BABU BANARASI DAS UNIVERSITY
School of Engineering
(School Code: 04) (University Branch Code: 32)
Department of Computer Science and Engineering
B. Tech: Computer Science and Engineering

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 & 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 & 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	3	0	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			**12**	**2**	**6**	**280**	**420**	**700**	**17**

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SEMESTER II									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**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 & Ecological Sustainability	2	1	0	40	60	100	3
ESC	RME5251	Engineering Mechanics and Mechatronics Lab	0	0	2	40	60	100	1
ESC	RME5253	Workshop Practices	0	0	2	40	60	100	1
BSC	RBS5251	Quantum Physics and Advanced Functional Materials Lab	0	0	2	40	60	100	1
Total			**11**	**3**	**6**	**280**	**420**	**700**	**17**
GROUP 'B'									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
ESC	REE5201	Electrical Engineering Concepts	3	1	0	40	60	100	4
BSC	RBS5202	Sustainable Chemical Sciences	3	1	0	40	60	100	4
BSC	RHSA5201	Professional and Workplace Communication	2	1	0	40	60	100	3
ESC	RCS5202	Basics of Artificial Intelligence	3	0	0	40	60	100	3
ESC	REE5251	Electrical Engineering Lab	0	0	2	40	60	100	1
BSC	RBS5252	Sustainable Chemical Sciences Lab	0	0	2	40	60	100	1
ESC	RME5252	Engineering Graphics Lab	0	0	2	40	60	100	1
Total			**11**	**3**	**6**	**280**	**420**	**700**	**17**

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SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
HSMC	RHS5301 / RHS5302	Work and Organizational Psychology in the Digital Age/Sociology of Work, Technology and Innovation	1	1	0	40	60	100	2
BSC	RBS5303	Linear Algebra	3	1	0	40	60	100	4
PCC	RCS5305	Data Structures using 'C'	3	1	0	40	60	100	4
PCC	RCS5306	Core and Advanced Java	3	1	0	40	60	100	4
PCC	RCS5307	Digital Logic Design	3	0	0	40	60	100	3
ESC	RCS5311	Startup and Innovation	2	0	0	40	60	100	2
MC	RMC5301	Indian Constitution	1	0	0	40	60	100	1
PCC	RCS5355	Data Structures Using 'C' Lab	0	0	2	40	60	100	1
PCC	RCS5356	Core and Advanced Java Lab	0	0	2	40	60	100	1
PCC	RCS5357	Digital Logic Design Lab	0	0	2	40	60	100	1
GP	RGP5301	General Proficiency	-	-	-	100	-	100	1
Total			**17**	**4**	**6**	**500**	**600**	**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	RAI5402	Computer Organization & Architecture	3	1	0	40	60	100	4
PCC	RCS5401	Database Management Systems	3	1	0	40	60	100	4
PCC	RCS5402	Software Engineering	3	0	0	40	60	100	3
PCC	RCS5404	Operating Systems	3	1	0	40	60	100	4
PCC	RCS5451	Database Management Systems Lab	0	0	2	40	60	100	1
PCC	RCS5452	Software Engineering Lab	0	0	2	40	60	100	1
PCC	RCS5454	Operating Systems Lab	0	0	2	40	60	100	1
MC	RMC5451	YOGA Activities	0	0	2	100	-	100	1
GP	RGP5401	General Proficiency	-	-	-	100	-	100	1
Total			**16**	**5**	**8**	**560**	**540**	**1100**	**26**

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SEMESTER V									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
HSMC	RHS5501	AI Economy and Digital Innovation	2	1	0	40	60	100	3
PCC	RCS5501	Automata Theory & Formal Languages	3	1	0	40	60	100	4
PCC	RCS5503	Microprocessor and Intelligent Embedded System	3	0	0	40	60	100	3
PCC	RCS5502	Computer Networks	2	1	0	40	60	100	3
PCC	RCS5504	Machine Learning using Python	3	0	0	40	60	100	3
MC	RMC5501	Essence of Indian Knowledge Tradition	1	0	0	40	60	100	1
PCC	RCS5552	Computer Networks Lab	0	0	2	40	60	100	1
PCC	RCS5554	Machine Learning Using Python Lab	0	0	2	40	60	100	1
PSI	RCS5555	Seminar	0	0	2	100	-	100	1
PSI	RCS5553	Minor Project-I	0	0	2	100	-	100	1
GP	RGP5501	General Proficiency	-	-	-	100	-	100	1
Total			**14**	**3**	**8**	**620**	**480**	**1100**	**22**

SEMESTER VI									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
HSMC	RHS5601	Industrial Management	2	1	0	40	60	100	3
PEC	RPEC53211-14	**Professional Elective Course-I**	2	1	0	40	60	100	3
PEC	RPEC53221-24	**Professional Elective Course-II**	2	1	0	40	60	100	3
PCC	RCS5603	Design & Analysis of Algorithms	3	1	0	40	60	100	4
PCC	RCS5604	Compiler Design	3	1	0	40	60	100	4
PCC	RCS5605	Deep Learning using Python	3	0	0	40	60	100	3
PCC	RCS5653	Design and Analysis of Algorithms Lab	0	0	2	40	60	100	1
PCC	RCS5655	Deep Learning using Python Lab	0	0	2	40	60	100	1
PCC	RCS5654	Compiler Design Lab	0	0	2	40	60	100	1
PSI	RCS5652	Minor Project-II	0	0	2	100		100	1
GP	RGP5601	General Proficiency	-	-	-	100	-	100	1
Total			**15**	**5**	**8**	**460**	**540**	**1000**	**25**

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SEMESTER VII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
PEC	RPEC53231-34	**Professional Elective Course-III**	2	1	0	40	60	100	3
OEC		**Open Elective I***	3	1	0	40	60	100	4
PCC	RCS5701	Distributed Systems	2	1	0	40	60	100	3
PCC	RCS5702	Cryptography and Network Security	3	0	0	40	60	100	3
PCC	RCS5703	AI Ethics	2	0	0	40	60	100	2
PSI	RCS5753	Major Project I#	0	0	8	100	-	100	4
PSI	RCS5754	Industrial Training Evaluation	0	0	2	100	-	100	1
GP	RGP5701	General Proficiency	-	-	-	100	-	100	1
Total			**12**	**3**	**10**	**500**	**300**	**800**	**21**

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

SEMESTER VIII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
PEC	RPEC53241-44	**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	RCS5851	Major Project II##	0	0	16	160	240	400	8
GP	RGP5801	General Proficiency	-	-	-	100	-	100	1
Total			**8**	**3**	**16**	**380**	**420**	**800**	**20**

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

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List of Professional Elective Courses

S.No	Course Code	Professional Elective Course I	Credit
1	RPEC53211	DevOps	3
2	RPEC53212	Computer Vision	3
3	RPEC53213	Natural Language Processing	3
4	RPEC53214	Full Stack Development	3
S.No	**Course Code**	**Professional Elective Course II**	**Credit**
1	RPEC53221	Essentials of Blockchain	3
2	RPEC53222	Cloud Computing Essentials	3
3	RPEC53223	Big Data Analytics	3
4	RPEC53224	Internet of Things	3

S.No	Course Code	Professional Elective Course III	Credit
1	RPEC53231	Generative AI and LLMs	3
2	RPEC53232	Edge AI and Tiny ML	3
3	RPEC53233	Digital Twins	3
4	RPEC53234	Explainable and Responsible AI	3

S.No	Course Code	Professional Elective Course IV	Credit
1	RPEC53241	Soft Computing	3
2	RPEC53242	Quantum Computing	3
3	RPEC53243	Augmented and Virtual Reality	3
4	RPEC53244	Sustainable Computing and Green AI	3

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

S.No	Course Code	Open Elective I	Credit
1	OE53101	Disaster Management	4
2	OE53201	Database Administration	4
3	OE53501	Quality Management	4
4	OE53301	Energy Management	4
S.No	**Course Code**	**Open Elective II**	**Credit**
1	OE53102	Concepts of Climate Smart Agriculture	4
2	OE53202	Computational Intelligence	4
3	OE53502	Product Development	4
4	OE53302	Non-Conventional Energy Resources	4

