BABU BANARASI DAS UNIVERSITY
School of Engineering
(School Code: 04) (University Branch Code: 39)
Department of Computer Science and Engineering
Bachelor of Technology: Computer Science and Engineering
(Artificial Intelligence)
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
ESC	RCS5101	Computer Concepts and Programming in C	3	0	0	40	60	100	3
ESC	RCS5151	Programming in C 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 and 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**	**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**

SEMESTER II					
Course	**Course**	**Course Title**	**Contact**	**Evaluation Scheme**	**Credit**

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Category	Code		Hours						
			L	T	P	CIA	ESE	Total	
BSC	RBS5203	Discrete Mathematics	3	1	0	40	60	100	4
ESC	RCS5201	Programming Concepts with Python	3	0	0	40	60	100	3
ESC	RCS5251	Python Programming Lab	0	0	2	40	60	100	1
GP	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 and 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**

SEMESTER III

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credit
			L	T	P	CIA	ESE	Course Total	

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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
MC	RMC5311	Startup and Innovation	2	0	0	40	60	100	2
PCC	RCS5306	Core and Advance Java	3	1	0	40	60	100	4
PCC	RCS5305	Data Structure Using 'C'	3	1	0	40	60	100	4
PCC	RCS5307	Digital Logic Design	3	0	0	40	60	100	3
PCC	RCS5355	Data Structure Using 'C' Lab	0	0	2	40	60	100	1
PCC	RCS5357	Digital Logic Design Lab	0	0	2	40	60	100	1
PCC	RCS5356	Core and Advance Java 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			**15**	**4**	**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	RCS5404	Operating Systems	3	1	0	40	60	100	4
PCC	RAI5402	Computer Organization and Architecture	3	1	0	40	60	100	4
PCC	RCS5401	Database Management Systems	3	1	0	40	60	100	4
PCC	RAI5401	Concepts of Machine Learning With Python	3	0	0	40	60	100	3
PCC	RCS5454	Operating Systems Lab	0	0	2	40	60	100	1
PCC	RCS5451	Database Management Systems Lab	0	0	2	40	60	100	1
PCC	RAI5451	Machine Learning Lab	0	0	2	40	60	100	1
MC	RMC5401	Indian Constitution	1	0	0	40	60	100	1
GP	RGP5401	General Proficiency	-	-	-	100	-	100	1
Total			**17**	**5**	**6**	**500**	**600**	**1100**	**26**

SEMESTER V

Course Category	**Course Code**	**Course Title**	**Contact Hours**	**Evaluation Scheme**	**Credit**

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			L	T	P	CIA	ESE	Course Total	
HSMC	RHS5501	AI Economy and Digital Innovation	2	1	0	40	60	100	3
PCC	RCS5501	Automata Theory and Formal Languages	3	1	0	40	60	100	4
PCC	RCS5502	Computer Networks	2	1	0	40	60	100	3
PCC	RAI5501	Concepts of Data Science with Python	3	1	0	40	60	100	4
BSC	RBS5515	Optimization Techniques	3	1	0	40	60	100	4
MC	RMC5501	Essence of Indian Knowledge Tradition	1	0	0	40	60	100	1
PCC	RCS5552	Computer Networks Lab	0	0	2	40	60	100	1
PCC	RAI5551	Data Science with Python Lab	0	0	2	40	60	100	1
PSI	RAI5553	Minor Project-I	0	0	2	100	-	100	1
GP	RGP5501	General Proficiency	-	-	-	100	-	100	1
Total			**14**	**5**	**6**	**520**	**540**	**1000**	**23**

SEMESTER VI

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credit
			L	T	P	CIA	ESE	Course	
HSMC	RHS5601	Industrial Management	2	1	0	40	60	100	3
PEC	(RPEC53911-14)	**Professional Elective Course-I**	2	1	0	40	60	100	3
PEC	(RPEC53921-24)	**Professional Elective Course-II**	2	1	0	40	60	100	3
PCC	RCS5603	Design and Analysis of Algorithms	3	1	0	40	60	100	4
PCC	RCS5604	Deep Learning	3	0	0	40	60	100	3
PCC	RCS5653	Design and Analysis of Algorithms Lab	0	0	2	40	60	100	1
PCC	RCS5605	Deep Learning Lab	0	0	2	40	60	100	1
PSI	RAI5652	Minor Project-II	0	0	2	100	-	100	1
PSI	RAI5653	Seminar	0	0	2	100	-	100	1
GP	RGP5601	General Proficiency	-	-	-	100	-	100	1
Total			**12**	**4**	**8**	**580**	**420**	**1000**	**21**

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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	(RPEC53931-34)	**Professional Elective Course-III**	2	1	0	40	60	100	3
OEC		**Open Elective I***	3	1	0	40	60	100	4
PCC	RAI5701	Natural Language Processing	3	0	0	40	60	100	3
PCC	RAI5702	Artificial Neural Networks	3	1	0	40	60	100	4
PCC	RCS5703	AI Ethics	2	0	0	40	60	100	2
PCC	RAI5751	Natural Language Processing Lab	0	0	2	40	60	100	1
PCC	RAI5752	Artificial Neural Networks Lab	0	0	2	40	60	100	1
PSI	RAI5753	Major Project I#	0	0	8	100	-	100	4
PSI	RAI5754	Industrial Training Evaluation	0	0	2	100	-	100	1
GP	RGP5701	General Proficiency	-	-	-	100	-	100	1
Total			**13**	**3**	**14**	**580**	**420**	**1000**	**24**

*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	(RPEC53941-44)	**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	RAI5851	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

#	Course Code	Professional Elective Course I	Credit
1	RPEC53911	Robotics and Intelligent System	3
2	RPEC53912	Introduction to Unmanned Aerial Vehicles	3
3	RPEC53931	System Modeling and Simulation	3
4	RPEC53914	Internet of Things	3
#	**Course Code**	**Professional Elective Course II**	**Credit**
1	RPEC53921	Cyber Law and Security	3
2	RPEC53922	Computer Vision	3
3	RPEC53923	Recommender Systems	3
4	RPEC53924	Block Chain Technology	3

#	Course Code	Professional Elective Course III	Credit
1	RPEC53913	Sentiment Analysis	3
2	RPEC53932	Soft Computing	3
3	RPEC53933	Evolutionary Multi-objective Optimization	3
4	RPEC53934	Bioinformatics	3

#	Course Code	Professional Elective Course IV	Credit
1	RPEC53941	Cloud Computing	3
2	RPEC53942	Data Mining and Ware Housing	3
3	RPEC53943	Introduction to Drones	3
4	RPEC53944	Computer Forensics	3

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

#	Course Code	Open Elective I	Credit
1	OE53101	Disaster Management	4
2	OE53201	Database Administration	4
3	OE53501	Quality Management	4
4	OE53301	Energy Management	4
#	**Course Code**	**Open Elective II**	**Credit**
1	OE53102	Concepts of Climate Smart Agriculture	4
2	OE53202	Computational Intelligence	4
3	OE53502	Product Development	4
4	OE53302	Non-Conventional Energy Resources	4

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

#	Course Code	Vocational Courses	Credit
1	RVC53911	Programming with Python	2
2	RVC53912	Fundamentals of Artificial Intelligence	2
3	RVC53913	Cyber Crime and Computer Forensics	2
4	RVC53914	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-AI)				
Year	I	Semester	I		
Course Name	Computer Concepts and Programming in C				
Code	RCS5101				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of logical reasoning	3	0	0	3
Course Objectives	1. To develop problem-solving skills using the C programming language. 2. To understand fundamental concepts of C such as data types, operators, control statements, arrays, strings, and functions. 3. To implement structured and modular programming techniques for real-world computing problems. 4. To apply pointers, file handling, searching, and sorting techniques in C programs.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand and apply the basic concepts of C programming including data types, variables, operators, and expressions.				
CO2	Develop programs using decision-making statements, loops, and arrays to solve computational problems.				
CO3	Implement functions, recursion, strings, and pointers using modular programming concepts.				
CO4	Design and develop C programs involving file handling.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**History and importance of C:** Components, Basic structure of C program, Translators: Compiler & Interpreter, Compiling and executing C programs, C tokens, Keywords and Identifiers and execution of a C program. Data types: Basic data types, Enumerated data types, derived data types. Constants and variables: declaration and assignment of variables, Symbolic Constants, Storage Classes in C: Automatic, register, static, extern **Operators and Expressions**: Arithmetic, relational, logical, assignment, increment/decrement and conditional operators, precedence of operators in an expression. **Standard I/O**: Standard Input/output functions, printf( ), scanf( ), getch( ), getchar( ), getche( ) etc.	15 Hours	CO1

2	**Control Statements:** if statement, if-else statement, nested if else statement, else if ladder, switch statements, restrictions on switch values, Use of break and default statement with switch. **Iteration and loops:** use of while, do while and for loops, nesting of loops, use of break and continue statements. **Functions:** Function Declaration, function Definition, function call, passing values between functions, Global and local variables and their scope, call by value and call by reference **Arrays:** Array notation and representation, multi-dimensional arrays, Strings. Structure, Union, Enumerated data types.	15 Hours	CO2, CO3
3	**Pointers:** Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free functions), Use of pointers in self-referential structures, notion of linked list. **File handling:** File I/O functions, Standard C pre-processors, defining and calling macros, command-line arguments.	15 Hours	CO4

Suggested Readings:

1. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Addison-Wesley, 2006.
2. E Balaguruswami, Computer Concepts and Programming in C, McGraw Hill, 2017.
3. Kernighan Brain W. and Ritchie Dennis M, the C programming, Pearson Education, 2023.
4. Reema Thareja, Computer Fundamentals and Programming in C, Oxford Publication, 2016.
5. Vikas Gupta, Computer Concepts and Programming in C, Wiley India Publication, 2018.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs40

Course Articulation Matrix

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

Program	B. Tech (CSE-AI)				
Year	I	**Semester**	I		
Course Name	Programming in C Lab				
Code	RCS5151				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of logical reasoning	0	0	2	1
Course Objectives	1. Understand the fundamentals of C programming and develop logical problem-solving skills. 2. Design and implement algorithms using structured programming concepts in C. 3. Apply concepts such as arrays, functions, pointers, and file handling to solve computational problems. 4. Develop debugging, testing, and program execution skills for real-world applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the fundamentals of C programming, data types, operators, input/output functions, and decision-making statements.				
CO2	Develop programs using looping constructs, functions, and problem-solving techniques for mathematical and logical applications.				
CO3	Apply arrays, strings, structures, unions, and pointers to solve computational problems effectively.				
CO4	Design and implement programs involving file handling and data management using C programming.				

S. No.	List of Experiments	Mapped CO
1	a) Programs using scanf( ) and printf( ) statements. b) To accept the values of int, float, char data types and display them	CO1,2
2	a) Program to demonstrate Relational and Logical Operators. b) Program to demonstrate Conditional (Ternary) Operator. c) Program to check whether a number is even or odd using the Modulus Operator	CO 1,2
3	a) Check whether a number is divisible by 5. b) Display grades (A, B, C, D, F) based on percentage. c) Check whether a number is an Armstrong number.	CO1,2
4	a) Find the sum of first N natural numbers. b) Generate the Fibonacci series. c) Convert a decimal number to binary.	CO1,2
5	a) Find out the sum of series $1^2 + 2^2 + \ldots + n^2$ b) Generate the following patterns * ** *** **** *****	CO2,3

	c) Generate the following patterns * *** ***** *******	
6	a) Program to swap two numbers using a function. b) Program to calculate the factorial of a given positive integer using a function.	CO3,4
7	a) Program to find the average of elements in a one-dimensional array. b) Program to find the transpose of a given matrix.	CO2,3
8	a) Program to create and display employee details using structures. b) Program to demonstrate memory sharing in a union.	CO2,3
9	a) Program to access a variable through a pointer. b) Program to demonstrate pointer arithmetic.	CO2,3
10	a) Program to Create and Write Data into a File. b) Program to copy contents from one file to another file.	CO3,4

Suggested Readings:

1. Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3 rd Edition, 2017.
2. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education, 6th Edition, 2012.
3. Yashavant Kanetkar, "Exploring C", BPB Publishers, 2nd Edition, 2003.
4. Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014

Online Resources:

1. https://ps-iiith.vlabs.ac.in/
2. https://www.vlab.co.in/ba-nptel-labs-computer-science-and-engineering

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

Program	B.Tech (CSE-AI)				
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 systems, industrial automation, robotics, smart manufacturing and applications of mechatronics in modern engineering systems..	15 Hours	CO4

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 –AI)					
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 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.	15 Hours	CO3, CO4

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-AI)				
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-AI)					
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 car 2. pentry, fitting, welding, machining, sheet metal, black-smithy, and foundry shops. 3. Impart hands-on skills in performing manufacturing operations such as cutting, shaping, joining, forming, machining, and casting. 4. Enhance safety awareness, precision, workmanship, and professional ethics while working in workshop environments.					
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.					

