint P Garrison Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data, Syngress Publishing, Inc. 2010.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
2. https://onlinecourses.swayam2.ac.in/cec21_ge10/preview

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

Program	B.Tech CSE (AIBC)					
Year	IV	**Semester**	VII			
Course Name	Blockchain Architecture: Design and Use Cases					
Code	RPEC54131					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics knowledge of the Networking.		2	1	0	3
Course Objectives	1. Blockchain technology and the key concepts like cryptography and cryptocurrency concepts 2. Gain a deep insight into Bitcoin, its network and how Bitcoin transactions are validated by miners 3. Interpret the prospects of Blockchain and assess how Blockchain can improve your business standards 4. Deploy your private Blockchain on the web where you can visually see your chains & send transactions between nodes.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand how blockchain solutions are transforming the industry landscape.					
CO2	Analyse a deeper understanding of blockchain technical topics such as consensus, cryptography, privacy and security.					
CO3	Evaluate hands-on expertise using popular blockchain open source technology, including Hyperledger Fabric.					
CO4	Apply on design and develop for a permissioned Blockchain.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Blockchain prerequisites and Introduction to Blockchain** Introduction to Blockchain – I (Basics, History, Architecture, Conceptualization), Basic Crypto Primitives, Bitcoin Basics Distributed Consensus. **Blockchain in detail and Blockchain Status:** Consensus in Bitcoin – I (The Basics, PoW and Beyond, The Miners) Permissioned Blockchain (Basics, Consensus), Permissioned Blockchain(RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance), Blockchain for Enterprise – Overview Blockchain Components and Concepts	15 Hours	CO1
2	**Linux Foundation Hyperledger Project:** Hyperledger Fabric – Transaction Flow, Hyperledger Fabric Details, Hyperledger Fabric Membership and Identity Management, Hyperledger Fabric Network Setup, Hyperledger Fabric Demo on IBM Blockchain Cloud, Hyperledger Fabric Demo Deployment from Scratch. Hyperledger Composer – Application Development, Hyperledger Composer – Network Administration. **Blockchain Use Cases:** Blockchain in Financial Services (Payments and Secure Trading, Compliance and Mortgage, Financial Trade), Revolutionizing Global Trade, Blockchain in Supply Chain Management, Blockchain in Other Industries.Blockchain in Government: Advantages, Use Cases, Digital Identity, Hyperledger Indy, Tax Payments, and Land Registry Records.	15 Hours	CO2, CO3

3	**Blockchain Security:** Blockchain Security (Overview, Membership and Access control in Fabric, Privacy in Fabric), Blockchain Security (Fabric SideDB) Research Aspects (Consensus Scalability, Bitcoin-NG, Collective Signing, Byzcoin), Research Aspects (Algorand, Cross Fault Tolerance, Secured Multi-Party Computation), Blockchain for Science (Blockchain for Big Data, Blockchain and AI). **Project:** Research Activities on Blockchain network	15 Hours	CO4

Suggested Readings:

1. Nitin Gaur, Luc Desrosiers, Petr Novotny, Siddhartha Baset, Salman A. Baset, and Venkatraman Ramakrishna, Implementing Blockchain Solutions Using Hyperledger (also published as Hands-On Blockchain with Hyperledger), Packt Publishing, 2018.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs63/preview
2. https://archive.nptel.ac.in/courses/106/105/106105184/

Course Articulation Matrix													
PO- PS O	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO 1	2	1	2		1							1	3
CO 2	2	1		1								2	2
CO 3			1	1	2							3	3
CO 4	1		2	1	2							2	2