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

S.No	Course Code	Vocational Courses	Credit
1	RVC53211	Programming with Python	2
2	RVC53212	Fundamentals of Artificial Intelligence	2
3	RVC53213	Cyber Crime and Computer Forensics	2
4	RVC53214	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)					
Year	I	**Semester**	I			
Course Name	Computer Concepts & 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)				
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. To understand the fundamentals of C programming and develop logical problem-solving skills. 2. To design and implement algorithms using structured programming concepts in C. 3. To apply concepts such as arrays, functions, pointers, and file handling to solve computational problems. 4. To 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, CO2
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	CO1, CO2
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, CO2
4	a) Find the sum of first N natural numbers. b) Generate the Fibonacci series. c) Convert a decimal number to binary.	CO1, CO2
5	a) Find out the sum of series $1^2 + 2^2 + \ldots + n^2$ b) Generate the following patterns * ** *** **** *****	CO2, CO3

	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, CO4
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, CO3
8	a) Program to create and display employee details using structures. b) Program to demonstrate memory sharing in a union.	CO2, CO3
9	a) Program to access a variable through a pointer. b) Program to demonstrate pointer arithmetic.	CO2, CO3
10	a) Program to Create and Write Data into a File. b) Program to copy contents from one file to another file.	CO3, CO4

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

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

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

Suggested Reading:

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

Online Resources:

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

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

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

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

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

Suggested Readings:

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

Online Resources:

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

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

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

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

Program	B.Tech.(CSE)				
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.				
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.				

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

Program	B.Tech. (CSE)				
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, Artifcial Intelligence: A Modern Approach, Pearson Education, Inc., 2010.
2. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, 2003.

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

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ge20/preview.
2. https://www.youtube.com/@IITDelhiJuly

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

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

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

Online Resources:

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

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

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

S.No	List of Experiments	Mapped CO
1	**Scales**: Representative factor, plain scales, diagonal scales, scales of chords.	CO1
2	**Projection**: Types of projection, orthographic projection, first and third angle projection.	CO1
3	**Projection of points:** The principle of orthographic projections of a point on HP and VP, Conventional representation, Projection of a point in all the quadrants.	CO1
4	**Projection of Lines:** Line inclined to one plane, inclined with both the plane, True Length and True Inclination, Traces of straight lines.	CO2
5	**Projection of planes and solids**: Projection of Planes like circle and polygons in different positions; Projection of polyhedrons like prisms, pyramids and solids of revolutions like cylinder,	CO2

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

Suggested Readings:

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

Virtual Lab Resources:

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

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

Program	B. Tech.(CSE)					
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	15 Hours	CO2

	Sequences, Unpacking Sequences,		
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)				
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 Readings:

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)					
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 analyse the performance of data structures algorithms					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand the applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching and sorting of each data structure.					
CO2	Apply knowledge of underlying data structures stack and linked list.					
CO3	Understand tree searching, sorting and operations on graph data.					
CO4	Understanding the graph representation and traversal					

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

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

Suggested Readings:

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

Online Resources:

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

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

	package naming convention, The Package Declaration, The CLASSPATH variable, The import statement, The Java 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 Mordern 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, 2024.
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)				
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 variable, 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)					
Year	II	**Semester**	III			
Course Name	Startup and Innovation					
Code	RCS5311					
Course Type	ESC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Artificial Intelligence and innovation concepts.		2	0	0	2
Course Objectives	1. To understand entrepreneurship concepts in the context of Artificial Intelligence. 2. To develop skills to identify AI-based business opportunities and innovative solutions. 3. To learn startup development, business models, and funding mechanisms for AI ventures. 4. To 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)				
Year	II	**Semester**	III		
Course Name	Indian Constitution				
Code	RMC5301				
Course Type	MC	**L**	**T**	**P**	**Credit**
Pre-Requisite	The basic knowledge of Indian Constitutions	1	0	0	1
Course Objectives	1. To realize the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution. To Know the need and importance of protecting traditional. 2. To identify the importance of fundamental rights as well as fundamental duties. 3. To understand the functioning of Union, State and Local Governments in Indian federal system. 4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the concept of Indian constitution.				
CO2	Identify the powers and functions of Supreme Court and High court.				
CO3	Analyze the role Governor and Chief Minister.				
CO4	Explain the district administration role and importance.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Indian Constitution:** Constitution meaning of the term - The making of the Indian Constitution - Sources and constitutional history – Philosophy of Constituent Assembly - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy. Union Government and its Administration Structure: President and Vice President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions.	7 Hours	CO1, CO2

2	**The States and The Union Territories:** State Government and its Administration: Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions – Relation between the Union and the States. **Local Administration:** District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative – Panchayati Raj: Functions PRI: Zillah Panchayat, Elected officials and their roles - Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy	8 Hours	CO3, CO4

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

Program	B.Tech.(CSE)					
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

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)				
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 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://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)				
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)				
Year	II	**Semester**		IV	
Course Name	Computer Organization & 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 communication, Standard communication interfaces.	15 Hours	CO4

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)					
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)					
Year	II	**Semester**	IV			
Course Name	Software Engineering					
Course Code	RCS5402					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Programming Fundamentals and Object Oriented Concepts	3	0	0	3	
Course Objectives	1. Understand the fundamental concepts of Software Engineering, software process models, and software project estimation techniques. 2. Analyze software requirements and develop SRS using standard practices. 3. Apply software design methodologies, UML modeling techniques, and design patterns for developing software solutions. 4. Evaluate software quality through testing, maintenance, reliability, DevOps practices, and software project management techniques.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain software engineering principles, software development life cycle models, and software project estimation techniques for software development projects.					
CO2	Analyze software requirements, prepare SRS, and apply requirement validation, CASE tools, software reuse, and component-based development concepts.					
CO3	Design software systems using function-oriented and object-oriented approaches, UML diagrams, design patterns, and interface design techniques.					
CO4	Apply software testing techniques, quality assurance practices, software reliability concepts, DevOps principles, software maintenance, and project management methodologies to improve software quality and project outcomes.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Software Engineering, Software Engineering Approaches, Software Life Cycle Models: Waterfall Model, Spiral Model, Iterative Model, Incremental Model, Rapid Application Development Model, Agile SCRUM Model; Visual Modeling, Software Cost Estimation, Staffing Level Estimation, Estimating Software Maintenance Cost	15 Hours	CO1
2	**Software Requirement:** Software Requirement Specification (IEEE Format), Functional and Non-Functional Requirements, SRS Traceability, Requirement Verification and Validation, Computer Aided Software Engineering Tools, Software Reuse, Component-Based Software Development, Extreme Programming. **Software Design:** Function-Oriented Software Design, Object-Oriented Design, Unified Modeling Language: Class Diagram, Use Case Diagram, State Chart Diagram, Transition Diagram; Design Patterns, User Interface Design Pattern, High Level Design and Low Level Design.	15 Hours	CO2, CO3
3	**Software Testing:** Unit Testing, Integration Testing, System Testing, Black Box Testing and Types, White Box Testing and Types, V-Model, Debugging Techniques. **Software Quality and Maintenance:** DevOps, CI/CD, Software Engineering Institute Capability Maturity Model, Software Reliability and Fault Tolerance, Software Project Management, Software Project Planning, Software Monitoring and Control, Software Maintenance	15 Hours	CO4

Suggested Readings:

1. Rajib Mall, “Fundamentals of Software Engineering”, 5th Edition, PHI Learning, 2018.
2. Pankaj Jalote, “An integrated approach to Software Engineering”, 3rd Edition, Springer, 2005.
3. Roger S. Pressman and Bruce R. Maxim, “Software Engineering: A Practitioner's Approach”, 9th Edition, McGraw-Hill, 2019.
4. Ian Sommerville, “Software Engineering”, 10th Edition, Pearson, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106105182
2. https://onlinecourses.swayam2.ac.in/cec20_cs07

Course Articulation Matrix

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

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

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

	Disk Scheduling, Disk Management, Swap-Space Management.		

Suggested Readings:

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

Online Resources:

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

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

Program	B.Tech.(CSE)					
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.					