S. No.	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 panel box.	CO3
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

Online Resources:

1. https://www.vlab.co.in
2. https://nptel.ac.in
3. https://spoken-tutorial.org
4. http://msvs1-dei.vbalbs.ac.in

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

Program	B. Tech (CSE-AI)					
Year	I	Semester	II			
Course Name	Programming Concepts with Python					
Course Code	RCS5201					
Course Type	ESC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic Knowledge of Computer Fundamentals and Programming Concepts.	3	0	0	3	
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.	15 Hours.	CO1
2	**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.	CO2
3	**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	B.Tech (CSE-AI)					
Year	I	Semester	II			
Course Name	Python Programming Lab					
Code	RCS5251					
Course Type	ESC		L	T	P	Credit
Pre-Requisite	Basic Knowledge of Computer Fundamentals and Programming Concepts.		0	0	2	1
Course Objectives	1. Describe the core syntax and semantics of Python programming language. 2. Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets. 3. Discover the need for working with the functions, modules and packages. Infer the Object-oriented Programming concepts in Python. 4. Implement mini projects using python basic concepts					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Develop Python programs using basic programming constructs, operators, decision-making, and looping statements.					
CO2	Implement solutions using Python data structures, functions, and file handling techniques.					
CO3	Develop object-oriented Python programs and apply exception handling and modular programming concepts.					
CO4	Create simple Python applications utilizing libraries for data analysis and visualization					

S. No.	List of Experiments	Mapped CO
1	Write Python programs to perform arithmetic operations and demonstrate the use of different data types and operators.	CO1
2	Develop Python programs using conditional statements to determine the largest of three numbers, check leap year, and grade calculation.	CO1
3	Write Python programs using loops to generate multiplication tables, factorials, Fibonacci series, and prime numbers.	CO1
4	Implement Python programs for string manipulation, including palindrome checking, character counting, and string reversal.	CO2
5	Develop Python programs using lists, tuples, sets, and dictionaries to perform various operations such as searching, sorting, and updating elements.	CO2
6	Write Python programs using user-defined functions and recursive functions to solve mathematical and logical problems.	CO2
7	Implement file handling operations to create, read, write, append, and process text files in Python.	CO2
8	Develop Python programs using classes and objects to demonstrate constructors, inheritance, and polymorphism.	CO3
9	Write Python programs incorporating exception handling, modules, and packages for robust application development.	CO3
10	Create a mini-project using NumPy, Pandas, and Matplotlib for basic data analysis and visualization.	CO4

Suggested Reading:

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.
2. Paul Deitel and Harvey Deitel, Python for Programmers, Pearson Education, 2020.

Online Resources:

1. https://python-iitk.vlabs.ac.in/
2. https://www.vlab.co.in/participating-institute-iit-kanpur

Course Articulation Matrix													
PO/ PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PSO1**	**PSO2**
CO1	3	2	1	1	3							1	1
CO2	3	3	2	1	2							1	2
CO3	2	3	2	2	3							2	1
CO4	3	2	3	1	2							1	1

Program	B.Tech (CSE-AI)				
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
	Electrical Measuring Instruments: Essential components of indicating instruments, Smart permanent magnet moving coil instruments, moving iron instruments, Dynamometer		

3	wattmeter and Energy meter. **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.	15 Hours	CO3
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. Vincent Del Toro; Electrical Engineering Fundamentals; Englewood Cliffs, NJ: Prentice-Hall; 1986.
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				
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. Study of historical perspectives of AI and its foundations. 2. Understanding the fundamental principles of AI. 3. Study of advanced AI techniques; like soft computing and nature inspired computing. 4. 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, Artificial 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-AI)				
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 and 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 and Field)	CO4
9	Load Test on DC Machine & Efficiency Calculation	CO4
10	Transformer O.C. and S.C. Test and Performance Analysis	CO4

Suggested Reading:

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

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

Program	B.Tech (CSE-AI)					
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, cones in different positions.	CO2
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	CO3

	Method, using Top and Front, Top and Side views.	
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 Reading:

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.

Online 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-AI)					
Year	II	**Semester**	III			
Course Name	Startup and Innovation					
Code	RMC5311					
Course Type	MC	**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-AI)				
Year	II	**Semester**	III		
Course Name	Core and Advanced Java				
Code	RCS5306				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Programming Knowledge	3	1	0	4
Course Objectives	1. To impart the core language features of Java and its Application Programming Interfaces (API). 2. To demonstrate the use of threads, exceptions, files and collection frameworks in Java. 3. Understand the principles of inheritance, packages and interfaces. 4. Gain knowledge in the concepts of exception handling, swing and JDBC.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand to use the syntax and semantics of java programming language and basic concepts of Object-Oriented Programming (OOP).				
CO2	Analyse reusable programs using the concepts of Inheritance, Multithreading, Polymorphism, Interfaces.				
CO3	Evaluate the concepts of Packages, String Handling and Exception handling to develop efficient and error free codes.				
CO4	Apply the concept of advanced Java such as Swing Application and web related applications which mimic the real word scenarios.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to core java programming:** History and evolution, Features of java environment, Difference from C and C++, The java architecture, Java Development Kit, Types of Java programs, A sample Java program, Compilation and Execution, Variable Declaration, Data types in Java, Java Tokens, Variable Declaration, Type casting and conversion, Arrays, Operators in Java, Operators-Introduction, Operator Precedence, Control Statements, Introduction to classes, Instance Variables, Class Variables, Instances Methods, Constructors, Declaring Object, Garbage collection, Method Overloading, Constructor Overloading, this reference, Using objects in methods, Recursion, Access modifiers, Inner class.	15 Hours	CO1
2	**Inheritance**: Super class variables and subclass Objects, the super reference, Constructor chaining, Method overriding, The final keyword, Abstract Classes and Interfaces. **Exception handling:** Hierarchy of exception classes, Types of exception, Exception classes, Uncaught exceptions, User defined Exception	15 Hours	CO2
3	**Multithreaded Programming**: The Java Thread model, The runnable interface, The thread class, Thread creation, Thread's Life cycle, Thread scheduling, Synchronization and Deadlock, Inter-thread communication, Joining threads, Suspending, resuming and stopping threads, Wrapper classes, Input and output classes. **Packages**: Packages and access modifier, Recommended package naming convention, The Package Declaration, The CLASSPATH variable, The import statement, The Java	15 Hours	CO3

	language packages, Importance of Package Design, Access Protection		
4	**Handling string, input output classes:** Handling strings, Create Strings, Operations on strings, Character Extraction method, String comparison method, Searching and modifying strings, Data conversions and ValueOf ( ) methods, the StringBuffer classes and its methods, Hierarchy of classes in java.io package, File classes, InputStream and OutputStream classes. **Layout management and event handling Swing**: Swing packages, Structure of swing application, swing containers, **Advance Java:** JDBC architecture - JDBC connection, Servlets, Java Server Pages. Java Beans, Enterprise Java and Morden Framework.	15 Hours	CO4

Suggested Readings:

1. E. Balagurusamy, Programming with Java Third Edition- McGraw Hill Companies,2014.
2. Patrick Naughton and HerbertzSchildt, "Java-2: The Complete Reference", TMH, 1999.
3. Paul Dietel and Harvey Deitel, "Java How to Program", PHI, 8th Ed., 2010.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105191/
2. https://cse.iitkgp.ac.in/~dsamanta/java/index.htm

Course Articulation Matrix

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

Program	B. Tech (CSE-AI)				
Year	II	**Semester**	III		
Course Name	Data Structures Using 'C'				
Code	RCS5305				
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 analyze 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	15 Hours	CO3

	Implementation.		
4	**Graphs** 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	1
CO2	1	1	2	2	1							1	1
CO3	2	1	2	2	2							1	2
CO4	2	2	2	2	2							1	1

Program	B. Tech (CSE-AI)				
Year	II	**Semester**		III	
Course Name	Digital Logic Design				
Code	RCS5307				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Hardware Devices	3	0	0	3
Course Objectives	1. To Introduce the concept of digital and binary systems 2. Able to design and analyze combinational logic circuits. 3. Able to design and analyze sequential logic circuits. 4. To reinforce theory and techniques taught in the classroom through experiments and projects in the laboratory.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Define different number systems, binary addition and subtraction, 1' and 2's complement representation and operations with this representation.				
CO2	To implement logical operations using combinational logic circuits.				
CO3	Define the memory and programmable devices and their designing.				
CO4	Understand sequential circuits, like counters and shift registers, and to perform simple projects with them. Digital logic families.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Digital Design and Binary Numbers:** Binary Arithmetic, Negative Numbers and their Arithmetic, Floating point representation, Binary Codes, Cyclic Codes, Error Detecting and Correcting Codes, Hamming Codes. Min term and Max term Realization of Boolean Functions, **Gate-level minimization:** The map method up to four variables, don't care conditions, SOP and POS simplification, NAND and NOR implementation, QuineMc - Cluskey Method (Tabular method).	15 Hours	CO1
2	**Combinational Logic:** Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adder-Subtractor, Code Converters, Parity Generators and Checkers, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, Hazards and Threshold Logic. **Memory and Programmable Logic Devices:** Semiconductor Memories, RAM, ROM, PLA, PAL, Memory System design.	15 Hours	CO2, CO3
3	**Synchronous Sequential Logic:** Sequential Circuits, Storage Elements: Latches, Flip Flops, Analysis of Clocked Sequential circuits, state reduction and assignments, design procedure. Registers and Counters: Shift Registers, Ripple Counter, Synchronous Counter, Other Counters. **Asynchronous Sequential Logic:** Analysis procedure, circuit with latches, design procedure, hazards. Digital logic families: Introduction to Transistor-Transistor Logic (TTL) and CMOS Logic,	15 Hours	CO4

Suggested Readings:

1. Donald D. Givone, "Digital Principles and Design", Tata McGraw-Hill Education- 1st

Edition, 2003.
2. Marcovitz , Introduction to logic Design ,Tata McGraw-Hill Education- 3rd Edition, 2010.
3. Raj Kamal, Digital Systems Principle and Design, Pearson Education- 1st Edition, 2012.
4. R.P. Jain, Modern Digital Electronics‖, McGraw-Hill Education- 5th Edition, 2022.

Online Resources:

1. https://nptel.ac.in/courses/106105185
2. https://nptel.ac.in/courses/108106177

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

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

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

Suggested Readings:

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

Online Resources:

1. https://cse01-iiith.vlabs.ac.in/
2. https://cse.iitkgp.ac.in/~rkumar/pds-vlab/index1.html
3.

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-AI)					
Year	II	**Semester**	III			
Course Name	Digital Logic Design Lab					
Code	RCS5357					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic knowledge of Hardware Devices	0	0	2	1	
Course Objectives	1. To study the basic of various number systems, negative number representation, binary. 2. To study the combinational logic design of various logic and switching devices and their realization. 3. To study the sequential logic circuits design both in synchronous and asynchronous modes. 4. To study some of the programmable logic devices and their use in realization of switching functions.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand various types of number systems and their conversions.					
CO2	Design and implement variety of logical devices using combinational circuit concepts.					
CO3	Demonstrate and compare the construction of programmable logic devices and different types of ROM.					
CO4	Analyze sequential circuits like Registers and Counters using flip-flops.					

