



JOY UNIVERSITY

Established vide Tamil Nadu State Pvt. Universities Act 2019



SCHOOL OF COMPUTATIONAL INTELLIGENCE

Outcome Based Curriculum Framework with CBCS

for

***BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE
AND ENGINEERING***

(B.Tech. CSE)

Students admitted from 2025 -26 onwards



VISION

♣ To create and nurture a multidisciplinary global university with highest academics, research and ethical standards in a creative and innovative environment.

MISSION

♣ To be a premier University of choice for all stakeholders and contribute for academic demographic dividend. To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.

QUALITY OBJECTIVES

- To disseminate knowledge with skills through teaching, training, seminars, workshops, conferences and symposia in Engineering and Technology, Art and Design, Management and Commerce, Allied Health Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences, Law and Agricultural Sciences to enable students to meet the current needs and trends of industries, business and society.
- To provide technical and scientific solutions to real time problems posed by industries, business and society in all Schools of Joy University.
- To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.
- To promote the spirit of entrepreneurship in the young generation to help and create more career opportunities in the society by incubating a nurturing technology product idea backed by Technology Business Incubation.
- To identify and nurture leadership and innovate skills in students to become future leaders to enrich society.
- To develop collaborations and partnerships with International global and reputed Universities, research establishments, Government and NGO's, industries and businesses. To support both faculties and students for international exposure.

SCHOOL OF COMPUTATIONAL INTELLIGENCE

VISION

The SOCI envisions a 'cooperatively competitive' academic environment in the thematic areas of the school and relevant research backed by quality education to churn out graduates with professional acumen, exceptional leadership and a humane heart to meet both national and global needs.

MISSION

The SOCI offers a value-based, technology-oriented education striving to achieve high levels of academic excellence, intellectual competence and exemplary values. The tri-value system of our school is designed to deliver education through three interconnected values: **Learning, Transmutation and Transformation.**

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Graduates will have the ability and attitude to acquire new skills and adapt recent technological changes.

PEO 2: To prepare the graduates to serve in the industries related to Computer Science and Engineering or to do higher education and research.

PEO 3: Graduates will work with professionalism and ethics by contributing to the advancement of the society.

GRADUATE ATTRIBUTES

The Graduate Attributes of B.Tech (Computer Science and Engineering) are:

GA 1 Apply appropriate knowledge in Computer Science and Engineering to identify, formulate, analyze, and solve complex engineering problems in order to reach substantive conclusions.

GA 2 Self-learn and engage in use of advanced computing tools.

GA 3 Develop sustainable computing solutions in broader economic, societal and environmental contexts

GA 4 Think critically, creatively and analytically as a computer scientist, whilst being able to work effectively, independently and collaboratively as part of a team in research, technology development and entrepreneurial ventures.

GA 5 Apply evolving ethics and privacy laws across various domains and territories.

GA 6 Effectively communicate engineering concepts and ideas to peers in written or oral forms

GA 7 Be motivated to engage in independent and life-long learning in the broadest context of evolving technological challenges

PROGRAMME OUTCOMES

On completion of the **B.Tech (Computer Science and Engineering) Programme**, students should be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO 1: Understanding of ethical considerations and societal impacts related to AI/ML systems, ensuring responsible and fair use of technology.

PSO 2: Proficiency in handling, cleaning, and preprocessing large datasets to extract meaningful insights and improve model predictions.

PSO 3: Ability to design, implement, and evaluate AI/ML models for real-world applications, optimizing performance and accuracy.

Summary of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	21	21	20	24	20	20	21	167
Contact Hrs./Week	24	24	24	22	26	22	17	06	165

SEMESTER WISE CREDIT STRUCTURE

Sl. No.	Category of Courses	1 st Year		2 nd Year		3 rd Year		4 th Year		Total
		Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Sem VII	Sem VIII	
1.	Departmental Core	08	07	20	11	12	11	07	–	76
2.	Programme Specific Electives (PSE)	–	–	–	06	06	06	06	06	30
3.	Open Electives	–	–	–	–	03	03	03	–	09
4.	Applied Sciences	08	11	–	–	–	–	–	–	19
5.	Internships/ Field Visits	–	–	–	–	–	–	02	–	02
6.	Project	–	–	–	–	–	–	02	15	17
7.	Skill Enhancement Course	–	01	–	03	03	–	–	–	07
8.	Ability Enhancement Courses (AECC)	03	–	–	–	–	–	–	–	03
9.	Value-Added Course	01	02	01	–	–	–	–	–	04
Total		20	21	21	20	24	20	20	21	167

School of Computational Intelligence
B.Tech (Computer Science and Engineering)
Semester – I
(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS111	Core Course Fundamentals of Computing	3	0	0	3	3
2.	25BTCS112	Core Course Introduction to Programming	3	0	0	3	3
3.	25BTCS113	Applied Science Mathematics – I	3	1	0	4	4
4.	25BTCS114	Applied Science Physics I	3	1	0	4	4
5.	25BTCS211	Core Course Fundamentals of Computing Lab	0	0	2	2	1
6.	25BTCS212	Core Course Introduction to Programming Lab	0	0	2	2	1
7.	25AEEN911	Ability Enhancement Compulsory Course (AECC) Effective Communication	3	0	0	3	3
8.	25BTCS911	Value-Added Course Performing Arts/Sports	3	0	0	3	1
		Total	18	2	4	24	20

Semester – II**(Total Credits: 21)**

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS121	Core Course Python Programming	3	0	0	3	3
2.	25BTCS122	Applied Science Probability, Statistics and Stochastic Processes	3	0	0	3	3
3.	25BTCS123	Applied Science Mathematics II	3	1	0	4	4
4.	25BTCS124	Applied Science Physics II	3	0	0	3	3
5	25BTCS125	Core Course Discrete Structures for Computer Science	3	0	0	3	3
6	25BTCS221	Core Course Python Programming Lab	0	0	2	2	1
7	25BTCS222	Applied Science Physics Lab	0	0	2	2	1
8	25BTCS223	Skill Enhancement Course Extended Reality and its Applications Lab	0	0	2	2	1
9	25EVST921	Value Added Course Environmental Science	2	0	0	2	2
		TOTAL	17	1	6	24	21

Semester – III**(Total Credits: 21)**

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS131	Core Course Microprocessors and Microcontrollers	3	0	0	3	3
2.	25BTCS132	Core Course Signals and Systems	3	0	0	3	3
3.	25BTCS133	Core Course Digital Design	3	0	0	3	3
4.	25BTCS134	Core Course Data Structures and Algorithms	3	0	0	3	3
5.	25BTCS135	Core Course Object-Oriented Programming with Java	3	0	0	3	3
6.	25BTCS136	Core Course Professional Ethics	2	0	0	2	2
7.	25BTCS231	Core Course Digital Design Lab	0	0	2	2	1
8.	25BTCS232	Core Course Data Structures and Algorithms Lab	0	0	2	2	1
9.	25BTCS233	Core Course Object-Oriented Programming with Java Lab	0	0	2	2	1
10.	25BTCS931	Value Added Course Indian Constitution	1	0	0	1	1
		Total	18	0	06	24	21

Semester – IV

(Total Credits: 20)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS141	Core Course Introduction to Artificial Intelligence and Machine learning	3	0	0	3	3
2.	25BTCS142	Core Course Database Management Systems	3	0	0	3	3
3.	25BTCS143	Core Course Computer Organization and Architecture	3	0	0	3	3
4.	25BTCS341 25BTCS342 25BTCS343	Programme Specific Elective (PSE) I Operating Systems Data Mining and Data Warehousing Social Network Analysis	3	0	0	3	3
5.	25BTCS344 25BTCS345 25BTCS346	Programme Specific Elective (PSE) II Full Stack Development Advanced Data Structures and Algorithms Design and Analysis of Algorithms	3	0	0	3	3
6	25BTCS241	Core Course Introduction to Artificial Intelligence and Machine learning Lab	0	0	2	2	1
7	25BTCS242	Core Course Database Management Systems Lab	0	0	2	2	1
8	25BTCS841	Skill Enhancement Course Engineering Economics and Foreign Trade	3	0	0	3	3
		Total	18	0	04	22	20

Semester – V

(Total Credits: 24)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS151	Core Course Computer Graphics and Multimedia	3	0	0	3	3
2.	25BTCS152	Core Course Computer Networks	3	0	0	3	3
3.	25BTCS153	Core Course Theory of Computation	3	1	0	4	4
4.	25BTCS351 25BTCS352 25BTCS353	Programme Specific Elective (PSE) III Software Engineering Nature Inspired Computing Fuzzy sets, Logics and Systems	3	0	0	3	3
5.	25BTCS354 25BTCS355 25BTCS356	Programme Specific Elective (PSE) IV Digital Image Processing Cognitive Computing Natural Language Processing	3	0	0	3	3
6	25BTCS251	Core Course Computer Graphics and Multimedia Lab	0	0	2	2	1
7	25BTCS252	Core Course Computer Networks Lab	0	0	2	2	1
8	25BTCS851	Skill Enhancement Course Principles of Management	3	0	0	3	3
9	25BTCS051 25BTCS052 25BTCS053	Open Elective I (Generic) Artificial Intelligence Python Programming Computer Networks	3	0	0	3	3
		Total	21	01	04	26	24

Semester – VI

(Total Credits: 20)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS161	Core Course Embedded Systems	3	0	0	3	3
2.	25BTCS162	Core Course Compiler Design	3	0	0	3	3
3.	25BTCS163	Core Course Cryptography and Network Security	3	0	0	3	3
4.	25BTCS361 25BTCS362 25BTCS363	Programme Specific Elective (PSE) V Big Data Analytics Neuromorphic Computing Computer Vision	3	0	0	3	3
5.	25BTCS364 25BTCS365 25BTCS366	Programme Specific Elective (PSE) VI Computational Learning Theory Soft Computing Data Visualization	3	0	0	3	3
6.	25BTCS261	Core Course Embedded Systems Lab	0	0	2	2	1
7.	25BTCS262	Core Course Compiler Design Lab	0	0	2	2	1
8.	25BTCS061 25BTCS062 25BTCS063	Open Elective II (Generic) AI Tools Internet of Things Cybersecurity	3	0	0	3	3
		Total	18	0	04	22	20

Semester – VII

(Total Credits: 20)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS171	Core Course High Performance Computing	3	0	0	3	3
2.	25BTCS172	Core Course Mobile and Pervasive Computing	3	0	0	3	3
3.	25BTCS371	Programme Specific Elective (PSE) VII Systems Engineering	3	0	0	3	3
	25BTCS372	Evolutionary Computation					
	25BTCS373	Digital Marketing					
4.	25BTCS374	Programme Specific Elective (PSE) VIII Pattern Recognition	3	0	0	3	3
	25BTCS375	Augmented Intelligence					
	25BTCS376	Computational and Systems Biology					
5	25BTCS271	Core Course High Performance Computing Lab	0	0	2	2	1
6	25BTCS471	Industrial Internship	0	0	0	0	2
7	25BTCS571	Mini Project	0	0	0	0	2
8	25BTCS071	Open Elective III Advanced Python Programming	3	0	0	3	3
	25BTCS072	Optimization Algorithms					
	25BTCS073	Computing (Latest)					
		Total	15	0	02	17	20

Semester – VIII**(Total Credits: 21)**

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTCS581	Capstone Project	0	0	0	0	15
2.	25BTCS381	Programme Specific Elective (PSE) IX Game Theory	3	0	0	3	3
	25BTCS382	Semantic Web Technology					
	25BTCS383	GPU Computing					
3.	25BTCS384	Programme Specific Elective (PSE) X Resource Constrained Artificial Intelligence	3	0	0	3	3
	25BTCS385	Web Data Mining					
	25BTCS386	Generative AI					
		Total	06	0	0	06	21

Semester I

Programme	B.Tech CSE	Programme Code	BTCS
Course Code	25BTCS111	Number of Hours/Week	3
Semester	I	Max. Marks	100
Year	I	Credits	3

Course

Course Title	FUNDAMENTALS OF COMPUTING	L	T	P
		3	0	0

L-Lecture Hours T-Tutorial Hours P-Practical Hours

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To have a comprehensive understanding of a foundational understanding of computer systems.
- To learn about various number systems including decimal, binary, octal, and hexadecimal
- To develop a comprehensive grasp of how computers function, the types of software used and the significance of networking in today's digital world.
- To explore various types of software applications including operating systems, word processors, database management systems and Internet.
- To build basic competency in using computer applications for everyday tasks.

UNIT	TOPICS	HOURS
I	<p>INTRODUCTION TO COMPUTER Evolution of Computers, Generations of Computers, Classification of Computers, The Computer System, Computing Concepts, Applications of Computers.</p> <p>MEMORY AND STORAGE SYSTEMS Computer Software and Hardware components and its requirements- Storage Devices.</p> <p>COMPUTER VIRUSES Types of Viruses – Spreading of Virus, Prevention of Computer Virus, Virus Detection, Computer Security, Maintenance, Desktop functions, Dialog boxes, Single Document Interface (SDI), Multiple Document Interface (MDI), Windows Controls, Main Menu Display, Categories of Menus, Main and Context Sensitive Menus, Booting/Shutting Down.</p>	9
II	<p>MICROSOFT SOFTWARE MS DOS, MS Word System, MS Excel System, MS Power point System, MS Access System, MS Publisher.</p> <p>NUMBER SYSTEM Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System, BCD, XS,3, Gray Code, Alphanumeric Codes,(ASCII, EBCDIC).</p>	9
III	<p>COMPUTER SOFTWARE Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, System Management Programs , Standard Application Programs , Unique Application Programs, Problem Solving, Structuring the Logic.</p>	9

IV	MEMORY MANAGEMENT Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems.	9
V	THE INTERNET AND WORLD WIDE WEB History of the Internet-The Internet Applications-Understanding World Wide Web-Web Browsers-Browsing the Internet-Using a Search Engine- Email Service-Protocols used in the Internet. DATA COMMUNICATIONS AND NETWORKS Introduction-Data Communication Using Modem-Computer Networks- Network Topologies-Network Protocols and Software-Applications of Network.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basic concepts of computers.

CO2: Analyze the basics of number systems.

CO3: Apply system development programs to create and manage simple software projects.

CO4: Analyze the performance of different memory management techniques and their impact on system efficiency.

CO5: Evaluate the knowledge of Internet history to understand current Internet technologies and to solve problems in communication and information access.

Text Books:

1. Fundamentals of Computers, E. Balagurusamy, Tata McGraw Hill Education Private Limited, 2009.

Reference Books:

1. Introduction to Computer Fundamentals, Bright Siaw Afriyie, Second edition, Trafford Publishing, Canada, 2003-2006.
2. Computer Fundamentals, P. K. Sinha, BPB Publications, Sixth Edition, 2004.
3. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Ninth edition, 2013.
4. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth edition, Prentice Hall, 2011.
5. Computing Fundamentals: Introduction to Computers, Faithe Wempen, Wiley 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	1	0	0	0	2	0	0	0	1	3	2	0	0
CO2	3	3	0	2	3	0	0	0	0	0	1	3	2	0	0
CO3	3	3	3	2	2	0	0	0	0	0	3	3	2	1	1
CO4	2	3	1	3	2	0	0	0	0	0	1	3	2	1	1
CO5	3	3	2	3	3	0	0	0	0	0	1	3	2	1	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS211	Number of Hours/Week	2			
Semester	I	Max. Marks	100			
Year	I	Credits	1			
Core Course						
Course Title	FUNDAMENTALS OF COMPUTING LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						

LIST OF PROGRAMS

1. Basics of Microsoft Word.
2. Insert Table and Generating Chart.
3. Mail Merging.
4. Study on features of Microsoft Excel.
5. Incorporating the predefined functions in Excel.
6. Inserting table and generating chart in Excel.
7. Pivot chart, table and slicing in Excel.
8. Study on features in Microsoft PowerPoint.
9. Creating presentation incorporating the features of PowerPoint.
10. Study on HTML.
11. Basic web page design, formatting, inclusion of image and video.
12. Creation of Table.
13. Designing own web page.

On successful completion of this course, the student will be able to

- CO1:** Understand the basic functionalities of Microsoft Word
- CO2:** Apply advanced Excel features for data management.
- CO3:** Create complex data presentations using Excel pivot tables, charts, and slicers.
- CO4:** Develop professional presentations using advanced PowerPoint features.
- CO5:** Design and develop basic web pages using HTML

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	1	0	0	0	2	0	0	0	1	3	2	0	0
CO2	3	3	0	2	3	0	0	0	0	0	1	3	2	0	0
CO3	3	3	3	2	2	0	0	0	0	0	3	3	2	1	1
CO4	2	3	1	3	2	0	0	0	0	0	1	3	2	1	1
CO5	3	3	2	3	3	0	0	0	0	0	1	3	2	1	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS112	Number of Hours/Week	3			
Semester	I	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	INTRODUCTION TO PROGRAMMING			L	T	P
			3	0	0	
COURSE OBJECTIVES:						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language. • To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language • Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management . • Build a foundation for advanced programming and software development. To develop skills to handle complex programming challenges such as file handling, Debugging. 						
UNIT	TOPICS				HOURS	
I	Introduction to programming Algorithm, Formalism, Flow chart, Assembly language, Introduction to program, Program components, structure, Execution path, Programming paradigms introduction, Syntax and Semantics				9	
II	Introduction to C language History of C, Prerequisites of C, Features and its applications, Structure of C, Preprocessor directives, Data types and constants, variables and its types, Tokens, Identifiers and format specifiers, Operators and Enums, Data I/O, Decision making and Branching, Loop Introduction, programs with looping structure, Control Flow programs with control flow				9	
III	Array and Strings Introduction to Array, Initialization, Single dimensional array, Multidimensional array, String, Functions with string: Read, Display string and string functions, String Arrays.				9	
IV	Functions and Pointers Function Introduction, Function calling, Return type, Function types, Recursion, Types of Recursion, Introduction to Pointers, Types Pointers, Programming exercises with pointers.				9	
V	Structures and Unions Introduction to structure and simple program using structure concepts, Introduction to Union and programs with union, Storage Classes- Introduction to DMA, Introduction to Pre-processor.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1 :** Acquiring foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.
- CO2 :** Understanding C language fundamentals.
- CO3 :** Applying various types of arrays and string manipulation technique to manage and process data in programming scenarios.
- CO4 :** Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.
- CO5 :** Develop modular programs using control structures, unions.

Text Books

1. Introduction to Programming Languages 1st Edition by Arvind Kumar Bansal, CRC Press, Taylor and Francis group, 2014.
2. C Programming Language by Brian Kernighan and Dennis Ritchie, Prentice Hall Software, 1988.
3. Programming with C 2 nd Edition Byron Gottfried Schaum's outlines, Tata McGraw-Hill publishers, 1998.

Reference Books

1. E. Balagurusamy, 'Programming in ANSI C', 3rd edition, Tata McGraw-Hill Publishers, 2004.
2. Eric C.R. Hehner, 'The Logic of Programming', Prentice hall of India, 1991.
3. C: Herbert Schildt, 'The Complete Reference', McGraw Hill, 4th edition , 2017

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	0	0	0	0	1	3	0	0	0
CO2	3	3	0	0	0	0	1	0	0	0	0	3	1	0	0
CO3	3	2	2	0	0	1	1	0	0	0	0	3	0	1	1
CO4	3	2	2	0	0	0	0	0	0	0	0	3	1	0	1
CO5	3	3	2	2	2	0	0	0	0	0	0	3	3	0	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS
Course Code	25BTCS212	Number of Hours/Week	2
Semester	I	Max. Marks	100
Year	I	Credits	
INTRODUCTION TO PROGRAMMING LAB			
	L	T	P
	0	0	2

LIST OF PROGRAMS

1. Write a C program to print Integer, Float, Character values
2. a) Write a c program to demonstrate use of arithmetic operators
2. b) Write a C program using increment and decrement operators
3. a) Write a C program using Decision making constructs (Switch case statement)
3. b) Program to find if a number is Negative, Positive, or zero (using if..elseif..else statement)
4. C program to perform factorial of a number
5. a) Write a C program to print a message 5 times using "while" statement
5. b) Illustrate the Do-while statement using C program
5. c) Program using for loop statement
6. a) Program to implement break statement
6. b) write a program to demonstrate continue statement
7. Program to insert elements into an array and display the array elements using C language
8. Program to solve multiplication of 2 matrices
9. String
 - a) Program to accept a string and display it as reverse using C language
 - b) program to concatenate 2 string using C
10. Array
 - a) Program to illustrate the concepts of arrays.
 - b) Program to illustrate pointer to 2-dimensional array
11. Program to take mark details of students and display the name of the students with highest marks using Structure concept
12. Program to implement union concept

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Acquire foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.
CO2	Understand C language fundamentals
CO3	Apply various types of arrays and string manipulation technique to manage and process data in programming scenarios
CO4	Analyze and experiment with functions, develop recursive solutions and pointers to solve complex problems.
CO5	Develop modular programs using control structures, unions

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	0	0	0	0	1	3	0	0	0
CO2	3	3	0	0	0	0	1	0	0	0	0	3	1	0	0
CO3	3	2	2	0	0	1	1	0	0	0	0	3	0	1	1
CO4	3	2	2	0	0	0	0	0	0	0	0	3	1	0	1
CO5	3	3	2	2	2	0	0	0	0	0	0	3	3	0	1

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B. Tech CSE	Programme Code	BTCS			
Course Code	25BTCS113	Number of Hours/Week	4			
Semester	I	Max. Marks	100			
Year	I	Credits	4			
Applied Science Course						
Course Title	MATHEMATICS - I			L	T	P
				3	1	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To recall and remember basics of matrices, complex numbers, and differential calculus. • To understand the concepts of basic mathematical methods for matrices, complex numbers and differential calculus. • To apply methods to solve engineering problems. • To analyze engineering problems and evaluate. • To solve and evaluate the problems using matrices, complex numbers, and differential calculus. 						
UNIT	TOPICS				HOURS	
I	Introduction to Differentiation and its applications: Fundamentals of Differentiation, Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders, Indeterminate forms and L'Hopital's rule, Maxima and Minima				10	
II	Integration and its applications: Double integral, Triple integral, Change of order of integration, Change of variables, Beta and Gamma functions and their properties, Dirichlet's integral and its applications to area and volume, Liouville's extensions of Dirichlet's integral.				12	
III	Sequence: Real number system, Convergence of sequence and series, Tests for convergence				8	
IV	Series: Power series, Taylor's series, Series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.				8	
V	Advanced Multivariable Calculus: Limit, continuity and partial derivatives, Directional derivatives, Total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient, curl and divergence				10	
VI	Advanced Matrix Theory: Introduction, types of matrices- symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, unitary matrices, Rank of a matrix - echelon form, normal form, consistency of system of linear equations (Homogeneous and Non- Homogeneous). Inverse and rank of a matrix, rank-nullity theorem				12	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the concepts of mean value theorems, higher order derivative, series expansion and associated problems
CO2	Acquire problem solving skills for finding area and volume using multiple integrals
CO3	Analyze sequences and series, including Fourier series
CO4	Apply the differentiation of functions of two variables for maximization and minimization
CO5	Evaluate basic matrix operations, linear systems of equations

Text Books

1. Advanced Engineering Mathematics, 10th Edition, Erwin Kreyszig, 1998.
2. Calculus and Analytical Geometry, Thomas and Finney, 1996.
3. Engineering Mathematics-I, Veerarajan T., Tata McGraw-Hill, New Delhi, 2008.
4. Higher Engineering Mathematics, Ramana B.V., , Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 36th Edition, 2010.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	0	0	0	1	0	0	0	2	1	1
CO2	3	2	1	1	2	0	0	0	1	0	0	0	1	2	1
CO3	2	3	2	1	1	0	0	0	1	0	0	0	0	1	2
CO4	3	2	2	2	2	0	0	0	1	0	0	0	1	1	2
CO5	3	2	1	1	2	0	0	0	1	0	0	0	1	2	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS114	Number of Hours/Week	4			
Semester	I	Max. Marks	100			
Year	I	Credits	4			
Applied Science Course						
Course Title	PHYSICS I			L	T	P
			3	1	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To impart knowledge on the basics of the vector and scalar representation of forces and moments with Special reference to differentiation and integration methods • To acquire knowledge on moment of inertia and angular momentum. • To impart knowledge on the concept of central force problems and uniformly accelerating systems. 						
UNIT	TOPICS				HOURS	
I	Algebra of vectors-Describing motion: displacement, velocity, speed, acceleration; Cartesian, polar, spherical, and cylindrical polar coordinates; Mathematical tools- differentiation and integration methods, Taylor's series				12	
II	Concept of inertia; concept of inertial and non-inertial frames; Newton's laws of motion; Application of Newton's laws: particles in gravitational field, simple harmonic motion, tension in a string, frictional force, viscous force, damped harmonic oscillator, forced harmonic oscillator and resonance. Concept of momentum- center of mass, conservation of momentum, momentum and flow of mass, work-energy theorem, conservative and non-conservative forces, conservation of energy, concept of power, conservation laws and particle collisions				12	
III	Concept of moment of inertia; fixed axis rotation; angular displacement, angular velocity, and angular acceleration; vector nature of angular velocity; angular momentum; torque; conservation of angular momentum; gyroscope motion				12	
IV	Central forces; central force motion as one-body problem; conservation laws in central force motion; Kepler's laws				12	
V	Galilean transformations; uniformly accelerating systems; principle of equivalence; Physics in rotating coordinates systems				12	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Apply the concepts of polar, rectangular, cylindrical and spherical systems.
- CO2:** Ability to differentiate statics and kinematics.
- CO3:** Demonstrate the ability to solve the problems in Newton's laws.
- CO4:** Appreciate to understand rotational kinetic energy & angular momentum.
- CO5:** Acquire adequate knowledge on conservation laws.