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

Suggested Readings:

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

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

Online Resources:

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

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

Program	B. Tech.(CSE)				
Year	II	**Semester**	IV		
Course Name	Software Engineering Lab				
Code	RCS5452				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Programming Fundamentals and Object Oriented Concepts.	0	0	2	1
Course Objectives	1. To understand and apply software engineering principles during software development. 2. To model software systems using UML diagrams and requirement analysis techniques. 3. To develop software design artifacts and test cases for real-world applications. 4. To gain hands-on experience with software development, testing, and documentation practices.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Analyze software requirements and develop UML-based models such as use-case, class, sequence, and state-transition diagrams.				
CO2	Design software architecture and deployment models for software systems using software engineering methodologies.				
CO3	Apply software engineering principles for requirement analysis, system design, and software documentation.				
CO4	Develop and evaluate software test cases using black-box and white-box testing techniques.				

S. No.	List of Experiments	Mapped CO
1	Preparation of Software Requirement Specification (SRS) for a software system.	CO3
2	Development of Use Case Diagram for a software system.	CO1
3	Development of Class Diagram for a software system.	CO1
4	Development of Sequence Diagram for a software system.	CO1
5	Development of Activity Diagram for a software system.	CO1
6	Development of State Transition Diagram for a software system.	CO1
7	Development of Deployment Diagram for a software system.	CO2
8	Design High-Level Design (HLD) and Low-Level Design (LLD) for a software system.	CO2
9	Design and documentation of software project artifacts using CASE tools.	CO3
10	Development of test cases using Black Box and White Box Testing techniques.	CO4

Suggested Readings:

1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI Learning, 2018.
2. Pankaj Jalote, "An integrated approach to Software Engineering", 3rd Edition, Springer, 2005.
3. Roger S. Pressman and Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", 9th Edition, McGraw-Hill, 2019.
4. Ian Sommerville, "Software Engineering", 10th Edition, Pearson, 2015.

Online Resources:

1. https://se-iitkgp.vlabs.ac.in/List%20of%20experiments.html

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

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

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

Suggested Readings:

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

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

Online Resources:

1. https://erpjietuniverse.in/virtual_lab/Operating_system/labs/index.html
2. https://www.vlab.co.in/.
3. https://pdos.csail.mit.edu/6.828/2025/xv6/book-riscv-rev5.pdf

Course Articulation Matrix

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

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

Module	Course Contents	Contact Hrs.	Mapped CO
1	**General Introduction of Yoga:** Yoga it's Origin, Meaning, Definition & Objectives, Historical Development of Yoga, Relevance of Yoga in modern age and scope, Misconceptions about Yoga and their solutions, Difference between physicalexercise and yogasans system of exercises. Yogasans for male and female	7 Hours	CO1, CO2
2	**Purification Practice:** Dhauti/yogic Eneama/Neti/Eye protection Yoga Practices. **Asanas** Yoga Stretching, Suryanamaskar(Warming-up), Standing Asana, SittingAsana, Prone position Asana, Supine position Asana, Meditative Asana, Relaxation Asana **Pranayam-** Why pranyam? How to practise of pranyam? a) AnulomaViloma/Surya Bhedana Pranayama Sheetlipranyam/sheetkaripranyam/Brhamaripranyam/ kapalbhati b) Ujjayi Pranayama c) Kumbhaka Pranayama d) Sampoorna Yoga Shwasana (Full Yogic Breathing e) Balance Diet f) Inner silence **Meditation and Mudras**	8 Hours	CO3, CO4

Suggested Reading:

1. Prof. Ramharsh Singh – Yoga evam Yogik Chikitsa, Chaukhambha Sanskrit Pratishthan, Delhi-07, 2016.
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.- https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_hs74

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

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

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

Suggested Readings:

1. John C. Martin, Introduction to Languages and Automata Theory, Tata McGraw-Hill, 3rd Edition, 2007.
2. Daniel I. A. Cohen, Introduction to Computer Theory, John Wiley & Sons, 2nd Edition, 1996.
3. Marvin L. Minsky, Computation: Finite and Infinite Machines, Prentice-Hall, Reprint Edition, 1972.

Online Resources:

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

Course Articulation Matrix

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

Program	B.Tech (CSE)					
Year	III	**Semester**	V			
Course Name	Microprocessor and Intelligent Embedded System					
Course Code	RCS5503					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Computer Architecture and Organisation	3	0	0	3	
Course Objectives	1. Understand the evolution of microprocessors from 8085/8086 to modern multi-core, ARM, RISC-V, and AI-enabled processors. 2. Analyze processor architecture, memory systems, instruction execution, and communication interfaces used in embedded systems. 3. Design and implement embedded and IoT-based systems using modern microcontrollers, sensors, and communication protocols. 4. Apply AI and machine learning techniques on edge devices and intelligent hardware platforms for real-world applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the architecture, instruction set, and operation of classical processors 8085 & 8086.					
CO2	Analyze the progression of microprocessor architectures from 8085/8086 processors to modern multi-core, ARM, RISC-V, and AI-accelerated computing platforms.					
CO3	Develop embedded applications using modern microcontrollers					
CO4	Demonstrate the ability to deploy AI and machine learning models on edge devices and intelligent hardware platforms for real-world problem-solving.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to computer architecture:** Evolution of processors: 8085, 8086, Pentium, ARM, Multi-core processors, AI processors CPU organization and instruction cycle, Addressing modes and instruction formats, Basics of assembly language programming, 8085 Microprocessor, Architecture and pin configuration, Register organization, Instruction set and programming, Interrupts and timing diagrams.	15 Hours	CO1
2	**8086 Architecture:** segmentation, Introduction to modern processor architectures, Multi-core and superscalar architecture, Hyper-threading and SIMD concepts, GPU architecture fundamentals, ARM Cortex processors, RISC-V architecture overview. Embedded controllers: STM32, ESP32, and Raspberry Pi.	15 Hours	CO2
3	**Embedded system:** Design methodology, Sensors and actuators, Real-Time Operating Systems (RTOS), Embedded Linux basics, Internet of Things (IoT) architecture, Cloud-connected embedded systems, Edge computing fundamentals, Power-efficient embedded design. **Introduction to AI for hardware engineers**: Machine	15 Hours	CO3, CO4

	learning fundamentals, AI accelerators and tensor processing, FPGA-based AI acceleration, Hardware-aware AI optimization, AI-enabled embedded systems.		

Suggested Readings:

1. Kenzo Nonami "Autonomous Flying Robots" Springer Publication, 2010
2. Kimon P. Valavanis "Advances in Unmanned Aerial Vehicles: State of the Art and the road to Autonomy" Springer Publication, 2007
3. Stuart Russell "Artificial Intelligence: A Modern Approach" Pearson, 2022
4. Pete Warden and Daniel Situnayake, TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, O'Reilly Media, 2019.
5. Sudip Misra, Anandarup Mukherjee and Arijit Roy, Introduction to IoT, Cambridge University Press, 2021.

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

Program	B.Tech (CSE)					
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	Describe the functions of Data link layer and Network layer					
CO3	Describe the functions of Transport, Session Layer					
CO4	Describe the functions of Presentation and Application Layer					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Computer Networks & Physical Layer:** 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	15 Hours	CO2

	Examples.		
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)				
Year	III	**Semester**	V		
Course Name	Machine Learning using Python				
Code	RCS5504				
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 Applying Supervised learning techniques.				
CO3	Understanding and Applying Unsupervised Learning techniques				
CO4	Understanding and Applying 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, Partitional: K-means clustering, K-Mode Clustering, Self- Organizing Map, Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE). Factor Analysis	15 Hours	CO3

	Probabilistic Learning Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Mining, Frequent Patterns**.**		

Suggested Readings:

1. Ethem Alpaydın, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition, 2014.
2. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, Foundations of Machine Learning, MIT Press, 2012.
3. Tom Mitchell, Machine Learning, McGraw-Hill, 3rd Edition, 1997.
4. Charu C. Aggarwal, Data Classification: Algorithms and Applications, CRC Press, 2014.
5. Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2nd Edition, CRC Press, 2015.