S. No.	List of Experiments	Mapped CO
1	Verification, Simplification and Realization of Boolean Expressions using Logic gates/Universal gates.	CO1
2	Realization of Binary to Gray code conversion and vice versa.	CO1
3	Realization of Half/Full adder and Half/Full Subtractor using logic gates.	CO2
4	Realization of parallel Adder/Subtractor using 7483 chips.	CO2
5	Realization of Encoder and Decoder using logic gates.	CO2
6	MUX/DEMUX–use of 74153, 74139 for arithmetic circuits and code converter.	CO2
7	Realization of One/Two-bit comparator and study of 7485 magnitude comparator.	CO3
8	Truth table verification of Flip-Flops: a JK Master slave (ii) T type (iii) D type.	CO4
9	Realization of 3-bit counters as a sequential circuit and MOD–N counter design (7476, 7490, 74192, 74193)	CO4
10	Perform Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 74S95.	CO4

Suggested Readings:

1. Donald D. Givone, "Digital Principles and Design", Tata McGraw-Hill Education- 1st Edition, 2003.
2. Marcovitz , Introduction to logic Design ,Tata McGraw-Hill Education- 3rd Edition, 2010.
3. Raj Kamal, Digital Systems Principle and Design, Pearson Education- 1st Edition, 2012.
4. R.P. Jain, Modern Digital Electronics, McGraw-Hill Education- 5th Edition, 2022.

Online Resources:

1. https://cse15-iiith.vlabs.ac.in
2. https://nptel.ac.in/courses/117106086

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

Program	B. Tech (CSE-AI)				
Year	II	**Semester**	III		
Course Name	Core and Advanced Java Lab				
Code	RCS5356				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Coding Skills	0	0	2	1
Course Objectives	1. To write programs using abstract classes. 2. To write programs for solving real world problems using java collection frame work. 3. To write multithreaded programs. 4. To write GUI programs using swing controls in Java.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the programming concepts using Java.				
CO2	Develop Java programs incorporating exception handling techniques to create robust and reliable applications.				
CO3	Able to write multithreaded programs and Strings.				
CO4	Develop database-driven Java applications using JDBC for establishing database connectivity and performing CRUD operations.				

S. No.	List of Experiments	Mapped CO
1	WAP that describes a class person. It should have instance variables to record name, age and salary. Create a person object. Set and display its instance variables.	CO1
2	Write a Java program to demonstrate Method overloading.	CO1
3	Write a java programs to demonstrate hierarchical inheritance.	CO1
4	Write a Java program to understand how to accept input using Scanner or BufferedReader and print output using System.out.println statement.	CO1
5	Write java program to create a user defined Exception class known as PayOutOfBoundsException. Organization does not offer basic salary less than 8000. If entered salary is less than 8000 then program should create an Exception of Type PayOutOfBounds Exception. Program should calculate gross salary by considering salary parameters such as DA, HRA, CA, TA, Professional tax, TDS, PF etc.	CO2
6	Write java programs to create user defined threads by extending thread class and by implementing runnable.	CO3
7	Write a Java program to test if a given string contains the specified sequence of char values.	CO3
8	Write a Java program to establish a JDBC connection with MySQL and display database records.	CO4
9	Develop a JDBC application to perform CRUD (Create, Read, Update, Delete) operations on a Student database.	CO4
10	Design a Student Registration Form using Swing Components with Layout Management and Event Handling. Use JLabel, JTextField, JRadioButton, JCheckBox, JComboBox, JButton, GridLayout/GridBagLayout, and ActionListener to validate and display entered information.	CO3

Suggested Reading:

1. E. Balagurusamy, Programming with Java Third Edition- McGraw Hill Companies,2014.
2. Patrick Naughton and HerbertzSchildt, “Java-2: The Complete Reference”, TMH, 1999.
3. Paul Dietel and Harvey Deitel, “Java How to Program”, PHI, 8th Ed., 2010.

Online Resources:

1. https://nptel.ac.in/courses/106/105/10610519

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

Program	B.Tech.(CSE-AI)				
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 physical exercise 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. 1.AsanasYoga Stretching, Suryanamaskar(Warming-up), Standing Asana, SittingAsana, Prone position Asana, Supine position Asana, Meditative Asana, Relaxation Asana 2.Pranayam- Why pranyam? How to practise of pranyam? • AnulomaViloma/Surya Bhedana Pranayama • Sheetlipranyam/sheetkaripranyam/Brhamaripranyam/kapalbhati • Ujjayi Pranayama • Kumbhaka Pranayama • Sampoorna Yoga Shwasana (Full Yogic Breathing • Balance Diet • Inner silence 3.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-AI)				
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. Analyze Operating System concepts that include architecture mutual exclusion algorithms, deadlock detection algorithms and agreement. 3. Understand the principles of concurrency and Deadlocks. 4. Analyze various memory management schemes. Study I/O management and File systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understanding of the concepts, structure and design of Operating System and Learning about Processes, Threads and Scheduling algorithms.				
CO2	Understand the principles of concurrency and Deadlock.				
CO3	Evaluate various memory management schemes.				
CO4	Analyse and Implement a prototype file system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Operating System and Process Concept** Operating system and functions, Types of Operating System, Classification of Operating systems, Operating System Structure, Operating System Services, System call and System program, Process concept, Process state, Process control block, Context switching, Operation on process, Threads and their management, Benefits of multithreading, Types of threads, Threading issues, CPU-scheduling, Scheduling criteria, Scheduling Algorithms, Concurrent Processes, Inter Process Communication models and Schemes.	15 Hours	CO1
2	**Process Synchronization and Deadlock** Process synchronization, Producer/Consumer Problem, Critical Section Problem, Peterson's solution, Synchronization of hardware, Semaphore, Classical-problem of synchronization, Deadlock, Deadlock characterization, Deadlock Prevention, Deadlock Avoidance, Resource allocation graph algorithm, Banker's algorithm, Deadlock detection, Recovery from deadlock.	15 Hours	CO2
3	**Memory Management** Memory Management, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing.	15 Hours	CO3
4	**I/O Management and File System** File System Structure, File System Implementation, Directory Implementation and Allocation Methods, Free space Management, Kernel I/O Subsystems, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management.	15 Hours	CO4

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech (CSE-AI)				
Year	II	**Semester**	IV		
Course Name	Computer Organization and Architecture				
Code	RAI5402				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Digital Logic Design	3	1	0	4
Course Objectives	1. To study of the basic structure and operation of a digital computer system, functional units. 2. To explain the internal Architecture of CPU and understand the format, execution of the Instruction. 3. Comprehend hierarchical memory system and understand the processor organization. 4. To understand data transfer mechanism between CPU and Peripheral devices such as Interrupts, DMA and Standard Communication interfaces.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Identify the basic structure and function unit of a digital computer.				
CO2	Understanding Control Unit and ALU.				
CO3	Understanding and analyze the effect of addressing modes and instructions.				
CO4	Understanding Interrupts and I/O.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Evolution of Computer Systems: A Brief History of Computers. Von Neumann Architecture, Harvard Architecture, Computer Components, Interconnection Structures, Bus Interconnection, Bus Architecture, Bus and Memory Transfers, Bus Arbitration Techniques, Register Transfer Language, Shift Micro-operations, Arithmetic Algorithms (Additions, Subtraction, Booth multiplication, Division)	15 Hours	CO1
2	Control Unit: Control Unit Design (Hardwired & Micro-programmed), Multiple Bus Organization, Arithmetic and Logical Operations, Microinstruction, Micro-program Sequencing, Wide Branch addressing, Pre-fetching, Parallel Processing, Pipelining (Arithmetic Pipeline, Instruction Pipeline), Pipeline Performance.	15 Hours	CO2
3	Processor Organization: Processor Design: General Register Organization, Stack Organization, Addressing Modes, Instruction Format, RISC and CISC Architecture, Data Transfer and Manipulation, Memory Organization: Basic concept and hierarchy, semiconductor RAM memories, 2D & $2\frac{1}{2}$D memory organization, ROM memories, Cache memory, Auxiliary memories (Magnetic Disc, Optical Disc, Flash Memory, Introduction of SSD), Virtual memory.	15 Hours	CO3
4	Input Output Organization: Peripheral devices, I/O Interface, Interrupt Hardware, Type of Interrupts and exceptions, Modes of Data Transfer: (Programmed I/O, Interrupt initiated I/O, Direct Memory Access), I/O channels and processors, Serial Communication: Synchronous & asynchronous	15 Hours	CO4

	communication, Standard communication interfaces.		

Suggested Readings:

1. Patterson, "Computer Organization and Design", Elsevier Publication.4th edition 2011.
2. Moris Mano," Computer System Architecture", PHI.3rd edition 2004.
3. John P Hays, "Computer Organization", McGraw Hill.3rd edition 2006.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs88

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

Program	B. Tech (CSE-AI)				
Year	II	**Semester**	IV		
Course Name	Database Management Systems				
Course Code	RCS5401				
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(AI)					
Year	II	**Semester**	IV			
Course Name	Concepts of Machine Learning with Python					
Code	RAI5401					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Programming Knowledge of Python	3	0	0	3	
Course Objectives	1. Acquire knowledge of setting hypotheses for problems. 2. Applying suitable machine learning techniques for problems. 3. Evaluate the performance of machine learning. 4. Identify and integrate more than one technique to enhance the performance of learning.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understanding machine learning strategies, hypothesis testing and python.					
CO2	Understanding and Appling Supervised learning techniques.					
CO3	Understanding and Appling Unsupervised Learning techniques					
CO4	Understanding and Appling probabilistic and Ensemble Learning techniques					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Machine Learning:** Introduction, Examples of various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension. **Machine Learning using Python:** Introduction to python; basic library; functions of library; implementation of library; Design, Analysis and Evaluation of Machine Learning Experiments, Other Issues: Handling imbalanced data sets.	15 Hours	CO1
2	**Supervised Learning Algorithms:** Learning a Class from Examples, Linear, Non- linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression. **Advanced Supervised Learning:** Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K- Nearest Neighbors **Ensemble Learning** Ensemble Learning Model Combination Schemes, Voting, Bagging: Random Forest Trees, boosting: Adaboost, Stacking.	15 Hours	CO2
3	**Unsupervised Learning:** Introduction to clustering, Hierarchical: AGNES, DIANA, **Partitioned:** K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis **Probabilistic Learning:** Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Mining, Frequent Patterns	15 Hours	CO3, CO4

Suggested Readings:

1. Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations
3. of Machine Learning", MIT Press, 2012.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
5. Charu C.Aggarwal,"Data Classification Algorithms and Applications", CRC Press, 2014.
6. Stephen Marsland, "Machine Learning – An Algorithmic Perspective",2nd Edition, CRC Press, 2015.
7. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
8. Jiawei Han and Micheline Kamber and Jian Pei, "Data Mining – Concepts and Techniques", 3rd Edition,Morgan Kaufmann Publications, 2012.
9. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs52/preview
2. https://nptel.ac.in/courses/106106139

Course Articulation Matrix

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

Program	B.Tech(CSE-AI)				
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.				

S. No.	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. Silberschatz, Galvin and Gagne, “Operating Systems Concepts”, Wiley Publication
2. SibsankarHalder and Alex A Aravind, “Operating Systems”, Pearson Education
3. Harvey M Dietel, “An Introduction to Operating System”, Pearson Education
4. D M Dhamdhere, “Operating Systems: A Concept-based Approach”, TMH
5. William Stallings, “Operating Systems: Internals and Design Principles”, Pearson Education

Online Resources:

1. IIT Interactive Simulation Portal:
2. KodeKloud Free Linux Lab Environment.
3. https://www.vlab.co.in/
4. 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							1	2
CO2	3	3	2	2	1							1	1
CO3	3	3	3	2								2	2
CO4	3	3	3	2	1							1	2

Program	B. Tech (CSE-AI)				
Year	II	**Semester**	IV		
Course Name	Database Management Systems Lab				
Course Code	RCS5451				
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.				