Text Book:

1. An Introduction to Mechanics by Daniel Kleppner, Robert Kolenkow, 2nd edition, McGraw Hill, 2006.

Reference Books:

1. Mechanics: Course of Theoretical Physics - Vol. 1, L.D. Landau and E.M. Lifshitz, Third Edition, CBS Publishers, 2002.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	0	0	0	0	0	0	0	0	0	2	0	0	2
CO2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	2
CO3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	24AEEN 911	Number of Hours/Week	3			
Semester	I	Max. Marks	100			
Year	I	Credits	3			
Ability Enhancement Compulsory Course (AECC)						
Course Title	EFFECTIVE COMMUNICATION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students to</p> <ul style="list-style-type: none"> • To define and explain the fundamental concepts, types, and processes of communication. • To develop active listening and effective speaking skills to enhance interpersonal communications. • To improve reading comprehension skills through different techniques. • To apply grammar and vocabulary rules and public communication for accurate sentence structure and effective written communication. • To prepare and deliver effective presentations by planning, structuring, and overcoming stage fright. 						
UNIT	TOPICS				HOURS	
I	Introduction to Communication Definition of Communication, Types of Communication: Formal, Informal, Oral, Written, Verbal, non-verbal, interpersonal, intrapersonal Process of Communication: Sender, Message, Channel, Receiver, Feedback Barriers: Intrapersonal, Interpersonal, Organizational Overcoming Barriers				10	
II	Listening and Speaking Active Listening: Types of Listening, Reasons for poor listening Traits of the good listener, Effective Speaking: Achieving Confidence, Clarity, and Fluency, Public Speaking, Drafting the Speech				10	
III	Reading and Writing Reading Comprehension: Improving Comprehension Skills, Scanning and Skimming, Predicting the Content, Understanding the Gist, PQRS Technique, Grammar and Vocabulary: Sentence Structure, Preposition, Punctuation, Articles, Common errors and Correct Usage, Word formation: Affixes, Active and Passive Vocabulary				13	
IV	Presentation Skills Planning: Occasion, Audience, Purpose, Thesis Statement, Material, Outlining and Structuring, Guidelines for Effective Delivery, Strategies for Reducing Stage Fright				8	
V	Practice Grammar Bites, English Fluency Drills				4	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyse different types and processes of communication and the barriers that may arise.

CO2: Demonstrate active listening skills and strategies for confident and fluent public speaking.

CO3: Improve reading comprehension through effective reading techniques.

CO4: Apply proper grammar, sentence structures, and vocabulary for clear and correct written communication.

CO5: Create structured presentations, incorporating techniques to manage stage fright and engage the audience effectively.

Text Books

1. Kumar, Sanjay and Pushp Lata. Communication Skills. 2nd. ed., Oxford University Press, 2015.
2. Raman, Meenakshi and Sangeetha Sharma. Technical Communication: Principles and Practice, 4th ed., Oxford University Press, 2022.

Reference Books

1. Adair, John. Effective Communication: The Most Important Management Skill of All.
2. Pan Books Publishers, 1997.
3. Gorrell, Robert M and Charlton Laird. Modern English Handbook. 6th ed., Prentice Hall Publications, 1976.
4. Rose, William. GNVQ Core Skills Communication. 2nd. ed., Pitman Publishing, 1995.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0
CO2	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0
CO3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1
CO5	0	0	0	0	0	0	0	0	3	3	0	0	0	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Semester II

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS121	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	PYTHON PROGRAMMING			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Understand the fundamentals of the Python programming language and its historical development
- To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation.
- To demonstrate object oriented concept in python
- To familiarize with machine learning tools in python
- To develop simple Python programs for data analysis

UNIT	TOPICS	HOURS
I	Introduction to python programming Introduction to python ; setting up python programming environment; variables; strings and its operations; special characters; stripping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice;	9
II	Python data types Tuples and its operations; relational operators; conditional statements – if, if-else, if-elif-else; multiple conditional blocks; dictionaries; key- value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting;	9
III	Loop and function While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module;	9

IV	OOPs in python Classes;_init_() method; instance of a class; accessing attributes; calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block;	9
V	Python machine learning tools Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python based machine learning libraries – pytorch, tensorflow; virtual environment; machine learning application using python tools;	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :Comprehend the holistic view of programming language design and behavior

CO2 : Understand the programming concepts in abstract and paradigm level

CO3 : Structure python programs for solving problems

CO4 : Develop python programs using OOP concept

CO5 : Execute ML project using python tools

Text Book:

1. A Hands-On, Project-Based Introduction to Programming, Eric Matthes. Python Crash Course, 2nd Edition:No Starch Press, Inc., 2019.

Reference Books:

1. Boring Stuff with Python by Al Sweigart. AutomA ,William Pollock, 2015.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	0	0	1	0	1	0	1	0	2	0	1	1
CO2	3	3	2	3	1	2	0	2	1	1	0	2	1	1	2
CO3	3	2	3	2	3	1	1	0	0	1	0	2	2	2	2
CO4	3	2	3	2	1	2	1	0	1	1	0	1	2	1	3
CO5	2	2	3	3	3	0	1	3	1	1	1	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS		
Course Code	25BTCS221	Number of Hours/WK	2		
Semester	II	Max. Marks	100		
Year	I	Credit			
Course Title	PYTHON PROGRAMMING LABORATORY		L	T	P
			0	0	2

Course Objectives:

The main learning objective of this course is to prepare the students for:

- To learn fundamentals in python programming language
- To introduce python modules for application
- To familiarize python framework for machine learning applications
- To develop machine learning application using python
- To implement research topic as part of python project

List of experiments:

S.NO	TITLE
1	Implement basic algebraic problems to get into python programming
2	Implement string manipulations problems using python
3	Implement problems using python datatypes such as tuple, list, dictionary etc
4	Implement problems for python loops, conditional statements and functions
5	Implement object oriented programming concepts in python to solve different problems
6	Implement problems for python file manipulations
7	Implement standard machine learning algorithms using python frameworks such as TensorFlow, PyTorch etc.
8	Implement advanced problems using python tools in a virtual environment as part of python project

Course outcomes:

On successful completion of this course, the student will be able to

- CO1 : Develop basic coding skills in python
- CO2 : Understand python datatypes, modules, frameworks
- CO3 : Implement standard ML algorithms using python tools
- CO4 : Apply python frameworks for ML applications
- CO5 : Create ML model for existing problems

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	0	0	1	0	1	0	1	0	2	0	0	2
CO2	3	3	2	3	1	2	0	2	1	1	0	2	0	1	2
CO3	3	2	3	2	3	1	1	0	0	1	0	2	2	2	3
CO4	3	2	3	2	1	2	1	0	1	1	0	1	2	3	3
CO5	2	2	3	3	3	0	1	3	1	1	1	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS122	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Applied Science Course						
Course Title	PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES			L	T	P
				3	0	0

COURSE OBJECTIVES:

- Understand fundamental probability concepts and their applications in real-world scenarios.
- Analyze data using descriptive statistics such as mean, variance, and standard deviation.
- Apply probability distributions (e.g., binomial, normal) to model and solve problems.
- Conduct hypothesis testing and confidence intervals to make informed statistical inferences.
- Utilize statistical tools and software for data analysis and decision-making in various fields.

UNIT	TOPICS	HOURS
I	Introduction to Probability: Introduction to set algebra- sigma algebra-Borel sigma algebra-sequence of sets and its limits- lim-sup and lim-inf of sequence of sets; Axiomatic definition of probability-space-properties of probability functions-conditional probability-Bayes' rule-independence of events-continuity of probability functions-Borel Cantelli lemmas.	10
II	Random variables -distribution function and its property probability mass and density functions-symmetric distribution and its properties- expectation-moments moment generating function-Markov inequality-Chebyshev's inequality.	7
III	Joint distributions -marginal and conditional distributions-moments- independence of random variables-covariance, and correlation joint moment generating functions-additive properties of random variables-functions of random variables-ordered Statistics.	9

IV	Special distributions: Discrete uniform-Bernoulli-binomial-geometric negative binomial-hypergeometric-Poisson-exponential-gamma-normal- bivariate normal distribution; Population- sample-parameters- distributions of the sample mean and the sample variance for a normal population-Chi-Square-t, F distributions-law of large numbers–central limit theorem-point estimation-method of moments-maximum likelihood estimator-unbiasedness.	9
V	Testing of hypothesis: Null and alternate hypothesis-Neyman Pearson fundamental lemma and its applications-tests for one sample and two sample problems for normal populations-tests for proportions- confidence interval estimation-confidence interval for parameters of normal population	10

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand Basic Probability Concepts

CO2: Analyze Random Variables and Probability Distributions, Joint Distributions and Conditional Probability

CO3: Implement the Central Limit Theorem and Law of Large Numbers

CO4: Perform Hypothesis Testing and Statistical Inference, Regression and Correlation for Data Analysis

CO5: Employ Statistical Tools in Engineering Applications

Text Books:

1. First Course in Probability, Sheldon Ross, 2022.
2. An Introduction to Probability and Statistics, V.K. Rohatgi and A.K. Md. E. Saleh, 2015.

Reference Books:

1. Introduction to Probability and Statistics, S. Milton and J.C. Arnold, 2003.
2. Introduction to Mathematical Statistics, R V Hogg, A Craig and J W McKean, 2019.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	2	1	1	2	1	2	1	0	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	1	1	2	0	0	2	0	2
CO4	2	2	1	2	0	2	2	1	0	0	1	1	2	2	2
CO5	2	2	0	2	1	2	2	2	1	1	2	2	0	0	2

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech CSE	Programme Code	BTCS
Course Code	25BTCS123	Number of Hours/Week	4
Semester	II	Max. Marks	100
Year	I	Credits	4

Applied Science Course

Course Title	Mathematics II	L	T	P
		3	1	0

COURSE OBJECTIVES:

- To develop a strong understanding of vector spaces, subspaces, basis, and dimension, as well as how linear transformations relate to matrices and their properties.
- To gain proficiency in solving systems of linear equations using techniques like Gaussian elimination, matrix operations, and determinants.
- To compute eigen values and eigenvectors, and apply them to diagonalize matrices, a critical tool for solving differential equations.
- To solve first-order and second-order ordinary differential equations (ODEs) with applications to physical, biological, and engineering problems.
- To understand the interplay between linear algebra and differential equations, especially in systems of linear differential equations, using matrix methods such as the Laplace transform and matrix exponentials.

UNIT	TOPICS	HOURS
I	Advanced Matrix Theory: Systems of linear equations: Elementary operations-row-reduced echelon matrices-Gauss elimination LU factorization-linear independence-rank of a matrix-solutions of linear systems-existence and uniqueness.	12
II	Vector spaces: Vector space-subspaces-spanning space-bases and dimensions. Linear transformation-matrix representations of linear transformations-range space and rank-null space and nullity-the rank and nullity theorem-invertibility.	10
III	Eigenvalues and eigenvectors: Eigen values-eigenvectors and some applications of eigenvalue problems-Hermitian, skew-Hermitian, unitary matrices and their eigenvalues-eigen bases.	12
IV	Elementary Canonical Forms: Diagonalization: Annihilating polynomial-the minimal polynomial and the characteristic polynomial- Cayley-Hamilton theorem-real quadratic form; Inner product spaces: Inner product spaces-orthonormal bases- Gram-Schmidt process.	12
V	Ordinary Differential Equations: Review of First Order ODE- Lipschitz condition-Picard's theorem; Linear differential equations: Linear dependence and Wronskian-linear ODE with constant coefficients of higher order characteristic equations-Cauchy-Euler equations-method of undetermined coefficients-method of variation of parameters- solutions methods using Laplace Transform	14

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Learn different types of matrices, concept of rank, methods of matrix inversion and their applications, systems of linear equations, and manipulate vectors in various dimensions.

CO2: Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.

CO3: Apply the concept of eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces for understanding physical and engineering problems.

CO4: Understand the first- and second-order ordinary differential equations (ODEs), both analytically and numerically, with applications to real-world phenomena.

CO5: Develop the skills to model physical systems using differential equations and linear algebra.

Text Books:

1. Linear Algebra, Hoffman Kunze, 2015.
2. Differential Equations, S. L Ross, 2007.

Reference Books:

1. Introduction to Linear Algebra, Gilbert Strang, 2016.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 2010.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	2	1	1	2	1	2	1	0	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	1	1	2	0	0	2	0	2
CO4	2	2	1	2	0	2	2	1	0	0	1	1	2	2	2
CO5	2	2	0	2	1	2	2	2	1	1	2	2	0	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS 124	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Applied Science Course						
Course Title	PHYSICS II			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To understand the working principle of various lasers, fibre optics and its applications. • To impart knowledge on acoustics and ultrasonics and its applications. • To provide knowledge on magnetism and superconducting phenomenon. • To introduce the fundamental concepts of quantum mechanics and their applications. • To develop an understanding of dielectric and conducting materials and their applications. 						
UNIT	TOPICS			HOURS		
I	Introduction – Components of laser – Principle of laser action – Properties of laser – Spontaneous emission and stimulated emission – Einstein’s coefficients – Population inversion – Types of lasers – He-Ne laser – Nd- YAG laser – Semiconductor laser – Industrial applications of laser – Medical applications of laser – Holography			9		
II	Introduction – Propagation of light in optical fiber – Total internal reflection – Principle of optical fiber – Fractional Refractive index - Numerical aperture and acceptance angle – Types of optical fibers based on materials, modes of propagation and refractive index profile – Power losses in optical fibers – Fiber optic communication system – Fiber optic sensors – Temperature and Displacement – Fibre endoscope			9		
III	Introduction – Classification of sound – Characteristics of musical sound – Pitch – Loudness – Quality – Intensity of sound – Weber Fechner Law – Reverberation – Reverberation Time – Sabine’s Formula – Factors affecting the acoustics of a building – Absorption Coefficient – Measurement of Absorption coefficient			9		
IV	Introduction – Production of ultrasonic waves – Magnetostriction Effect – Magnetostriction generator – Piezoelectric Effect – Properties of ultrasonics - Acoustic grating – Applications of ultrasonics – Industrial applications – SONAR – NDT -- Medical Applications			9		
V	Types of electronic materials: metals, semiconductors, and insulators, Dia, Para, Ferro magnetic materials properties, Temperature effects - Hysteresis curve, Hard and soft magnetic engineering materials - Applications: Magnetic recording and reading – Hard disc. Superconductors: Properties of superconducting materials - Type I and Type II superconductors- Applications: Maglev.			9		

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the concept of lasers and apply laser action in industries.

CO2: Explain and interpret the principle of fiber optics for different types of industrial sensors.

CO3: Discern the laws governing acoustics and implement the same in acoustic quieting.

CO4: Apply the fundamentals of ultrasonics in non-destructive testing.

CO5: Evaluate and perceive various laws governing magnetism with special reference to magnetic confinement for future power generation.

Text Books:

1. Engineering Physics, D.K. Bhattacharya and Poonam Tandon, New Delhi: Oxford University Press (2017)
2. Engineering Physics, S.Mani Naidu, New Delhi: Pearson India Education Services Pvt. Ltd., (2014)

Reference Books:

1. Engineering Physics, R.K. Gaur and S.L.Gupta, New Delhi: Dhanpat Rai Publications (P) Ltd. (2008)
2. Engineering Physics, Shatendra Sharma and Jyotsna Sharma, New Delhi: Pearson India Education Services Pvt. Ltd., (2019)
3. Engineering Physics, Dattu R. Joshi, New Delhi: Tata McGraw Hill Education Private Ltd., (2010)
4. A Textbook of Engineering Physics, M. N. Avadhanulu and P. G. Kshirsagar, New Delhi: S.Chand and Company Ltd., (2009)
5. Principles of Physics, Jearl Walker, David Halliday and Robert Resnick, Wiley India Pvt. Ltd., New Delhi(2014), Tenth Edition
6. Sears and Zemansky's University Physics with Modern Physics, Hugh D. Young and Roger A. Freedman, Pearson Education, New Delhi (2018), Fourteenth Edition.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	2	2	0	0
CO2	2	0	0	3	0	0	0	0	0	0	0	0	1	0	0
CO3	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
CO4	2	1	0	0	0	0	0	0	0	0	0	0	2	0	0
CO5	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS222	Number of Hours/Week	2			
Semester	II	Max. Marks	100			
Year	I	Credits				
Applied Science Course						
Course Title	PHYSICS LAB			L	T	P
				0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • Understand the concept of lasers and its action in industries. • Explain the principle of fiber optics for different types of industrial sensors. • Apply the basics of Lasers and Optical fibers. • Study the principles and applications of acoustics. • Discern the laws governing acoustics and its applications in acoustic quieting. • Relate the application of light in optical devices. 						
List of Experiments						
1	Wavelength Determination – LASER diffraction					
2	Particle size Determination – LASER diffraction					
3	Attenuation of an Optical fibre– Fibre Optic Cable					
4	Numerical Aperture measurement of an Optical Fibre– Fibre Optic Cable					
5	Determination of Planck’s constant – LED					
6	Reverberation Time of a hall - Acoustics					
7	Refractive index of a prism – Spectrometer					
8	Wavelength of Mercury spectrum – Diffraction grating – Spectrometer					

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	1	0	0	0	0	0	0	2	0	0	2
CO2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2
CO3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
CO4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
CO5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS125	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	DISCRETE STRUCTURES FOR COMPUTER SCIENCE			L	T	P
			3	0	0	
L-Lecture Hours		T-Tutorial Hours		P-Practical Hours		
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To get familiar and understand the fundamental notions in discrete structures focusing on aspects of computer science • To describe binary relations between two sets, combine relations using set operations and composition. • To understand and demonstrate the basic concept of algorithm and its application in combinatorial mathematics. • To identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm. • To classify the basic properties of graphs and trees and model simple applications. 						
UNIT	TOPICS				HOURS	
I	Set Theory and Logic Sets – Functions – Relations - Equivalence Relation – Poset - Functions Logic: Propositional logic - Truth Tables – Tautologies - Resolution Proof System - Predicate Logic				9	
II	Induction and Combinatorics Peano's Axioms - Mathematical Induction - Pigeon-Hole Principle - Principle of Inclusion and Exclusion - Review of Permutations and Combinations - Distribution Problems - Derangements - Bijection Principle.				9	
III	Algebraic Structures Semi-Groups – Monoids – Groups - Subgroups and Their Properties - Cyclic Groups - Cosets - Permutation Groups - Lagrange's Theorem - Cayley's Theorem - Normal Subgroups - Homomorphism of Groups - Quotient Groups –Introduction to Rings and Fields				9	
IV	Linear Algebra and Recurrence Relations Linear Algebra: Vector Space – Basis, Dimension, Orthogonality - Recurrence Relations: Homogeneous and Inhomogeneous Recurrences and their Solutions - Solving Recurrences Using Generating Functions.				9	
V	Graph Theory Definitions and Basic Results - Representation of a Graph by a Matrix and Adjacency List - Trees - Cycles - Properties - Paths and Connectedness - Subgraphs - Graph Isomorphism - Operations on Graphs - Vertex and Edge Cuts - Vertex and Edge Connectivity.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :Understand the fundamental aspects of discrete and continuous mathematical structures.

CO2: Demonstrate the principles of mathematical induction to prove statements.

CO3: Differentiate between various algebraic structures and analyze their properties.

CO4: Apply logical reasoning and mathematical techniques to solve problems in set theory, algebra and graph theory.

CO5: Construct new mathematical models thereby generating solutions to complex recurrence relations and graph problems.

Text Books

1. Elements of Discrete Mathematics: A Computer Oriented Approach, C. L. Liu, D. P. Mohapatra, McGraw Hill, Third Edition, 2012.
2. Applied Discrete Structures, Al Doerr, Ken Levasseur, LibreTexts, Third Edition, 2023

Reference Books

1. Discrete Mathematical Structures with applications to Computer Science, Tremblay J.P. and Manohar R., McGraw Hill International Edition, 1987.
2. Discrete Mathematics and Its Applications, Kenneth H. Rosen, Sixth Edition, Tata McGraw Hill, 2012.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	1	2	0	0	0	0	1	2	0	0	3
CO2	1	2	1	1	1	0	0	0	0	0	1	0	0	1	3
CO3	2	1	1	2	0	0	0	0	0	0	1	1	0	0	2
CO4	2	2	1	1	0	0	0	0	0	0	2	2	1	1	1
CO5	3	2	1	2	3	0	0	0	0	0	1	1	0	2	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	23EVST921	Number of Hours/Week	2			
Semester	II	Max. Marks	100			
Year	I	Credits	2			
Value Added Course						
Course Title	ENVIRONMENTAL SCIENCE			L	T	P
				2	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • To understand the Environmental Foundations. • To differentiate between renewable and non-renewable resources and assess the impacts of land use changes, land degradation, and water resource exploitation. • To study the causes and effects of pollution and its impacts on earth. • To analyze the population causes, its effects and control measures. • To understand the importance of biodiversity conservation. 						
UNIT	TOPICS				HOURS	
I	Introduction to Environmental studies Definition and Scope of Environmental Studies - Interdisciplinary Nature of Environmental Science-Historical Perspectives on Environmental Issues- Principles of Sustainability and Sustainable Development, Ecosystem- Structure and functions of ecosystem-Aquatic ecosystems				6	
II	Natural Resources- Renewable and Non-renewable Resources Land resources and land use change, Land degradation, soil erosion, Desertification- Deforestation- exploitation of surface and ground water, floods, droughts, conflicts over water Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.				6	
III	Biodiversity and Conservation Levels of biological diversity- genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity pattern and global biodiversity hot spots.				6	
IV	Environmental Pollution Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution - Nuclear hazards and human health risks-Solid waste management: Control measures of urban and industrial waste. Pollution case studies, Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment Laws: Environment Protection Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights, human wildlife conflicts in Indian context.				6	

V	Human Communities and the Environment Human population growth: Impacts on environment, human health and welfare- Resettlement and rehabilitation of project affected persons, Disaster management: floods, earthquake, cyclones and landslides, Environmental movements- Chipko, Silent valley, Bishnoi's of Rajasthan	6
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Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Define environmental studies and its interdisciplinary nature.
CO2	Analyze the structure and functions of various ecosystems, including aquatic ecosystems.
CO3	Evaluate the growing energy needs and the role of alternative energy sources.
CO4.	Understand levels of biodiversity (genetic, species, and ecosystem) and identify biodiversity hotspots, with a focus on conservation strategies.
CO5	Evaluate the effects of human population growth on the environment and the importance of disaster management, resettlement, and environmental movements.