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

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

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

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

Suggested Readings:

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

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

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

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech (CSE)				
Year	II	**Semester**		V	
Course Name	Machine Learning Lab				
Code	RAI5451				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python	0	0	2	1
Course Objectives	1. To apply machine learning algorithms on real-world datasets for data analysis and prediction. 2. To understand and implement supervised and unsupervised learning techniques. 3. To implement machine learning concepts and algorithms using a suitable programming language and development environment. 4. To understand and apply techniques for handling imbalanced datasets in machine learning applications.				
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
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 Alpaydın, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition, 2014.
2. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, Foundations of Machine Learning, MIT Press, 2012.
3. Tom Mitchell, Machine Learning, McGraw-Hill, 3rd Edition, 1997.
4. Charu C. Aggarwal, Data Classification: Algorithms and Applications, CRC Press, 2014.

5. Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2nd Edition, CRC Press, 2015.

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

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

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

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech.(CSE)				
Year	III	**Semester**		VI	
Course Name	Deep Learning using Python				
Code	RCS5605				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Machine Learning	3	0	0	3
Course Objectives	1. To provide basic concepts of Deep Learning and applications in various fields. 2. To this course emphasis is on analysing the fundamental issues to develop Deep Learning models and applied to solve complex engineering and social problems. 3. To develop industry-oriented skills. 4. To 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 analyse large dataset and demonstrate the results in various formats.				
CO3	Analyse 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 & 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)					
Year	III	**Semester**	VI			
Course Name	Design & Analysis of Algorithms Lab					
Code	RCS5653					
Course Type	PCC		L	T	P	Credit
Pre-Requisite	Strong Knowledge of Programming Language		0	0	2	1
Course Objectives	1. To analyze the asymptotic performance of algorithms. 2. To calculate rigorous correctness proofs for algorithms. 3. To demonstrate a familiarity with major algorithms and data structures. 4. To apply important algorithmic design paradigms and methods of analysis.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Implement various search techniques					
CO2	Implement various sorting techniques.					
CO3	Implement backtracking strategy.					
CO4	Implement various greedy and dynamic programming techniques.					

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

Suggested Readings:

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

Online Resources:

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)				
Year	III	**Semester**	VI		
Course Name	Deep Learning using Python Lab				
Code	RCS5655				
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)					
Year	III	**Semester**	VI			
Course Name	Compiler Design Lab					
Code	RCS5654					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Concept of Data Structures and Theory of Automata & Formal Languages.	0	0	2	1	
Course Objectives	1. To understand the various phases in the design of a compiler 2. To understand the design of top-down and bottom-up parsers 3. To understand syntax directed translation schemes. 4. To introduce lex and yacc tools.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Ability to design, develop, and implement a compiler for any language.					
CO2	Implement a parser for different context free grammars.					
CO3	Implement code optimization techniques.					
CO4	Able to use lex and yacc tools for developing a scanner and a parser.					

S. No.	List of Experiments	CO Mapped
1	Implementation of lexical analyser for if statement.	CO1
2	Implementation of lexical analyser for arithmetic expression.	CO4
3	Construction of NFA from regular expression.	CO2
4	Construction of DFA from NFA.	CO2
5	Implementation of shift reduce parsing algorithm.	CO3
6	Implementation of operator precedence parser.	CO3
7	Implementation of recursive descent parser	CO4
8	Implementation of LALR parser	CO1
9	Implementation of code optimization techniques.	CO2
10	Implementation of code generator.	CO2

Suggested Readings:

1. Aho, Sethi& Ullman, “Compilers: Principles, Techniques and Tools”, Pearson Education Second Edition 2006.
2. K. Muneeswaran, Compiler Design, First Edition, Oxford University Press.2012
3. J.P. Bennet, “Introduction to Compiler Techniques”, Second Edition, McGraw-Hill,2003.
4. HenkAlblas and Albert Nymeyer, “Practice and Principles of Compiler Building with C”, PHI, 2001.
5. V Raghvan, “ Principles of Compiler Design”, McGraw-Hill,2017.
6. Kenneth Louden,” Compiler Construction”, Cengage Learning,1997
7. Charles Fischer and Ricard LeBlanc,” Crafting a Compiler with C”, Pearson Education,1991.

Online Resources:

1. https://nptel.ac.in/courses/106108113
2. https://github.com/topics/compiler-design?o=desc&s=updated

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

Program	B. Tech.(CSE)				
Year	IV	**Semester**	VII		
Course Name	Distributed Systems				
Course Code	RCS5701				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Operating Systems	2	1	0	3
Course Objectives	1. To understand the concepts, challenges, and architectural models of distributed systems. 2. To analyze synchronization, communication, and coordination mechanisms in distributed environments. 3. To examine distributed object communication and agreement protocols used in distributed applications. 4. To apply techniques for mutual exclusion, deadlock handling, fault tolerance, and recovery in distributed systems.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand the architecture, models, and fundamental concepts of distributed systems.				
CO2	Analyze logical clocks, global state determination, message ordering, and synchronization issues in distributed systems.				
CO3	Evaluate mutual exclusion, deadlock handling, agreement protocols, distributed file systems, and shared memory systems.				
CO4	Apply fault tolerance, recovery mechanisms, and resource management techniques in distributed environments.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to distributed systems:** Definitions, Examples and Applications of Distributed systems; System Models: Architectural models and Fundamental models; limitations of distributed systems, Introduction to Edge computing, Introduction to Cloud Computing. **Logical Clocks:** Lamport's clocks, Vector logical clock, Network Time Protocol; Message Passing System: Causal ordering of messages, Sates of a Distributed system, Local and Global State, Consistent and inconsistent states; Termination detection.	15 Hours	CO1
2	**Mutual Exclusion:** Requirements of Mutual Exclusion, Classification of distributed mutual exclusion: Non-token based Quorum Based and Token Based mutual exclusion with examples; Performance metric for distributed mutual exclusion algorithms. **Deadlock Detection:** System models, Preliminaries, Deadlock prevention, Deadlock avoidance, Deadlock detection & resolution. **Agreement Protocols:** Classification of Agreement Problem: Byzantine agreement problem, Consensus problem, Interactive consistency problem; Solution to Byzantine Agreement problem; Application of Agreement problem.	15 Hours	CO2

3	**Distributed File Systems:** Introduction, Issues in distributed File System, Mechanism for building distributed file systems; Distributed Shared Memory, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory. **Failure Recovery:** Backward and Forward recovery, Recovery in Concurrent systems: Checkpoints; Recovery in Distributed Database Systems; Fault Tolerance: Issues in Fault Tolerance, Voting Protocols.	15 Hours	CO3, CO4

Suggested Readings:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, Wiley, 2018.
2. M. Tamer Özsu and Patrick Valduriez, "Principles of Distributed Database Systems", 4th Edition, Springer, 2020.
3. Vijay K. Garg, "Elements of Distributed Computing", 2nd Edition, Wiley, 2009.
4. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, "Distributed Systems: Concepts and Design", 5th Edition, Pearson Education, 2012.
5. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2nd Edition, Pearson/PHI, 2007.

Online Resources:

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

Course Articulation Matrix

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	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)				
Year	IV	**Semester**	VII		
Course Name	Cryptography and Network Security				
Code	RCS5702				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Security Services and Mechanism	3	0	0	3
Course Objectives	1. Have a fundamental understanding of the objectives of cryptography and network security 2. Getting familiar with the cryptographic techniques that provide information andnetwork security. 3. To know the different types of algorithms of exchanging information in a secretway. 4. To know the possible threats which can break the secure communication.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understanding cryptography and network security concepts and applications.				
CO2	Apply security principals to system design and Real time Scenarios.				
CO3	To evaluate the application of security with Digital signature.				
CO4	Analysis of network traffic and security threats.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cryptography and Symmetric Ciphers** Security Attacks: Security Services and mechanism; Classical encryption techniques: Substitution ciphers and Transposition ciphers, Steganography, Cryptanalysis; Modern Block Ciphers: Stream and Block Cipher, Block Cipher Principles, Block Cipher Modes of Operations; Shannon‘s theory of Confusion and Diffusion; Fiestal structure; Data encryption standard(DES); Strength of DES; Idea of differential cryptanalysis; Triple DES; Symmetric Key Distribution; Finite Fields: Introduction to groups, rings and fields, Modular Arithmetic, Euclidean Algorithm, Finite Fields of the form GF(p).	15 Hours	CO1
2	**Basics of Number Theory and Public key Cryptography:** Introduction to Number Theory: Prime and Relative Prime Numbers, Fermat‘s and Euler‘s theorem, Testing for Primality, Chinese Remainder theorem, Discrete Logarithms; Public Key Cryptography: Principles of Public-Key Cryptography, RSA Algorithm, Security of RSA; Key Management: Deffie-Hellman Key Exchange.	15 Hours	CO2
3	**Hash Functions and Digital Signatures** Message Authentication; Hash Functions; Secure Hash Functions; Security of Hash functions and MACs; Digital Signatures; Digital Signature Standards (DSS); Proof of digital signature algorithm; Advanced Encryption Standard (AES) encryption and decryption. **Network and System Security** Authentication Applications: Kerberos, X.509 Certificates;	15 Hours	CO3, CO4

	Electronic Mail Security: Pretty Good Privacy, S/MIME; IP Security: IP Security Architecture, Authentication Header, Encapsulating security payloads, Combining Security Associations; Web Security: Secure Socket Layer and Transport Layer Security, Secure Electronic transaction; Intruder; Viruses; Firewalls.		