Program	B. Tech CSE (AIBC)					
Year	IV	**Semester**	VII			
Course Name	Robotics					
Code	RPEC54132					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of mathematics, control systems, and programming		2	1	0	3
Course Objectives	1. Understand the fundamental concepts of digital image processing, image formation, and visual perception used in computer vision systems. 2. Apply image enhancement, filtering, segmentation, and feature extraction techniques for analyzing visual data. 3. Develop computer vision solutions using machine learning and deep learning techniques for object detection, recognition, and classification. 4. Design and evaluate vision-based systems for motion analysis, tracking, scene understanding, and real-world intelligent applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain image formation models, image representation, and fundamental image processing operations.					
CO2	Apply filtering, edge detection, segmentation, and feature extraction techniques to solve image analysis problems.					
CO3	Implement machine learning and deep learning methods for image classification, object detection, and recognition tasks.					
CO4	Analyze and develop computer vision applications involving motion estimation, object tracking, video analytics, and intelligent vision systems.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Robotic Systems:**-Overview and Preliminaries- Biological Paradigms and Biomimetic Robots- Manipulator Architectures and Kinematics (DH Parameters, Forward Kinematics, Jacobian, Singularity)- Sensors and Actuators (Encoders, IMUs, Motors, LIDAR, Ultrasonic)- Low-Level Robot Control (Open-loop vs Closed-loop, PWM, PID Basics)- Mobile Robots (Differential Drive, Omnidirectional)- Controller Hardware/Software (Microcontrollers, SBCs, RTOS)- Sensor Integration (ADC, Filtering, Kalman Filter)	15 Hours	CO1
2	**Intelligent Systems and Control:**- Rule-Based Expert Systems (Structure, Inference Chaining, Conflict Resolution)- Fuzzy Expert Systems (Fuzzy Sets, Linguistic Variables, Inference & Defuzzification)- Applications of Fuzzy Logic (Obstacle Avoidance, Path Planning)- Genetic Algorithms (Simulation of Evolution, Genetic Operators, Fitness Function)- Applications in Robotics (Trajectory Optimization, Gait Generation)- Simulation and Control using Simulink- PID Controller Design and Tuning- Fuzzy Controller Implementation- Stability and Performance Evaluation (Bode, Root-Locus) **Neural Networks:**- Learning Processes and Biological Inspiration- Single Layer Perceptron (Structure, Limitations)- Multilayer Perceptron (Architecture, Backpropagation, Activation Functions)- Regularization and Overfitting- Radial Basis Function Networks (Gaussian Basis, Center Selection,	15 Hours	CO2

	Applications)- Self-Organizing Maps (Competitive Learning, Unsupervised Mapping)- Learning Vector Quantization Networks (Prototype-based Classification)		
3	**Goal-Oriented Control:**- Optimal Control (LQR Design, Cost Functions, Pontryagin's Principle)- Robust Control (Uncertainty Models, H∞ Control, Loop Shaping)- Adaptive Control (Model Reference Adaptive Control, Lyapunov Stability, Gain Scheduling)- Neural Control (Neuro-Adaptive Controllers, Reinforcement Learning - Q-Learning, DQN)- Task Planning (RRT, PRM, A*, D* Lite)- Multi-Agent Systems (Coordination, Consensus, Decentralized SLAM)- ROS Communication (Publish/Subscribe, Services, Actions)	15 Hours	CO3, CO4

Suggested Readings:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, September 30, 2022 Springer
2. James F James F. Peters, "Foundations of Computer Vision, Computational Geometry, Visual Image, Structures and Object Shape Detection", 124, Springer
3. E. R. Davies, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Fourth Edition, 2012, Elsevier
4. Ramesh Jain, Rangachar Kasturi, Brian G. Schunck,"MACHINE VISION", McGraw-Hill, Inc., ISBN 0-07-032018-7, 1995

Online Resources:

1. https://nptel.ac.in/courses/107106090

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

Program	B.Tech CSE (AIBC)					
Year	IV	**Semester**	VII			
Course Name	Big Data Security					
Code	RPEC54133					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Knowledge of SQL, Data Warehousing, and Database Knowledge.	2	1	0	3	
Course Objectives	1. Understand the Big Data Security module and introduce the concepts of Big Data. 2. Understand & define security control –core disciplines. 3. Analyze and monitor the data usage. 4. Apply the data protection laws for secure the data.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	To understand Big Data, Big Data use cases and Capabilities, Big Data Architecture Security goals, controls.					
CO2	Analyze and classifying sensitive data, Remediation plans, Security Perimeters Encryption of data.					
CO3	To Understand the Kerberos, Identity management, Activity Monitoring, Apache Knox overview.					
CO4	Understand the Guardium overview, working with Data in motion, implementing Masking, Data life cycle management, Access Management, Case studies & hands on.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Big Data** Explain what Big Data is Reviewing concept of Big data capabilities, use cases & Architecture Explain Threats Introduction to Security Disciplines.	15 Hours	CO1
2	**Securing & Protecting Data** Understand how to identify data for down streaming processes, Understand how to integrate, process, generate data, Understand Security perimeter for security Management, Know how Access management and Auditing works.	15 Hours	CO2
3	**Monitor, Enforce and Audit** Understand Guardium data activity Monitoring, Benefits of Big Infosphere Guardium, Understand Architecture of Guardium, Hands-on experience with all of them. **Data Protection Laws for Big data** Explain GDPR Laws, Explain ILG (Lifecycle Governance), ISO 27000 Series HIPAA	15 Hours	CO3, CO 4

Suggested Readings:

1. IBM, IBM Courseware, IBM Corporation, Latest Edition.

Online Resources:

1. https://nptel.ac.in/courses/106104189

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

Program	B. Tech CSE (AIBC)					
Year	IV	**Semester**	VII			
Course Name	Computer Vision					
Code	RPEC54134					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine Learning, Computer Graphics		2	1	0	3
Course Objectives	1. Understand the fundamental concepts of image formation, image representation, and image processing techniques used in computer vision systems. 2. Apply filtering, edge detection, and feature extraction methods for analyzing and enhancing digital images. 3. Develop computer vision solutions using deep learning models for image classification, object detection, segmentation, and recognition tasks. 4. Analyze motion, feature correspondence, and video understanding techniques to solve real-world vision-based applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain image formation models, image representation techniques, and fundamental image processing operations used in computer vision					
CO2	Apply filtering, edge detection, and feature extraction techniques to enhance and analyze digital images.					
CO3	Implement deep learning-based computer vision models for image classification, object detection, segmentation, and recognition tasks					
CO4	Apply feature detection, feature matching, motion estimation, and video analysis techniques for understanding dynamic visual scenes.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to image processing, Image formation:** Geometric primitives and transformations, Photometric image formation, digital camera, Image processing: Point operators, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Model fitting and optimization, Variational methods and regularization, Markov random fields	15 Hours	CO1
2	**Linear Filtering:** Filter Kernels, Linear Filter Experiments, Linear Convolution Filtering, Selecting a Region-of-Interest, Adding Noise to Image, Mean Filtering, Median Filtering, Rank Order Filtering, Normal Distribution Filtering, Edges, Lines, Corners, Gaussian Kernel and Voronoï Meshes Linear Function, Edge Detection, Double Precision Laplacian Filter, Enhancing Digital Image Edges, Gaussian Kernel, Gaussian Filter, Image Gradient Approach to Isolating Image Edges	15 Hours	CO2
3	**Deep Learning:** Supervised learning, Unsupervised learning, Deep neural networks, Convolutional neural networks, More complex models Recognition: Instance recognition, Image classification, Object detection, Semantic segmentation, Pose estimation, Video understanding, Vision and language Feature detection and matching: Edges and contours, Contour tracking, Lines and vanishing points, Segmentation Motion estimation: Translational alignment, Parametric motion, Optical flow, Layered motion Computational photography, High dynamic range imaging, Super-	15 Hours	CO3, CO4

	resolution, denoising, and blur removal, Image matting and compositing, Video matting, Texture analysis and synthesis		

Suggested Readings:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, September 30, 2022 Springer
2. James F James F. Peters, "Foundations of Computer Vision, Computational Geometry, Visual Image, Structures and Object Shape Detection", 124, Springer
3. E. R. Davies, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Fourth Edition, 2012, Elsevier
4. Ramesh Jain, Rangachar Kasturi, Brian G. Schunck,"MACHINE VISION", McGraw-Hill, Inc., ISBN 0-07-032018-7, 1995

Online Resources:

1. https://nptel.ac.in/courses/106105216

Course Articulation Matrix

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

Program	B. Tech CSE (AIBC)				
Year	IV	**Semester**		VIII	
Course Name	Distributed Systems				
Code	RPEC54141				
Course Type	PEC	L	T	P	Credit
Pre-Requisite	Operating System	2	1	0	3
Course Objectives	1. To learn issues related to clock synchronization and the need for global state in Distributed system. 2. Have knowledge and understanding of the main principles, techniques and Methods involved when dealing with distributed systems. 3. To get the knowledge of how distributed objects communicate by means of Remote invocation. 4. To learn distributed mutual exclusion and Deadlock detection algorithms.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the foundations and issues of distributed systems.				
CO2	Analyze distributed applications work and requirements they aim to satisfy				
CO3	Evaluate the various synchronization issues and global state for distributed system.				
CO4	Apply distributed applications work, techniques and infrastructures they are built upon.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to distributed systems:** Definitions and Examples of Distributed systems; System Models: Architectural models and Fundamental models; limitations of distributed systems. **Logical Clocks:** Lamport's clocks, Vector logical clock, NTP; Message Passing System: Causal ordering of messages, Sates of a Distributed system, Local and Global State, Consistent and inconsistent states; Termination detection.	15 Hours	CO1
2	**Mutual Exclusion:** Requirements of Mutual Exclusion, Classification of distributed mutual exclusion: Non-token based Quorum Based and Token Based mutual exclusion with examples; Performance metric for distributed mutual exclusion algorithms. **Deadlock Detection:** System models, Preliminaries, Deadlock prevention, Deadlock avoidance, Deadlock detection & resolution. **Agreement Protocols:** Classification of Agreement Problem: Byzantine agreement problem, Consensus problem, Interactive consistency Problem; Solution to Byzantine Agreement problem; Application of Agreement problem.	15 Hours	CO2
3	**Resource Management:** Distributed File Systems, Issues in distributed File System, Mechanism for building distributed file systems; Distributed Shared Memory, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory. **Failure Recovery:** Backward and Forward recovery, Recovery in Concurrent systems: Checkpoints; Recovery in Distributed Database Systems; Fault Tolerance: Issues in Fault Tolerance, Voting Protocols.	15 Hours	CO3, CO4