Textbooks

- 1.Environmental and Sustainable Development, Keiji Ujikawa, Mikio Ishiwatari, Eric van Hullebusch, 1st Edition springer publishers Singapore, 2022.
- 2.Environmental Science: Toward A Sustainable Future, Dorothy F. Bourse and Richard T. Wright, 13th edition, Pearson publishers, 2017.
- 3.Social Learning in Environmental Management: Towards a Sustainable Future, Meg Keen, Valerie A. Brown, Rob Dyball, 2012.
- 4.Principles of Environmental Science, William P. Cunningham and Mary Ann Cunningham, 10th edition, Mc graw hill publishers, 2004.
- 5.Visualizing Environmental Science, Linda R. Berg, Mary Catherine Hager and David M. Hassenzahl, 2017.

Reference Books

1. Waste Water Treatment, Rao, M.N., Datta, A.K., Oxford and IBH Publishing Co. Pvt. Ltd, 1987.
- 2.Fundamentals of Ecology, Odum, E.P., Odum, H.T., and Andrews, J., , Saunders, Philadelphia, 1971, USA.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0
CO2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
CO3	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

3 – High, 2 – Average, 1 – Low , 0-Null

Semester III

Programme	B.Tech CSE	Programme Code	BTCS		
Course Code	25BTCS131	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Year	II	Credits	3		
Core Course					
Course Title	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	
		3	0	0	

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the architecture and programming of the 8086 microprocessor.
- To learn system design using 8086, including multiprocessor configurations.
- To explore 8051 microcontroller programming and peripheral interfacing.
- To understand embedded systems design and ARM processor functionality.
- To optimize performance and validate embedded computing platforms.

UNIT	TOPICS	HOURS
I	THE 8086 MICROPROCESSOR Introduction to 8086 – Microprocessor architecture - Addressing modes - Instruction set and assembler directives - Assembly language programming - Modular Programming - Linking and Relocation - Stacks - Procedures -Macros - Interrupts and interrupt service routines - Byte and String Manipulation.	9
II	8086 SYSTEM BUS STRUCTURE 8086 signals - Basic configurations - System bus timing –System design using 8086 - IO programming - Introduction to Multiprogramming - System Bus Structure – Multiprocessor configurations - Coprocessor, Closely coupled and loosely Coupled configurations - Introduction to advanced processors.	9
III	MICROCONTROLLER Architecture of 8051 - Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Programming 8051 Timers - Interfacing Microcontroller - Serial Port Programming - Interrupts Programming - LCD & Keyboard - External Memory Interface - Stepper Motor.	9
IV	INTRODUCTION TO EMBEDDED SYSTEMS Complex systems and micro processors - Embedded system design process – Instruction sets preliminaries - ARM Processor - CPU: programming input and output supervisor mode, exceptions and traps - Co-processors - Memory system mechanisms - CPU performance.	9

V	<p>EMBEDDED COMPUTING PLATFORM DESIGN AND OPTIMIZATION</p> <p>The CPU - Bus -Memory devices and systems - Designing with computing platforms - platform level performance analysis - Components for embedded programs - Models of programs Assembly, linking and loading - compilation techniques - Program level performance analysis - Software performance optimization - Analysis and optimization of program size - Program validation and testing.</p>	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1 : Analyze and program the 8086 microprocessor for modular applications.
- CO2 : Design systems using 8086 with multiprogramming and multiprocessor setups.
- CO3 : Implement 8051 microcontroller-based systems with peripherals.
- CO4 : Apply embedded system design principles using ARM processors.
- CO5 : Optimize and validate embedded programs for performance and efficiency.

Text Books:

1. K. M. Bhurchandi and A. K. Ray, Advanced Microprocessors and Peripherals, 4th ed., McGraw Hill Education, 2022.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 3rd ed., Pearson Education, 2021.
3. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 4th ed., McGraw Hill Education, 2023.

Reference Books:

1. Douglas V. Hall, Microprocessors and Interfacing, Programming and Hardware, 2nd ed., Tata McGraw-Hill, 2022.
2. Jonathan W. Valvano, Embedded Microcomputer Systems: Real-Time Interfacing, 4th ed., Cengage Learning, 2017.
3. David E. Simon, An Embedded Software Primer, 2nd ed., Pearson Education, 2018.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	3	2	3	2	3	3	2	2
CO2	3	3	2	3	2	3	3	2	2	2	3	3	3	2	3
CO3	2	2	3	3	2	2	3	2	2	2	2	2	2	2	3
CO4	3	3	2	3	3	3	2	3	3	3	2	3	3	3	2
CO5	2	3	2	2	3	2	3	2	3	3	3	2	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS
Course Code	25BTCS132	Number of Hours/Week	3
Semester	III	Max. Marks	100
Year	II	Credits	3

Core Course

Course Title	SIGNALS AND SYSTEMS	L	T	P
		3	0	0

COURSE OBJECTIVES:

The main aim of learning this course is:

1. Understanding the fundamental characteristics of signals and systems.
2. Understanding the concepts of vector space, inner product space and orthogonal series.
3. Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
4. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

UNIT	TOPICS	HOURS
I	Classification of Signals: Continuous-time vs discrete-time signals, analog vs digital signals, energy and power signals, deterministic vs random signals. Signal Operations: Scaling, time shifting, time inversion, and time scaling of signals. Signal Properties: Symmetry (even and odd signals), periodicity of signals, and absolute integrability. Elementary Signals: Unit step, unit impulse, ramp, exponential, sinusoidal signals.	9
II	Systems: Classification of Systems: Continuous-time vs discrete-time systems, linear vs nonlinear systems, causal vs non-causal systems, time-invariant vs time-varying systems, stable vs unstable systems. System Properties: Linearity, time/shift invariance, causality, and stability. LTI and LSI Systems: Continuous-time linear time-invariant (LTI) systems, discrete-time linear shift-invariant (LSI) systems. Impulse and Step Response: Impulse response and step response of systems. Response to Arbitrary Input: Convolution in continuous and discrete time domains. System Representation: Representation of systems using differential equations for continuous-time systems and difference equations for discrete-time systems.	9
III	Fourier Series and Transforms: Fourier Series Representation: Fourier series representation of continuous-time periodic signals, Fourier series of discrete-time periodic signals, properties of Fourier series. Continuous-Time Fourier Transform (CTFT): Fourier transform of continuous-time signals, properties of CTFT (linearity, time shifting, time scaling, etc.), Parseval's theorem, and time-bandwidth product. Discrete-Time Fourier Transform (DTFT): Fourier transform of discrete-time signals, properties of DTFT (linearity, time shifting, time scaling, etc.). Relationships among Fourier Representations: Relationship between Fourier series, CTFT, and DTFT.	9
IV	Laplace Transform and Sampling: Laplace Transform: Definition of	9

	the Laplace transform, region of convergence (ROC), properties of Laplace transforms (linearity, time shifting, scaling, initial value theorem, final value theorem, etc.), inverse Laplace transform. Sampling: Sampling theorem for bandlimited signals, aliasing in the sampling process, and Nyquist rate. Signal Reconstruction: Ideal signal reconstruction using interpolators, zero-order hold, and first-order hold methods.	
V	Z-Transform and Discrete Fourier Transform: Z-Transform: Definition of the z-transform, region of convergence (ROC) for z- transform, properties of the z-transform (linearity, time shifting, scaling, etc.), inverse z-transform (using partial fraction expansion and power series methods). Discrete Fourier Transform (DFT): Definition and properties of the DFT, relationship between DFT and DTFT, computation of DFT, inverse DFT.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :To Understand different types of signals-continuous and discrete, odd and even, periodic and aperiodic etc

CO2 :Be able to classify systems based on their properties

CO3 :To familiarize the concepts of transform based continuous time and discrete time

CO4 : Analyze continuous time and discrete time signals and systems by using appropriate mathematical tools

CO5 : Determine Fourier transforms for continuous-time and discrete-time signals (or impulse response functions), and understand how to interpret and plot Fourier transform magnitude and phase functions

Text Books

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, 1997.
2. D.C. Lay, Linear Algebra and its Applications (2/e), Pearson, 2016.
3. Digital Signal Processing by John G. Proakis, Dimitris G. Manolakis, 2007.

Reference Books

1. Signal Processing and Linear Systems by B.P. Lathi, 1998.
2. Signals and Systems: Continuous and Discrete by Roger E. Ziemer, William H. Tranter, 1998.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1
CO2	2	2	2	1	2	2	2	1	0	1	0	2	2	1	1
CO3	2	1	3	3	2	2	2	1	2	0	2	1	2	2	2
CO4	2	2	2	2	2	3	2	1	2	0	2	1	2	0	1
CO5	2	3	3	2	1	1	1	1	1	1	2	1	1	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS133	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Year	II	Credits	4			
Core Course						
Course Title	DIGITAL DESIGN			L	T	P
			3	0	0	
COURSE OBJECTIVES:						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> ➤ To teach various number systems, binary codes and their applications ➤ To familiarize the students the importance of error detection and errorcorrection codes. ➤ To inculcate concepts of K-MAP to simplify a Boolean expression ➤ To facilitate students in designing a logic circuit 						
UNIT	TOPICS				HOURS	
I	Number Representations: Binary numbers: binary, octal, and hexadecimal number systems; conversion between different number systems; signed and unsigned numbers; representation of negative numbers using 1's complement and 2's complement. Integer representation: fixed-point number representation; range and precision of fixed-point numbers; overflow and underflow conditions. Floating- point representation, Arithmetic operations in binary: binary addition, subtraction, multiplication, and division; overflow detection and handling.				7	
II	Combinatorial Circuits: Boolean Algebra: fundamental theorems and postulates; simplification of Boolean expressions using algebraic techniques. Logic Gates: basic gates (AND, OR, NOT), universal gates (NAND, NOR), XOR and XNOR gates. Minimization of Boolean functions: simplification using Boolean identities; Karnaugh map (K- map) technique for 2, 3, 4, and 5 variables; don't care conditions in K- maps. Combinational Circuits: design and analysis of arithmetic circuits (adders, subtractors); code converters (Binary to Gray, Gray to Binary, BCD to Binary, etc.); multiplexers, demultiplexers, encoders, decoders.				12	
III	Sequential Circuits: Introduction to sequential circuits: difference between combinational and sequential circuits; clock signals and timing diagrams. Latches and Flip-Flops: SR Latch, D Latch, JK Flip-Flop, D Flip-Flop, T Flip-Flop; timing constraints: setup time, hold time, propagation delay. Counters: asynchronous (ripple) counters and synchronous counters; modulus of counters; design of up-down counters, ring counters, Johnson counters. Shift Registers: serial-in serial-out (SISO) registers, serial-in parallel-out (SIPO) registers, parallel-in serial-out (PISO) registers; applications of shift registers.				12	

IV	Data Converters: purpose of sample and hold circuits in digital signal processing; working principle and block diagram. Analog to Digital Converters (ADCs): working principle of ADCs and Digital to Analog Converters (DACs): working principle of DACs	7
V	Memory and Programmable Logic: Introduction to memory: classification of memory: volatile vs non-volatile, primary vs secondary; characteristics of memory: access time, memory cycle time, and bandwidth. Random Access Memory (RAM): types of RAM: Static RAM (SRAM) and Dynamic RAM (DRAM); memory cell architecture and organization. Memory decoding: address decoding techniques for RAM; row and column address selection. Read Only Memory (ROM): types of ROM: PROM, EPROM, EEPROM, Programmable Logic Array (PLA) architecture; Programmable Array Logic (PAL) structure.	7

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :Understand various number systems and their arithmetic operations.

CO2: Design and analyze combinatorial circuits using Boolean algebra, K-maps, and logic gates.

CO3 :Work with sequential circuits like latches, flip-flops, counters, and shift registers.

CO4 :Interface and design systems using data converters like ADCs and DACs.

CO5:Explore different types of memory and programmable logic devices and apply them in digital systems.

Text Books

1. Digital Design by M. Morris Mano, Michael D. Ciletti, 2013.
2. Digital Systems: Principles and Applications by Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, 2004.
3. Microelectronics: Digital and Analog Circuits and Systems by Jacob Millman and Arvin Grabel, 1987.

Reference Books

1. Roth (2004), Fundamentals of Logic Design, 5th Edition, Thomson, India, 2018.
2. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson, 2nd Ed, 2003.
3. F. Vahid, Digital Design, 1st Ed., Wiley India, 2011

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	3	3	3	2	3	2	1	0	1	2	1	2	3	2	1
CO3	3	3	3	2	2	2	2	1	1	2	0	0	2	0	2
CO4	3	2	3	2	3	2	2	1	0	0	1	1	2	2	2
CO5	3	3	3	2	3	2	2	2	1	1	2	2	3	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS 134	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	DATA STRUCTURES AND ALGORITHMS			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To Comprehensive understanding of fundamental data structures and algorithms. • To equip algorithms with the skills to analyze and implement various computational techniques. • To Learn to select appropriate data structures for solving complex problems, optimize algorithm performance, and gain insight into advanced topics such as dynamic programming and NP- completeness. • To develop the ability to design efficient algorithms and evaluate their time and space complexity. • To apply data structures and algorithms to real-world problem-solving scenarios and computational applications. 						
UNIT	TOPICS				HOURS	
I	Introduction to Data Structures: Algorithms- asymptotic notations and analysis- Analyzing Algorithms - Insertion sort, Divide and Conquer approach, Sorting, Building Heaps, Heap sort, Quick sort, Analysis of sorting algorithms.				9	
II	Elementary data structures: Stacks and Queues, linked lists and its operations, Hash Tables - Direct and Open addressing Tree data structure Tree- Tree Traversals-Binary Search Trees-Red Black Trees - Red-blacktrees and its operations. B-Tree-Insertion-Deletion.				9	
III	Dynamic programming Memorization, Tabulation, Rod Cutting, Matrix Chain Multiplication, Longest common subsequence, Greedy Algorithms- Introducing greedy approach, activity selection problem, Huffman codes, Graphs, Trees and Algorithms				9	
IV	Introducing spanning trees Minimum spanning tree, algorithms, Kruskal, Prims, Bellman-Ford algorithm, Single source shortest path in directed acyclic graphs, Dijkstra's algorithms, Floyd-Warshall algorithm				9	
V	NP-Completeness Polynomial time, Verification algorithms, NP-Complete, NP-Hard				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1 : Understand the Fundamental Data Structures
- CO2 : Applying the concept of stack, queue, list, binary search tree and Red black tree.
- CO3 : Analyzing the dynamic programming, greedy algorithms and binary search trees, including performing tree traversals, insertions, and deletions.
- CO4 : Utilize graph representations and perform operations.
- CO5 : Evaluating the implications of computational complexity for algorithm design and problem-solving strategies, including approaches for handling NP-Complete and NP- Hard problems.

Text Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 4th ed., Cambridge, MA, USA: MIT Press, 2022.
2. M. T. Goodrich, R. Tamassia, and D. M. Mount, Data Structures and Algorithms in C++, 2nd ed., Hoboken, NJ, USA: Wiley, 2014.
3. N. Karumanchi, Data Structures and Algorithms Made Easy, 2nd ed., CareerMonk Publications, 2023.
4. E. Horowitz and S. Sahni, Fundamentals of Data Structures, Rockville, MD, USA: Computer Science Press, 1978.

Reference Books:

1. Chitra and P. T. Rajan, Data Structures, 2nd ed., India: Vijay Nicol Imprints Pvt. Ltd., McGraw-Hill Education (India) Pvt. Ltd., 2016.
2. G. A. V. Pai, Data Structures and Algorithms, New Delhi, India: Tata McGraw-Hill, 2009.
3. D. Samanta, Classic Data Structures, New Delhi, India: Prentice Hall of India Pvt. Ltd., 2006.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	3
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS135	Number of Hours/Week	3			
Semester	III	Max.Marks	100			
Year	II	Credits	3			
Core Course						
CourseTitle	OBJECT ORIENTED PROGRAMMING WITH JAVA			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To introduce the fundamentals of Java programming language. • To enable students to write object-oriented programs. • To familiarize students with advanced Java concepts like multithreading, exception handling, and collections. • To provide hands-on experience in developing real-world applications using Java. • To develop problem-solving skills using Java programming techniques. 						
UNIT	TOPICS				HOURS	
I	Basics of Java Programming Introduction to Java: Features, JVM, JDK, and JRE.-Writing, compiling, and executing Java programs.-Data types, variables, and operators.-Control structures: Decision-making ,loops .- Arrays and Strings: Declaration, initialization, and operations.				9	
II	Object-Oriented Programming in Java Classes and Objects: Declaration, instantiation, and initialization.-Methods: Static, instance, and parameterized methods -Constructors and destructors.-Inheritance: Single, multilevel, hierarchical, and overriding.Polymorphism: Compile-time and runtime,Encapsulation and abstraction.Interfaces and abstract classes.				9	
III	Exception Handling and Multithreading Exception handling: Try-catch block, multiple catch, finally, throw, and throws. Built-in exceptions and user-defined exceptions. Multithreading: Thread lifecycle, creating threads -Thread class, Runnable interface. Thread synchronization and inter-thread communication.				9	
IV	File I/O and Streams Reading and writing files using FileReader, FileWriter, BufferedReader, and BufferedWriter. Byte and character streams. Serialization and deserialization.				9	
V	GUI Programming and Event Handling Introduction to AWT and Swing-Layout managers -FlowLayout, GridLayout, BorderLayout.Event handling: ActionListener, MouseListener, KeyListener. Creating simple GUI applications.				9	

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand and apply Java syntax and semantics.
CO2:	Implement object-oriented programming concepts in Java.
CO3:	Develop Java applications with exception handling and multithreading.
CO4:	Use Java frameworks and APIs for GUI and database integration.
CO5:	Solve real-world problems using Java programming.

Text Books:

1. Programming in Java by K. Somasundaram, by **PHI Learning Pvt. Ltd.**
2. Java: The Complete Reference by Herbert Schildt

Reference Books:

1. Thinking in Java by Bruce Eckel
2. Effective Java by Joshua Bloch
3. Java Programming for Beginners by Mark Lassoff

Websites for Learning & Tools:

1. **Oracle Java Tutorials**
Website: <https://docs.oracle.com/javase/tutorial/>
2. **GeeksforGeeks - Java Programming**
Website: <https://www.geeksforgeeks.org/java/>
3. **W3Schools - Java Tutorial**
Website: <https://www.w3schools.com/java/>
4. **JavaTpoint**
Website: <https://www.javatpoint.com/>

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	-	2	-	-	-	-	3	2	-
CO2	3	3	3	2	3	-	-	2	-	-	-	-	3	3	2
CO3	3	3	3	3	3	2	-	2	1	-	-	-	3	3	2
CO4	3	3	3	3	3	-	-	3	-	-	-	-	3	3	3
CO5	3	3	3	3	3	2	-	2	-	-	-	-	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS136	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Year	II	Credits	2			
Core Course						
Course Title	PROFESSIONAL ETHICS			L	T	P
			2	0	0	
L-Lecture Hours	T-Tutorial Hours	P-Practical Hours				
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to						
<ul style="list-style-type: none"> • To identify and understand key concepts of human values, including ethics, integrity, and professional responsibility. • To explore moral theories and frameworks related to engineering ethics, and analyze how these impact decision-making. • To evaluate the role of engineers in society through the lens of social experimentation, responsibility, and professional codes of conduct. • To assess safety and risk management principles, rights and responsibilities, including intellectual property and occupational ethics. • To apply ethical principles and human values in real-life engineering and professional scenarios. 						
UNIT	TOPICS				HOURS	
I	Human Values Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.				6	
II	Engineering Ethics Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest, Customs and Religion – Uses of Ethical Theories.				6	
III	Engineering as Social Experimentation Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.				6	

IV	Safety, Responsibilities and Rights Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	6
V	Global issues Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility	6

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Recognize the significance of human values and ethics in personal and professional life.
- CO2:** Analyze various moral theories and ethical dilemmas in engineering practices.
- CO3:** Evaluate the responsibilities of engineers as experimenters and decision-makers within legal and ethical frameworks.
- CO4:** Assess risk and safety issues, including intellectual property and employee rights in engineering contexts.
- CO5:** Apply ethical theories and frameworks to make informed engineering decisions.

Text Book:

1. Naagarazan, R.S. A Textbook on Professional Ethics and Human Values, New Age International Limited Publishers: New Delhi, 2006.

Reference Books:

1. Charles B. Fleddermann, – Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, – Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	2	0	0	2	2	0	0	1	0	0
CO2	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0
CO3	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0
CO4	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0
CO5	0	0	0	0	0	0	2	0	0	3	0	0	1	0	0

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS231	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Year	II	Credits	1			
Core Course						
Course Title	DIGITAL DESIGN LAB			L	T	P
				0	0	2

List of experiments

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates
2. Construction of half and full adder using XOR and NAND gates and verification of its operation
3. To Study and Verify Half and Full Subtractor
4. Realization of logic functions with the help of Universal Gates (NAND, NOR)
5. Construction of a NOR gate latch and verification of its operation
6. Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates
7. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers
8. Implementation and verification of decoder or de-multiplexer and encoder using logic gates
9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates
10. Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK FlipFlop
11. Verify Binary to Gray and Gray to Binary conversion using NAND gates only
12. Verify the truth table of one bit and two bit comparator using logic gates

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	3	3	3	2	3	2	1	0	1	2	1	2	3	2	1
CO3	3	3	3	2	2	2	2	1	1	2	0	0	2	0	2
CO4	3	2	3	2	3	2	2	1	0	0	1	1	2	2	2
CO5	3	3	3	2	3	2	2	2	1	1	2	2	3	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS
Course Code	25BTCS232	Number of Hours/Week	2
Semester	III	Max. Marks	100
Year	II	Credits	1

Core Course

Course Title	DATA STRUCTURES AND ALGORITHMS LAB	L	T	P
		0	0	2

L-Lecture Hours T-Tutorial Hours P-Practical Hours

COURSE OBJECTIVES:

- To implement basic data structures like arrays linked lists, stacks, and queues.
- To develop skills in implementing algorithms for searching and sorting.
- To gain hands-on experience with tree and graph data structures.
- To apply recursion and dynamic memory management in problem-solving.
- To understand the practical implications of algorithm efficiency and optimization.

List of Experiments:

1. Program for Insertion sort.
2. Program for Quick sort.
3. Program for Merge sort.
4. Program for Heap sort.
5. Implementation of a stack using an array with push and pop operations.
6. Implementation of swap () function using stack.
7. Implementation of swap () function using queue.
8. Singly linked list with basic operations.
9. Double linked list with basic operations.
10. Hash table using direct addressing.
11. Hash table using indirect addressing.
12. Binary search tree with insertion and traversal.
13. Graphs
 - a. Depth First Search (DFS)
 - b. Breadth First Search (BFS)
 - c. Dijkstra's Algorithm (Shortest Path in Weighted Graph)
 - d. Kruskal's Algorithm (Minimum Spanning Tree)
14. Tree Algorithms
 - a. Binary Search Tree (BST) Operations
 - b. AVL Tree (Balanced BST) Insertions
15. Verifying a Solution for the Knapsack Problem.