Suggested Readings:

1. William Stallings, ‒Cryptography and Network Security: Principals and Practice‖, Pearson Education.2020
2. Behrouz A. Frouzan: ‒Cryptography and Network Security‖, Tata McGraw- Hill,2015
3. Bruce Schiener, ‒Applied Cryptography‖. John Wiley & Sons,1993

Online Resources:

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

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

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

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

Suggested Readings:

1. Mark Coeckelbergh, AI Ethics, The MIT Press, 1st Edition, 2020.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux, 1st Edition, 2019.

3. Markus D. Dubber, Frank Pasquale, and Sunit Das (Eds.), The Oxford Handbook of Ethics of AI, Oxford University Press, 1st Edition, 2020.

Online Resources:

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

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

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

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

	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 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)					
Year	III	**Semester**	VI			
Course Name	DevOps					
Code	RPEC53211					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Operating Systems, Computer Networks, Cloud, Linux commands, and Programming fundamentals.		2	1	0	3
Course Objectives	1. Understand the fundamentals of DevOps, Agile methodologies, Scrum framework, and collaborative software development practices. 2. Apply version control systems, GitHub repository management, and CI/CD pipeline concepts for software integration and deployment. 3. Implement containerization and orchestration techniques using Docker and Kubernetes for scalable application deployment. 4. Analyze cloud computing concepts, infrastructure automation, monitoring tools, and DevOps deployment practices using Terraform, Ansible, and cloud platforms.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Apply knowledge of computing fundamentals, software engineering, and DevOps practices to solve real-world problems.					
CO2	Design and develop automated software delivery pipelines and scalable cloud-native applications using modern DevOps tools.					
CO3	Utilize modern IT infrastructure, containerization, cloud computing, and orchestration technologies for efficient deployment and management of applications.					
CO4	Analyze professional, ethical, security, and operational challenges in DevOps environments while ensuring continuous improvement and system reliability.					

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to DevOps:** Evolution of DevOps, Benefits and Challenges of DevOps, Software Development Life Cycle (SDLC), Agile Methodology, Agile vs Waterfall Model, Scrum Framework, Scrum Roles and Artifacts, Introduction to Design Thinking, Collaboration and Communication in DevOps.	15 Hours	CO1
2	**Introduction to Version Control Systems:** Git Fundamentals, GitHub Repository Management, Branching and Merging Strategies, Continuous Integration (CI), Continuous Deployment (CD), Building CI/CD Pipelines using GitHub Actions, Automated Testing Concepts, and Pipeline Automation Best Practices.	15 Hours	CO2

3	**Introduction to Containerization:** Docker Architecture, Docker Installation and Commands, Docker Images and Containers, Dockerfile and Docker Compose, Container Networking and Volumes, Introduction to Kubernetes, Kubernetes Architecture, Pods, Deployments and Services, Scaling and Managing Applications using Kubernetes. **Introduction to Cloud Computing:** Definition and Characteristics of Cloud Computing, benefits of cloud computing, IBM Cloud fundamentals and resources, DevOps Security Best Practices, Virtualization and Containers including VMs vs Containers, Serverless Computing using AWS Lambda and IBM Cloud Functions, Edge Computing, and End-to-End DevOps Project Deployment.	15 Hours	CO3, CO4

Suggested Readings:

1. IBM, Agile Development and Methodologies, IBM Courseware, 2015.
2. A. Maurya, Running Lean: Iterate from Plan A to a Plan That Works, Sebastopol, CA, USA: O'Reilly Media, 2nd Edition, 2012.
3. J. Sutherland, Scrum: The Art of Doing Twice the Work in Half the Time, New York, NY, USA: Crown Business, 1st Edition, 2014.
4. G. Kim, K. Behr, and G. Spafford, The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win, Portland, OR, USA: IT Revolution Press, 1st Edition, 2013.

Online Resources:

1. https://www.azuredevopslabs.com/
2. https://www.youtube.com/@nptel-speciallectureseries6651

Course Articulation Matrix

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

Program	B. Tech.(CSE)					
Year	III	**Semester**	VI			
Course Name	Computer Vision					
Code	RPEC53212					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Machine Learning, Computer Graphics	2	1	0	3	
Course Objectives	1. Understand the fundamental concepts of image formation, image representation, and image processing techniques used in computer vision systems. 2. Apply filtering, edge detection, and feature extraction methods for analyzing and enhancing digital images. 3. Develop computer vision solutions using deep learning models for image classification, object detection, segmentation, and recognition tasks. 4. Analyze motion, feature correspondence, and video understanding techniques to solve real-world vision-based applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain image formation models, image representation techniques, and fundamental image processing operations used in computer vision					
CO2	Apply filtering, edge detection, and feature extraction techniques to enhance and analyze digital images.					
CO3	Implement deep learning-based computer vision models for image classification, object detection, segmentation, and recognition tasks					
CO4	Apply feature detection, feature matching, motion estimation, and video analysis techniques for understanding dynamic visual scenes.					

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

	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		

Suggested Readings:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, Springer, 2022
2. James F James F. Peters, "Foundations of Computer Vision, Computational Geometry, Visual Image, Structures and Object Shape Detection", 124, Springer,2017
3. E. R. Davies, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Fourth Edition, Elsevier, 2012,
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/e-learning/preview/noc19_cs58
2. https://visionbook.mit.edu/

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

Program	B.Tech .(CSE)				
Year	III	**Semester**	VI		
Course Name	Natural Language Processing				
Course Code	RPEC53213				
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)				
Year	III	**Semester**	VI		
Course Name	Full Stack Development				
Code	RPEC53214				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	HTML DBMS	2	1	0	3
Course Objectives	1. Understanding the fundamentals of web development tools to become and industry-ready engineer who can readily deploy in a project. 2. Apply basic programming principles to the construction of websites 3. Design user interactions on web pages 4. Create servers and databases for functionality.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand basics of HTTP, HTML, CSS, Web Sockets, JSON, DOM, AJAX basics JavaScript, and jQuery.				
CO2	Apply frontend and backend scenarios to read, write and update data stored in MongoDB.				
CO3	Analyze AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters.				
CO4	Evaluate strong expertise to develop front end application using Angular JS.				