Suggested Readings:

1. Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill, 1994.
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 2003.
3. Vijay K. Garg, Elements of Distributed Computing, Wiley, 2002.
4. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, Pearson Education, 2011.
5. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems: Principles and Paradigms, Prentice Hall of India (PHI), 2007.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs87/preview
2. https://archive.nptel.ac.in/courses/106/106/106106168/

Course Articulation Matrix													
PO- PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	1	1	2							2	1
CO2	1	2	2	2	2							2	2
CO3	1	2	2	2	2							2	1
CO4	2	2	2	2	2							2	2

Program	B. Tech CSE (AIBC)				
Year	IV	**Semester**		VIII	
Course Name	Cryptography and Information Security				
Code	RPEC54142				
Course Type	PEC	L	T	P	Credit
Pre-Requisite	Basic knowledge of Operating System	2	1	0	3
Course Objectives	1. To understand basics of Cryptography and Network Security 2. To be able to secure a message over insecure channel by various means. 3. To learn about how to maintain the Confidentiality, Integrity and Availability. 4. To understand various protocols for network security to protect against the threats in the networks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the DES/AES standard.				
CO2	Analyze the different public key cryptography and authentication.				
CO3	Evaluate various authentication algorithms such like digital signature.				
CO4	Understand the IP security system and key management concepts.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cryptography and Block Ciphers:** Introduction to Security Attacks, Security Services and Mechanisms, Introduction to Cryptography, Conventional Encryption, Conventional Encryption Model, Classical Encryption Techniques, Substitution Ciphers, Transposition Ciphers, Cryptanalysis, Steganography, Stream Ciphers, Block Ciphers, Block Cipher Principles, Shannon's Theory of Confusion and Diffusion, Feistel Structure, Data Encryption Standard (DES), Strength of DES, Differential Cryptanalysis of DES, Linear Cryptanalysis of DES, Block Cipher Modes of Operation, Triple DES, AES. **Confidentiality and Modular Arithmetic**: Confidentiality using Conventional Encryption, Traffic Confidentiality, Key Distribution, Random Number Generation, Introduction to Graph, Ring and Field, Prime and Relative Prime Numbers, Modular Arithmetic, Fermat's Theorem, Euler's Theorem, Primality Testing, Euclid's Algorithm, Chinese Remainder Theorem, Discrete Algorithms.	15 Hours	CO1
2	**Public Key Cryptography and Authentication Requirements**: Principles of Public Key Cryptosystems, RSA Algorithm, Security of RSA, Key Management, Diffie–Hellman Key Exchange Algorithm, Introductory Idea of Elliptic Curve Cryptography (ECC), ElGamal Encryption, Authentication Requirements, Authentication Functions, Message Authentication Code (MAC), Hash Functions, Birthday Attacks, Security of Hash Functions and MACs.	15 Hours	CO2

3	**Integrity Checks and Authentication Algorithms:** MD5 Message Digest Algorithm, Secure Hash Algorithm (SHA), Digital Signatures, Authentication Protocols, Digital Signature Standards (DSS), Proof of Digital Signature Algorithm, Authentication Applications: Kerberos and X.509, Directory Authentication Service, Electronic Mail Security, Pretty Good Privacy (PGP), S/MIME. **IP Security and Key Management:** IP Security (IPSec) Architecture, Authentication Header (AH), Encapsulating Security Payload (ESP), Combining Security Associations, Key Management. **Web and System Security:** Web Security: Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). System Security: Intruders, Viruses and Related Threats, Firewall Design Principles, Trusted Systems.	15 Hours	CO3, CO4

Suggested Readings:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education.
2. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105162/

Course Articulation Matrix													
PO- PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2		2	3							2		1
CO2		2	3		2						2		2
CO3			1	2								2	1
CO4	2		2		2						2	2	2

Program	B. Tech CSE(AIBC)				
Year	IV	**Semester**		VIII	
Course Name	AI For Blockchain				
Code	RPEC54143				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of AI, ML, and Python programming	2	1	0	3
Course Objectives	1. To understand the fundamentals of Blockchain and Artificial Intelligence. 2. To explore the synergies between AI and Blockchain technologies. 3. To develop insights into implementing AI techniques within Blockchain systems. 4. To analyse the role of Blockchain in ensuring trustworthy AI systems.				