Course Outcomes:

By learning Data Structures and Algorithms, students will be able to

CO1 : Demonstrate the implementation of basic data structures in real-world problems.

CO2 : Apply various searching and sorting techniques in practical scenarios.

CO3 : Implement tree and graph algorithms effectively.

CO4 : Solve complex problems using recursion and dynamic memory management.

CO5 : Analyze and optimize algorithms for better performance in practical applications.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	3
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS233	Number of Hours/Week	2			
Semester	III	Max.Marks	100			
Year	II	Credits	1			
Core Course						
Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To introduce the fundamentals of Java programming language. • To enable students to write object-oriented programs. • To familiarize students with advanced Java concepts like multithreading, exception handling, and collections. • To provide hands-on experience in developing real-world applications using Java. • To develop problem-solving skills using Java programming techniques. 						
PROGRAMS						
<ol style="list-style-type: none"> 1. Write a Java program to calculate the factorial of a number using loops. 2. Implement a program to demonstrate the use of arrays and string operations (reverse, concatenate, length). 3. Create a program to find the largest and smallest numbers in an array. 4. Create a class Student with properties name, rollNumber, and marks. Write methods to calculate and display the grade. 5. Demonstrate single and multilevel inheritance using classes for Shape, Rectangle, and Square. 6. Implement polymorphism using method overloading and method overriding. 7. Write a program to handle ArrayIndexOutOfBoundsException and NumberFormatException. 8. Create a multithreaded program to calculate the sum of odd and even numbers in an array using two threads. 9. Demonstrate thread synchronization by simulating a producer-consumer problem. 10. Write a program to copy the contents of one text file to another using FileReader and FileWriter. 11. Implement a program to serialize and deserialize an object of a class Employee. 12. Create a program to count the number of words and characters in a text file. 13. Create a simple calculator using AWT/Swing with basic arithmetic operations. 14. Develop a GUI application to accept student details and display them in a table format. 15. Create a Java Swing application to simulate a login screen with username and password validation. 						

COURSE OUTCOMES

CO1: To introduce the fundamentals of object-oriented programming using Java.

CO2: To enable students to design and implement object-oriented programs.

CO3: To familiarize students with core Java concepts such as inheritance, polymorphism, abstraction, and encapsulation.

CO4: To provide exposure to advanced Java features including exception handling, multithreading, and collections.

CO5: To develop problem-solving skills through real-world application development using Java.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	3
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3–High,2–Average,1–Low,0–Null

Semester IV

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS141	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	INTRODUCTION TO ARTIFICIAL INTELLIGENCE & MACHINE LEARNING			L	T	P
			3	0	0	
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • Understand the fundamental concepts and theories of Artificial Intelligence (AI). • Explore key applications of AI across various domains. • Gain familiarity with major subfields of AI, including machine learning, natural language processing, computer vision, and robotics. • Learn the basics of Python programming to write and understand code effectively. • Develop problem-solving skills using Python as a foundation for implementing AI algorithms. 						
UNIT	TOPICS				HOURS	
I	Introduction to Artificial Intelligence Definition of AI – History of AI – AI vs Machine Learning – Need for AI in modern technologies – Key AI Concepts: Reasoning, Problem Solving, Knowledge Representation, Planning – AI Approaches: Symbolic, Sub-symbolic, Statistical – Applications of AI in various industries.				9	
II	Machine Learning Fundamentals Introduction to Machine Learning – Forms of Learning: Supervised Learning, Unsupervised Learning – Machine Learning Algorithms: Linear Regression, Decision Trees, Random Forests – Data Preprocessing: Feature Extraction, Principal Component Analysis (PCA).				9	
III	Advanced Machine Learning Models Classification Algorithms: Support Vector Machines (SVM), Naive Bayes – Regression Models: Support Vector Regression – Unsupervised Learning: K-Means Clustering – Evaluation Metrics: Accuracy, Precision, Recall.				9	
IV	Model Development and Evaluation Machine Learning Model Development: Data Collection – Preprocessing: Model Selection – Model Training: Cross-Validation – Hyperparameter Tuning: Performance Metrics – Evaluation Techniques: Confusion Matrix – ROC Curve: AUC – Learning from Feedback: Learning from interaction with environments and feedback signals.				9	

V	AI Applications and Future Trends Applications of AI and ML: Image Classification – Natural Language Processing: Speech Recognition – Predictive Maintenance: Case Studies – AI in healthcare – Autonomous Systems: Robotics – Ethical Considerations: AI Governance – Future Trends: Explainable AI – Edge AI.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Learn the basics of AI and ML and how they differ.

CO2: Use and evaluate machine learning algorithms like regression and decision trees.

CO3: Build and improve machine learning models.

CO4: Assess models using performance metrics like accuracy and recall.

CO5: Apply AI and ML to real-world problems like image classification and speech recognition.

Text Books:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed., Pearson, 2020.
2. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, 1st ed., MIT Press, 2016.

Reference Books:

1. A. Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed., O'Reilly Media, 2019.
2. C. Bishop, Pattern Recognition and Machine Learning, 2nd ed., Springer, 2021.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS142	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	DATABASE MANAGEMENT SYSTEMS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> ● To learn data models, conceptualize and depict a database system using ER diagram ● To understand the internal storage structures in a physical DB design ● To know the fundamental concepts of transaction processing techniques ● To understand the concept of Database Design in Normalization techniques ● To know the manipulation of SQL Queries 						
UNIT	TOPICS				HOURS	
I	Unit I Data base System Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models , the ER Model , Relational Model , Other Models , Database Languages , DDL , DML , database Access for applications Programs, data base Users and Administrator , Transaction Management , data base Architecture, Storage Manager , the Query Processor Data base design and ER diagrams , ER Model, Entities, Attributes and Entity sets , Relationships and Relationshipsets , ER Design Issues, Concept Design , Conceptual Design for University Enterprise. Introduction to the Relational Model, Structure, Database Schema, Keys, Schema Diagrams.				9	
II	Unit II Relational Query Languages, Relational Operations. Relational Algebra, Selection and projection set operations, renaming , Joins , Division , Examples of Algebra overviews , Relational calculus , Tuple relational Calculus , Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions , GROUPBY , HAVING, Nested Sub queries, Views, Triggers.				9	
III	Unit III Normalization, Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms , dependency preservation, Boyee/Codd normal form. Higher Normal Forms ,Introduction, Multi, valued dependencies and Fourth normal form, Join dependencies and Fifth normal form				9	

IV	Unit IV Transaction State, Implementation of Atomicity and Durability, Concurrent, Executions, Serializability, Recoverability , Implementation of Isolation , Testing for serializability, Lock ,Based Protocols , Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log Based Recovery , Recovery with Concurrent Transactions , Buffer Management , Failure with loss of nonvolatile storage, Advance Recovery systems, Remote Backup systems.	9
V	Unit V File organization, various kinds of indexes. Query Processing, Measures of query cost , Selection operation , Projection operation , Join operation , set operation and aggregate operation , Relational Query Optimization , Transacting SQL queries , Estimating the cost , Equivalence Rules.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Install, configure, and interact with a relational database management system
- CO2:** Master the basics of SQL and construct queries using SQL
- CO3:** Design and develop a large database with optimal query processing
- CO4:** Develop efficient storage scheme of saving and retrieving Records and Files
- CO5:** Design the database with normalization techniques

Text Books

1. Data base System Concept, Silberschatz, Korth, McGraw hill, Sixth Edition, 2010.
2. Data base Management Systems , Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill Third Edition, 2003.

Reference Books

1. Fundamentals of Database Systems, Elmasri Navathe Pearson Education, 201.
2. An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition, 2019.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	2	2	0	0	0	0	0	0	0	0	0	0	2
CO2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	3
CO3	2	0	3	3	2	3	0	1	2	0	2	1	0	0	3
CO4	2	2	2	2	2	3	0	1	2	0	2	1	2	0	1
CO5	0	0	0	2	1	1	1	1	1	1	2	1	1	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS143	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	COMPUTER ORGANIZATION AND ARCHITECTURE			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the architecture and basic components of a computer system. • To learn data representation and perform arithmetic operations. • To study control unit design and high-performance processor concepts. • To explore memory systems and storage technologies. • To examine I/O interfacing, communication, and bus systems. 						
UNIT	TOPICS				HOURS	
I	Fundamentals of Computer Architecture and Organization Overview of Organization vs. Architecture - Functional components: Registers, Register files, Interconnection of components - IAS computer function, von Neumann & Harvard architectures - CISC vs. RISC architectures - Introduction to Instruction Sets - Instruction Set Architecture (ISA), instruction formats, instruction set categories - Addressing modes - Phases of instruction cycle.				9	
II	Data Representation and Arithmetic Operations Representation of data: Binary, Hex, Character codes - Fixed-point arithmetic: Booth's Algorithm, Modified Booth's; Restoring and Non-restoring Division - Floating-point arithmetic: Addition, Subtraction, Multiplication, Division - ALU concepts - Performance Metrics: Execution time, MIPS, MFLOPS.				9	
III	Control Unit and High Performance Processors Datapath and Control Unit: Hardwired Control; Microprogrammed Control - Pipelining: Two-stage, Multi-stage - Hazards: Structural, Data, Control - Hazard resolution techniques and limitations - Branch handling techniques - Flynn's taxonomy (SISD, SIMD, MISD, MIMD) - Superscalar and Super pipeline architectures - Amdahl's Law, Speed-up and Efficiency.				9	
IV	Memory System Organization and Storage Subsystems Memory hierarchy & types - Byte storage methods, conceptual view of memory cells - RAM and ROM, scalable memory design - Cache memory: Mapping techniques, Replacement policies, Management techniques, Mean access time evaluation - Memory Interleaving and Address mapping - External Storage: SSDs, Disk structure - RAID levels, ECC (Error detection & correction) - Reliability of memory systems.				9	

V	Interfacing, Communication and I/O Systems I/O Fundamentals: Handshaking, Buffering, I/O Modules - I/O Techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access (DMA), Direct Cache Access - Interrupt structures: Vectored, Prioritized - Bus systems: Synchronous & Asynchronous - Bus Arbitration Techniques - I/O Performance considerations	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Describe computer architecture, organization, and instruction formats.
- CO2:** Perform binary, fixed-point, and floating-point arithmetic operations.
- CO3:** Explain control unit design, pipelining, and parallel architectures.
- CO4:** Analyze memory hierarchy, cache systems, and storage reliability.
- CO5:** Evaluate I/O techniques, bus structures, and interfacing methods.

Text Books:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design – The Hardware / Software Interface, 6th Edition, Morgan Kaufmann, 2020.

Reference Books:

1. Computer Architecture and Organization – Designing for Performance, William Stallings, 11th Edition, Pearson Education Series, 2022.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, Fifth Edition, Reprint 2011.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	2
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3–High,2–Average,1–Low,0–Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS341	Number of Hours/Week	3			
Semester	IV (PSE I)	Max. Marks	100			
Year	II	Credits	3			
Programme Specific Elective						
Course Title	OPERATING SYSTEMS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To explore fundamental concepts in operating system • To understand essential functions of operating system • To equip process synchronization problems in real life applications • To acquire memory and file management concepts in operating system. • To understand memory management techniques and virtual memory concepts. 						
UNIT	TOPICS				HOURS	
I	Introduction to Operating System Introduction, operating system operations, process management, memory management, storage management, protection and security, distributed systems, Operating system services and systems calls, system programs, operating system structure, operating systems generations.				9	
II	Process Management and Concurrency Process concepts, process state, process control block, scheduling queues, process scheduling, multithreaded programming, threads in UNIX, comparison of UNIX and windows, Process synchronization, critical section problem, Peterson's solution, synchronization hardware, semaphores, classic problems of synchronization, readers and writers problem, dining philosophers problem, monitors.				9	
III	Deadlocks and Memory Management System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery from deadlock banker's algorithm. Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, allocation of frames, thrashing				9	
IV	File System Concept of a file, access methods, directory structure, file system mounting, file sharing, protection. File system implementation: file system structure, file system implementation, directory implementation, allocation methods, free-space management, efficiency and performance				9	

V	I/O System Mass storage structure - overview of mass storage structure, disk structure, disk attachment, disk scheduling algorithms, swap space management, stable storage implementation, tertiary storage structure. I/O: Hardware, application I/O interface, kernel I/O subsystem, transforming I/O requests to hardware operations, streams, performance.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Differentiate basic functionalities in operating system
CO2	Solve process synchronization and scheduling problems
CO3	Implement mutual exclusion principles in real applications
CO4	Develop system model to handle deadlock situations
CO5	Design file and I/O system to improve performance

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 9th edition, Wiley India Private Limited, New Delhi, 2012.

Reference Books:

1. Andrew S. Tanenbaum, Herbert Bos, Modern Operating Systems, 4th edition, Prentice Hall of India, India, 2016.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	1	0	0	1	2	3	0	1	0	2	2	0	2
CO2	3	3	2	3	2	2	2	0	0	2	0	2	0	0	2
CO3	3	3	3	2	2	1	2	0	0	2	0	2	0	0	2
CO4	3	2	3	2	1	2	2	0	0	2	0	2	1	0	2
CO5	2	2	3	3	1	0	2	0	0	2	2	2	1	0	2

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS342	Number of Hours/Week	3			
Semester	IV (PSE I)	Max. Marks	100			
Year	II	Credits	3			
Programme Specific Elective						
Course Title	DATA MINING AND DATA WAREHOUSING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understanding of data warehousing, data mining, and advanced analytics techniques essential for effective business decision-making. • To learn how to build, manage, and utilize data warehouses and apply various data mining techniques for insightful analysis. • To understand different data sources and data preprocessing methods. • To apply basic analytical techniques to discover patterns in data. • To interpret analytical results to support business decisions. 						
UNIT	TOPICS				HOURS	
I	Data Warehousing and Business Analysis: Data warehousing Components –Building a Data warehouse – Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis				9	
II	Data Mining: Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems				9	
III	Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining				9	
IV	Classification and Prediction: Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section				9	

V	Cluster Analysis: Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand Data Warehousing Concepts.
CO2	Apply data extraction, cleanup, and transformation tools effectively and utilize metadata in reporting and querying applications.
CO3	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP Capabilities.
CO4	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.
CO5	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics. Utilize ensemble methods for improved prediction accuracy.

Text Book:

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011

Reference Books:

1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta “Introduction to Data Mining with Case Studies”, 3rd Edition, Prentice Hall of India, 2014.

Mapping of Course Outcomes (CO’s) with PO’s & PSO’s

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	2	1	3	2	2	1	2	1	3
CO2	3	2	3	2	3	1	2	1	3	3	3	2	2	1	3
CO3	3	3	3	2	3	2	3	1	3	2	2	2	2	1	3
CO4	3	3	3	2	3	2	2	1	3	3	3	2	3	1	3
CO5	3	3	3	2	3	3	2	1	3	3	3	2	3	2	3

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS343	Number of Hours/Week	3			
Semester	IV (PSE I)	Max. Marks	100			
Year	II	Credits	3			
Programme Specific Elective						
Course Title	SOCIAL NETWORK ANALYSIS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Explain the evolution of the Semantic Web, its limitations, and the role of social web platforms in network analysis. • Apply ontology-based knowledge representation and advanced modelling techniques to social network data. • Analyse and extract insights from web communities and study their evolution using archival data. • Evaluate human behaviour in social networks and address privacy, trust, and reputation challenges. • Utilize visualization techniques and graph theory to analyse and interpret social networks in practical scenarios. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web. Emergence of the Social Web – Social Network analysis: Development of Social Network. Analysis – Key concepts and measures in network analysis – Electronic sources for network.				9	
II	MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Language – Modelling and aggregating social network data: State-of-the-art in network data. social relationships – Aggregating and reasoning with social network data – Advanced Representations.				9	
III	EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS: Extracting evolution of Web Community from a Series of Web Archive – Detecting.				9	
IV	VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.				9	

V	<p>PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES Understanding and predicting human behaviour for social communities – User data management.– Inference and Distribution – Enabling new human experiences – Reality mining – Context –Awareness – Privacy in online social networks – Trust in online environment – Trust modelsbased on subjective logic – Trust network analysis – Trust transitivity analysis – Combining Trust and reputation – Trust derivation based on trust comparisons.</p>	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Illustrate the Evolution of the Semantic Web and Social Web Platforms
CO2	Apply Ontology-Based Knowledge Representation and Modeling Techniques
CO3	Extract Insights from Web Communities and Evaluate Evolution
CO4	Assess Human Behavior and Address Privacy, Trust, and Reputation Challenges
CO5	Employ Graph Theory and Visualization Techniques for Social Network Analysis

Text Books:

1. **Semantic Web for the Working Ontologist:** Effective Modeling in RDFS and OWL, **Authors:** Dean Allemang, James Hendle, **Publisher:** Morgan Kaufmann, **Edition:** 2nd Edition (2011)

Reference Books:

1. **The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management,** **Authors:** Tim Berners-Lee, James Hendler, Ora Lassila, **Publisher:** Morgan Kaufmann, **Edition:** 1st Edition (2001)

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	2	3	2	2	1	1	2	1	2
CO2	3	3	3	2	3	2	2	2	3	3	2	2	3	3	3
CO3	2	3	3	3	3	2	2	2	3	3	2	2	3	3	3
CO4	3	2	2	3	2	2	3	3	2	3	2	3	3	2	2
CO5	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS344	Number of Hours/Week	3			
Semester	IV (PSE II)	Max. Marks	100			
Year	II	Credits	3			
Programme Specific Elective						
Course Title	FULL STACK DEVELOPMENT			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the various components of full stack development • To learn Node.js features and applications • To develop applications with MongoDB • To understand the role of Angular and Express in web applications • To develop simple web applications with React 						
UNIT	TOPICS				HOURS	
I	Basics Of Full Stack: Understanding the Basic Web Development Framework – User – Browser – Webserver – Backend Services – MVC Architecture – Understanding the different stacks –The role of Express – Angular – Node – Mongo DB – React				9	
II	Node JS: Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers – Call backs – Handling Data I/O – Implementing HTTP services in Node.js				9	
III	Mongo DB: Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications				9	
IV	Express And Angular: Implementing Express in Node.js – Configuring routes – Using Request and Response objects Angular – Typescript – Angular Components – Expressions – Data binding – Built-in directives				9	
V	React: MERN STACK – Basic React applications – React Components – React State – Express REST APIs – Modularization and Web pack – Routing with React Router – Server-side rendering				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understanding of full-stack development, including front-end, back-end, and database integration using popular technologies.
CO2	Develop practical knowledge of Node.js, including installation, using npm, creating applications, and handling asynchronous operations with events, callbacks, and timers.
CO3	Master MongoDB and NoSQL concepts, from database setup to collection management, and connecting MongoDB with Node.js applications.
CO4	Learn how to build dynamic web applications using Angular, including components, directives, data binding, and Typescript.
CO5	Acquire hands-on experience with the MERN stack to build full-stack applications with React, Express, and REST APIs, including routing and server-side rendering.

Text Books:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019.

Reference Books

1. Full-Stack JavaScript Development by Eric Bush.
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	2	1	3	2	2	1	2	1	3
CO2	3	2	3	2	3	1	2	1	3	3	3	2	2	1	3
CO3	3	3	3	2	3	2	3	1	3	2	2	2	2	1	3
CO4	3	3	3	2	3	2	2	1	3	3	3	2	3	1	3
CO5	3	3	3	2	3	3	2	1	3	3	3	2	3	2	3

3 - high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS		
Course Code	25BTCS345	Number of Hours/Week	3		
Semester	IV (PSE II)	Max. Marks	100		
Year	II	Credits	3		
Programme Specific Elective					
Course Title	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	
		3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours					
COURSE OBJECTIVES:					
The main learning objective of this course is to prepare the students:					
<ul style="list-style-type: none"> • To extend the students' knowledge of algorithms and data structures. • To enhance their expertise in algorithmic analysis and algorithm design techniques. • To learn a variety of useful algorithms and techniques. • To extrapolate from them in order to apply those algorithms and techniques to solve problems. • To implement algorithms and data structures effectively using a programming language. 					
UNIT	TOPICS				HOURS
I	FUNDAMENTALS Mathematical Proof Techniques: Induction, proof by contradiction, direct proofs – Asymptotic Notations – Properties of Big-oh Notation – Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Introduction to NP-Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Tradeoff.				9
II	HEAP STRUCTURES Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy-Binomial Heaps				9
III	SEARCH STRUCTURES Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees – B-Trees – Splay Trees – Tries.				9
IV	GEOMETRIC ALGORITHMS Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Convex Hulls – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram				9
V	PARALLEL ALGORITHMS Flynn's Classifications – List Ranking – Prefix computation – Array Max – Sorting on EREW PRAM – Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on mesh and butterfly – Matrix Multiplication – Data Distribution on EREW, Mesh and Butterfly				9

COURSE OUTCOMES:

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

CO1	Develop a basic ability to analyze algorithms and determine their correctness and time efficiency.
CO2	Understand a variety of advanced data structures and their implementations, along with different algorithm design techniques in computational geometry and parallel algorithms.
CO3	Apply and implement learned algorithm design techniques and data structures to solve problem.
CO4	Compare and evaluate multiple algorithms for efficiency and scalability.
CO5	Gain hands-on experience with algorithmic problem-solving in real-world applications.

Text books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 4th ed. Cambridge, MA: MIT Press, 2022.
2. M. A. Weiss, Data Structures and Algorithm Analysis in C++, 5th ed. Boston, MA: Pearson, 2019.
3. S. S. Skiena, The Algorithm Design Manual, 3rd ed. Cham: Springer, 2020.

References:

1. M. de Berg, O. Cheong, M. van Kreveld, and M. Overmars, Computational Geometry: Algorithms and Applications, 4th ed. Cham: Springer, 2023.
2. H. Casanova, A. Legrand, and Y. Robert, Parallel Algorithms, 2nd ed. Boca Raton, FL: CRC Press, 2018.
3. P. Brass, Advanced Data Structures, 2nd ed. New York, NY: Cambridge University Press, 2019.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3	3	2	2	2	3	3	3	2	2
CO2	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	3	3	2	2	3	2	2	2	3	3
CO4	3	2	3	2	2	3	2	3	2	2	3	3	2	2	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	3	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS346	Number of Hours/Week	3			
Semester	IV (PSE II)	Max. Marks	100			
Year	II	Credits	3			
Programme Specific Elective						
Course Title	DESIGN AND ANALYSIS OF ALGORITHMS			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To prove correctness of algorithms • To analyse algorithms asymptotically • To demonstrate the efficiency of algorithms by using in existing problems • To utilize advanced algorithms and data structures in complex problems • To design and implement efficient algorithms for solving real-world computational problems 						
UNIT	TOPICS				HOURS	
I	Algorithm analysis and height balanced BST Analysis of algorithms – introduction; solving recurrences – substitutions, recursion tree, and master method; binary search tree (BST) – insertion, deletion; BST applications – runway reservation; height balanced BSTs; AVL Tree – rotations, insertions, deletions;				9	
II	Divide and Conquer and Hashing Interval or activity scheduling; Divide and Conquer approach – Strassen’s algorithm for matrix multiplication; randomized algorithms, median and order statistics, Hashing – direct address tables, hash tables, chaining; Hash function; Universal hashing; Open addressing – linear probing, quadratic probing and double hashing;				9	
III	Dynamic and Greedy algorithms Dynamic and greedy algorithms, Matrix-chain multiplication, Longest common subsequence; Huffman codes; B Trees – searching, search, insertion, deletion; Data structures for disjoint sets – linked list representation, tree representation, union by rank and path compression;				9	
IV	Graph Algorithms Graph algorithms – depth first search, breadth first search, topological sort, strongly connected components, Kruskal and Prim algorithm for minimum spanning tree; Single source shortest paths – Bellman-Ford algorithm, Single-source shortest path in directed acyclic graphs; Dijkstra’s algorithm;				9	
V	P and NP Problems NP-Completeness – polynomial time, verification, NP-Completeness and reducibility, NP-Complete problems; Naïve string matching algorithm, Rabin-Karp algorithm;				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 : Write correctness proofs for algorithms

CO2 : Analyse asymptotic performance of algorithms

CO3: Implement efficient algorithms in engineering applications

CO4 : Demonstrate the familiarity with advanced algorithms and data structures

CO5 : Design algorithms in terms of asymptotic performance

Text Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 4th ed. Cambridge, MA, USA: MIT Press, 2022.