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

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

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech CSE				
Year	III	**Semester**	VI		
Course Name	Essentials of Blockchain				
Code	RPEC53221				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Distributed Systems, Computer Networking, Cryptography.	2	1	0	3
Course Objectives	1. To understand the fundamental concepts of Distributed Systems, Cryptography, and Blockchain technology. 2. To analyze various Blockchain architectures, Consensus mechanisms, and Decentralized applications. 3. To explore Cryptocurrencies, Smart contracts, and Blockchain-based platforms such as Bitcoin and Ethereum. 4. To evaluate emerging Blockchain applications and their role in domains such as IoT, Healthcare, Finance, and AI.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Explain the principles of Distributed Systems, Cryptographic techniques, and Blockchain fundamentals.				
CO2	Analyze Blockchain architecture, Mining mechanisms, Consensus protocols, and Transaction processing.				
CO3	Evaluate various Distributed Consensus algorithms and their suitability for decentralized systems.				
CO4	Demonstrate understanding of crypto currencies, Bitcoin, Ethereum, Smart Contracts, and **B**lockchain applications in real-world scenarios.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics:** Distributed Database, CAP theorem, Replication and Sharding techniques, Consensus, Two General Problem, Byzantine General Problem and Fault Tolerance, Hadoop Distributed File System, NameNode and DataNode architecture, Block storage, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function (SHA-256), Digital Signature- ECC and ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	15 Hours	CO1
2	**Blockchain:** Evolution of Blockchain technology, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas mechanism and Gas Limit, Fee calculation models, Mempool and transaction prioritization, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public Block chain. **Distributed Consensus:** Need for consensus in decentralized systems, Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Delegated PoS (DPoS), Practical Byzantine Fault Tolerance (PBFT), Forking Mechanisms, Difficulty Level, Sybil Attack, Eclipse attack, Energy utilization and alternate.	15 Hours	CO2, CO3

3	**Crypto currency:** History, Distributed Ledger Technology(DLT), Bitcoin protocols - Architecture and Network structure, Mining strategy and rewards, Transaction verification process, Ethereum - Account-based model, Ethereum Virtual Machine (EVM), Gas mechanism and fee structure, Construction, DAO, Smart Contract: Benefits and Applications, GHOST, Vulnerability, 51% 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, Convergence of AI and Blockchain technologies.	15 Hours	CO4

Suggested Readings:

1. Antonopoulos, A. M. Mastering Bitcoin: Unlocking Digital Crypto currencies. O'Reilly Media, Inc. , 2014.
2. Wood, G. Ethereum: A Secure Decentralized Transaction Ledger (Yellow Paper). Ethereum Project. , 2014.
3. Lewis, A. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the technology that powers them (2nd ed.). Mango Publishing. , 2021.
4. Bambara, J. J., Allen, P. R., Iyer, K., Madsen, R., Lederer, S., & Wuehler, M. Blockchain: A practical guide to developing business, law, and technology solutions. McGraw-Hill Education. , 2018.

Online Resources:

1. https://onlinecourses.nptel.ac.in/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	3	2	1	2	2					1		2	2
CO2	3	3	2	3	2					1		3	2
CO3	3	3	2	3	2					1		3	2
CO4	2	3	2	2	2	1				1		3	3

Program	B. Tech.(CSE)					
Year	III	**Semester**	VI			
Course Name	Cloud Computing Essentials					
Code	RPEC53222					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Basic knowledge of computer 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	**Foundations and Architecture of Cloud Computing:** 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	**Cloud Architecture, Deployment Models, Resource Management, and Security:** 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	**Cloud Platforms, Federation, and Applications:** Hadoop, MapReduce, VirtualBox, 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	15 Hours	CO3, CO4

	Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.		

Suggested Readings:

1. C. Surianarayanan and P. R. Chelliah, Essentials of Cloud Computing: A Holistic, Cloud-Native Perspective, 2nd ed. Cham, Switzerland: Springer Nature, 2024.
2. M. S. Kingsley, Cloud Technologies and Services: Theoretical Concepts and Practical Applications. Cham, Switzerland: Springer Nature, 2024.
3. T. Erl, R. Puttini, and Z. Mahmood, Cloud Computing: Concepts, Technology & Architecture, 2nd ed. Pearson Education, 2023.
4. N. B. Ruparelia and W. Dixon, Cloud Computing, Updated ed., MIT Press Essential Knowledge Series. Cambridge, MA, USA: The MIT Press, 2024.
5. A. Bahga and V. K. Madisetti, Cloud Computing: A Hands-On Approach, 2nd ed. Hyderabad, India: Universities Press, 2024.

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)				
Year	III	**Semester**	VI		
Course Name	Big Data Analytics				
Code	RPEC53223				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine Learning, Statistics, Probability	2	1	0	3
Course Objectives	1. Optimize business decisions and create competitive advantage with Big data analytics 2. Understand several key big data technologies used for storage, analysis and manipulation of data. 3. Recognize the key concepts of Hadoop framework, map reduce. 4. To learn Basic methodologies of PIG and HIVE.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand what Big Data, importance and various sources of data. Describe the elements of big data-volume, variety, velocity and veracity.				
CO2	Analyse the Big Data framework like Hadoop and NoSQL to efficiently store and process Big Data to generate analytics				
CO3	Design of Algorithms to solve Data Intensive Problems using MapReduce Paradigm				
CO4	Demonstrate and evaluate an ability to use frameworks like pig and hive to process Big Data and Analytics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Essentials of big data and analytics:** Data, Characteristics of data and Types of digital data, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data; Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.	15 Hours	CO1
2	**HADOOP :** Introducing Hadoop, Need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed computing challenges, History of Hadoop , Hadoop overview, Use case of Hadoop, Hadoop distributors, HDFS (Hadoop Distributed File System) , Processing data with Hadoop, Managing resources and applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.	15 Hours	CO2
3	**MapReduce programming:** Introduction , Mapper, Reducer, Combiner, Practitioner, Searching, Sorting, Compression, Real time applications using Map Reduce, Data serialization and Working with common serialization formats, Big data serialization formats. **Introduction to PIG and HIVE:** Introducing Pig: Pig architecture, Benefits, Installing Pig, Properties of Pig, Running Pig, Getting started with Pig Latin, Working with operators in Pig, Working with functions in Pig. Introducing Hive: Getting started with Hive, Hive Services, Data types in	15 Hours	CO3, CO4

	Hive, Built-in functions in Hive, Hive DDL.		

Suggested Readings:

1. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley Publications,2nd Edition,2014DT Editorial Services, ―Big Data, Dream Tech Press, 2ndEdition, 2015.
2. Tom White, Hadoop: The Definitive Guide, O'Reilly, 3rd Edition, 2012.
3. Black Book Big Data, dreamtech publications , 1st Edition, 2017.

Online Resources:

1. https://nptel.ac.in/courses/106104189.
2. http://www.datameer.com/pdf/big-data-analytics-ebook.pdf?mkt_tok.

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

Program	B.Tech.(CSE)					
Year	III	**Semester**	VI			
Course Name	Internet of Things					
Code	RPEC53224					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of AI and Computer Network		2	1	0	3
Course Objectives	1. To understand the fundamentals of IoT, including its vision, architecture, design principles, and M2M communication concepts. 2. Gain knowledge of IoT hardware and embedded platforms, such as sensors, actuators, RFID, wireless sensor networks, Arduino, and Raspberry Pi. 3. To learn IoT networking and programming techniques, including communication protocols, data handling, and Arduino-based application development. 4. To apply IoT technologies to develop smart solutions for real-world applications such as healthcare, home automation, smart metering, automotive systems, and smart cities.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Demonstrate basic concepts, principles and challenges in IoT.					
CO2	Illustrate functioning of hardware devices and sensors used for IoT.					
CO3	Analyze network communication aspects and protocols used in IoT.					
CO4	Apply IoT for developing real life applications using Ardunio programming.					

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

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech.(CSE)					
Year	IV	**Semester**	VII			
Course Name	Generative AI and LLMs					
Code	RPEC53231					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Programming Fundamentals, Machine Learning Basics, Probability and Statistics & Fundamentals of Artificial Intelligence		2	1	0	3
Course Objectives	1. To understand the fundamental concepts, architectures, and evolution of Generative AI and Large Language Models (LLMs). 2. To apply prompt engineering, retrieval-augmented generation (RAG), and fine-tuning techniques for developing intelligent AI applications. 3. To utilize modern LLM frameworks, tools, and APIs for building and evaluating generative AI solutions. 4. To analyze ethical, security, privacy, and societal challenges associated with Generative AI and promote responsible AI practices.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the fundamental concepts, architectures, and working principles of Generative AI and Large Language Models (LLMs).					
CO2	Apply prompt engineering, retrieval-augmented generation (RAG), and fine-tuning techniques to develop AI-driven applications.					
CO3	Utilize modern LLM frameworks, APIs, and tools to design, implement, and evaluate generative AI solutions.					
CO4	Analyze ethical, security, privacy, and societal implications of Generative AI systems and recommend responsible AI practices.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of Generative AI and Large Language Models:** Introduction to Artificial Intelligence and Generative AI, Evolution of Generative Models, Deep Learning Foundations for Generative AI, Natural Language Processing Fundamentals, Neural Language Models, Transformer Architecture, Self-Attention Mechanism, Encoder-Decoder Models, Large Language Models (LLMs), Tokenization Techniques, Embeddings and Vector Representations, Pre-training and Fine-Tuning Concepts, Foundation Models, Applications of Generative AI and LLMs.	15 Hours	CO1
2	**Prompt Engineering and Generative AI Application Development:** Prompt Engineering Fundamentals, Zero-Shot Learning, One-Shot Learning, Few-Shot Learning, Chain-of-Thought Prompting, Context Engineering, Retrieval-Augmented Generation (RAG), Vector Databases, Fine-Tuning Techniques, Parameter-Efficient Fine-Tuning (PEFT), LoRA, LLM APIs and Frameworks, LangChain Fundamentals, AI Agents and Tool Calling, Chatbot Development, Content Generation Systems, Evaluation Metrics for LLMs, Performance Assessment and Optimization.	15 Hours	CO2, CO3
	Responsible AI, Security and Emerging Trends: Ethical		