S. No.	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 (AI)				
Year	II	**Semester**		IV	
Course Name	Machine Learning Lab				
Code	RAI5451				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Python	0	0	2	1
Course Objectives	1. Make use of Data sets in implementing the machine learning algorithms 2. To implement unsupervised learning 3. Implement the machine learning concepts and algorithms in any suitable language of choice. 4. To implement handle unbalanced data sets				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Application of supervised learning.				
CO2	Application and Implementation of unsupervised learning.				
CO3	Design Java/Python programs for various Learning algorithms.				
CO4	Apply appropriate data sets to the Machine Learning algorithms.				

S. No.	List of Experiments	Mapped CO
1	Implement Decision Tree learning.	CO1
2	Implement Logistic Regression.	CO1
3	Implement classification using Multilayer perceptron.	CO1
4	Implement classification using SVM.	CO2
5	Implement Bagging using Random Forests.	CO2
6	Implement k-nearest Neighbors algorithm.	CO3
7	Implement K-means, K-Modes Clustering to Find Natural Patterns in Data.	CO3
8	Implement Hierarchical clustering.	CO3
9	Implement Gaussian Mixture Model Using the Expectation Maximization.	CO3
10	Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms.	CO4

Suggested Readings:

1. Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations
3. of Machine Learning", MIT Press, 2012.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
5. Charu C.Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.

Online Resources:

1. https://www.digimat.in/nptel/courses/video/106105152/L01.html/
2. https://nptel.ac.in/courses/106105152

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

Program	B.Tech CSE (AI)					
Year	II	**Semester**	IV			
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-AI)					
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 and DFA)					
CO2	Analyze the give automata, regular expression & grammar to know the language it represents					
CO3	Design Automata & Grammar for pattern recognition and syntax checking.					
CO4	Identify limitations of some computational models and possible methods of proving them					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals:** Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages. Finite Automata: Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA – Equivalence of NDFAs with and without €-moves, Minimization of finite automata, Equivalence between two DFA's, Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore.	15 Hours	CO1
2	**Regular Languages:** Regular expressions, Identity rules, Conversion of a given regular expression into a finite automaton, Arden's Theorem. Conversion of finite automata into a regular expression, Pumping lemma for regular sets, Closure properties of regular sets. **Context Free Grammars:** Context free grammars and languages, Derivation trees, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion and left factoring in context free grammars, Minimization of context free grammars, Normal forms for context free grammars, Chomsky normal form (CNF), Greibach normal form (GNF), Pumping Lemma for Context free Languages, Closure and decision properties of context free languages.	15 Hours	CO2
3	**Pushdown Automata:** Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence, Types of PDA, Equivalence of context free grammars and pushdown automata, Inter-conversion, Two Stack PDA.	15 Hours	CO3
4	**Turing Machine (TM):** Introduction to Turing machine, Basic Turing Machine Model, Turing Machine	15 Hours	CO4

	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.		

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-AI)					
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 (AI)				
Year	III	**Semester**	V		
Course Name	Concepts of Data Science with Python				
Code	RAI5501				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python programming fundamentals, Probability and Statistics	3	1	0	4
Course Objectives	1. Understand the fundamental concepts, processes, algorithms, and applications of Data Science along with data exploration and statistical analysis techniques. 2. Develop the ability to visualize and communicate data effectively using graphical representations and Python-based visualization tools. 3. Apply NumPy for numerical computing, simulation modeling, and efficient manipulation of multidimensional datasets. 4. Utilize Pandas for data preprocessing, transformation, integration, summarization, and analysis of structured and semi-structured data.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the Data Science lifecycle, data exploration methodologies, descriptive statistics, and the role of algorithms in data-driven decision making.				
CO2	Create effective visual representations of data using design principles and Python visualization libraries such as Matplotlib to support data analysis and interpretation.				
CO3	Perform numerical computations, array operations, simulation modeling, and data manipulation using NumPy.				
CO4	Analyze, clean, transform, integrate, and summarize datasets using Pandas, including handling diverse data formats and time-series data for real-world applications.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Science:** Case for data science, data science classification, data science algorithms; Data Science Process, prior Knowledge, Data Preparation, Modeling, Application, Knowledge; Data Exploration, Objectives of data Exploration; Datasets, Descriptive Statistics; Data Visualization, Roadmap for data exploration.	15 Hours	CO1
2	**Data Visualization:** Introduction, Forms of data graphics, Visualizing categories Design principles, Visualizing locations Interaction / animation, Visualizing locations, Visualizing time Building and using metrics, visualizing multivariate displays Perception principles and presenting data graphics, Visualizing multivariate displays. Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more.	15 Hours	CO2
3	**NumPy for Simulation Modeling:** Introduction to NumPy - Basics of NumPy Arrays, Computation on NumPy Arrays-indexing, slicing, reshaping. Universal Functions, Aggregations. Computation on Arrays – broadcasting, comparisons, Fancy indexing, Sorting Arrays, Structured Arrays.	15 Hours	CO3
4	**Pandas for Data Manipulation, analysis and Summarization**: Introducing Pandas Objects – Series, Data	15 Hours	CO4

	Frames, Index, Processing CSV, JSON, XLS data, Operations on Pandas Objects – indexing and selection, universal functions, missing data, hierarchical indexing, Combining Dataset – concat and append, merge and join. Aggregation and grouping, Pivot tables, Vectorized string operations, Working with time series, High performance Pandas – eval(), query().		

Suggested Readings:

1. Brian K. Jones and David M. Beazley. "Python Cookbook", O'Reilly Media, 2013, 3rd Edition.
2. Grus, Joel. "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015, 1st Edition.
3. Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next by Dr Gypsy Anand / Dr Rupam Sharma.2020
4. Wes McKinney. "Python for Data Analysis", O'Reilly Media, 2017, 2nd Edition.
5. Dipanjan Sarkar, "Text Analytics with Python: A Practitioner"s Guide to Natural Language Processing", A Press, 2019, 2nd Edition.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs21/preview

Course Articulation Matrix

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**	V		
Course Name	Essence of Indian Knowledge Tradition				
Course Code	RMC5501				
Course Type	MC	**L**	**T**	**P**	**Credit**
Pre-Requisite	The Concepts of Indian Traditional Knowledge and To Make Them Understand the Importance of Roots of Knowledge System.	1	0	0	1
Course Objectives	2. To Understand the concept of Traditional knowledge and its importance 3. To Know the need and importance of protecting traditional 4. To Apply, Know the various enactments related to the protection of traditional knowledge 5. To Understand the concepts of Intellectual property to protect the traditional.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	To Understand and elucidate the basic knowledge of traditional knowledge to develop the physical and social changes in traditional knowledge systems.				
CO2	To Analyze 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:** Introduction to Indian 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 the relationship between traditional knowledge and traditional ecological knowledge, Analysis of the role of TEK in environmental conservation and sustainable development.	7 Hours	CO1, CO2
	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		

2	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. Jha, A. (2009). Traditional Knowledge System in India. New Delhi: Atlantic Publishers & Distributors.
2. Mohanta, B. K., & Singh, V. K. (2012). Traditional Knowledge System and Technology in India. New Delhi: Pratibha Prakashan.
3. Jha, A. (2002). Traditional Knowledge System in India. New Delhi: Atlantic Publishers & Distributors.
4. Sampath, P. G. (2012). Traditional Knowledge Systems and Intellectual Property Rights. London: Routledge.
5. Sharma, G., & Kumar, V. (Eds.). (2016). Indian Traditional Knowledge and Intellectual Property Rights: Innovations in Traditional Knowledge Preservation. Singapore: Springer.
6. Ganguli, P. (2010). Indian Traditional Knowledge and Intellectual Property Rights: Indigenous Community Initiatives. New Delhi: 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-AI)				
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 study 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	1. Understand the concepts of Network Cables and Network Commands.				
CO2	2. Analyze the use of Local Area Networks.				
CO3	3. Evaluate the performance of different programs related to Networking.				
CO4	4. Design and Apply different Topologies through simulation.				

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

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech CSE (AI)				
Year	III	Semester		V	
Course Name	Data Science with Python Lab				
Code	RAI5551				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Python	0	0	2	1
Course Objectives	1. Implement the fundamentals of data science. 2. Know how to analyze data through summary statistics. 3. Use a range of Python features for numerical analysis. 4. Implementing data visualization.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement python programming to read files				
CO2	Implement Statistics Algorithms				
CO3	Perform data loading, cleaning, transformation and merging				
CO4	Create different plots for basic exploratory data analysis				

S. No.	List of Experiments	Mapped CO
1	Implementation of a program for reading of different types of data sets (.txt,.csv) from web and disk and writing in file in specific disk location.	CO1
2	Implementation of a program for reading EXCEL and XML data sheets Using Numpy.	CO1
3	Implementation of Basic Statistics functions and performs visualization.	CO2
4	Write a program to Find the data distributions using box and scatter plot.	CO2, CO3
5	Working with Pandas data frames.	CO1, CO3
6	Write a program to Develop a python program for Normal Curves.	CO3, CO4
7	Write a program to Develop a python program for Correlation and scatter plots.	CO4
8	Write a program to Develop a python program for Frequency distributions.	CO3, CO4
9	Write a program to Develop a python program for Correlation coefficient.	CO3, CO4
10	Write a program to Develop a python program for Variability.	CO3, CO4

Suggested Readings:

1. Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next by Dr Gypsy Anand/ Dr Rupam Sharma.
2. Wes McKinney. “Python for Data Analysis”, O'Reilly Media, 2017, 2nd Edition.
3. Grus, Joel. “Data Science from Scratch: First Principles with Python”, O'Reilly Media, 2015, 1st Edition.
4. Brian K. Jones and David M. Beazley. “Python Cookbook”, O'Reilly Media, 2013, 3rd Edition.
5. Dipanjan Sarkar, “Text Analytics with Python: A Practitioner‟s Guide to Natural Language Processing”, A Press, 2019, 2nd Edition.
6. Daniel Jurafsky, James H. Martin, “Speech and Language Processing”, Pearson, 2009.

Online Resources:

1. https://python-iitk.vlabs.ac.in
2. https://www.iiitmk.ac.in/DAVirtalLab

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

Program	B. Tech (CSE-AI)				
Year	III	**Semester**	VI		
Course Name	Design and Analysis of Algorithms				
Code	RCS5603				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Data Structures	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 (AI)				
Year	III	**Semester**	VI		
Course Name	Deep Learning				
Code	RCS5604				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Machine Learning	3	0	0	3
Course Objectives	1. Provide basic concepts of deep learning and applications in various fields. 2. This course emphasis is on analyzing the fundamental issues to develop deep learning models and applied to solve complex engineering and social problems. 3. Develop industry-oriented skills. 4. Understand the data needs of deep learning.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	To understand the basic concepts of deep learning.				
CO2	Applies basic principles of deep learning that are required to analyze large dataset and demonstrate the results in various formats.				
CO3	Analyze how to improve the learning quality of the model to make it more accurate.				
CO4	Evaluate current scope and limitations, and social impact of Deep learning.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Definition of machine learning- Linear models and Nonlinear Models, introduction to machine learning algorithms, biological neuron, perceptron, Neural Nets: shallow network, training a network: back propagation, gradient descent loss functions, and - Neural networks as universal function approximates	15 Hours	CO1
2	**Deep Networks:** History of Deep Learning- Deep Learning Platforms. A Probabilistic Theory of Deep Learning Back propagation and regularization, normalization, Deep Boltzmann Machine, Hidden Markov model, Deep Networks Vs. Shallow Networks- Convolutional Networks- Auto Encoder and Generative Adversarial Networks (GAN), Semi- supervised Learning	15 Hours	CO2
3	**Optimization Algorithms and Generalization**: Concept of Optimization, Optimization in deep learning– First Order, Second Order Methods, Stochastic Methods, Population Based Methods, Spatial Transformer Networks- Recurrent networks, LSTM **Recurrent Neural Network Language Models:** Word-Level RNNs & Deep Reinforcement Learning - Computational and Artificial Neuroscience.	15 Hours	CO3, CO4

Suggested Readings:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106106184
2. https://nptel.ac.in/courses/106106201

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**		VI	
Course Name	Design and 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	Implementation of various search techniques.				
CO2	Implementation of various sorting techniques.				
CO3	Implementation of backtracking strategy.				
CO4	Implementation of various greedy and dynamic programming techniques.				