ReferenceBooks:

2. Thomas H. Cormen. Algorithms Unlocked. The MIT Press, 2013.
3. Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran. Fundamentals of Computer Algorithms (Computer software engineering series). Galgotia Publications, new edition edition,2001.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	2
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code			BTCS
Course Code	25BTCS841	Number of Hours/Week			3
Semester	IV	Max. Marks			100
Year	II	Credits			3
Skill Enhancement Course					
Course Title	ENGINEERING ECONOMICS & FOREIGN TRADE			L	T
				3	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours					
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand basic economic principles relevant to engineering. • To analyze consumer and producer behavior using economic models. • To explore market structures and pricing mechanisms. • To apply cost estimation techniques in engineering decisions. • To gain awareness of foreign trade, globalization, and their impact. 					
UNIT	TOPICS				HOURS
I	Introduction The themes of economics – scarcity and efficiency – three fundamental economic problems – society’s capability – Production possibility frontiers (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Micro economies and Macro economies – the role of markets and government – Positive Vs negative externalities.				9
II	Consumer and Producer Behaviour Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behavior – consumer equilibrium – Approaches to consumer behavior – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short- run and long-run cost function – Relation between Production and cost function				9
III	Product and Factor Market Product market – perfect and imperfect market – different market structures – Firm’s equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and efficiency of competitive markets.				9

IV	<p>Engineering Costs & Estimation Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model. Inflation, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis.</p>	9
V	<p>Foreign Trade Introduction, Definition of Foreign Trade, balance of Trade, difference between international and domestic business, Advantages and Disadvantages of International Business, Globalization of Markets, Trends in Globalization, Effects and Benefits of Globalization, balance of payment and foreign exchange.</p>	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

Course Outcomes
CO 1: Understand the fundamental themes of economics
CO 2: Demonstrate market dynamics including demand and supply and their determinants.
CO 3: Appraise the firm equilibrium and supply in relation to market efficiency.
CO 4: Illustrate the different engineering cost concepts, including fixed, variable, and opportunity costs, and apply these concepts to perform break-even analysis.
CO 5: Evaluate the globalization trends, balance of payments and foreign exchange dynamics.

Textbook:

1. Karl E. Case and Ray C. fair, Principles of Economics, 7th edition, Pearson, Education Asia, NewDelhi, 2022.

Reference Books:

1. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, Economics,19thedition, Tata McGraw Hill, New Delhi, 2021
2. William Boyes and Michael Melvin, Textbook of economics, Biztantra, 2022.
3. N. Gregory Mankiw, Principles of Economics, 8th edition, Thomson learning, New Delhi,2021

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0
CO2	0	1	0	1	0	1	0	0	1	0	1	0	0	0	1
CO3	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1
CO4	0	1	0	1	0	0	0	0	1	0	2	0	0	0	0
CO5	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS241	Number of Hours/week	2			
Semester	IV	Max. Marks	100			
		Credit	1			
Course Title	INTRODUCTION TO ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB			L	T	P
				0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understand the basics of AI and ML, including key algorithms and how they are used.
- Apply machine learning algorithms like regression, classification, and clustering on real data.
- Assess machine learning models using metrics to make sure they perform well.
- Build and use neural networks and deep learning models for tasks like image classification.
- Explore how AI and ML are used in real-world industries.

List of experiments:

1. Linear Regression Implementation
2. Logistic Regression Implementation
3. Decision Tree Classification
4. K-Means Clustering
5. Random Forest Classifier
6. Principal Component Analysis (PCA)
7. Neural Network Training
8. Support Vector Machine (SVM) Classification
9. Model Evaluation Metrics
10. Image Classification Using CNN

COURSE OUTCOMES:

CO1: Learn how to prepare and clean data for machine learning.

CO2: Understand how to improve and optimize AI and ML models.

CO3: Be able to design experiments to test and compare AI and ML models.

CO4: Use Python and libraries like TensorFlow and Scikit-learn to build AI and ML models.

CO5: Understand the ethical issues and challenges in using AI and ML in real life.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	0	1	0	0	0	1	0	2	0	0	2
CO2	3	2	2	2	0	0	0	0	0	2	1	1	2	0	3
CO3	3	3	3	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	2	2	3	3	3	2	2	2	3	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS		
Course Code	25BTCS242	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Year	II	Credits	1		

Core Course

Course Title	DATABASE MANAGEMENT SYSTEMS LAB	L	T	P
		0	0	2

L-Lecture Hours T-Tutorial Hours P-Practical Hours

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understand and Apply SQL DDL and DML Commands
- Utilize SQL Functions and Operators Effectively
- Implement SQL Joins and Advanced Clauses
- Work with Constraints, Views, and Subqueries in SQL
- Master Database Management and PL/SQL Concepts

LIST OF EXPERIMENTS

1. DDL commands of SQL with suitable examples

Create table
Alter table Drop
Table

2. DML commands of SQL with suitable examples

Insert

Update Delete

3. Different types of function with suitable examples

Number function
Aggregate Function
Character Function
Conversion Function
Date Function

4. Different types of operators in SQL

Arithmetic Operators
Logical Operators
Comparison Operator
Special Operator
Set Operation

5. Different types of Joins

Inner Join
Outer Join Natural
Join etc..

6. Study and Implementation of
Group By & having clause
Order by clause
Indexing
7. Study & Implementation of
Sub queries
Views
8. Different types of constraints
9. Database Backup & Recovery commands.
Rollback, Commit, Savepoint.
10. Creating Database /Table Space
Managing Users: Create User, Delete User
Managing roles:-Grant, Revoke
11. PL/SQL
12. SQL Triggers

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Understand and apply SQL Data Definition Language (DDL) commands.
- CO2:** Understand and execute SQL Data Manipulation Language (DML) commands.
- CO3:** Apply different SQL functions to manipulate and retrieve data.
- CO4:** Understand and apply different types of constraints in SQL.
- CO5:** Design and implement SQL triggers for automated actions.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	2	2	0	0	0	0	0	0	0	0	0	0	2
CO2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	3
CO3	2	0	3	3	2	3	0	1	2	0	2	1	0	0	3
CO4	2	2	2	2	2	3	0	1	2	0	2	1	2	0	1
CO5	0	0	0	2	1	1	1	1	1	1	2	1	1	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Semester V

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS151	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	COMPUTER GRAPHICS AND MULTIMEDIA			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the fundamental concepts and principles of computer graphics and multimedia systems. • Explore various graphic transformation techniques in both 2D and 3D environments. • Learn the basics of multimedia elements like images, audio, and video, and their role in modern computing. • Apply animation and rendering techniques to create interactive multimedia applications. • Familiarize students with 3D modelling and real-time rendering tools and techniques. 						
UNIT	TOPICS				HOURS	
I	Introduction to Computer Graphics Definition and applications of computer graphics, Computer Graphics hardware (input and output devices), and Graphics software: Raster and vector graphics, Basics of graphics pipeline: Input, processing, and output.				9	
II	2D Transformations Basic transformations (Translation, Scaling, Rotation, Reflection), Homogeneous coordinates.				9	
III	3D Graphics 3D representation (Wireframe, Solid Models), 3D transformations (Translation, Scaling, Rotation), Viewing and projection transformations (Orthographic and Perspective Projection), Hidden surface removal techniques.				9	
IV	Multimedia Concepts Basics of multimedia: Text, images, audio, video, and animations, Compression techniques (Image, Audio, Video), Multimedia File Formats, Multimedia communication.				9	

V	Animation and Rendering 3D Modeling and Rendering Techniques: Animation techniques (Frame-by-frame, Key frame animation), Rendering algorithms (Ray tracing, Scanline rendering), Shading models (Flat shading, Gouraud shading, Phong shading), Basics of interactive graphics and virtual reality, 3D modeling tools and techniques, Lighting and texturing, Real-time rendering (OpenGL, WebGL, etc.), Overview of popular graphics and multimedia software.	9
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Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Identify and Apply Basic Concepts of Computer Graphics.
CO2:	Design and Implement 2D and 3D Graphics Application.
CO3:	Understand Core Principles of Multimedia.
CO4:	Utilize Multimedia Tools and Technologies.
CO5:	Apply Animation, Rendering Techniques, and Real-Time Rendering Algorithms.

Text Books:

1. Prabat K. Andleigh and Kiran Thakrar, Multimedia Systems and Design, PHI Learning, 2020.
2. Donald Hearn, M. Pauline Baker, and Warren Carithers, Computer Graphics with OpenGL, 4th ed., Pearson Education, 2017.
3. James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes, Computer Graphics: Principles and Practice, 3rd ed., Addison-Wesley, 2017.

Reference Books:

1. Tay Vaughan, Multimedia: Making It Work, 9th ed., McGraw Hill Education, 2016.
2. D. P. Mukherjee, Fundamentals of Computer Graphics and Multimedia, Revised ed., PHI Learning, 2017.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	2	3	2	2	2	3	2	1
CO2	3	3	3	3	3	1	1	1	1	2	2	2	3	2	2
CO3	3	3	2	3	3	1	3	1	1	3	1	2	3	3	2
CO4	3	3	3	3	3	1	1	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS152	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	COMPUTER NETWORKS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the concept of layering in networks. • To know the functions of protocols of each layer of TCP/IP protocol suite. • To visualize the end-to-end flow of information. • To learn the functions of network layer and the various routing protocols. • To familiarize the functions and protocols of the Transport layer. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION TO NETWORK MODELS Data Communication - Networks - Network Types: WAN, MAN, LAN - Protocol Layering – TCP/IP Protocol suite - OSI Model - Introduction to Sockets. Physical Layer: Transmission techniques - Guided - Un-Guided - Multiplexing: TDM, FDM, and WDM.				9	
II	DATA LINK LAYER Framing - Error Detection - Error Correction - Hamming Distance, Cyclic Redundancy Check, Flow Control and Error Control Protocol - Stop and Wait, Go-Back-N ARQ - Selective Repeat ARQ - Sliding Window - Piggybacking - Multiple Access Protocols - ALOHA, CSMA/CD, CSMA/CA.				9	
III	NETWORK LAYER Switching Techniques: Circuit Switching, Message Switching, Packet Switching - Internet protocol - IPv4 and IPv6 - Address Resolution Protocol (ARP), RARP – Internet Control Message Protocol (ICMP) - DHCP - Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing - OSPF - Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.				9	
IV	TRANSPORT LAYER User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Flow control - Congestion Control Algorithms: Leaky Bucket and Token Bucket Algorithm - Quality of Service.				9	
V	APPLICATION LAYER Application Layer protocols: HTTP - FTP - Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Explain the basic layers and its functions in computer networks.
CO2:	Design and implement simple models to simulate how data flows between nodes in a network.
CO3:	Evaluate and compare different routing algorithms.
CO4:	Design custom protocols to address specific network functions.
CO5:	Demonstrate various application-layer protocols in achieving end-to-end communication.

Text Books:

1. Data Communications and Networking, 5th Edition, Behrouz Forouzan, Mc Graw Hill, 2017.
2. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

Reference Books:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	2	2	2	3	3	2	2
CO2	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	3	3	2	2	3	2	2	2	3	3
CO4	3	2	3	2	2	3	2	3	2	2	3	3	2	2	2
CO5	2	3	3	3	3	3	2	3	2	2	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS153	Number of Hours/Week	4			
Semester	V	Max. Marks	100			
Year	III	Credits	4			
Core Course						
Course Title	THEORY OF COMPUTATION			L	T	P
				3	1	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To give an overview of the theoretical foundations of computer science from the perspective of formal languages. • To illustrate finite state machines to solve problems in computing • To familiarize Regular grammars and Context Free Grammar. • To solve various problems by normal form techniques, Push Down Automata and Turing Machines. • To analyze the computational capabilities and limitations of different automata models. 						
UNIT	TOPICS				HOURS	
I	Introduction-Finite Automata Introduction to Computation and Formal Languages- Syntax and Semantics- Finite Automata- Alphabets - Strings and Languages - Automata and Grammars - Deterministic Finite Automata (DFA) - Formal Definition - Simplified notation: State transition graph - Transition table - Language of DFA - Nondeterministic Finite Automata (NFA) - NFA with epsilon transition - Language of NFA - Equivalence of NFA and DFA - Minimization of Finite Automata - Distinguishing one string from other - Myhill-Nerode Theorem.				12	
II	Regular Expression (RE) Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleen's Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.				12	
III	Context Free Grammar (CFG) and Context Free Languages Definition - Examples - Derivation - Derivation trees - Ambiguity in Grammar - Inherent ambiguity - Ambiguous to Unambiguous CFG - Useless symbols - Simplification of CFGs - Normal forms for CFGs: CNF and GNF - Closure properties of CFLs - Decision Properties of CFLs: Emptiness - Finiteness and Membership - Pumping lemma for CFLs.				12	

IV	Push Down Automata (PDA) Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.	12
V	Turing Machines (TM) and Undecidability Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Church's Thesis - Recursive and recursively enumerable languages - Halting problem - Introduction to Undecidability - Undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of post correspondence problem - Introduction to recursive function theory.	12

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Design finite automata or regular expression for any tokenization task
CO2	Construct a context free grammar for parsing any language
CO3	Design Turing machine for any language
CO4	Conclude the decidable / undecidable nature of any language
CO5	Apply mathematical and formal techniques for solving real-world problems

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education, India, 2007

Reference Books:

1. K. L. P Mishra, N. Chandrashekar, Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India, 2003

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS351	Number of Hours/Week	3			
Semester	V (PSE III)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	SOFTWARE ENGINEERING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the nature of the software • To understand the different types of process models, agile developments and aspects of software engineer • To gain knowledge about the requirements stage and development of the software • To analyze the different types of architectural designs of the software • To evaluate different testing strategies of the software and Develop the software 						
UNIT	TOPICS				HOURS	
I	Unit I: The Nature of Software - Software Engineering - Software Process.				9	
II	Unit II: Process Models: Prescriptive Process Models - Agile Development - Human Aspects of Software Engineering				9	
III	Unit III: Understanding Requirements: Requirements Engineering - Establishing the Groundwork Building the Analysis Model - Negotiating Requirements Requirements Modeling: Scenario-Based Methods: Requirements Analysis - Scenario-Based Modeling				9	
IV	Unit IV: Design Concepts: Design within the Context of Software Engineering - The Design Process - Design Concepts Architectural Design: Software Architecture - Architectural Genres - Architectural Styles - Architectural Considerations - Architectural Decisions - Architectural Design				9	
V	Unit V:User Interface Design: The Golden Rules - User Interface Analysis and Design - Interface Analysis - Interface Design Steps - WebApp and Mobile Interface Design - Design Evaluation. Software Testing Strategies - Software Testing Fundamentals. Maintenance and Reengineering.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the nature of the software
CO2	Understand the different types of process models, agile developments and aspects of software engineer
CO3	Gain knowledge about the requirements stage and development of the software
CO4	Analyze the different types of architectural designs of the software
CO5	Evaluate different testing strategies of the software and Develop the software

Text Book

1. Roger S Pressman, Software Engineering a Practioner's Approach, 9th Edition, McGraw- Hill Higher Education, 2023.

Reference Books

1. Richard E.Fairly (2005), Software Engineering Concepts, Tata Mc Graw Hill Book Company.
2. Jawadekar (2004), Software Engineering,Tata Mc Graw-Hill Book Company.
3. Dr. Richard Hall Thayer and Dr. Merlin Dorfman(2012), Software Engineering Essentials, Volume I: The Development Process, Software Management Training; Fourth edition.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	3	2	2	3	2	2	2	2	3
CO2	3	3	3	2	3	2	3	3	3	2	3	2	2	2	2
CO3	3	3	2	3	2	2	3	3	2	3	2	2	3	3	2
CO4	3	2	2	3	1	2	3	2	2	3	1	2	3	3	2
CO5	3	2	2	2	1	2	3	2	2	2	1	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS352	Number of Hours/Week	3			
Semester	V (PSE III)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	NATURE INSPIRED COMPUTING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the Fundamentals of Bio-Inspired Computing. • Learn Evolutionary Models, Optimization Techniques and Explore Genetic Algorithms. • Investigate the biological basis of ant colonies and how this inspires optimization algorithms. • Explore variable-length PSO and its applications in optimization problems. • Application-Oriented Learning and Explore Advanced Nature-Inspired Algorithms. 						
UNIT	TOPICS				HOURS	
I	Introduction: From Nature-to-Nature Computing, – Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques- Optimisation Problems-Single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.				9	
II	Genetic Algorithms: Genetic algorithms: Mathematical foundation, Genetic problem solving, crossover and mutation. Genetic algorithms and Markov process, applications of genetic algorithms.				9	
III	Optimization Algorithms: Ant Colonies, hybrid ant system, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Variations of ACO.				9	
IV	Swarm Algorithms: Particle Swarm algorithms - particles moves, particle swarm optimization, variable length PSO, applications of PSO. Artificial Bee Colony algorithms - ABC basics, ABC in optimization, multi-dimensional bee colony algorithms, applications of bee algorithms.				9	
V	Applications: Selected nature inspired techniques - Bat algorithm- Cuckoo search algorithm. Deep Learning-Pattern recognition -Cybersecurity and its applications -Complex Network.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Apply nature-inspired computational techniques to solve real-world optimization and problem-solving tasks.
CO2	Demonstrate the ability to Implement Genetic Algorithms for Optimization and apply them to practical scenarios.
CO3	Utilize Ant Colony Optimization Techniques and evaluate the effectiveness of ACO algorithms in comparison to other optimization techniques.
CO4	Apply Swarm Intelligence Algorithms and analyse their applicability in real-world optimization problems.
CO5	Encourage creative and innovative problem-solving approaches by applying nature-inspired algorithms in emerging fields such as artificial intelligence, machine learning, and data science.

Text Books:

1. Fundamentals of Natural Computing: Basic Concepts, Algorithms, and applications, L. N. de Castro (2006).
2. Leandro Nunes de Castro, Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications, Chapman & Hall/ CRC, Taylor and Francis Group, 2007
3. Evolutionary Optimization Algorithms, D. Simon (2013), Wiley

Reference Books:

1. Floreano D. and Mattiussi C., Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, MIT Press, Cambridge, MA, 2008.
2. Albert Y.Zomaya, Handbook of Nature-Inspired and Innovative Computing, Springer, 2006.
3. Marco Dorigo, Thomas Stutzle, Ant Colony Optimization, PHI, 2005.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	2	1	2	1	2	1	2	3	2	2
CO2	3	3	3	3	3	2	1	2	1	3	2	3	3	2	2
CO3	2	3	3	3	2	2	1	3	2	3	2	2	3	2	2
CO4	3	2	3	2	3	3	1	2	2	3	2	3	3	2	3
CO5	3	3	3	3	3	3	2	2	3	3	2	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS353	Number of Hours/Week	3			
Semester	V (PSE III)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	FUZZY SETS, LOGICS AND SYSTEMS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the fundamental concepts of fuzzy sets and fuzzy logic. • To learn fuzzy inference systems and rule-based decision-making. • To explore fuzzification, defuzzification, and ANFIS architecture. • To apply fuzzy systems in machine learning and real-world applications. 						
UNIT	TOPICS				HOURS	
I	Introduction and Fuzzy Set Theory: Introduction to Fuzzy Logic and Soft Computing - Classical vs. Fuzzy Sets - Membership Functions: Types and Properties - Set Theoretic Operations on Fuzzy Sets.				9	
II	Fuzzy Arithmetic and Fuzzy Relations: Fuzzy Numbers and Arithmetic - Fuzzy Relations and Their Properties - Fuzzy Composition and Compatibility - Fuzzy Graphs and Clustering.				8	
III	Fuzzy Inference System: Fuzzy If-Then Rules - Rule-Based Systems Linguistic Variables & Hedges - Fuzzy Rule-Based Models Rule-Based Models: Mamdani and Sugeno FIS - Wang and Mendel Model - Takagi-Sugeno-Kang (TSK) Model - Difference Between Mamdani and TSK Models.				9	
IV	Fuzzifiers, and Defuzzifiers: Membership Function Design for Fuzzy Systems - Fuzzification & Defuzzification Techniques - Real-Time Defuzzification Applications. ANFIS: Introduction to Adaptive Neuro-Fuzzy Inference System (ANFIS) - ANFIS Architecture - Implementation and Examples.				10	
V	Fuzzy Systems in Machine Learning: Fuzzy Systems in Pattern Recognition and Clustering - Neuro-Fuzzy Systems - Evolutionary Fuzzy Systems.				9	

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity.

COURSE OUTCOMES:

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

CO1	Define fuzzy sets, illustrate membership functions, and perform set operations.
CO2	Explain fuzzy arithmetic, classify fuzzy relations, and apply clustering techniques.
CO3	Compare fuzzy inference systems, analyze Mamdani, Sugeno, Wang-Mendel, and TSK models, and assess their effectiveness.
CO4	Evaluate fuzzification and defuzzification techniques, implement ANFIS architecture, and interpret results.
CO5	Identify fuzzy system applications, assess their role in machine learning, and differentiate between traditional and fuzzy-based approaches.

Text book:

1. Fuzzy logic with engineering applications, Ross, T. J., John Wiley and Sons, 2005.
2. Neuro-Fuzzy and Soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall, 1997.

References:

1. Uncertain Rule-Based Fuzzy Systems: Introduction and New Directions, Mendel, J. M., Springer, 2nd Edition, 2017.
2. Fuzzy Sets and Fuzzy Logic: Theory and Applications, Klir, G. J., & Yuan, B., Prentice Hall, 1995.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	1	1	2	2	3	3	2	3
CO2	3	3	2	2	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO5	3	3	2	3	3	2	1	1	1	3	3	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS354	Number of Hours/Week	3			
Semester	V (PSE IV)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	DIGITAL IMAGE PROCESSING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To learn the fundamentals of image processing and various transformations applied in an image • To learn image enhancement techniques • To understand image restoration • To impart knowledge on different compression techniques. • To discuss on image segmentation and feature representations. 						
UNIT	TOPICS				HOURS	
I	Introduction Introduction to Digital Image Processing - Characteristics of Digital Image - Basic relationship between pixels - Image sampling and quantization - Color models - Basic Geometric Transformations - Fourier Transform - Cosine-Sine and Hartley Transform - Hadamard-HaarSlant Transform - Discrete Fourier Transform				9	
II	Image Enhancement Techniques Spatial Domain Methods - Basic Grey Level Transformation - Histogram Processing - Image subtraction - Image averaging - Spatial filtering - Smoothing - Sharpening filters - Laplacian filters - Frequency domain filters - Smoothing - Sharpening filters - Homomorphic filtering.				9	
III	Image Restoration Model of Image Degradation/restoration process - Noise models - Spatial and Frequency Filters - Inverse filtering & Wiener Filtering - Least mean square filtering - Constrained least mean square filtering.				9	
IV	Image Compression Fundamentals Image Compression Models - Lossless compression: Variable length coding - LZW coding - Bit plane coding - predictive coding - DPCM - Lossy Compression: Lossy Predictive Coding - Transform coding - Wavelet coding.				9	
V	Image Segmentation & Analysis Image Segmentation techniques - Edge detection - Thresholding - Region - Boundary Extraction & Representation - Region - Moment representation - chain codes - Polygonal approximation - Texture - Pattern Recognition. Applications - Fingerprint/iris recognition - Remote sensing - Automatic character recognition - Medical image processing.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Differentiate and interpret various image enhancement techniques
CO2	Reconstruct the image from the degraded image
CO3	Analyze and use appropriate image compression techniques
CO4	Suggest proper image features for classification problems
CO5	Develop the image segmentation techniques

Text Books:

1. Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, Second Edition, Mc Graw Hill, 2020.