3	Issues in Generative AI, Bias and Fairness in AI Systems, Hallucination and Reliability Challenges, Privacy and Data Protection, AI Security Risks, Prompt Injection Attacks, Jailbreak Attacks, Explainable and Responsible AI, AI Governance and Regulations, Intellectual Property and Copyright Issues, Deployment and Scalability of LLM Applications, Multimodal Generative AI, Autonomous AI Agents, Emerging Trends and Future Directions in Generative AI.	15 Hours	CO4

Suggested Readings:

1. Dhamani, Numa, and Maggie Engler. Introduction to generative AI. Simon and Schuster, 2026.
2. Bahree, Amit. Generative AI in action. Simon and Schuster, 2024.
3. Rodriguez, Carlos. Generative AI Foundations in Python: Discover key techniques and navigate modern challenges in LLMs. Packt Publishing Ltd, 2024.

Online Resources:

1. DeepLearning.AI – Generative AI Courses
   https://www.deeplearning.ai/courses/
2. Hugging Face Documentation (Transformers & LLMs)
   https://huggingface.co/docs
3. OpenAI API Documentation (GPT & LLM Development)
   https://platform.openai.com/docs
4. Google Cloud Generative AI Learning Path
   https://cloud.google.com/learn/training/generative-ai

Course Articulation Matrix

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

Program	B. Tech.(CSE)					
Year	IV	**Semester**	VII			
Course Name	Edge AI and Tiny ML					
Code	RPEC53232					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Programming in Python/C, Basics of Machine Learning, Fundamentals of Embedded Systems	2	1	0	3	
Course Objectives	1. To understand the fundamentals of Edge AI, TinyML, and resource-constrained machine learning systems. 2. To design and develop machine learning models optimized for edge devices and microcontrollers. 3. To apply model compression, quantization, and optimization techniques for efficient deployment. 4. To analyze real-time edge applications with constraints of power, memory, and computation.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the concepts and architecture of Edge AI and TinyML systems.					
CO2	Develop and deploy machine learning models on edge and embedded devices.					
CO3	Apply optimization techniques such as pruning, quantization, and compression for TinyML models.					
CO4	Evaluate edge AI applications considering performance, latency, power efficiency, and scalability.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Edge AI and TinyML:** Introduction to Edge AI, Cloud vs Edge Computing, TinyML Overview, Embedded AI Systems, Machine Learning on Microcontrollers, IoT and Edge Devices, Data Acquisition and Preprocessing at Edge, Sensor Integration, Real-time Constraints in Edge Systems, Edge AI Architectures, Applications of Edge AI (Smart Homes, Healthcare, Industry 4.0, Autonomous Systems), Introduction to TinyML Frameworks.	15 Hours	CO1
2	**Model Development and Deployment on Edge Devices:** Machine Learning Workflow for Edge Devices, Lightweight Neural Networks, CNNs for Edge Applications, Model Conversion Techniques (TensorFlow Lite, ONNX), Edge Deployment Frameworks, Microcontroller-based ML Deployment, Arduino and ESP32-based AI systems, Real-time Inference on Edge, Edge AI Toolchains, Dataset Optimization for TinyML, Performance Benchmarking on Embedded Devices.	15 Hours	CO2
3	**Model Optimization and Advanced Edge Applications:** Model Compression Techniques, Pruning and Quantization, Knowledge Distillation, Memory and Power Optimization, Latency Reduction Techniques, Federated Learning for Edge Devices, Privacy in Edge AI, Real-time Edge Analytics, Industrial Edge AI Applications, Smart Sensors and	15 Hours	CO3, CO4

	Predictive Maintenance, Challenges in Edge AI Deployment, Future Trends in TinyML and Edge Intelligence.		

Suggested Readings:

1. Situnayake, Daniel, and Jenny Plunkett. AI at the Edge. " O'Reilly Media, Inc.", 2023.
2. Imoize, Agbotiname Lucky, Dinh-Thuan Do, and Houbing Herbert Song, eds. Tiny Machine Learning: Design Principles and Applications. John Wiley & Sons, 2026.
3. El-Makkaoui, Khalid, et al., eds. Tiny Machine Learning Techniques for Constrained Devices. CRC Press, 2026.

Online Resources:

1. TensorFlow Lite for Microcontrollers (TinyML Deployment)
   https://www.tensorflow.org/lite/microcontrollers
2. Edge Impulse – TinyML Development Platform
   https://www.edgeimpulse.com/
3. Edge AI Foundation (formerly TinyML Foundation)
   https://www.edgeaifoundation.org/
4. Harvard TinyML Course / Edge ML Resources
   https://edge.seas.harvard.edu/tinyml

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

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

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

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

Suggested Readings

1. F. Tao and M. Zhang, Digital Twin Driven Smart Manufacturing. Cambridge, MA, USA: Academic Press, 2019.
2. M. Farsi, A. Daneshkhah, A. Hosseinian-Far, and H. Jahankhani (Eds.), Digital Twin Technologies and Smart Cities. Cham, Switzerland: Springer, 2020.
3. M. Grieves and J. Vickers, Digital Twin: Mitigating Unpredictable, Undesirable Emergent Behavior in Complex Systems. Cham, Switzerland: Springer, 2022.

Online Resources

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

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

Program	B. Tech.(CSE)					
Year	IV	**Semester**	VII			
Course Name	Explainable and Responsible AI					
Code	RPEC53234					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of Artificial Intelligence, Machine Learning Basics, Probability and Statistics & Python Programming		2	1	0	3
Course Objectives	1. To understand the fundamental concepts of Explainable AI (XAI) and Responsible AI frameworks. 2. To analyze machine learning models using interpretability and explainability techniques. 3. To evaluate fairness, bias, transparency, and accountability in AI systems. 4. To apply responsible AI principles in designing ethical and trustworthy AI solutions.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the concepts, need, and approaches of Explainable AI and Responsible AI.					
CO2	Apply model interpretability techniques to analyze and explain AI/ML models.					
CO3	Evaluate fairness, bias, transparency, and ethical concerns in AI systems.					
CO4	Design and propose responsible and trustworthy AI solutions for real-world applications.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of Explainable and Responsible AI:** Introduction to Artificial Intelligence, Need for Explainability in AI, Black Box vs Interpretable Models, Overview of Explainable AI (XAI), Responsible AI Principles, Transparency, Accountability, Fairness, Ethics in AI Systems, AI Lifecycle and Responsibility, Types of Interpretability (Global vs Local), Introduction to Bias in AI Systems, Real-world Impact of Unethical AI.	15 Hours	CO1
2	**Explainability Techniques and Model Interpretability:** Model Interpretability Techniques, Feature Importance Methods, LIME (Local Interpretable Model-Agnostic Explanations), SHAP (SHapley Additive Explanations), Saliency Maps, Counterfactual Explanations, Interpretable Machine Learning Models, Decision Trees, Linear Models, Rule-based Systems, Visualization Techniques for Explainability, Evaluation of Explainability Methods, Tools for XAI (AI Explainability 360, InterpretML).	15 Hours	CO2
3	**Responsible AI, Fairness and Governance:** AI Fairness Metrics, Types of Bias (Data Bias, Algorithmic Bias, Sampling Bias), Bias Detection and Mitigation Techniques, Privacy in AI Systems, Ethical AI Design Principles, AI Governance Frameworks, Regulatory Policies (GDPR, AI Act Overview), Trustworthy AI Development, Risk Management in AI Systems, Accountability and	15 Hours	CO3, CO4

	Auditability, Responsible AI Deployment, Case Studies in Ethical AI Failures and Best Practices.		