S. No.	List of Experiments	Mapped CO
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:

1. 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 (AI)				
Year	III	**Semester**	VI		
Course Name	Deep Learning Lab				
Code	RCS5605				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Python Programming and Machine Learning.	0	0	2	1
Course Objectives	1. To understand the fundamentals of deep learning and its applications. 2. To develop deep learning models using Python-based frameworks and libraries. 3. To apply deep learning techniques for image, text, and predictive analytics tasks. 4. To evaluate and optimize deep learning models for real-world applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement fundamental deep learning techniques using appropriate software tools and libraries.				
CO2	Develop deep learning models for classification and prediction tasks.				
CO3	Apply deep learning approaches to image analysis and sequence-processing applications.				
CO4	Evaluate and optimize deep learning models for solving real-world problems.				

S. No.	List of Experiments	Mapped CO
1	a) Write a program to install and configure TensorFlow, Keras, and the required Python libraries for deep learning applications. b) Write a program to create, manipulate, and perform mathematical operations on tensors using TensorFlow.	CO1
2	Write a program to perform data preprocessing, normalization, and feature scaling for deep learning applications.	CO1
3	Write a program to develop and train a deep learning model for binary classification problems.	CO1
4	Write a program to develop and train a deep learning model for multiclass classification problems.	CO2
5	Write a program to implement a deep learning model for image classification applications.	CO2
6	Write a program to apply transfer learning using a pre-trained deep learning model.	CO2
7	Write a program to develop a deep learning model for text classification and sentiment analysis.	CO2
8	Write a program to implement a deep learning model for time-series forecasting and prediction.	CO3
9	Write a program to evaluate and optimize a deep learning model using performance metrics and hyperparameter tuning techniques.	CO4
10	Write a program to save, load, and deploy a trained deep learning model for inference on new data.	CO4

Suggested Readings:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Online Resources:

1. http://www.digimat.in/nptel/courses/video/106105215/L40.html
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs22

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

Program	B.Tech CSE (AI)				
Year	IV	**Semester**	VII		
Course Name	Natural Language Processing				
Course Code	RAI5701				
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	Explain the fundamental concepts of Natural Language Processing, including text preprocessing, linguistic analysis, and language modeling techniques.				
CO2	Apply machine learning techniques for text classification, sentiment analysis, information extraction, and other NLP tasks.				
CO3	Analyze and implement deep learning and transformer-based models for advanced natural language understanding and generation.				
CO4	Develop NLP applications using large language models, conversational AI, and generative AI techniques while addressing ethical and societal challenges.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Natural Language Processing:** Introduction to Natural Language Processing (NLP), applications and challenges of NLP, text preprocessing techniques, tokenization, stemming and lemmatization, stop word removal, regular expressions, lexical analysis, syntactic and semantic analysis, part-of-speech tagging, parsing techniques, language models, n-gram models, text representation methods including Bag of Words, TF-IDF, and word embedding.	15 Hours	CO1
2	**Machine Learning and Deep Learning for NLP:** Text classification and clustering, sentiment analysis, named entity recognition, information extraction, topic modeling, sequence labeling, feature engineering for text analytics, machine learning algorithms for NLP, vector space models, word2vec and GloVe embeddings, introduction to deep learning for NLP, recurrent neural networks (RNN), long short-term memory (LSTM), gated recurrent units (GRU), sequence-to-sequence models and their applications.	15 Hours	CO2, CO3
3	**Advanced NLP and Generative AI:** Transformer architecture, attention mechanism, BERT and its variants, large language models (LLMs), prompt engineering concepts, text generation techniques, machine translation, question answering systems, conversational AI and chatbots, speech-to-text and text-to-speech systems, NLP applications in healthcare, finance, education, and social media, ethical issues, bias and fairness in NLP, future trends in NLP and Generative AI.	15 Hours	CO3, CO4

Suggested Readings:

1. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education, 2013.
2. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson Education, 2013.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_cs45.
2. http://www.digimat.in/nptel/courses/video/106101007/106101007.html

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									2	1

Program	B. Tech CSE (AI)				
Year	III	**Semester**	VII		
Course Name	Artificial Neural Networks				
Code	RAI5702				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Probability and statistics	3	1	0	4
Course Objectives	1. Understand the fundamental concepts, architectures, and learning mechanisms of artificial neural networks. 2. Analyze and implement learning algorithms for training feedforward and multilayer neural networks. 3. Apply advanced neural network models for pattern recognition, classification, and optimization problems. 4. Design and evaluate deep learning solutions using neural network frameworks for real-world applications.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the principles, architectures, and learning paradigms of artificial neural networks.				
CO2	Implement and evaluate multilayer neural networks using backpropagation and optimization techniques.				
CO3	Apply advanced neural network architectures to solve classification, clustering, and prediction problems.				
CO4	Design and develop deep learning models for real-world applications using modern neural network frameworks.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Artificial Neural Networks:** Introduction to Artificial Intelligence and Neural Networks, Biological Neuron vs. Artificial Neuron ,History and Evolution of Neural Networks ,Basic Neural Network Architectures ,Activation Functions and Network Topologies ,Learning Paradigms: Supervised, Unsupervised, and Reinforcement Learning **,**McCulloch-Pitts Neuron Model ,Perceptron Learning Rule and Applications ,Limitations of Single-Layer Perceptron.	15 Hours	CO1
2	**Multilayer Neural Networks and Learning Algorithms:** Multilayer Perceptron (MLP), Feed forward Neural Networks, Error Correction Learning, Gradient Descent Optimization, Backpropagation Algorithm ,Training, Validation, and Testing, Hyper parameter Tuning Performance Evaluation Metrics ,Overfitting and Under fitting Issues	15 Hours	CO2
3	Advanced Neural Network Architectures: Radial Basis Function (RBF) Networks, Recurrent Neural Networks (RNN) ,Hopfield Networks ,Self-Organizing Maps (SOM) ,Boltzmann Machines , Associative Memory Networks , Competitive Learning Networks ,Adaptive Resonance Theory (ART).	15 Hours	CO3
4	**Deep Learning and Applications of ANN:** Introduction to Deep Neural Networks, Convolutional Neural Networks (CNN) ,Long Short-Term Memory (LSTM) Networks, Autoencoders and Representation Learning ,Neural Networks for Classification and Regression ,Applications in Computer Vision, Natural Language Processing, and Healthcare ,Neural Network Frameworks: Tensor Flow and Keras.	15 Hours	CO4

Suggested Readings:

1. Neural Networks and Learning Machines, 3rd Edition, Pearson Education, 2009.
2. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Pearson Education, 1994.
3. Neural Network Design, 2nd Edition, Martin Hagan, 2014

Online Resources:

1. https://nptel.ac.in/courses/117105084

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

Program	B. Tech (CSE-AI)				
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	Analyze 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 (AI)				
Year	IV	**Semester**	VII		
Course Name	Natural Language Processing Lab				
Code	RAI5751				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Proficiency in Python Programming	0	0	2	1
Course Objectives	1. Understand machine learning techniques used in Natural Language Processing (NLP). 2. Analyze various algorithms applied within NLP. 3. Understand the fundamental concepts and applications of NLP. Apply NLP techniques for text processing and language analysis.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implement approaches to syntax and semantics in NLP.				
CO2	Implement approaches to discourse, generation, dialogue and summarization within NLP.				
CO3	Implement current methods for statistical approaches to machine translation.				
CO4	Implement Hidden Markov models and probabilistic context-free grammars.				

S.No.	List of Experiments	Mapped CO
1	**Word Analysis:** The objective of the experiment is to learn about morphological features of a word by analyzing it.	CO1
2	**Word Generation:** The objective of the experiment is to generate word forms from root and suffix information.	CO2
3	**Morphology:** Understanding the morphology of a word by the use of Add-Delete table	CO3
4	**N-Grams:** The objective of this experiment is to learn to calculate bigrams from a given corpus and calculate probability of a sentence.	CO4
5	**N-Grams Smoothing:** The objective of this experiment is to learn how to apply add-one smoothing on sparse diagram tables.	CO1
6	**POS Tagging - Hidden Markov Model:** The objective of the experiment is to calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.	CO2
7	**Building POS Tagger:** The objective of the experiment is to know the importance of context and size of training corpus in learning Parts of Speech	CO4
8	**Chunking:** The objective of the experiment is understanding and practicing syntactic chunking of sentences through interactive exploration of phrase structure across different languages.	CO3
9	**Building Chunker:** The objective of the experiment is to understand and practice building a chunker for Natural Language Processing through interactive exploration of feature selection and training corpus size	CO3

Suggested Readings:

1. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education, 2013.
2. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson Education, 2013.

Online Resources:

1. https://nlp-iiith.vlabs.ac.in/

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**		VII	
Course Name	Artificial Neural Networks Lab				
Code	RAI5752				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Python	0	0	2	1
Course Objectives	1. Apply the Perceptron model to solve classification problems. 2. Apply Convolutional Neural Networks (CNNs) to image and pattern recognition tasks. 3. Apply the Backpropagation (BP) algorithm for training neural networks. 4. Apply Recurrent Neural Networks (RNNs) to sequence and temporal data processing tasks.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Implementation of Perceptron for solving various problems.				
CO2	Implementation of Recurrent networks.				
CO3	Implementation of a time series.				
CO4	Implementation of CNN, Back Propagation Networks.				

S. No.	List of Experiments	Mapped CO
1	Write a program to implement Perceptron.	CO1
2	Write a program to implement AND, OR, NOT, NAND, NOR, XOR gates using Perceptron.	CO1
3	Write a program to implement Addition, Subtraction, Multiply and Divide functions.	CO1
4	Write a program to implement classification of linearly separable Data with a perceptron.	CO1
5	Write a program to implement Gated Recurrent Units to predict the stock prices based on historic data.	CO2
6	Write a program to implement Crab Classification using pattern net.	CO3
7	Write a program to implement Long Short-Term Memory for Time Series Prediction.	CO3
8	Write a program to implement Wine Classification using Back propagation.	CO4
9	Write a program to implement Convolutional Neural Network and Recurrent Neural Network.	CO4
10	Write a program to implement ImageNet, Google Net, Res Net convolutional Neural Networks.	CO4

Suggested Readings:

1. Haykin, S. (2004). Neural Networks: A Comprehensive Foundation (2nd ed.). New Delhi: Prentice Hall of India (PHI).
2. Yegnanarayana, B. (2005). Artificial Neural Networks. New Delhi: Prentice Hall of India Pvt. Ltd.
3. Fu, L. M. Neural Networks in Computer Intelligence. New Delhi: Tata McGraw-Hill (TMH).2003

Online Resources:

1. https://cse22-iiith.vlabs.ac.in/

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

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VIII		
Course Name	Cyber Security and Computer Forensics				
Code	RCS5801				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Computer Networks and 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, Information Technology (IT) Act and Legal Framework, Ethical Issues in Cyber Security, Professional Responsibilities, Emerging Trends in Cyber Security and	15 Hours	CO4