Reference Books:

1. A.K. Jain, Fundamentals of Digital Image Processing, 2nd ed., PHI Learning, 2022.
2. William K. Pratt, Digital Image Processing, 5th ed., John Wiley & Sons, 2022.
3. S.E. Umbaugh, Digital Image Processing and Analysis: Applications with MATLAB and CVIP Tools, 4th ed., Taylor & Francis, CRC Press, 2023.
4. Frank Y. Shih, Image Processing and Pattern Recognition, 2nd ed., Wiley – IEEE Press, 2019.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS355	Number of Hours/Week	3			
Semester	V (PSE IV)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	COGNITIVE COMPUTING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand cognitive computing fundamentals and modeling techniques. • To explore decision-making and learning models in cognitive systems. • To analyze machine learning and NLP in cognitive computing. • To study cognitive analytics and AI applications. • To examine cognitive computing platforms and ethical considerations. 						
UNIT	TOPICS				HOURS	
I	Fundamentals of Cognitive Computing: Basics of Cognitive Computing – Cognitive Psychology – Architecture of the Mind – Cognitive Architectures – Nature of Cognitive Psychology – Cognitive Processes – Cognitive Modeling Paradigms – Declarative / Logic-Based Computational Cognitive Modeling – Connectionist Models – Bayesian Models.				9	
II	Decision Support & Learning Models: Intelligent Decision Making – Fuzzy Cognitive Maps – Learning Algorithms: Nonlinear Hebbian Learning (NHL), Data-Driven NHL – Hybrid Learning – Fuzzy Grey Cognitive Maps – Dynamic Random Fuzzy Cognitive Maps.				9	
III	Machine Learning & NLP in Cognitive Systems: Machine Learning Techniques for Cognitive Decision-Making – Hypothesis Generation and Scoring – Natural Language Processing (NLP) – Representing Knowledge – Taxonomies and Ontologies – N-Gram Models – Applications.				9	
IV	Cognitive Analytics & AI Applications: Predictive Analytics – Text Analytics – Image Analytics – Speech Analytics – AI in Cognitive Systems – Cognitive Assistant for Visually Impaired – AI for Cancer Detection.				8	
V	Cognitive Computing Platforms & Case Studies: IBM Watson – Introduction to IBM’s Power AI Platform – Google’s TensorFlow Development Environment – Real-World Cognitive Computing Case Studies in Healthcare, Business, and Automation - Ethical Considerations in Cognitive AI.				10	

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity.

COURSE OUTCOMES:

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

CO1	Describe cognitive computing fundamentals, identify key aspects of cognitive psychology, and explain basic modeling techniques.
CO2	Compare decision-making models, differentiate learning algorithms, and examine their role in cognitive systems.
CO3	Apply machine learning models, use NLP techniques, and illustrate their role in decision-making.
CO4	Evaluate cognitive analytics methods, analyze AI applications, and discuss their industry impact.
CO5	Compare cognitive computing platforms, explore real-world use cases, and discuss ethical considerations.

Text book:

1. Cognitive Computing and Big Data Analytics, Judith S. Hurwitz, Marcia Kaufman, and Adrian Bowles, Wiley, 2015.

References:

1. Quantum Models of Cognition and Decision, erome R. Busemeyer and Peter D. Bruza, Cambridge University Press, 2nd Edition, 2024.
2. Cognitive Science: An Introduction, Neil A. Stillings, Steven E. Weisler, Christopher H. Chase, Mark H. Feinstein, Jay L. Garfield, and Edwina L. Rissland, MITPress, 2nd Edition, 1995.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	2	1	2	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	2	3	3	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS356	Number of Hours/Week	3			
Semester	V (PSE IV)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	NATURAL LANGUAGE PROCESSING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the Fundamentals of Lexical Analysis • Explore Speech Processing Techniques • Learn Parsing Techniques and Algorithms • Develop Knowledge of Lexical Networks and Word Sense Disambiguation • Apply Natural Language Processing in Real-world Applications 						
UNIT	TOPICS				HOURS	
I	Lexical Analysis Lexical Analysis - Regular expression and Automata for string matching - Words and Word Forms - Morphology fundamentals - Morphological Diversity of Indian Languages - Morphology Paradigms - Finite State Machine / Transducers Based Morphology - Automatic Morphology Learning - Parts of Speech - N-gram Models - Hidden Markov Models.				9	
II	Speech Processing Biology of Speech Processing - Place and Manner of Articulation - Word Boundary Detection - Argmax based computations - HMM and Speech Recognition - Text to Speech Synthesis - Rule Based-Concatenative based approach.				9	
III	Parsing Theories of Parsing - Parsing Algorithms – Earley Parser - CYK Parser - Probabilistic Parsing - CYK - Resolving attachment and structural ambiguity - Shallow Parsing - Dependency Parsing - Named Entity Recognition - Maximum Entropy Models - Conditional Random Fields.				9	
IV	Lexical Knowledge Networks Meaning: Lexical Knowledge Networks - Wordnet Theory - Indian Language Wordnets and Multilingual Dictionaries - Semantic Roles - Word Sense Disambiguation - WSD and Multilingualism - Metaphors - Coreference and Anaphora Resolution.				9	
V	Applications Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR).				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :	Ability to Analyze Lexical Structures
CO2 :	Competence in Speech Processing Techniques
CO3 :	Proficiency in Parsing Algorithms
CO4 :	Understanding and Application of Lexical Knowledge Networks
CO5 :	Application of NLP Techniques in Various Domains

Text Books

1. Jurafsky Daniel, Martin James, Speech and Language Processing, Second Edition, Tenth Impression, Pearson Education, 2018.
2. Christopher Manning, Schutze Heinrich, Foundations of Statistical Natural Language Processing, MIT Press, 1999. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Ninth edition, 2013.

Reference Books

1. Allen James, Natural Language Understanding, Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, Statistical Language Learning, MIT Press, 1993.
3. Foundations of Statistical Natural Language Processing, The MIT Press Cambridge, Massachusetts London, England, 1999.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	0	0	0	0	1	0	0	0	1	0	1	0	1
CO2	2	2	0	0	0	0	0	0	0	0	0	0	2	1	3
CO3	1	2	1	0	0	0	1	0	0	0	2	3	1	2	1
CO4	2	2	2	0	1	0	0	0	0	0	0	0	1	1	0
CO5	3	3	1	0	0	0	0	2	0	0	0	1	2	2	0

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS251	Number of Hours/Week	2			
Semester	V	Max. Marks	100			
Year	III	Credits	1			
Course						
Course Title	COMPUTER GRAPHICS AND MULTIMEDIA LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students to</p> <ul style="list-style-type: none"> • Understand the basic concepts and applications of computer graphics and multimedia. • Apply 2D and 3D transformations to graphical objects. • Implement fundamental graphics algorithms for drawing and clipping. • Explore multimedia elements, compression techniques, and file formats. • Develop animations and rendering techniques using graphics tools and software. 						
PROGRAMS						
<ol style="list-style-type: none"> 1. Implementation of Line Drawing Algorithms: DDA Algorithm, Bresenham's Algorithm 2. Implementation of Circle Drawing Algorithms: Midpoint Circle Algorithm 3. Implementation of 2D and 3D Transformations 4. Implementation of Cohen-Sutherland Line Clipping Algorithm 5. Implementation of Bezier Curve Drawing 6. Perform Object Transformations (Rotation, Scaling, Move) using Flash, Maya, or any 3D Tool 7. Create Bouncing Ball Animation using Key Frame and Path Animation Techniques 8. Display 3D Wireframe Cube and Apply 3D Transformations 9. Implement Basic Multimedia Playback for Audio and Video Files. 10. Image Compression and File Format Conversion using Multimedia Tools or Python Libraries 						

Course Outcomes:

By learning Computer Graphics and Multimedia lab, students will be able to

CO1:	Identify the components and functions of computer graphics systems.
CO2:	Apply 2D and 3D transformations to graphical objects.
CO3:	Implement standard algorithms for drawing and clipping.
CO4:	Analyze multimedia formats and use basic compression techniques.
CO5:	Create animations and rendering projects using graphics tools.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	2	2	2	3	3	2	2
CO2	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	3	3	2	2	3	2	2	2	3	3
CO4	3	2	3	2	2	3	2	3	2	2	3	3	2	2	2
CO5	2	3	3	3	3	3	2	3	2	2	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS252	Number of Hours/Week	2			
Semester	V	Max. Marks	100			
Year	III	Credits	1			
Course						
Course Title	COMPUTER NETWORKS LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To understand the concept of layering in networks. • To know the functions of protocols of each layer of TCP/IP protocol suite. • To visualize the end-to-end flow of information. • To learn the functions of network layer and the various routing protocols. • To familiarize the functions and protocols of the Transport layer. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Chat application for real-time communication between client and server. 2. Simulation of DNS using UDP Sockets. 3. Basic Packet Analysis. 4. Simulation of ARP/RARP Protocols. 5. Simulation of Leaky Bucket and Token Bucket algorithms. 6. Implementation of data transmission using TCP and UDP and measure metrics using throughput and latency. 7. Simulation of Distance Vector Routing Algorithm. 8. Implementation of Link State Routing Algorithm. 9. Simulation of CRC (Cyclic Redundancy Check). 10. Implementation of Simple Mail Transfer Protocol (SMTP) for sending emails. 						

Course Outcomes:

By learning Computer Networks, students will be able to

CO1:	Explain the basic layers and its functions in computer networks.
CO2:	Understand the basics of how data flows from one node to another.
CO3:	Analyze routing algorithms.
CO4:	Describe protocols for various functions in the network..
CO5:	Analyze the working of various application layer protocols.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	2	2	2	3	3	2	2
CO2	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	3	3	2	2	3	2	2	2	3	3
CO4	3	2	3	2	2	3	2	3	2	2	3	3	2	2	2
CO5	2	3	3	3	3	3	2	3	2	2	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS851	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Skill Enhancement Course						
Course Title	PRINCIPLES OF MANAGEMENT			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the basic concepts and importance of management and its early thinkers. • Learn the purpose, steps, and methods of planning and decision making. • Know how organizations are structured and how authority is managed. • Understand how managers direct, lead, motivate, and communicate with teams. • Learn how controlling helps managers check progress and improve performance. 						
UNIT	TOPICS				HOURS	
I	Fundamentals of Management: Introduction Concepts, Objectives, Nature Scope and Significance of management Evolution of management thought-Contribution of Taylor, Weber and Fayol management.				9	
II	Planning: Concept, Objectives, Nature, Limitation, Process of planning, Importance, Forms, Techniques and Process of decision making.				9	
III	Organizing: Concept, Objectives, Nature of organizing, Types of Organization, delegation of authority, Authority and responsibilities, Centralization and Decentralization, Span of control.				9	
IV	Directing: Concept, Principles & Techniques of directing and Coordination Concept of leadership-Style. Importance, Styles, Supervision, Motivation, Importance Theory of Motivation, Communication.				9	
V	Controlling: Concept, Principles, Process and Techniques of Controlling, Relationship between planning and controlling.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Discuss the management concepts, objectives, nature, scope, significance and evolution, with contributions from Taylor, Weber, and Fayol.
CO2	Illustrate the process of planning, including its objectives, forms, techniques and decision-making processes, explaining its importance and limitations in a management context.
CO3	Apply the principles of organizing by evaluating different organizational

	structures, analyzing delegation of authority, and assessing the impact of centralization and decentralization on business operations.
CO4	Examine the principles and techniques of directing, leadership styles and motivational theories, and analyze their significance in managing teams, ensuring effective communication, supervision and coordination within organizations.
CO5	Estimate the effectiveness of controlling processes and techniques and assess the relationship between planning and controlling to improve organizational performance.

Text Book:

1. D. Pagare, Principles of Management, 6th ed. New Delhi, India: Sultan Chand & Sons, 2018.

Reference Books:

1. L. M. Prasad, Principles and Practice of Management, 9th ed. New Delhi, India: Sultan Chand & Sons, 2016.
2. V. S. P. Rao and P. S. Narayana, Principles and Practice of Management. New Delhi, India: Konark Publishers Pvt. Ltd., 1987.
3. R. Srinivasan and S. A. Chunawalla, Management Principles and Practice, 1st ed. Mumbai, India: Himalaya Publishing House, 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	2	2	0	2	2	0	1	2	1	2	2	2	2
CO2	1	1	1	2	2	2	2	1	1	2	1	1	2	3	2
CO3	3	1	1	2	2	2	2	1	1	2	1	1	2	3	2
CO4	3	3	2	3	2	2	2	1	2	3	2	2	3	3	2
CO5	3	3	2	3	2	2	2	1	2	3	2	2	3	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Semester VI

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS161	Number of Hours/Week	3			
Semester	VI	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	EMBEDDED SYSTEMS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To learn the fundamental concepts of Embedded Systems. • To become familiar with the embedded computing platform design and analysis. • To get thorough knowledge in Embedded Firmware Development. • To understand the fundamentals of RTOS for Embedded Systems. • Implement Embedded C Programming for real-time applications. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION TO EMBEDDED SYSTEMS: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.				9	
II	EMBEDDED COMPUTING PLATFORM DESIGN: The CPU Bus-Memory devices and systems–Designing with computing platforms – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.				9	
III	EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object-oriented Model. Real Time Clock-Watchdog Timer				9	
IV	RTOS BASED EMBEDDED SYSTEM DESIGN: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.				9	
V	EMBEDDED C PROGRAMMING: Introduction-Creating 'hardware delays' using Timer 0 and Timer 1-Reading Switches-Adding Structure to the code-Generating a minimum and maximum delay-Example: Creating a portable hardware delay-Timeout Mechanisms-Creating loop timeouts-Testing loop timeouts- hardware timeouts-Testing a hardware timeout				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Identify the key characteristics, history, and applications of Embedded Systems
CO2	Design and implement embedded systems using appropriate computing platforms
CO3	Implement and manage EDLC with a clear understanding of hardware-software co-design.
CO4	Understand RTOS fundamentals and develop embedded systems with task scheduling, multitasking, and multiprocessing.
CO5	Design embedded C code to implement hardware delays, switch reading, and timeouts.

Text Books:

1. Marilyn Wolf, Computers as Components: Principles of Embedded Computing System Design, 4th ed., Morgan Kaufmann (Elsevier), 2021.
2. Frank Vahid and Tony Givargis, Embedded System Design, 2nd ed., Wiley, 2019.
3. Kenneth J. Ayala, The 8051 Microcontroller: Architecture and Programming Applications, 4th ed., Cengage Learning, 2018.

Reference Books:

1. Michael J. Pont, Embedded C, 3rd ed., Pearson Education, 2017.
2. David E. Simon, An Embedded Software Primer, 2nd ed., Pearson Education, 2018.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	2	1	2	1	1	2	3	2	1
CO2	3	3	3	2	2	3	2	2	3	2	2	2	3	3	2
CO3	3	3	3	2	3	3	2	2	3	3	3	2	3	3	3
CO4	3	2	3	3	2	3	2	2	3	2	3	3	3	3	2
CO5	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS162	Number of Hours/Week	3			
Semester	VI	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	COMPILER DESIGN			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To learn the various phases of compiler parsing techniques. • To understand intermediate code generation and run-time environment. • To learn to implement the front-end of the compiler. • To learn to implement code generator. • To learn to implement code optimization. 						
UNIT	TOPICS				HOURS	
I	Introduction To Compilers & Lexical Analysis Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA – Language for Specifying Lexical Analyzers – Lex tool.				9	
II	Syntax Analysis: Role of Parser – Grammars – Context-free grammars – Writing a grammar Top Down Parsing General Strategies – Recursive Descent Parser Predictive Parser-LL(1) – Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table – Introduction to LALR Parser Error Handling and Recovery in Syntax Analyzer-YACC tool – Design of a syntax Analyzer for a Sample Language				9	
III	Syntax Directed Translation & Intermediate Code Generation: Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator – Type Systems-Specification of a simple type Checker Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching.				9	
IV	Run-Time Environment And Code Generation: Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack, and Heap allocation – Parameter Passing-Symbol Tables – Dynamic Storage Allocation – Issues in the Design of a code generator – Basic Blocks and Flow graphs Design of a simple Code Generator – Optimal Code Generation for Expressions– Dynamic Programming Code Generation.				9	

V	Code Optimization: Classification of optimization, Principle sources of optimization, Optimization of basic blocks, Peephole Optimization, Loops in flow graphs, Local optimization, Global optimization, Data flow analysis of flow graph.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Learn Compiler phases, passes, and language translation mechanisms.
CO2	Understand the concept of token generation, parsing techniques, symbol table and intermediate code generation.
CO3	Apply syntax-directed translation to generate intermediate code representations, such as syntax trees and three-address code, and perform type checking.
CO4	Understand various types of errors and error handling techniques
CO5	Apply the code optimization algorithms.

Text Book:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Second Edition, Pearson Education, 2009.

Reference Books:

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, Compiler Design in C, Prentice-Hall Software Series, 1993.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS163	Number of Hours/Week	3			
Semester	VI	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	CRYPTOGRAPHY AND NETWORK SECURITY			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To gain insights into security principles, legal aspects, and threat mitigation strategies. • To explore encryption techniques and their role in ensuring data confidentiality. • To understand cryptographic algorithms and key management in secure communication. • To analyze authentication protocols and digital security measures for integrity. • To study real-world cybersecurity practices, including intrusion detection and firewall defense. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography) - Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.				9	
II	SYMMETRIC CRYPTOGRAPHY Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclids algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution				9	
III	PUBLIC KEY CRYPTOGRAPHY Mathematics Of Asymmetric Key Cryptography: Primes – Primarily Testing –Factorization – Euler ‘s totient function, Fermat ‘s and Euler ‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.				9	
IV	MESSAGE AUTHENTICATION AND INTEGRITY Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509				9	

V	SECURITY PRACTICE AND SYSTEM SECURITY Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand fundamental security concepts, threats, and classical encryption techniques
CO2	Apply symmetric and asymmetric cryptographic algorithms for secure communication
CO3	Implement authentication mechanisms, digital signatures, and hash functions for data integrity
CO4	Analyze network and system security threats, including malware, intrusion detection, and firewalls.
CO5	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.

Text Books

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	1	2	2	1	3	3	2	2
CO2	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2
CO3	3	2	3	3	3	2	2	2	3	2	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3
CO5	2	2	2	3	3	3	2	2	2	3	2	3	3	2	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS261	Number of Hours/Week	2			
Semester	VI	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	EMBEDDED SYSTEMS LAB			L	T	P
				0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To learn the fundamental concepts of Embedded Systems. • To become familiar with the embedded computing platform design and analysis. • To get thorough knowledge in Embedded Firmware Development. • To understand the fundamentals of RTOS for Embedded Systems. • Implement Embedded C Programming for real-time applications. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Study of ARM LPC2148 Processor Architecture and Features 2. GPIO Programming: LED and Switch Interface 3. Timer Delay Program Using Built-in Timer 4. Simple Interrupt Handler Implementation 5. Buzzer Interface using GPIO 6. Displaying a Message on LCD Display 7. I2C Communication using IDE Environment 8. I2C Interfacing with Serial EEPROM 9. Serial Communication using UART 10. Multitasking and Inter-task Communication using RTOS (Mailbox Concept) 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the architecture and features of ARM LPC2148 microcontroller.
CO2	Develop embedded C programs for GPIO, timer, interrupts, and peripheral interfaces.
CO3	Interface and control external devices like LEDs, switches, LCDs, buzzers, and EEPROM.
CO4	Implement serial and I2C communication protocols for data exchange.
CO5	Apply RTOS concepts like multitasking and inter-task communication in embedded applications.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	1	1	1	2	1	1	2	2	2	2
CO2	3	3	3	2	3	2	2	1	2	2	1	2	3	3	3
CO3	3	3	3	3	3	1	2	2	3	1	2	3	3	3	3
CO4	3	3	3	3	3	1	1	2	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	2	2	3	2	2	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS262	Number of Hours/Week	2			
Semester	VI	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	COMPILER DESIGN LAB			L	T	P
				0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • Master lexical analysis tools – build both manual and Lex-based scanners to identify tokens accurately. • Design and implement parsers – convert grammars to YACC specifications, construct ASTs, and resolve syntax errors. • Apply semantic analysis – implement symbol tables, type checking, and control/data-flow analyses for semantic correctness. • Simulate run-time behavior – experiment with storage-allocation strategies and DAG construction to support code generation. • Introduce code optimisation techniques – perform basic-block, peephole, and global optimisations to improve compiled output efficiency. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Implementation of Symbol Table 2. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.) 3. Implementation of Lexical Analyzer using Lex Tool 4. Generate YACC specification for a few syntactic categories. <ol style="list-style-type: none"> a) Program to recognize a valid arithmetic expression that uses operator +, -, * and /. b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits. c) Implementation of Calculator using LEX and YACC 5. Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree. 6. Implement type checking 7. Implement control flow analysis and Data flow Analysis 8. Implement any one storage allocation strategies (Heap, Stack) 9. Construction of DAG 10. Implementation of Simple Code Optimization Techniques. 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Implement Lexical Analysis: Construct accurate tokenizers for a subset of C both manually and with Lex.
CO2	Develop Syntax Analyzers: Write YACC grammars, resolve conflicts, and generate Abstract Syntax Trees for arithmetic expressions, variables, and calculators.
CO3	Perform Semantic Checks: Build symbol tables, enforce type-checking rules, and validate programs for semantic correctness.
CO4	Analyze Program Flow & Storage: Generate control- and data-flow graphs, construct DAGs, and experiment with stack vs. heap allocation to model run-time behavior.
CO5	Optimize Intermediate Code: Apply basic-block, peephole, and global data-flow optimizations to improve execution efficiency of compiled code.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	1	1	1	2	2	3	3	2	3
CO2	3	3	2	3	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO5	3	3	2	3	3	2	1	1	1	3	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS361	Number of Hours/Week	3			
Semester	VI (PSE V)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	BIG DATA ANALYTICS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To introduce the fundamental concepts and technologies of Big Data. • To understand NoSQL data models and distributed data management systems. • To learn the principles and working of MapReduce and YARN frameworks. • To gain knowledge of Hadoop architecture, HDFS, and data processing techniques. • To familiarize with Hadoop ecosystem tools such as HBase, Pig, and Hive for data analysis. 						
UNIT	TOPICS				HOURS	
I	UNDERSTANDING BIG DATA Introduction to Big Data – Convergence of Key Trends – Unstructured Data – Industry Examples of Big Data – Web Analytics – Big Data Applications – Big Data Technologies – Introduction to Hadoop – Open Source Technologies – Cloud and Big Data – Mobile Business Intelligence – Crowdsourcing Analytics – Inter and Trans Firewall Analytics.				9	
II	NoSQL DATA MANAGEMENT Introduction to NoSQL – Aggregate Data Models – Key-Value and Document Data Models – Relationships – Graph Databases – Schemaless Databases – Materialized Views – Distribution Models – Master-Slave Replication – Consistency – Cassandra – Cassandra Data Model – Cassandra Examples – Cassandra Clients.				9	
III	MAPREDUCE APPLICATIONS MapReduce Workflows – Unit Tests with MRUnit – Test Data and Local Tests – Anatomy of a MapReduce Job Run – Classic MapReduce – YARN – Failures in Classic MapReduce and YARN – Job Scheduling – Shuffle and Sort – Task Execution – MapReduce Types – Input Formats – Output Formats.				9	
IV	BASICS OF HADOOP Data Format – Analyzing Data with Hadoop – Scaling Out – Hadoop Streaming – Hadoop Pipes – Design of Hadoop Distributed File System (HDFS) – HDFS Concepts – Java Interface – Data Flow – Hadoop I/O – Data Integrity – Compression – Serialization – Avro – File-Based Data Structures – Cassandra-Hadoop Integration.				9	

V	HADOOP RELATED TOOLS HBase – Data Model and Implementations – HBase Clients HBase Examples – Praxis. Pig – Grunt – Pig Data Model – Pig Latin – Developing and Testing Pig Latin Scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the concepts, characteristics, and applications of Big Data.
CO2	Apply NoSQL data models and techniques for distributed data storage and management.
CO3	Analyze data using MapReduce programming and YARN framework.
CO4	Explain Hadoop architecture, HDFS operations, and data processing mechanisms.
CO5	Use Hadoop ecosystem tools such as HBase, Pig, and Hive for Big Data analytics tasks.