Course Outcomes :After successful completion of the course, the students will be able to:	
CO1	Understand the basic structure and types of blockchain systems and AI concepts.
CO2	Analyse blockchain architecture and implement smart contracts using Solidity.
CO3	Apply AI techniques for enhancing blockchain security and performance.
CO4	Integrate AI models with blockchain platforms like Hyper ledger Fabric.

Module	Course Contents	Contact Hours	Mapped CO
1	**Introduction to Blockchain and AI Integration: -**Overview of Blockchain Technology: History, structure, and types (public, private, and consortium). Introduction to AI: Concepts of AI, machine learning, deep learning, Integration of AI and Blockchain: Benefits and synergies. Use Cases: Decentralized AI models, AI-driven consensus mechanisms.	15 Hours	CO1
2	**Blockchain Fundamentals: -** Blockchain Architecture: Blocks, chains, consensus mechanisms (PoW, PoS, BFT). Cryptographic Primitives: Hash functions, digital signatures, public-key cryptography. Smart Contracts: Concept, creation, and deployment. Ethereum and Solidity: Basics of programming smart contracts, **Integrate AI models:** Integrate AI models with blockchain platforms like Hyperledger Fabric, Enable secure and transparent AI-driven applications,	15 Hours	CO2

3	**AI Techniques for Blockchain Enhancement: -** Machine Learning Applications: Anomaly detection, fraud prevention, and predictive analytics. ‘ Natural Language Processing: Smart contract auditing, documentation analysis. Reinforcement Learning: Optimizing consensus protocols.AI in Security: Blockchain threat detection and mitigation.	15 Hours	CO3, CO4

Suggested Readings:

1. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, Apress, 2017.
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 2021.

Online Resources:

1. Hyperledger and Ethereum official documentation
2. IEEE/ACM Research Papers on AI-Blockchain integration
3. Online platforms: Coursera, edX, MIT Open Courseware, GitHub Projects

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

Program	B.Tech CSE(AIBC)				
Year	IV	**Semester**	VIII		
Course Name	Natural Language Processing				
Course Code	RPEC54144				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python with Image Processing	2	1	0	3
Course Objectives	1. To learn fundamentals of text processing and statistical modeling. 2. To understand the transition from traditional NLP to Generative AI. 3. To evaluate and implement Large Language Models (LLMs). 4. To analyze the ethical implications and biases in AI-driven language systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understating leading trends and systems in natural language processing.				
CO2	Understating parsing of language				
CO3	Understating the syntactic, semantics, pragmatics of the language processing and familiarize with application of NLP				
CO4	Understand approaches to discourse, generation, dialogue and summarization with NLP				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations & Pre-processing:** History of NLP; Tokenization; Lemmatization vs. Stemming; Word Embeddings (Word2Vec, GloVe); Vector Databases; NLP vs. LLMs; Future of Human-Computer Interaction	15 Hours	CO1
2	**Sequence Modeling:** N-grams; Hidden Markov Models (HMM); Part of Speech Tagging; Recurrent Neural Networks (RNNs); LSTMs; The Attention Mechanism; Introduction to Transformers.	15 Hours	CO2
3	**Syntax, Semantics & LLMs** Dependency Parsing; Named Entity Recognition (NER); **Encoder-Decoder Architectures** (BERT, GPT, T5); Fine-tuning vs. **Prompt Engineering**; RAG (Retrieval-Augmented Generation). **Discourse & Ethics** Coherence and Cohesion; Sentiment Analysis; **AI Ethics**: Bias in NLP, Hallucinations, Sustainability; Dialogue Systems and Multi-modal NLP.	15 Hours	CO3, CO4

Suggested Readings:

1. Jurafsky & Martin: Speech and Language Processing, 3rd Edition Draft (2023/24) — Essential for modern LLM theory.
2. Lewis Tunstall et al.: Natural Language Processing with Transformers, O'Reilly, 2022.
3. Jay Alammar: The Illustrated Transformer (Online Resource).

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs56/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs87/preview

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

Program	B.Tech.(CSE)				
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)				
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)					
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)					
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)					
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)					
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)					
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)					
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