	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 (AI)				
Year	III	**Semester**	VI		
Course Name	Robotics and Intelligent Systems				
Code	RPEC53911				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Soft Computing	2	1	0	3
Course Objectives	1. To understand robotics, control systems, and intelligent systems. 2. To analyze the approaches and techniques required to build working robotic systems. 3. To acquire skills in robot task planning for problem solving. 4. To understand the modules of robotics and intelligent systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand robot manipulators and mobile robots.				
CO2	Analyze robot controllers by using appropriate methods.				
CO3	Design basic robot intelligent sensor systems including static system learning (kinematics) and dynamic learning; and intelligent course recognition.				
CO4	Apply skills in identifying areas in manufacturing where robotics can be deployed for enhancing productivity.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Robotics Systems:** Overview and Preliminaries, Biological Paradigms, Robotic Manipulators Sensors and Actuators, Low-Level Robot Control, Mobile Robots, Modelling Dynamic Systems Kinematics and Dynamics of Rigid Bodies, Continuous- and Discrete- time Dynamic Models, Linearization and Linear Response, Controller hardware/software systems, Sensor systems and integration.	15 Hours	CO1
2	**Intelligent Systems and Control:** General rule based expert systems- structure, characteristics, chaining inferences, conflict resolution, Fuzzy expert systems- fuzzy sets and their operations, linguistic variables, fuzzy rules, fuzzy inference, defuzzification, applications. **Neural Networks:** Learning processes, Single layer perceptron, Multilayer perceptron, Radial basis function neural networks, Self-organizing map neural networks Learning vector quantization neural networks.	15 Hours	CO2
3	**Evolutionary and Genetic Algorithms**: Simulation of natural evolution, genetic algorithms, genetic operators, fitness function, applications. Simulation and control of dynamics systems- modeling using Simulink, PID controllers, implementation, fuzzy control, stability and performance evaluations. **Goal-Oriented Control:** Optimal Control, Robust, Adaptive, and Neural Control, Training Neural Networks, Task Planning and Multi-Agent Systems.	15 Hours	CO3, CO4

Suggested Readings:

1. M. Negnevitsky, Artificial Intelligence – A guide to intelligent systems Addison-Wesley, 2005.
2. M. Tarokh, Intelligent Systems and Control, Lectures
3. J. J. Craig, Introduction to Robotics, Addison Wesley Publishers, 2005.
4. Autonomous Robots, G. Bekey, MIT Press, 2005
5. Jones, Joseph L., Flynn, Anita, M., and Seiger, B.A., "Mobile Robots: Inspiration to Implementation", AK Peters, 1999
6. Schilling R. J., Fundamentals of Robotics: Analysis and Control, Prentice Hall, 2004
7. McKerrow P. J., Introduction to Robotics, Addison-Wesley.
8. Siegwart R. and Nourbakhsh I. R., Introduction to Autonomous Mobile Robots, The MIT Press, 2004.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me76/preview

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**		VI	
Course Name	Introduction to Unmanned Aerial Vehicle				
Code	RPEC53912				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Computer and Drone Basics	2	1	0	3
Course Objectives	1. To understand the components and functions of UAVs and Indian aviation regulations related to UAVs. 2. To explain the concepts of aerodynamics, propulsion, and structures of model aircraft. 3. To describe the working principles and components of UAVs. 4. To demonstrate the UAV design process.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the basic concepts of UAV.				
CO2	Analyze the application of sensors and actuators in UAV.				
CO3	Evaluate the loads acting on various types of UAVs				
CO4	Apply concept of performance and stability analysis of UAVs				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics of Flight:** Different types of flight vehicles, Components and functions of an airplane Forces acting on Airplane Physical properties and structure of the atmosphere Aerodynamics, Air foil nomenclature, aerofoil characteristics, Angle of attack, Mach number, Lift and Drag, Propulsion and airplane structures. **Basic Review & Characteristics of UAV Types:** History, Classification and applications of UAVs, Unmanned Aircraft System (UAS), UAS composition, societal impact, future prospects. Types of Drones, Applications and Uses. Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles and their applications, Defence.	15 Hours	CO1, CO2
2	**Introduction to Design And Selection Of UAV Aspects Of Airframe Design:** Conceptual design, preliminary design, detailed design, selection of UAV for particular requirement. Airframe configuration, Scale effects, packaging density, Aerodynamic design, Strength, stiffness and reliability requirements, flight and gust envelopes including manoeuvre loads, selection of power plants, Design for stealth PAYLOADS FOR UAV Classification of Payloads, camera, sensors, radars, various measuring devices classification of payload based on applications, Hyper spectral sensors, laser detection and range, synthetic aperture radar, thermal cameras, ultrasonic detectors, case study on payloads.	15 Hours	CO3
3	**Avionics Hardware & Communication Autopilot**: AGL-pressure sensors, servos, accelerometer, gyros, actuators, power supply, processor, integration, installation, configuration, and testing. **UAV Navigation and Guidance** System Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite, Waypoint Navigation, Dijkstra's	15 Hours	CO4

	Algorithm, A-star Algorithm, UAV Guidance, Types of guidance, UAV communication systems, Ground control station, Telemetry, UAS future.		

Suggested Readings:

1. Andey Lennon *"*Basics of R/C model Aircraft design*"* Model airplane new publication
2. Randal W. Beard and Timothy W. McLain: Small Unmanned Aircraft: Theory and Practice, Princeton University Press,2012
3. Kimon P. Valavanis: Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer,2007

Online Resources:

1. https://nptel.ac.in/courses/101104073

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**		VI	
Course Name	System Modelling and Simulation				
Code	RPEC53931				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics about Simulation	2	1	0	3
Course Objectives	1. To introduce computer simulation technologies and techniques. 2. To provide the foundation for understanding computer simulation. 3. To implement and test a variety of simulation models. 4. To learn useful statistical models used in simulation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the basic concepts of Simulation.				
CO2	Analyze the Useful statistical models.				
CO3	Evaluate Input Modeling and Data Collection.				
CO4	Apply Model Building and Verification, Validation.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction and Overview of Simulation:** Advantages and Disadvantages of Simulation, Application areas, Steps in a Simulation Study, what is System, System Components, System Environment, Model of a system, Types of Models. **Concepts in Discrete-Event Simulation:** The Event Scheduling, Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling, List processing. Simulation in Java, Simulation in GPSS, Simulation in Spread sheet.	15 Hours	CO1, CO2
2	**Useful statistical models discrete distributions:** Continuous distributions, Poisson process, Empirical distributions, **Queuing Models:** Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems; Networks of queues, Rough-cut modelling.	15 Hours	CO3
3	**Input Modelling:** Data Collection, Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models. Measures of performance and their estimation, Output analysis for terminating simulations, Output analysis for steady-state simulations. Model building, verification and validation; Verification of simulation models, Calibration and validation of models, optimization via Simulation	15 Hours	CO4

Suggested Readings:

1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2nd Edition. Academic press2000
2. Shannon, R. E., *"*System Simulation: the Art and Science*"*, Prentice Hall Inc. 1990

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me25/preview

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

Program	B. Tech CSE (AI)					
Year	III	**Semester**	VI			
Course Name	Internet of Things					
Course Code	RPEC53914					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic knowledge of AI and Computer	3	0	0	3	
Course Objectives	1. To describe IoT architecture, communication protocols, and functional components. 2. To understand embedded IoT platforms (Arduino, Raspberry Pi) at an architectural and conceptual level. 3. To evaluate SDN-based networking, security, privacy, and scalability challenges in IoT deployments. 4. To apply IoT concepts in robotics, cyber-physical systems, and emerging domains.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand IoT concepts, functional blocks, communication models, and reference architectures.					
CO2	Describe the architecture of embedded IoT platforms (Arduino, Raspberry Pi) and their role in IoT systems.					
CO3	Analyze IoT applications, SDN integration, security threats, and scalability constraints.					
CO4	Apply IoT in robotics and cyber-physical systems; assess future trends including AIoT and digital twins.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to IoT:** IoT definition, characteristics, and functional blocks, Sensing and actuation principles; physical and logical design of IoT, Communication models and APIs; protocols: MQTT, CoAP, HTTP and selection criteria, Sensor networks and M2M vs IoT value chains. **IoT Architecture and Reference Models:** Reference Architecture and Reference Model of IoT, Four architectural views: Functional, Information, Operational, Deployment, Technical design constraints. **Embedded Platforms for IoT:** Arduino - microcontroller architecture (CPU, GPIO, ADC, PWM), communication interfaces (UART, I2C, SPI), sketch structure, role as IoT edge node, Raspberry Pi — SBC architecture, GPIO, Linux-based OS, Python libraries for IoT (RPi.GPIO, paho-mqtt), role as IoT gateway, Arduino vs Raspberry Pi — compute capability, OS, power, and use-case distinction in IoT systems.	15 Hours	CO1, CO2
	SDN, Applications, Security and Constraints: Control plane vs data plane separation; OpenFlow basics, SDN controllers (OpenDaylight, ONOS); dynamic traffic control and QoS, NFV and IoT edge networks; SDN for heterogeneous device scalability. **Domain-Specific Applications:** Home automation, Industry 4.0 and IIoT, surveillance, Case Study-Healthcare IoT (wearables, remote patient monitoring), smart agriculture, smart cities, Cloud platforms (AWS IoT Core, Azure IoT Hub) as deployment context.		

2	**Constraints, Security and Privacy:** Resource constraints-power, memory, compute on edge devices; interoperability and scalability, Threat landscape-device hijacking, botnets (Mirai), eavesdropping.	15 Hours	CO2, CO3
3	**IoT in Robotics, CPS and Future Trends:** Networked actuators, sensor fusion, and remote teleoperation, ROS and IoT integration; collaborative robots (cobots) and Autonomous Mobile Robots (AMRs), Predictive maintenance via IoT sensors; cloud robotics; swarm robotics, CPS architecture and integration of computation with physical processes, CPS vs IoT distinction; real-time control loops, Safety-critical CPS — autonomous vehicles, industrial control systems, AIoT - AI and IoT convergence for edge intelligence, Digital Twins - virtual replicas of physical IoT systems, Green IoT - energy harvesting, sustainable design, Standardization overview - Matter protocol, oneM2M, W3C WoT.	15 Hours	CO3, CO4

Suggested Readings:

1. Vijay Madisetti & Arshdeep Bahga, "Internet of Things: A Hands-on Approach", 1st Ed., 2014
2. Francis da Costa, "Rethinking the Internet of Things", Apress Publications, 2013
3. Cuno Pfister, *Getting Started with the Internet of Things*, O'Reilly Media, 2011.
4. Simon Monk, "Programming the Raspberry Pi", McGraw-Hill, 2nd Ed.
5. Raj Rajkumar et al., "Cyber-Physical Systems: The Next Computing Revolution",

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs53 — NPTEL IoT (IIT KGP)
2. https://www.coursera.org/specializations/iot — IoT Specialization (UC San Diego)
3. https://www.arduino.cc/en/Guide — Arduino Official Documentation

Course Articulation Matrix

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**	VI		
Course Name	Cyber Law and Security				
Code	RPEC53921				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Computer Security	2	1	0	3
Course Objectives	1. To introduce the basics of information and web security and computer communication. 2. To familiarize students with Cyber Laws and Security policies and Cryptography. 3. To exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization. 4. To monitor and analyze the nature of attacks through cyber/computer forensics software/tools.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the information systems, its types, threats, security issues related to it and also about cyber security and risk associated with it.				
CO2	Analyze about Application security, Data security and types of security Threats in network.				
CO3	Understand the importance of a secure information system and risk management issues in different applications.				
CO4	Understand modern copyright, patent law, skills of ethics, cyber-crime and IT ACT so that they can protect their inventions by making use of these Laws.				

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

	Cyber Law, Issues in E-Business Management Overview of Indian IT Act, Ethical Issues in Intellectual property rights, Copy Right, Patents, Data privacy and protection, Domain Name, Software piracy, Plagiarism, Issues in ethical hacking.		