Text Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley, 2013.
2. Eric Sammer, Hadoop Operations, O'Reilly Media, 2012.
3. Pramod J. Sadalage, NoSQL Distilled, Addison-Wesley, 2013.

Reference Books:

1. E. Capriolo, D. Wampler, and J. Rutherglen, Programming Hive, O'Reilly Media, 2012.
2. Lars George, HBase: The Definitive Guide, O'Reilly Media, 2011.
3. Eben Hewitt, Cassandra: The Definitive Guide, O'Reilly Media, 2010.
4. Alan Gates, Programming Pig, O'Reilly Media, 2011.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	0	3	0	1	0	3	2	0	0
CO2	3	2	3	3	0	2	0	0	0	2	0	1	0	3	3
CO3	3	1	2	2	0	2	0	0	0	2	1	1	1	1	3
CO4	3	1	2	2	0	2	0	0	0	2	1	1	0	1	2
CO5	2	2	3	3	3	1	3	3	3	2	2	1	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS362	Number of Hours/Week	3			
Semester	VI (PSE V)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	NEUROMORPHIC COMPUTING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the fundamental principles of neuromorphic computing and its biological inspirations. (Remembering, Understanding) • Analyze different neuromorphic architectures, including spiking neural networks (SNNs) and hardware implementations. (Analyzing) • Design and implement simple neuromorphic models using computational frameworks. (Applying, Creating) • Evaluate the performance of neuromorphic systems in comparison to traditional computing paradigms. (Evaluating) • Apply neuromorphic computing techniques to solve real-world problems in robotics, artificial intelligence, and edge computing. (Applying, Creating) 						
UNIT	TOPICS				HOURS	
I	Introduction to Neuromorphic Computing Basics of Neuromorphic Computing, Differences between Neuromorphic, Conventional, and AI-based Computing, Biological Inspiration: The Human Brain and Neurons, Historical Development of Neuromorphic Engineering, Key Applications of Neuromorphic Computing.				9	
II	Neuromorphic Hardware and Architectures Neuromorphic Processors: IBM TrueNorth, Intel Loihi, SpiNNaker, Analog vs Digital vs Mixed-Signal Neuromorphic Systems, Memristors and their Role in Neuromorphic Computing, Event-Driven Computing and Spiking Neural Networks (SNNs), Power Efficiency and Parallel Processing in Neuromorphic Chips.				9	
III	Spiking Neural Networks (SNNs) and Learning Models Introduction to Spiking Neural Networks (SNNs), Biological vs Artificial Neurons, Leaky Integrate-and-Fire (LIF) Model and Hodgkin-Huxley Model, Spike Timing-Dependent Plasticity (STDP) and Hebbian Learning, Training and Simulation Tools for SNNs (NEST, BindsNET, Brian2).				9	
IV	Algorithms and Applications Neuromorphic Vision and Auditory Processing, Brain-Inspired AI: Edge Computing and IoT Integration, Pattern Recognition and Sensor Fusion, Autonomous Robotics and Neuromorphic Control, Neuromorphic Computing in Medical Applications.				9	

V	Future Trends and Challenges in Neuromorphic Computing Limitations and Current Challenges in Neuromorphic Hardware, Quantum Computing vs Neuromorphic Computing, Hybrid AI: Combining Neuromorphic Computing with Deep Learning, Ethical and Societal Implications, Future Research Directions in Neuromorphic Computing.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the biological foundations of neuromorphic computing and its role in AI development. (Remembering, Understanding)
CO2	Differentiate between conventional computing and neuromorphic paradigms in terms of architecture and efficiency. (Understanding, Analyzing)
CO3	Implement spiking neural networks (SNNs) using tools like NEST, Brian2, or SpiNNaker. (Applying)
CO4	Critically evaluate neuromorphic computing applications and assess their feasibility for various domains. (Evaluating)
CO5	Develop prototype neuromorphic solutions for tasks such as pattern recognition, real-time decision-making, and IoT applications. (Creating)

Text Books:

1. Mohamed, Khaled Salah. Neuromorphic Computing and Beyond. 2020.

Reference Books:

1. Anderson, James A., et al., eds. Neurocomputing. Vol. 2. MIT press, 1993.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
CO2	1	2	0	2	0	0	0	0	0	0	2	0	0	0	3
CO3	0	0	0	0	0	1	1	1	0	0	0	3	2	0	1
CO4	0	0	0	0	0	1	0	2	0	0	0	3	1	0	0
CO5	1	1	1	0	0	0	0	0	0	2	2	0	0	3	1

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS363	Number of Hours/Week	3			
Semester	VI (PSE V)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	COMPUTER VISION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To introduce the fundamental concepts of computer vision, including image formation, feature extraction, and camera models. • To develop an understanding of image processing techniques such as edge detection, image segmentation, and feature extraction. • To study various algorithms for object detection, recognition, and tracking. • To explore advanced topics in computer vision, including 3D vision, motion analysis, and image stitching. • To apply computer vision methods to real-world applications, including robotics, augmented reality, and autonomous vehicles. 						
UNIT	TOPICS				HOURS	
I	Introduction to Computer Vision Overview of Computer Vision-History, scope, and applications of computer vision-Computer vision vs. image processing-Basic concepts: image formation, camera models, and projection-Image Representation and Properties-Color models -Image transformations.				9	
II	Image Processing for Computer Vision Image Preprocessing-Image enhancement -Image smoothing and filtering-Edge-Detection and Feature Extraction-Sobel, Canny, and Laplacian edge detection-Corner detection (Harris, FAST, SIFT, SURF)-Image Segmentation-Thresholding-Region-based segmentation -region growing, watershed-Clustering-based segmentation.				9	
III	Geometric Transformations and Camera Models Geometric Transformations-Affine and projective transformations-Homography and its applications in image stitching.Camera Models and Calibration-Pinhole camera model-Camera calibration techniques-intrinsic and extrinsic parameters-Depth estimation using stereo vision				9	
IV	Object Detection and Recognition Object Detection-Sliding window, Haar cascades, Histogram of Oriented Gradients features-Modern approaches -YOLO, SSD, Faster R-CNN-Object Recognition-Template matching, feature matching-Machine learning for object recognition -Deep learning-based recognition (CNNs)-Face Recognition-Eigenfaces, Fisherfaces-Deep learning approaches				9	

V	Motion Analysis and Tracking Optical Flow-Horn-Schunck and Lucas-Kanade methods for optical flow estimation-Motion segmentation-Object Tracking-Tracking algorithms -Kalman filter, Mean-shift, and CAMShift-Multi-object tracking-Visual odometry and motion capture	9
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Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand the core principles and techniques used in computer vision.
CO2:	Apply image processing algorithms for feature extraction, edge detection, and image segmentation.
CO3:	Implement object detection and recognition algorithms.
CO4:	Analyze motion in images and videos using optical flow and tracking techniques.
CO5:	Develop computer vision solutions for practical applications in robotics, augmented reality, and autonomous systems.

Text Books:

- Computer Vision: Algorithms and Applications** by Richard Szeliski Publisher: Springer. ISBN: 978-1848829343
- Computer Vision: A Modern Approach** by David A. Forsyth and Jean Ponce, Publisher: Pearson, ISBN: 978-0136085928
- Multiple View Geometry in Computer Vision** by Richard Hartley and Andrew Zisserman, Cambridge University Press, ISBN: 978-0521540513
- Deep Learning for Computer Vision** by Rajalingappaa Shanmugamani, Publisher: Apress, ISBN: 978-1484229577

Reference Books:

- Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library** by Adrian Kaehler and Gary Bradski, Publisher: O'Reilly Media, ISBN: 978-1491937996
- Programming Computer Vision with Python: Tools and algorithms for analyzing images** by Jan Erik Solem, Publisher: O'Reilly Media, ISBN: 978-1449316434

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS364	Number of Hours/Week	3			
Semester	VI (PSE VI)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	COMPUTATIONAL LEARNING THEORY			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the theoretical foundations of machine learning and learning algorithms. • Analyze the learnability of different concept classes and hypothesis spaces. • Apply computational learning theory concepts to evaluate and design machine learning algorithms. • Comprehend the trade-offs between sample complexity, computational complexity, and hypothesis complexity. • Explore advanced topics in learning theory, including online learning and reinforcement learning. 						
UNIT	TOPICS				HOURS	
I	Introduction and Foundations: Introduction to machine learning, types of learning (supervised, unsupervised, reinforcement), basic concepts of learning theory (concept class, hypothesis space, error, generalization), probability theory and statistics review, introduction to complexity theory.				9	
II	Probably Approximately Correct (PAC) Learning: PAC learning framework, finite hypothesis spaces, sample complexity bounds, VC dimension, infinite hypothesis spaces, Sauer's Lemma, applications of PAC learning.				9	
III	Mistake-Bound Model and Online Learning: Mistake-bound model, online learning algorithms (Perceptron, Winnow), regret analysis, online convex optimization, applications in online prediction and decision making.				9	
IV	Computational Complexity of Learning: Computational complexity of learning, NP-hardness of learning, cryptographic hardness of learning, efficient learnability, boosting algorithms, applications in feature selection and model selection.				9	
V	Advanced Topics and Applications: Reinforcement learning theory, active learning, kernel methods and learning theory, learning with unlabeled data, recent trends and research directions in computational learning theory, case studies.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand the fundamental principles and concepts of computational learning theory.
CO2:	Analyze the learnability of concept classes using the PAC learning framework.
CO3:	Implement and evaluate online learning algorithms and understand mistake-bound analysis.
CO4:	Understand the computational complexity aspects of machine learning problems.
CO5:	Apply computational learning theory to advanced topics like reinforcement learning and explore recent research trends.

Text Books:

1. S. Shalev-Shwartz and S. Ben-David, Understanding Machine Learning: From Theory to Algorithms. Cambridge, U.K.: Cambridge Univ. Press, 2014.
2. M. Mohri, A. Rostamizadeh, and A. Talwalkar, Foundations of Machine Learning, 2nd ed. Cambridge, MA, USA: MIT Press, 2018.
3. Y. S. Abu-Mostafa, M. Magdon-Ismael, and H.-T. Lin, Learning from Data. AMLBook Press, 2012.

Reference Books:

1. F. Bach, Learning Theory from First Principles. Cambridge, MA, USA: MIT Press, 2024.
2. M. Kejriwal, C. A. Knoblock, & P. Szekely, Knowledge Graphs. Cambridge, MA, USA: MIT Press, 2021.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	2	1	3	3	2	1
CO2	3	3	2	2	2	1	1	1	2	2	1	3	3	2	1
CO3	2	3	3	3	3	2	1	1	2	2	2	2	3	3	1
CO4	3	3	3	3	3	2	2	1	2	3	2	2	3	2	1
CO5	2	3	3	3	3	2	2	1	2	3	3	3	3	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS365	Number of Hours/Week	3			
Semester	VI (PSE VI)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	SOFT COMPUTING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the fundamental principles and components of soft computing techniques. • Explore the architecture, learning methods, and applications of artificial neural networks. • Gain knowledge of fuzzy logic concepts, fuzzy inference systems, and decision-making. • Learn the working of genetic algorithms and their role in solving optimization problems. • Apply hybrid soft computing techniques to real-world problems and engineering applications. 						
UNIT	TOPICS				HOURS	
I	Introduction to Soft Computing Soft Computing constituents – Difference between conventional AI and computational intelligence – Introduction to Artificial Neural Networks: characteristics, learning methods, taxonomy, basic models, technologies, and applications – Introduction to Fuzzy Logic: crisp sets and relations, fuzzy sets and relations, tolerance and equivalence relations – Introduction to Genetic Algorithms: biological background, traditional optimization, and basic concepts.				9	
II	Neural Networks McCulloch-Pitts neuron, linear separability – Hebb network – Supervised learning: Perceptron, ADALINE, MADALINE, BPN, RBF, TDNN – Associative memory: auto and hetero associative networks, BAM, Hopfield network – Unsupervised learning: Kohonen networks, LVQ, CP, ART networks.				9	
III	Fuzzy Logic Membership functions: features, fuzzification, value assignment methods – Defuzzification methods and lambda cuts – Fuzzy arithmetic and measures – Fuzzy rule base and approximate reasoning – Fuzzy inference systems – Overview of fuzzy expert systems and decision-making.				9	
IV	Genetic Algorithms Introduction to Genetic Algorithms – Biological background – Traditional optimization vs GA – Basic concepts, operators, encoding schemes, fitness evaluation – Crossover, mutation – Genetic programming – Multilevel optimization – Real-life applications and advances in GA.				9	

V	Hybrid Soft Computing Techniques and Applications Neuro-fuzzy, genetic-neuro, and fuzzy-genetic hybrid systems – Simplified fuzzy ARTMAP – Applications: image fusion (multispectral & SAR), optimization (TSP), hybrid fuzzy controllers.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Identify and describe the components and significance of soft computing techniques.
CO2	Develop neural network models for pattern recognition and classification tasks.
CO3	Apply fuzzy logic concepts for reasoning and decision-making in uncertain environments.
CO4	Implement genetic algorithms to solve optimization and search problems.
CO5	Integrate hybrid soft computing approaches for real-world applications in engineering.

Text Books:

1. S.N. Sivanandam and S.N. Deepa, Principles of Soft Computing, 3rd Edition, Wiley India Pvt. Ltd., 2018.
2. Rudolf Kruse, Christian Borgelt, Matthias Steinbrecher, and Andre Nurnberger, Computational Intelligence: A Methodological Introduction, 2nd Edition, Springer, 2022.

Reference Books:

1. Pradip Debnath, Oscar Castillo, Poom Kumam (Eds.), Soft Computing: Recent Advances and Applications in Engineering and Mathematical Sciences, CRC Press, 2023.
2. Tarun K. Sharma et al., Soft Computing: Theories and Applications, Springer, 2022.
3. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning, Pearson Education India, 2013.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	2	3	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS366	Number of Hours/Week	3			
Semester	VI (PSE VI)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	DATA VISUALIZATION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the various types of data, apply and evaluate the principles of data visualization • Acquire skills to apply visualization techniques to a problem and its associated dataset • To apply structured approach to create effective visualizations • To learn how to bring valuable insight from the massive dataset using visualization • To create interactive visualization for better insight using various visualization tools 						
UNIT	TOPICS				HOURS	
I	Introduction to Data Visualization Overview of data visualization, Data Abstraction, Task Abstraction, Analysis: Four Levels for Validation				9	
II	Visualization Techniques Scalar and point techniques, vector visualization techniques, multidimensional techniques, visualizing cluster analysis, matrix visualization in Bayesian data analysis				9	
III	Visual Analytics Networks and Trees, Heat Map, Map Color and Other channels, Manipulate View, Visual Attributes				9	
IV	Visualization Tools and Techniques Introduction to various data visualization tools, Visualization using R, Diverse Types of Visual Analysis, Time, Series data visualization, Text data visualization, Multivariate data visualization and case studies				9	
V	Integration of Data Visualization & Recent Trends Integration of visualization tools with Hadoop, Dashboard creation using visualization tools for the use cases: Finance, marketing-insurance-healthcare etc., Recent trends				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the concept of augmented intelligence and its distinction from traditional AI, along with its applications and ethical challenges.
CO2	Demonstrate the use of machine learning, natural language processing, and computer vision in the development of augmented intelligence systems.
CO3	Design human-centric AI solutions that enhance human decision-making through effective human-machine collaboration.
CO4	Evaluate the performance of augmented intelligence systems, focusing on model optimization, data integration, and system architecture.
CO5	Develop forward-thinking augmented intelligence solutions, incorporating emerging technologies and ethical practices to address future challenges.

Text Books:

1. Wilke CO. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media; 2019 Mar 18.

Reference Books:

1. Chen M, Hauser H, Rheingans P, Scheuermann G, editors. Foundations of data visualization. Cham, Switzerland: Springer International Publishing; 2020 Aug 11.
2. Healy K. Data visualization: a practical introduction. Princeton University Press; 2024 Sep 10.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	2	0	2	0	0	0	0	0	0	0	0	1	0
CO2	0	2	0	1	1	0	2	0	3	0	1	2	2	1	3
CO3	0	0	0	1	0	0	2	0	0	0	0	0	2	3	1
CO4	0	2	2	0	1	2	0	0	3	0	0	1	1	0	0
CO5	3	0	2	0	0	0	0	0	1	1	0	0	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Semester VII

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS171	Number of Hours/Week	3			
Semester	VII	Max. Marks	100			
Year	IV	Credits	3			
Core Course						
Course Title	HIGH PERFORMANCE COMPUTING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand high-performance computing (HPC) system architectures and various computational models. • To learn the fundamentals of CUDA programming and its applications in parallel computing. • To apply parallel execution models and methodologies for developing parallel programming and applications. • To design and implement compute-intensive applications on HPC platforms for optimized performance. • To explore advanced techniques and tools for improving efficiency in high-performance computing environments. 						
UNIT	TOPICS				HOURS	
I	Parallel Programming & Computing - Introduction Era of Computing - Parallel Computing - Multiprocessors and Multicomputer Architectures - Scalar vs Vector Processing - Multivector and Superscalar Machines - Pipelined Processors - SIMD Computers - Conditions of parallelism - Program flow mechanisms - Types of Parallelism – ILP, PLP, LLP - Program partitioning and scheduling.				9	
II	Introduction to High Performance Computing Era of Computing - Scalable Parallel Computer Architectures - Towards low-cost computing - Network of Workstations project by Berkeley - Cluster Computing Architecture – Components - Cluster Middleware and SSI - Need of Resource Management and Scheduling - Programming Environments				9	
III	Cluster Computing Introduction to Cluster Computing - Basics and importance of cluster computing - Clustering Models and Architectures - Key architectures and factors affecting cluster design - Types of Clusters - High-performance, high-availability, and load-balancing clusters - Fault Detection and Handling - Heartbeats, Check Pointing, and Watchdog Timers - Failover and Recovery - Concepts of failover and fallback.				9	
IV	High Speed Networks & Message Passing Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster				9	

V	CUDA Programming Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of shared memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, Memory Management, CUDA C on multiple GPUs - OpenMP: Parallel Programming using OpenMP.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the foundational concepts of computer architecture and modern processors.
CO2	Grasp the fundamental principles of access optimization and parallel computers
CO3	Explain the various parallel processing platforms utilized in high-performance computing
CO4	Design efficient and high-performance parallel programming solutions
CO5	Learn and implement parallel programming using the message-passing paradigm.

Text Books:

1. Laurence T.Yang, Minyi Guo – High Performance Computing Paradigm and Infrastructure, John Wiley.
2. Ahmar Abbas, Grid Computing: Practical Guide to Technology & Applications, Firewall Media, 2004.
3. Joshy Joseph and Craig Fellenstein , Grid Computing, Pearson Education, 2004.
4. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.

Reference Books:

1. Lan Foster, et al., The Open Grid Services Architecture, Version 1.5 (GFD.80). Open Grid Forum, 2006.
2. Rajkumar Buyya, High Performance Cluster Computing: Architectures and Systems. Prentice Hall India, 1999.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	3	2	3	1	3	2	1	3	2	3
CO2	2	3	1	2	3	2	3	1	3	2	3	2	1	3	2
CO3	1	2	3	2	1	3	2	3	2	3	1	3	2	3	1
CO4	3	2	1	3	2	1	3	2	3	1	2	3	3	1	2
CO5	2	3	2	1	3	2	1	3	2	3	2	1	3	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS172	Number of Hours/Week	3			
Semester	VII	Max. Marks	100			
Year	IV	Credits	3			
Core Course						
Course Title	MOBILE AND PERVASIVE COMPUTING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • Understand the fundamental principles and evolution of mobile and pervasive computing. • Analyze the architectural components and enabling technologies for mobile and pervasive systems. • Apply security and privacy strategies to safeguard mobile and pervasive environments. • Evaluate the impact of mobile and pervasive computing technologies on various applications and industries. • Create innovative solutions leveraging emerging trends in mobile and pervasive computing. 						
UNIT	TOPICS				HOURS	
I	Introduction to Mobile Computing: Mobile Computing – Networks – Middleware and Gateways – Developing Mobile Computing Applications – Mobile Computing Architecture: Architecture for Mobile Computing – Three-Tier Architecture – Design Considerations for Mobile Computing				9	
II	Global System for Mobile Communications : GSM Architecture – GSM Entities – Call Routing in GSM – GSM Addresses and Identifiers – Network Aspects in GSM – GSM Frequency Allocation – Authentication and Security – Mobile Computing through Internet –Mobile Computing through Telephone – Emerging Technologies: Bluetooth – RFID –Wireless Broadband (WiMax) –Mobile IP				9	
III	Mobile Messaging and GPRS : Short Message Service (SMS)- Value Added Services through SMS – GPRS - GPRS and Packet Data Network – GPRS Network Architecture – GPRS Network Operations –Data Services in GPRS- Applications for GPRS – Limitations of GPRS – CDMA and 3G- Spread Spectrum Technology – CDMA Versus GSM – Wireless Data – Third Generation Networks – Applications on 3G				9	
IV	Pervasive Computing: Past, Present and Future Pervasive Computing - Pervasive Computing Market – m-Business – Application Examples: Retail, Airline check-in and booking – Sales force automation – Health care – Tracking – Car information system – E-mail access via WAP				9	
V	Device Technology: Hardware – Human Machine Interfaces – Biometrics – Mobile OS – Programming for Pervasive devices.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the core concepts, characteristics, and challenges of mobile computing and pervasive computing
CO2	Identify and analyze enabling technologies such as wireless sensor networks and RFID, and their role in pervasive computing environments.
CO3	Design and implement mobile and pervasive architectures using middleware solutions and context-aware systems.
CO4	Assess security and privacy risks in mobile and pervasive systems, and propose effective mitigation strategies.
CO5	Explore and predict future trends in mobile and pervasive computing, considering societal and ethical implications.