Suggested Readings:

1. Lu, Qinghua, et al. Responsible AI: Best practices for creating trustworthy AI systems. Addison-Wesley Professional, 2023.
2. Masood, Adnan, and Heather Dawe. Responsible AI in the Enterprise: Practical AI risk management for explainable, auditable, and safe models with hyperscalers and Azure OpenAI. Packt Publishing Ltd, 2023.
3. Hall, Patrick, James Curtis, and Parul Pandey. Machine learning for high-risk applications: approaches to responsible AI. " O'Reilly Media, Inc.", 2023.

Online Resources:

1. IBM AI Explainability 360 Toolkit
   https://aix360.mybluemix.net/
2. Google Responsible AI Principles
   https://ai.google/responsibility/principles/
3. Microsoft Responsible AI Resources
   https://www.microsoft.com/en-us/ai/responsible-ai
4. SHAP Explainability Library Documentation
   https://shap.readthedocs.io/en/latest/

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

Program	B. Tech.(CSE)					
Year	IV	**Semester**	VIII			
Course Name	Soft Computing					
Code	RPEC53241					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Mathematics, Probability, Statistics, and Programming Fundamentals.		2	1	0	3
Course Objectives	1. To understand the fundamental concepts, principles, and significance of soft computing techniques for handling uncertainty, imprecision, and complex decision-making problems. 2. To apply fuzzy logic, artificial neural networks, and evolutionary computing methods to model and solve real-world computational problems. 3. To analyze and evaluate the performance of intelligent systems developed using soft computing approaches in diverse application domains. 4. To design and develop hybrid soft computing solutions by integrating multiple intelligent techniques for optimization, prediction, classification, and decision-support applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the fundamental concepts and principles of soft computing and fuzzy logic.					
CO2	Apply artificial neural network models for solving classification and prediction problems.					
CO3	Analyze and implement evolutionary algorithms for optimization tasks.					
CO4	Design hybrid soft computing solutions for real-world intelligent systems.					

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

Program	B.Tech.(CSE)					
Year	IV	**Semester**	VIII			
Course Name	Quantum Computing					
Code	RPEC53242					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Engineering Mathematics, Data Structures and Algorithms, Python Programming		2	1	0	3
Course Objectives	1. To understand the basics of quantum computing. 2. To understand the mathematics required for quantum computing. 3. To understand the building blocks of quantum computing and design algorithms. 4. To understand quantum hardware principles and tools for quantum computing.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Understand basic concepts of quantum computing. Appraise various mathematical models required for quantum computing.					
CO2	Analyse various quantum hardware-building principles.					
CO3	Apply various quantum hardware-building principles.					
CO4	Evaluate the various quantum algorithms.					

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

Suggested Readings:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University Press, 2010.
2. David McMahon, “Quantum Computing Explained”, Wiley, 2008.
3. Vladimir Silva, Practical Quantum Computing for Developers, 2018.

Online Resources:

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

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

Program	B.Tech.(CSE)				
Year	IV	**Semester**	VIII		
Course Name	Augmented and Virtual Reality				
Code	RPEC53243				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of AI and 3D Visualization.	2	1	0	3
Course Objectives	1. To provide students with a solid background of 3D compositing techniques. 2. Applications in interactive interfaces augmented reality interfaces 3. Provide students with a comprehensive knowledge in 3D vision. 4. Develop skills in the design of interactive augmented reality games.				
Course Outcomes: After successful completion of the course, the students will be able to:					
CO1	Understand interactive augmented reality applications.				
CO2	Analyze about some Software Technologies used in Visualization.				
CO3	Evaluate the 3D interaction techniques.				
CO4	Apply knowledge of the research literature in Augmented Reality.				

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

Suggested Readings:

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

Online Resources:

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

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

Program	B. Tech.(CSE)					
Year	IV	**Semester**	VIII			
Course Name	Sustainable Computing and Green AI					
Code	RPEC53244					
Course Type	PEC		**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of Computer, Science, Basics of Artificial Intelligence and Machine Learning, Operating Systems & Basic Environmental Science concepts		2	1	0	3
Course Objectives	1. To understand the principles of sustainable computing and environmental impact of digital technologies. 2. To analyze energy consumption and carbon footprint of computing systems and AI models. 3. To apply Green AI techniques for energy-efficient model design and deployment. 4. To evaluate sustainable computing strategies for real-world IT and AI applications.					
Course Outcomes: After successful completion of the course, the students will be able to:						
CO1	Explain the concepts of sustainable computing, Green IT, and environmental impact of computing systems.					
CO2	Analyze energy efficiency and carbon footprint of AI models and computing infrastructures.					
CO3	Apply Green AI techniques to design energy-efficient machine learning and computing solutions.					
CO4	Evaluate and propose sustainable computing strategies for real-world applications and systems.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Sustainable Computing:** Introduction to Sustainable Computing, Green IT Concepts, Environmental Impact of Computing, Carbon Footprint of IT Systems, Energy Consumption in Data Centers, Sustainable Hardware Design, Green Software Engineering Principles, Lifecycle Assessment of Computing Systems, Energy-Aware Computing Models, Sustainable ICT Infrastructure, E-waste Management and Recycling, Global Sustainability Standards in IT.	15 Hours	CO1
2	**Green AI and Energy-Efficient Machine Learning:** Introduction to Green AI, Energy Consumption in Machine Learning Models, Efficient Training Techniques, Model Compression, Pruning and Quantization, Low-Power AI Algorithms, Efficient Data Processing Techniques, Energy-Aware Neural Networks, Hardware Acceleration for Green AI, Edge vs Cloud Energy Trade-offs, Carbon-Aware AI Training, Optimization Techniques for AI Workloads, Tools for Measuring AI Energy Usage.	15 Hours	CO2, CO3
3	**Sustainable Systems and Future Trends:** Sustainable Software Engineering Practices, Energy-Efficient Cloud Computing, Green Cloud Architectures, Sustainable IoT Systems, Smart Energy Management Systems, Renewable Energy in Data Centers, AI for Climate Change Solutions,	15 Hours	CO3, CO4

	Policy and Regulations for Green Computing, Corporate Sustainability Strategies, Ethical Considerations in Sustainable Computing, Future Trends in Green AI and Sustainable Technologies.		

Suggested Readings:

1. Jain, Vishal, et al., eds. Convergence Strategies for Green Computing and Sustainable Development. IGI Global, 2024.
2. Singh, Niharika, et al., eds. Green Computing for Sustainable Development. CRC Press, 2025.
3. Rane, Nitin Liladhar, Reshma Amol Chaudhari, and Jayesh Rane. Green Artificial Intelligence: Sustainable Techniques, Applications, and Future Directions. Deep Science Publishing, 2025.

Online Resources:

1. Google Sustainability & AI Research
   https://ai.google/responsibility/sustainability/
2. Green Software Foundation
   https://greensoftware.foundation/
3. Microsoft Sustainable AI & Cloud Resources
   https://www.microsoft.com/en-us/sustainability/cloud
4. IBM Green IT and Sustainability
   https://www.ibm.com/sustainability

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

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

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

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

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

Suggested Readings:

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

Online Resources:

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

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

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

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

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

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

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

Suggested Readings

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

Online Resources:

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

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

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

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

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

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

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

Suggested Readings:

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

Online Resources:

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

Course Articulation Matrix

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

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

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

Suggested Readings:

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

Online Resources:

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

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

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

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

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

Suggested Readings:

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

Online Resources:

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

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

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

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

Suggested Readings:

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

Online Resources:

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

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

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

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

Suggested Readings:

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

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

Online Resources:

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

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

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

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

Suggested Readings:

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

Online Resources:

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

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

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

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

Suggested Readings:

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

Online Resources:

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

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