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VI		
Course Name	Computer Vision				
Code	RPEC53922				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine Learning, Computer Graphics	2	1	0	3
Course Objectives	1. Provide a strong foundation in image formation, image processing Techniques and computer vision principles. 2. Develop the ability to apply filtering, enhancement, edge detection, and Motion estimation techniques for visual data analysis. 3. Equip students with knowledge of feature extraction, image Segmentation, object recognition, and scene understanding methods. 4. Introduce deep learning models, particularly convolutional neural networks, for solving computer vision problems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the fundamentals of image formation, image processing, photometric models, geometric transformations, and optimization techniques used in computer vision.				
CO2	Apply image filtering, enhancement, edge detection, motion estimation, and computational photography techniques to analyze and improve visual data.				
CO3	Analyze and implement feature detection, feature matching, contour analysis, segmentation, and object representation techniques for image understanding.				
CO4	Apply deep learning models, including convolutional neural networks, for image classification, object detection, semantic segmentation, and video analysis tasks.				

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 Voronoi Meshes, Linear Function, Edge Detection, Double Precision Laplacian Filter, Enhancing Digital Image Edges, Gaussian Kernel, Gaussian Filter, Image Gradient Approach to Isolating Image Edges **Motion estimation:** Translational alignment, Parametric motion, Optical flow, Layered motion Computational photography, High dynamic range imaging, Super-resolution, denoising, and blur removal, Image matting and compositing, Video matting, Texture analysis and synthesis	15 Hours	CO2
	Deep Learning: Supervised learning, Unsupervised learning, Deep neural networks, Convolutional neural		

3	networks, More complex models **Feature detection and matching:** Edges and contours, Contour tracking, Lines and vanishing points, Segmentation **Recognition:** Instance recognition, Image classification, Object detection, Semantic segmentation, Pose estimation, Video understanding, Vision and language	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://onlinecourses.nptel.ac.in/noc21_ee23/preview

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

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Recommender Systems				
Code	RPEC53923				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	AI and Machine Learning.	2	1	0	3
Course Objectives	1. To understand the basic concepts of recommender systems. 2. To learn personalization algorithms, evaluation techniques, and user experience aspects. 3. To develop an understanding of content-based recommender systems. 4. To study a comprehensive survey of neighborhood-based recommendation methods.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the basic concepts behind recommender systems.				
CO2	Analyze the Content-based Recommender Systems and Knowledge-based recommendation system.				
CO3	Evaluate the variety of approaches for recommender systems.				
CO4	Analyze the different approaches towards the recommender system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Recommender Systems, Recommender Systems Function, Applications of recommendation systems, Issues with Recommender system, Data and Knowledge Sources, Recommendation Techniques, Recommender Systems and Human Computer Interaction, Recommender Systems as a Multi-Disciplinary Field, Application and Evaluation. **Data Mining Methods for Recommender Systems, Collaborative Filtering:** Data Preprocessing, Classification: Nearest Neighbors, Decision Trees, Rule-based Classifiers, Bayesian Classifiers, Artificial Neural Networks, Support Vector Machines, Ensembles of Classifiers.	15 Hours	CO1
2	**Cluster Analysis:** k-Means, Alternatives to k-means. User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems. **Content-based Recommender Systems, Knowledge based recommendation:** Basics of Content-based Recommender Systems. High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms. Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.	15 Hours	CO2, CO3
3	**Hybrid approaches, Evaluating Recommender System Recommender Systems and communities:** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level,	15	CO4

	Limitations of hybridization strategies. Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics. Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations, Group recommender systems.	Hours	

Suggested Readings:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer (2011), 1.
3. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013)1.

Online Resources:

1. https://nptel.ac.in/courses/110101145

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

Program	B. Tech CSE (AI)				
Year	III	**Semester**	VI		
Course Name	Blockchain Technology				
Code	RPEC53924				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Distributed Systems, Computer Networking, Cryptography.	2	1	0	3
Course Objectives	1. To design, build, and deploy smart contracts and decentralized applications. 2. To understand different types of decentralized applications developed using blockchain technology. 3. To describe Bitcoin and Blockchain applications. 4. To study cryptocurrencies and their functions.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand about the distributed database and function.				
CO2	Analyze the basic concepts and structural aspects of block chain and application.				
CO3	To Understand the distributed consensus and Nakamoto consensus.				
CO4	Explain the fundamental characteristics of Crypto currency and bit coin.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics:** 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.	15 Hours	CO1
2	**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 Block chain application, Soft & Hard Fork, Private and Public block chain **Distributed Consensus:** Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.	15 Hours	CO2, CO3
3	**Crypto currency:** History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin Crypto currency **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 Block chain.	15 Hours	CO4

Suggested Readings:

1. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Crypto currencies, "O'Reilly Media, Inc.", 03-Dec-2014 - Business & Economics.
2. Dr. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
3. Antony Lewis, The Basics of Bitcoins and Block chains: An Introduction to Crypto currencies and the Technology that Powers Them(Cryptography, Crypto Trading, Digital Assets, NFT) Paperback – April 13,2021
4. Joseph J. Bambara, Paul R. Allen, Block Chain: A Practical Guide to Developing Business, Law And Technology.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs44/preview
2. https://nptel.ac.in/courses/106104220

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

Program	B. Tech CSE(AI)				
Year	IV	**Semester**	VII		
Course Name	Sentiment Analysis				
Code	RPEC53913				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics about Artificial Intelligence	2	1	0	3
Course Objectives	1. To discuss various algorithms used for opinion mining, subjectivity detection, and emotion analysis. 2. To identify the sentiment of documents, web pages, and social networking content. 3. To recognize aspect-based opinion summarization and entity extraction. 4. To understand opinion summarization using various approaches.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	**Understand key issues involved in the study of semantic fields**				
CO2	Analyze the meanings of an expression in a systematic manner				
CO3	Evaluate simple problems in semantic analysis				
CO4	Apply the basic goals of several different approaches to semantics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Need for Sentiment Analysis, Problem of Sentiment Analysis, Subjectivity, Stance, Words to Discourse, Pragmatics, Natural Language Processing Issues, Opinion Definition, Sentiment Analysis Tasks, Opinion Summarization, Types of Opinion, Subjectivity and Emotion. **Document Sentiment Classification:** Sentiment Classification Using Supervised Learning Unsupervised Learning Rating Prediction, Cross-Domain Sentiment Classification, Cross Language Sentiment Classification, Sentence Subjectivity And Classification Subjectivity Classification, Sentence Sentiment Classification, Conditional Sentences, Sarcastic Sentences Cross, Language Subjectivity and Sentiment Classification Discourse Information for Sentiment Classification	15 Hours	CO1, CO2
2	**Aspect Based Sentiment Analysis:** Aspect sentiment classification, Basic rules of opinions and Compositional Semantics, Aspect Extraction, Identifying Resource usage aspect, Simultaneous Opinion Lexicon Expansion and Aspect Extraction, Grouping aspects into categories, Entity, Opinion Hold and Timing Extraction, Co reference Resolution and Word Sense Disambiguation Aspect and Entity Extraction, Sentiment Lexicon Generation, Corpus Based Approach, Dictionary Based Approach, Desirable and Undesirable Facts.	15 Hours	CO3
3	**Opinion Summarization & Tools for Sentiment Analysis:** Aspect Based Opinion Summarization, Improvements to Aspect-Based Opinion Summarization, Contrastive view Summarization, Traditional Summarization, Analysis of Comparative Opinions, Identifying Comparative Sentences, Identifying Preferred Entities, Opinion Search and Retrieval, Opinion Spam Detection, Types of Spam Detection,	15 Hours	CO4

	Supervised and Unsupervised Approach, Group Spam Detection. Detecting Fake or Deceptive Opinions, Quality of Review, Quality as Regression Model, Other Methods, Case Study, and Sentiment Analysis Applications Tools for Sentiment Analysis.		

Suggested Readings:

1. Bo Pang and Lillian Lee, Opinion Mining and Sentiment Analysis, Now Publishers Inc., 2008.
2. Roy De Groot, Data Mining for Tweet Sentiment Classification (Twitter Sentiment), 2009.

Online Resources:

1. https://nptel.ac.in/courses/106105158

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**	**PSO 1**	**PSO 2**
CO1	1	2	1	2	1							2	1
CO2	1	2		3	1							2	2
CO3	1	2	3	1	2							1	1
CO4	1	1	1	1	2							2	1

Program	B. Tech CSE-AI				
Year	IV	**Semester**		VII	
Course Name	Soft Computing				
Code	RPEC53932				
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,	15 Hours	CO1, CO2
2	**Backpropagation:** Backpropagation Learning Algorithm ,Radial Basis Function Networks ,Applications of Neural Networks in Pattern Recognition and Prediction. **Evolutionary Computing and Optimization:** Introduction to Evolutionary Computing, Genetic Algorithms: Principles and Operators, Selection, Crossover, and Mutation Techniques, Fitness Evaluation and Constraint Handling , Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO),Applications of Evolutionary Algorithms in Optimization Problems.	15 Hours	CO2, CO3
	Hybrid Soft Computing Systems and Applications: Neuro-Fuzzy Systems and Adaptive Neuro-Fuzzy Inference System (ANFIS), Hybrid Intelligent Systems, Soft		

3	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 (AI)				
Year	IV	**Semester**	VII		
Course Name	Evolutionary Multi-objective Optimization				
Code	RPEC53933				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of AI	2	1	0	3
Course Objectives	1. To develop the understanding of evolutionary algorithms and multi-objective evolutionary optimization algorithms. 2. To develop the understanding of genetic computing. 3. To learn the application of evolutionary algorithms for solving optimization problems. 4. To explain the details of evolutionary algorithms such as GA and other related algorithms.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand evolutionary algorithms.				
CO2	Analyse and develop understanding of genetic computing.				
CO3	Design evolutionary algorithms for solving optimization problems.				
CO4	Applying genetic algorithm to Optimization Multi-objectives.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Evolutionary Computation** - Biological and artificial evolution, Evolutionary computation and AI, Different historical branches of EC, e.g., GAs, EP, ES, GP, etc., A simple evolutionary algorithm. Evolutionary strategies- Evolution in continuous variables. Transformations, Search Operators, Selection Schemes and mutation	15 Hours	CO1
2	**Genetic Algorithms** - Representation, operators, and standard algorithms. The building block hypothesis and the schema theorem. Genetic Programming - Trees as individuals, Major steps of genetic programming, e.g., functional and terminal sets, initialization, crossover, mutation, fitness evaluation, etc. Search operators on trees, Automatically defined functions, Issues in genetic programming, e.g., bloat, scalability, etc.	15 Hours	CO2
3	Multi-objective optimization and their combination with multi-criteria decision-making techniques. Classical methods for treating multi-objective problems, advanced methods based on Pareto-optimality. Evolutionary techniques for optimization problems with and without constraints. NSGA-II, SPEA-2, and MO-CMA-ES. Methods to compare algorithms including test functions and measures to analyze the obtained approximated Pareto-optimal set and front. Methods to cope with limitations to handle the dimensionality of the Pareto-front. Multi-criteria decision-making approaches.	15 Hours	CO3, CO4

Suggested Readings:

1. Ashish M. Gujarathi, B. V. Babu," Evolutionary Computation: Techniques and Applications",CRC Press 2016.
2. X. Yao (ed)," Evolutionary Computation: Theory and Applications", World Scientific Publ. Co., Singapore, 1999
3. Dan Simon, "Evolutionary Optimization Algorithms", Wiley, 2013

Online Resources:

1. https://nptel.ac.in/courses/112103301

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

Program	B. Tech CSE (AI)				
Year	IV	**Semester**		VII	
Course Name	Bioinformatics				
Code	RPEC53934				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
Course Objectives	1. Understanding methods and software tools for understanding biological data. 2. To analyze fundamentals of evolution, molecular biology, and molecular evolution. 3. To understand DNA, RNA important molecules, protein data, etc. their structure, replication and transcription. 4. To Evaluate the biological databases which help in analyzing biological data and their interpretation.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	To understand the basic concept of Bioinformatics and its significance in Biological data analysis				
CO2	To Analyze properties of bio informatical databases, perform text- and sequence-based searches.				
CO3	To Apply the major steps in pair wise and multiple sequence alignment by dynamic programming.				
CO4	To Evaluate different types of Biological databases.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction**: Bioinformatics objectives and overviews, Interdisciplinary nature of Bioinformatics, Data integration, Data analysis, Major Bioinformatics databases and tools. Metadata: Summary & reference systems, finding new type of data online. **Molecular Biology and Bioinformatics:** Systems approach in biology, Central dogma of molecular biology, problems in molecular approach and the bioinformatics approach, Overview of the bioinformatics applications	15 Hours	CO1
2	**The Information Molecules and Information Flow:** Basic chemistry of nucleic acids, Structure of DNA, Structure of RNA, DNA Replication, -Transcription, -Translation, Genes-the functional elements in DNA, Analyzing DNA,DNA sequencing. **Proteins:** Amino acids, Protein structure, Secondary, Tertiary and Quaternary structure, Protein folding and function, Nucleic acid-Protein interaction **Perl:** Perl Basics, Perl applications for bioinformatics-Boiler, Linux Operating System, Understanding and Using Biological Databases, Java clients, CORBA, Introduction to biostatics	15 Hours	CO2
3	**Nucleotide sequence data:** Genome, Genomic sequencing, expressed sequence tags, gene expression, transcription factor binding sites and single nucleotide polymorphism. Computational representations of molecular biological data storage techniques: databases (flat, relational and object oriented), and controlled vocabularies, general data retrieval techniques: indices, Boolean search, fuzzy search and neighboring, application to biological data	15 Hours	CO3, CO4

	warehouses. **Biological data types and their special requirements:** Sequences, macromolecular structures, chemical compounds, generic variability and its connection to clinical data, representation of patterns and relationships: alignments, regular expressions, hierarchies and graphical models.		

Suggested Readings:

1. O'Reilly, "Developing Bio informatics computer skills", Indian Edition's
2. Publication,2019
3. Rastogi, Mendiratta, Rastogi, "Bioinformatics concepts, skills &
4. Applications", CBS Publishers,2020
5. "Bioinformatics", Addison Wesley,2021

Online Resources:

1. https://nptel.ac.in/courses/102103044
2. https://nptel.ac.in/courses/102106065

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

Program	B. Tech CSE (AI)				
Year	IV	**Semester**		VIII	
Course Name	Cloud Computing				
Code	RPEC53941				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of network	2	1	0	3
Course Objectives	1. To understand the concepts of Cloud Computing. 2. To learn Cloud Computing Architecture. 3. To learn Taxonomy of Virtualization Techniques. 4. To acquire knowledge on Cloud Deployment models.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the concept of virtualization and how this has enabled the development of Cloud Computing.				
CO2	To analyze fundamentals of cloud, cloud Architectures and types of services in cloud.				
CO3	To evaluate and Understand scaling, cloud security and disaster management				
CO4	To apply to explore some important cloud computing driven commercial systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Origins of Cloud computing:** Cloud components, Evolution of Cloud Computing, Characteristics of Cloud Computing, Underlying Principles of Parallel and Distributed Computing, driving factors towards cloud, Architecture, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models: IaaS, PaaS, SaaS, NaaS, Cloud Clients, Comparing cloud providers with traditional IT service providers.	15 Hours	CO1
2	**Introduction, Cloud Reference Model:** Architecture, Infrastructure Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance. Cloud deployment model: Public clouds, Private clouds, Community clouds, Hybrid clouds, advantages of Cloud computing. Inter Cloud Resource Management, Resource Provisioning and Resource Provisioning Methods Global Exchange of Cloud Resources, Security Overview, Cloud Security Challenges, Software-as-a-Service Security, Security Governance, Virtual Machine Security, IAM, Security Standards.	15 Hours	CO2
3	Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack, Federation in the Cloud, Four Levels of Federation, Federated Services and Applications, Future of Federation. Scientific Applications: Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.	15 Hours	CO3, CO4

Suggested Readings:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers,2012.
2. Ritting house, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press,2017
3. George Reese Cloud Application Architectures, First Edition, O"Reilly Media 2009.
4. Cloud Computing 2nd Edition by Dr. Kumar Saurabh from Wiley India 2012.
5. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
6. Cloud computing for dummies- Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Wiley Publishing, Inc,2010

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://archive.nptel.ac.in/courses/106/105/106105167

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

Program	B.Tech. CSE (AI)				
Year	IV	**Semester**	VIII		
Course Name	Data Mining and Data Ware Housing				
Code	RPEC53942				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	DBMS	2	1	0	3
Course Objectives	1. To introduce the concept of data mining with detailed coverage of basic tasks, metrics, issues, and implications. 2. To understand and implement classical models and algorithms in data warehousing and data mining. 3. To introduce the concept of data warehousing with special emphasis on architecture and design. 4. To characterize the types of patterns that can be discovered through association rule mining, classification, and clustering.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the functionality of the various data mining and data warehousing components.				
CO2	To analyze Appreciate the strengths and limitations of various data mining and data warehousing models.				
CO3	To evaluate and Explain the analyzing techniques of various data. Describe different methodologies used in data mining and data warehousing.				
CO4	To apply Compare different approaches of data warehouse and data mining with various technologies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Mining:** Introduction, what is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and dissimilarity-Basics.	15 Hours	CO1
2	**Data Warehouse and OLAP technology:** Introduction to Data Warehouse, Differences between operational database systems and data Warehouse, Data Warehouse characteristics, Data Warehouse Architecture and its components, Extraction-Transformation-Loading, Logica (Multi-Dimensional), Data Modelling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Additive Measures, Factless-Facts, Dimension Table characteristics, Factless-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture- ROLAP, MOLAP and HOLAP.	15 Hours	CO2
3	**Association Rules:** Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP- Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set. **Classification and prediction:** What is Classification &Prediction , Issues regarding Classification and prediction, Decision tree, Bayesian Classification, Classification by	15 Hours	CO3, CO4

	Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods ,K nearest neighbor classifiers, Genetic Algorithm, Cluster Analysis, Data types in cluster analysis, Categories of clustering methods, Partitioning methods, Hierarchical Clustering, CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods-STING,CLIQUE.		

Suggested Readings:

1. Han, J., & Kamber, M. (2006). Data Mining: Concepts and Techniques (2nd Edition). Morgan Kaufmann Publishers (Elsevier).
2. Tan, P.-N., Kumar, V., & Steinbach, M. (2006). Introduction to Data Mining. Pearson Education.
   (Note: The commonly cited edition is 2006, not 2016.)
3. Pujari, A. K. (2013). Data Mining Techniques (3rd Edition). Universities Press.
4. Ponniah, P. (2010). Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals (2nd Edition). Wiley Student Edition.
5. Kimball, R., Ross, M., Thornthwaite, W., Mundy, J., & Becker, B. (2008). The Data Warehouse Lifecycle Toolkit (2nd Edition). Wiley Student Edition.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/cec19_cs01/preview
2. https://nptel.ac.in/courses/106105174

Course Articulation Matrix

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

Program	B. Tech CSE (AI)				
Year	IV	**Semester**		VIII	
Course Name	Introduction to Drones				
Code	RPEC53943				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of sensors	2	1	0	3
Course Objectives	1. To develop an overall understanding of UAS history, UAS types, and civilian small UAS applications 2. To develop a firm understanding of UAS operational safety and rule-compliance requirements 3. To understand basic UAS elements 4. To obtain a basic knowledge of UAS aerodynamics and flight dynamics				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	To be able to understand typical civilian low-cost UAS systems.				
CO2	To analyze and comply with FAA regulations on small UAS operations.				
CO3	To evaluate integration of typical mission sensors in typical civilian low cost UAS systems.				
CO4	To be able to apply to create UAS related engineering practice/service or to join the UAS work force.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Flights:** Introductions , Understanding geospatial technology, UAS platform overview, UAS flight demo, FAA regulations, UAS safety , Flight checklists, Roles and responsibilities of personnel involved in flight operations, Different types of flight vehicles, Components and functions of an airplane, Forces acting on Airplane, Physical properties and structure of the atmosphere, Aerodynamics, Airfoil nomenclature, aero foil characteristics, Angle of attack, Mach number, Lift and Drag - Propulsion and air plane structures.	15 Hours	CO1
2	**Unmanned Aerial Vehicle:** Difference between aircraft and UAV, Parts and functions of Fixed, Rotorcraft and flapping wing UAV-various History of UAV's, Types of Drones, Applications and Uses. Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles and their applications, Defense, Civil, Environmental monitoring (physical, chemical and biological).	15 Hours	CO2
3	**Payloads For UAV:** Payloads, Classification of Payloads, camera, sensors, radars, various measuring devices, classification of payload based on applications, Hyper spectral sensors, laser detection and range, synthetic aperture radar, thermal cameras, ultra-sonic detectors, case study on pay loads. **Launch and Recovery:** Launching systems, UAV Launch Methods for Fixed, Wing Vehicles, Vertical Takeoff and Landing UAV Launch, Recovery systems. **UAV Navigation And Guidance Systems:** Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite, Way point Navigation. Dijkstra's Algorithm, A- star Algorithm, UAV Guidance, Types of guidance, UAV communication	15 Hours	CO3, CO4

	systems, and Ground control station, Telemetry, UAS future.		

Suggested Readings:

1. Andey Lennon “Basics of R/C model Aircraft design” Model airplane news publication, 2016.
2. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha Ph.D. (Author), 2016.
3. Unmanned Aerial Vehicles- Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014.
4. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010.

Online Resources:

1. https://nptel.ac.in/courses/101104073

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

Program	B. Tech CSE (AI)				
Year	IV	**Semester**		VIII	
Course Name	Computer Forensics				
Code	RPEC53944				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of operating system	2	1	0	3
Course Objectives	1. To know computer forensics and its issues, resources to forensics the data. 2. To understand the file logs, event file logs, working of the files system. 3. To understand the importance of identification of evidence with their impact, file recovery process. 4. To understand the application of various computer forensics techniques in different areas.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	To Understand proper documentation over the forensics analysis process.				
CO2	To analyze the representation and organization of data and metadata in modern computers.				
CO3	To evaluate the working process of Windows and Linux file systems and its application.				
CO4	To apply tools, recover deleted files, extract hidden data, and also create disk images.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction toComputer Forensics**: Computer Forensics, history of computer forensics, Types of Computer Forensics Technology, resources required to develop computer forensics, Computer Investigation. **Computer Forensics System**: Window and artifact Window File system system-File allocation, File allocation table, Registry, Event logs, Executable Window, prefetch file. Linux Systems and artefacts Linux Systems: Linux File Systems, File System Layer, Metadata Layer, Data Unit Layer, Journal Tools, Deleted Data, Linux Logical Volume Manager, Linux Boot Process and Services, Linux System Organization and Artefacts, Partitioning, File system Hierarchy	15 Hours	CO1, CO2
2	**Computer Forensics Analysis:** Evidence Identification, Data Seizure, Replication and avoiding of evidence, Digital image verification and authentication, Reconstruction of Past Evidence- fighting against macro threats, Information safety, Network Forensics and investigating logs, network Intrusion and crime, Network Traffic investigation, Tactics of military-terrorist and private company; Forensics Identification and Analysis of surveillance Devices.	15 Hours	CO3
3	**Computer Forensics Technology:** Need of evaluation Tools, Operation performed by Techniques, Types of Computer Forensics Techniques- Software techniques, Command Line techniques, Unix/Linux Techniques, GUI based techniques, Hardware based Techniques- Forensics Workstation, Write Blocker, Comparison of Techniques; Cyber Forensics techniques and Case study.	15 Hours	CO4

Suggested Readings:

1. Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, Syngress imprint of Elsevier.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Fourth Edition, Course Technology.
3. MariE-Helen Maras, "Computer Forensics: Cyber criminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition,2014.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
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	PSO3
CO1	3	2	1	1	1								2	1
CO2	1	3	1		2								2	1
CO3	2	1	2	1	2								1	2
CO4	1	2	3	2	1								1	2

Program	B. Tech (CSE-AI)				
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-AI)				
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-AI)					
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-AI)					
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-AI)					
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-AI)					
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-AI)					
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-AI)					
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