Text Books:

1. A. K. Talukder and R. R. Yuvagal, Mobile Computing, 3rd ed. New Delhi, India: Tata McGraw Hill, 2020.
2. J. Burkhardt, H. Henn, S. Heper, K. Rindtorff, and T. Schack, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, 2nd ed. Boston, MA: Addison-Wesley, 2016.

Reference Books:

1. U. Hansmann, L. Merk, M. Nivlacous, T. Stober, and U. Hansmann, Pervasive Computing, 2nd ed. Berlin, Germany: Springer Verlag, 2021.
2. J. H. Schiller, Mobile Communications, 3rd ed. Boston, MA: Addison-Wesley, 2020.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	1	0	2	0	0	0	0	3	0	0	3	1	3
CO2	0	3	0	0	1	0	1	0	2	0	0	2	2	0	3
CO3	1	1	2	3	0	0	0	0	0	0	0	0	2	2	1
CO4	0	0	2	0	1	2	0	0	3	0	0	0	1	1	3
CO5	1	0	1	0	0	3	0	0	0	1	0	1	0	2	1

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS371	Number of Hours/Week	3			
Semester	VII (PSE VII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	SYSTEMS ENGINEERING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the principles and methodologies of system engineering. • Explore system design, development, and lifecycle management. • Analyze system reliability, security, and performance considerations. • To study risk assessment and mitigation strategies in system engineering. • To apply system engineering concepts to solve real-world engineering problems. 						
UNIT	TOPICS				HOURS	
I	Introduction to System Engineering: Definition, Scope, and Importance of System Engineering. System Engineering Lifecycle: Concept, Design, Development, and Deployment. Role of System Engineers in Cybersecurity and IT Infrastructure. System Thinking and Problem-Solving Approaches.				9	
II	System Design and Development: Requirement Analysis and Specification Development. System Architecture and Modular Design. Prototyping and Simulation in System Engineering. Software and Hardware Integration in Complex Systems.				9	
III	System Reliability and Security: Reliability Engineering Principles. Fault Tolerance and Redundancy Strategies. Cybersecurity Considerations in System Design. Access Control, Encryption, and Secure System Implementation.				9	
IV	Risk Assessment and Mitigation: Risk Analysis Techniques: FMEA, Fault Tree Analysis. Threat Modeling and Attack Surface Analysis. Disaster Recovery and Business Continuity Planning. Incident Response and System Resilience Strategies.				9	

V	Case Studies and Applications: Case Studies in Cyber-Physical System Security. System Engineering Applications in Network Security. AI and Machine Learning Integration in Secure Systems. Future Trends in System Engineering and Cybersecurity.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the fundamentals and applications of system engineering.
CO2	Apply system design and architecture principles in real-world scenarios.
CO3	Analyze system reliability, security, and performance issues
CO4	Develop risk assessment and mitigation strategies for complex systems.
CO5	Implement system engineering methodologies in cybersecurity applications.

Text Book

1. Benjamin S. Blanchard - System Engineering Management, Wiley, 2018.
2. Dennis M. Buede, William D. Miller - The Engineering Design of Systems: Models and Methods, Wiley, 2016.

Reference Books

1. Howard Eisner - Essentials of Project and Systems Engineering Management, Wiley, 2011.
2. Richard Stevens - Systems Engineering: Coping with Complexity, Pearson, 2005.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	1	1	2	1	2	1	2	3	1	3
CO2	3	2	1	0	2	2	0	2	1	1	1	0	3	0	2
CO3	2	0	3	3	3	3	0	1	1	3	2	3	2	3	2
CO4	2	3	1	3	0	3	1	0	0	1	0	0	2	2	2
CO5	3	2	3	1	3	2	1	3	2	2	2	0	3	1	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code		BTCS		
Course Code	25BTCS372	Number of Hours/Week		3		
Semester	VII (PSE VII)	Max. Marks		100		
Year	IV	Credits		3		
Programme Specific Elective						
Course Title	EVOLUTIONARY COMPUTATION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the fundamental principles of evolutionary computation and its applications. • Develop and implement various evolutionary algorithms, including genetic algorithms, evolutionary programming, and genetic programming. • Apply evolutionary computation techniques to solve optimization, search, and machine learning problems. • Analyse the performance and behaviour of evolutionary algorithms. • Explore advanced topics and recent trends in evolutionary computation. 						
UNIT	TOPICS				HOURS	
I	Introduction to Evolutionary Computation: Introduction to optimization and search problems, biological evolution as inspiration, history and development of evolutionary computation, overview of evolutionary algorithms, basic terminology (population, fitness, selection, crossover, mutation).				9	
II	Genetic Algorithms (GAs): Representation schemes (binary, real-valued, permutation), selection methods (roulette wheel, tournament selection), crossover operators (one-point, two-point, uniform), mutation operators (bit-flip, Gaussian), GA implementation and parameter tuning.				9	
III	Evolutionary Programming (EP) and Genetic Programming (GP): Evolutionary programming: representation, mutation, and selection. Genetic programming: tree-based representation, function and terminal sets, crossover and mutation operators, applications of GP.				9	
IV	Advanced Evolutionary Algorithms and Optimization: Particle swarm optimization (PSO), ant colony optimization (ACO), differential evolution (DE), multi-objective optimization (MOO), constraint handling techniques, applications in engineering optimization problems.				9	

V	Applications and Advanced Topics: Evolutionary machine learning, neuroevolution, evolutionary robotics, parallel and distributed evolutionary algorithms, recent trends and research directions, case studies and real-world applications.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the fundamental principles and concepts of evolutionary computation.
CO2	Implement and apply genetic algorithms to solve optimization and search problems.
CO3	Develop and utilize evolutionary programming and genetic programming techniques.
CO4	Apply advanced evolutionary algorithms like PSO, ACO, and DE to complex optimization tasks
CO5	Analyze and apply evolutionary computation to emerging areas like machine learning and robotics, and understand current research trends.

Text Books:

1. Eiben, A. E., & Smith, J. E. (2015). From evolutionary computation to computational evolution: Evolving artificial life. Springer.
2. Engelbrecht, A. P. (2007). Computational intelligence: an introduction. John Wiley & Sons.
3. Mitchell, M. (1998). An introduction to genetic algorithms. MIT press.

Reference Books:

1. Goldberg, D. E. Genetic algorithms in search, optimization, and machine learning. Addison-Wesley Professional, 1989.
2. Fogel, D. B., Evolutionary computation: toward a new philosophy of machine intelligence. John Wiley & Sons, 2006
3. Kennedy, J., Eberhart, R. C., & Shi, Y. Swarm intelligence. Morgan Kaufmann, 2001.
4. Dorigo, M., & Stützle, T. Ant colony optimization. MIT press, 2004.
5. Back, T., Fogel, D. B., Michalewicz, Z., Handbook of Evolutionary Computation. Oxford University Press, 1997.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1	1	2	2	1	3	3	2	1
CO2	3	3	3	3	3	2	2	1	2	3	2	2	3	3	1
CO3	3	3	3	3	3	2	2	1	2	3	3	2	3	3	2
CO4	2	3	3	3	3	2	1	1	2	2	3	2	3	2	1
CO5	2	2	3	3	3	2	2	1	2	3	3	3	3	3	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS373	Number of Hours/Week	3			
Semester	VII (PSE VII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	DIGITAL MARKETING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Comprehend the Fundamentals of Digital Marketing. • Develop Effective Content Marketing Strategies and Email Marketing Campaigns. • Understand and Implement Social Media Marketing Techniques and Display Marketing. • Develop Expertise in Search Engine Marketing (SEM) and Utilize Mobile Marketing. • Apply Analytics to Optimize Digital Marketing Strategies. 						
UNIT	TOPICS				HOURS	
I	Introduction to Digital Marketing: Fundamentals of Digital marketing & Its Significance, Traditional marketing Vs Digital Marketing, Evolution of Digital Marketing. Opportunities for building Brand Website – Planning and Creation – Marketing strategies for the digital world-latest practices.				9	
II	Content and Email Marketing: Content Marketing: Step-by-step Content Marketing, Developing a content marketing strategy. Email Marketing: Types of Emails in email marketing- Email Automation-Integrating Email with social media and Mobile.				9	
III	Social Media Marketing and Display Marketing: Social Media Marketing- Social Media Marketing Channels-Leveraging media for brand conversations and buzz. Successful/benchmark social media campaigns. Display Advertising: Working of Display Advertising; Benefits and challenges; Overview of Display ad Process.				9	
IV	Search Engine and Mobile Marketing: Introduction of SEM: How Search Engine works - SEM components. Search Engine Optimization: Keyword Strategy- SEO Strategy- SEO success factors-On Page Techniques-Off Page Techniques -PPC advertising. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.				9	
V	Digital Innovation and Trends: The contemporary digital revolution, digital transformation and Channel Attribution, security and privatization issues with digital marketing. Analytics- Ad-words, Email, Mobile, social media, Web Analytics – Changing your strategy based on analysis- Recent trends in Digital marketing.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the Fundamentals and Evolution of Digital Marketing
CO2	Develop and Implement Content and Email Marketing Techniques.
CO3	Leverage Social Media Marketing for Brand Growth and Gain Expertise in Display Advertising.
CO4	Develop Skills in Search Engine Marketing (SEM) and Utilize Mobile Marketing Techniques.
CO5	Understand Digital Innovation and Emerging Trends

Text Books:

1. Mouty Maiti: Internet Marketing, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).
4. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).
5. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
3. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	2	2	1	3	2	1	3	2	2	1
CO2	2	2	2	1	3	2	3	2	2	3	2	2	3	3	2
CO3	3	2	3	2	1	2	3	2	3	3	2	3	2	3	3
CO4	3	2	3	3	3	3	2	3	3	3	3	3	3	3	2
CO5	3	3	3	2	3	3	3	2	3	3	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS374	Number of Hours/Week	3			
Semester	VII (PSE VIII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	PATTERN RECOGNITION			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To introduce the fundamental concepts of pattern recognition and machine learning. • To explore various feature extraction, classification, and clustering techniques. • To understand probabilistic models and deep learning approaches in pattern recognition. • To apply pattern recognition techniques to real-world problems. • To evaluate the performance of pattern recognition models using standard metrics. 						
UNIT	TOPICS				HOURS	
I	Introduction to Pattern Recognition Definition and applications of Pattern Recognition-Design cycle of pattern recognition systems-Supervised vs. Unsupervised learning-Probability and statistical decision theory-Bayes Decision Theory and minimum error classification				9	
II	Feature Extraction and Dimensionality Reduction Feature types: Geometric, statistical, and symbolic features-Feature extraction techniques -PCA, LDA, ICA-Feature selection and ranking-Discriminant analysis and manifold learning-Introduction to Kernel methods				9	
III	Classification Techniques Nearest Neighbor Classifier (KNN)-Bayesian Classifiers -Naïve Bayes, Gaussian Bayes-Decision Trees and Random Forests-Support Vector Machines (SVM) Deep learning-based classification -CNNs, RNNs				9	
IV	Clustering and Unsupervised Learning Partition-based clustering: K-Means, K-Medoids-Hierarchical clustering: Agglomerative and Divisive-Density-based clustering: DBSCAN-Gaussian Mixture Models (GMM) and Expectation-Maximization (EM)-Self-Organizing Maps (SOM) and Fuzzy clustering				9	
V	Applications of Pattern Recognition Optical Character Recognition (OCR)-Speech and Face Recognition-Biometric Authentication -Fingerprint, Iris, Palm-print-Image-based object detection and recognition-Real-time applications in healthcare, finance, and security				9	

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the fundamentals of pattern recognition and its real-world applications.
CO2	Perform feature extraction and dimensionality reduction techniques.
CO3	Implement classification techniques for supervised learning problems.
CO4	Apply clustering algorithms for unsupervised learning and pattern discovery.
CO5	Develop and evaluate pattern recognition models for industrial applications.

Text Books:

1. **Pattern Recognition and Machine Learning** – Christopher M. Bishop
2. **Pattern Classification** – Richard O. Duda, Peter E. Hart, and David G. Stork
3. **Introduction to Machine Learning** – Ethem Alpaydin

Reference Books:

1. **Computer Vision: Algorithms and Applications** – Richard Szeliski
2. **Deep Learning** – Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	1	2	1	3	3	2	2	3
CO2	3	3	3	3	3	2	2	2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS375	Number of Hours/Week	3			
Semester	VII (PSE VIII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	AUGMENTED INTELLIGENCE			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the fundamental concepts and evolution of augmented intelligence and its applications in various industries. • Analyze the enabling technologies such as machine learning, natural language processing, and computer vision for building augmented intelligence systems. • Apply principles of human-computer interaction and collaborative systems to design user-friendly augmented intelligence solutions. • Evaluate different architectures and methodologies for developing, deploying, and maintaining augmented intelligence systems. • Create innovative augmented intelligence solutions by leveraging emerging technologies and addressing ethical considerations. 						
UNIT	TOPICS				HOURS	
I	Introduction to Augmented Intelligence Overview and Evolution - Definition, history, and evolution of augmented intelligence - Human-Centric AI - Difference between AI and augmented intelligence; role in enhancing human decision-making. Applications: Healthcare, finance, education, customer service, and other industries - Ethics and Challenges: Ethical considerations, biases in AI, data privacy, and security issues.				9	
II	Enabling Technologies for Augmented Intelligence Machine Learning (ML) - Supervised, unsupervised, and reinforcement learning - Natural Language Processing (NLP) - Text processing, sentiment analysis, and conversational AI - Computer Vision: Image recognition, object detection, and augmented reality - Data Analytics: Big data technologies, real-time analytics, and predictive modeling.				9	
III	Human-Machine Collaboration Human-Computer Interaction (HCI) - Principles of HCI, user experience (UX) design, and usability - Collaborative Systems - Tools and platforms for human-machine collaboration - Cognitive Augmentation: Enhancing cognitive tasks with AI tools - Case Studies- Examples of successful human-machine collaboration in different sectors.				9	

IV	Designing and Developing Augmented Intelligence System System Architecture - Components and architecture of augmented intelligence systems - Data Collection and Integration - Data sources, data integration, and preprocessing - Model Training and Optimization: Training ML models, hyperparameter tuning, and performance evaluation -Deployment and Maintenance: Deploying AI systems, monitoring performance, and continuous improvement.	9
V	Future Trends and Innovations Emerging Technologies - Trends in AI, ML, IoT, and edge computing - Augmented Intelligence in Industry 4.0 - Role in smart manufacturing, automation, and supply chain optimization - Ethical AI - Ensuring fairness, accountability, transparency, and inclusivity - Future Directions: Research directions, potential innovations, and societal impact.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the concept of augmented intelligence and its distinction from traditional AI, along with its applications and ethical challenges.
CO2	Demonstrate the use of machine learning, natural language processing, and computer vision in the development of augmented intelligence systems.
CO3	Design human-centric AI solutions that enhance human decision-making through effective human-machine collaboration.
CO4	Evaluate the performance of augmented intelligence systems, focusing on model optimization, data integration, and system architecture.
CO5	Develop forward-thinking augmented intelligence solutions, incorporating emerging technologies and ethical practices to address future challenges.

Text Book:

1. Jena OP, editor. Augmented Intelligence: Deep Learning, Machine Learning, Cognitive Computing, Educational Data Mining. Bentham Science Publishers; 2022 Jul 29.

Reference Book:

1. Geroimenko V, editor. Augmented Reality and artificial intelligence: the Fusion of advanced technologies. Springer Nature; 2023 Apr 29.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	1	2	0	0	0	3	2	0	0	0
CO2	0	0	0	0	1	2	0	0	0	2	2	3	0	1	2
CO3	1	2	0	0	1	1	2	0	0	0	1	1	0	0	3
CO4	2	0	0	0	1	3	0	0	0	2	1	0	2	0	1
CO5	3	0	0	0	0	1	2	0	0	3	0	0	1	2	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS376	Number of Hours/Week	3			
Semester	VII (PSE VIII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	COMPUTATIONAL AND SYSTEMS BIOLOGY			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Explain fundamental concepts of computational and systems biology, including modeling, simulation, and analysis of biological systems. (Understanding) • Utilize computational tools and programming languages (e.g., Python, R, MATLAB) to analyze biological datasets and develop predictive models. (Applying) • Deconstruct complex biological networks and pathways to identify key components, interactions, and emergent behaviors. (Analyzing) • Critically assess computational models and algorithms used in systems biology, comparing their effectiveness and limitations in biological research. (Evaluating) • Design and implement a computational model to simulate a biological process, integrating experimental data for validation. (Creating). 						
UNIT	TOPICS				HOURS	
I	Introduction to Computational and Systems Biology Overview of Systems Biology- Definitions, scope, and importance, Computational Approaches in Biology- Bioinformatics vs. Systems Biology, Molecular Networks- Genetic, protein, and metabolic networks, Mathematical Foundations- Graph theory, probability, and dynamical systems, High-Throughput Data- Genomics, transcriptomics, and proteomics, Tools & Software- Introduction to MATLAB, Python (Biopython, NumPy, SciPy), and R				9	
II	Mathematical and Computational Modeling of Biological Systems Deterministic Models- Ordinary Differential Equations (ODEs) for gene regulation and metabolic pathways, Stochastic Models- Master equation, Gillespie algorithm for stochastic gene expression, Boolean Networks and Logical Models- Gene regulatory networks modeling, Parameter Estimation & Sensitivity Analysis- Optimization techniques (Gradient Descent, MCMC), Simulating Biological Systems- MATLAB/Python-based simulations				9	
III	Omics Data Analysis and Machine Learning in Biology Next-Generation Sequencing (NGS) Data Analysis- RNA-Seq, ChIP-Seq, and variant calling, Gene Expression Analysis- Microarrays, clustering, and PCA, Machine Learning in Biology- Classification and clustering of biological data, Deep Learning Applications- Convolutional Neural Networks (CNNs) for bioimage analysis, Network Inference- Bayesian networks, correlation networks, and network reconstruction				9	

IV	Biological Networks and Systems Dynamics Types of Biological Networks- Protein-protein interaction (PPI), gene regulatory, metabolic pathways, Network Analysis Techniques- Degree distribution, centrality measures, clustering, Dynamic Network Models- Time-series analysis of networks, Systems Biology Applications- Drug-target interaction prediction, disease modeling, Case Studies- Cancer systems biology, metabolic network modeling	9
V	Synthetic Biology and Computational Drug Discovery Synthetic Biology Principles- Engineering biological circuits, CRISPR-based design, Computational Drug Discovery- Molecular docking, structure-based drug design, Pharmacokinetics and Pharmacodynamics (PK/PD) Modeling, Multi-Omics Integration- Combining genomics, transcriptomics, and metabolomics, Future Trends in Computational and Systems Biology- AI in biology, single-cell analysis, personalized medicine	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand fundamental concepts in computational and systems biology, including biological data analysis, modeling, and simulation.
CO2	Apply computational techniques and bioinformatics tools to analyze genomic, proteomic, and metabolomic data.
CO3	Analyze biological networks and systems dynamics using mathematical and computational models.
CO4	Evaluate different machine learning and statistical methods for biological data interpretation and decision-making.
CO5	Create computational models and simulations to study complex biological systems and predict biological behavior.

Text Books:

1. Raman K. An introduction to computational systems biology: systems-level modelling of cellular networks. Chapman and Hall/CRC; 2021 May 30.

Reference Books:

1. Huang T, MARTON, Computational Systems Biology. Huang T, editor. Springer Science+ Business Media, LLC, part of Springer Nature; 2018.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	0	0	0	0	0	0	0	0	0	3	2	3
CO2	0	2	0	0	0	0	1	0	0	0	0	2	2	1	3
CO3	3	1	2	0	0	0	0	0	0	0	0	0	1	2	1
CO4	0	0	2	0	1	0	0	0	3	0	0	0	1	1	0
CO5	0	0	1	0	0	0	0	0	0	1	0	1	2	2	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS271	Number of Hours/Week	2			
Semester	VII	Max. Marks	100			
Year	IV	Credits	1			
Core Course						
Course Title	HIGH PERFORMANCE COMPUTING LAB			L	T	P
				0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To provide an understanding of the fundamental concepts of parallel programming and computing architectures. • To explore the principles and techniques of high-performance computing and cluster architectures. • To enable students to work with high-speed networks and efficient resource management systems in cluster environments. • To introduce CUDA programming for parallel processing and develop skills in shared memory and multi-GPU programming. • To familiarize students with parallel programming tools like OpenMP for efficient parallel execution. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Implementation of matrix vector multiplication using OPENMP. 2. Development of parallel matrix addition using MPI. 3. Configuration of cluster setup and testing communication. 4. Implementation of fault detection using heartbeat mechanisms and develop failover and recovery strategies in a cluster. 5. Simulation of resource management in cluster environments. 6. Development of CUDA program for vector addition. 7. Development of CUDA program with shared memory. 8. Implementation of load balancing algorithms. 9. Parallelization of numerical integration using OPENMP. 10. Implementation and testing of different network topologies. 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Demonstrate knowledge of parallel computing, architectures, and processing techniques like SIMD and pipelined processors.
CO2	Analyze the architecture and components of scalable parallel and cluster computing systems
CO3	Implement resource management, job scheduling, and fault-tolerant mechanisms in high-speed cluster networks
CO4	Develop CUDA-based parallel programs utilizing shared memory, thread cooperation, and multi-GPU support
CO5	Apply OpenMP and other parallel programming models to create efficient and scalable solutions for computational problems

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	3	2	3	1	3	2	1	3	2	3
CO2	2	3	1	2	3	2	3	1	3	2	3	2	1	3	2
CO3	1	2	3	2	1	3	2	3	2	3	1	3	2	3	1
CO4	3	2	1	3	2	1	3	2	3	1	2	3	3	1	2
CO5	2	3	2	1	3	2	1	3	2	3	2	1	3	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Semester VIII

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS381	Number of Hours/Week	3			
Semester	VIII (PSE IX)	Max.Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	GAME THEORY			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand fundamental concepts, types of games, Nash equilibrium, and strategic decision-making. • To analyze sequential games, backward induction, Subgame Perfect Equilibrium, and applications in auctions. • To study repeated games, Bayesian Nash Equilibrium, mechanism design, and auction theory. • To explore evolutionarily stable strategies, replicator dynamics, learning in games, and AI applications. • To learn cooperative game solutions, Shapley value, market design, and real-world applications in networks and economics. 						
UNIT	TOPICS				HOURS	
I	Introduction to Game Theory and Strategic Form Games Definition of Game Theory and Strategic Interactions - Types of Games: Cooperative vs Non-Cooperative, Zero-Sum vs Non-Zero-Sum, Static vs Dynamic - Key Concepts: Strategies, Payoff Matrix, Utility Functions, Nash Equilibrium: - Applications of Game Theory in Computer Science and Engineering.				9	
II	Strategic Form Games and Nash Equilibrium Representation of Strategic Form Games - Dominant and Dominated Strategies - Nash Equilibrium: Existence and Proofs - Mixed Strategy Nash Equilibrium - Best Response Functions and their Role in Game Solutions - Applications: Network Design, Distributed Systems, Algorithms in Game Theory				9	
III	Extensive Form Games and Sequential Decision Making Representation of Sequential Games using Game Trees - Perfect vs Imperfect Information in Games - Strategies in Dynamic Games: Commitment, Bluffing, and Strategic Moves - Applications: AI in Game Playing, Path finding Algorithms, Decision Making in Robotics.				9	
IV	Cooperative Game Theory and Algorithmic Applications Cooperative vs Non-Cooperative Games - The Core of a Game and Shapley Value - Coalition Formation and Cost-Sharing in Multi-Agent Systems - Applications in Distributed Computing and Resource Allocation				9	

V	Evolutionary Game Theory and Mechanism Design Evolutionary Stable Strategies (ESS) - Adaptive Strategies and Learning in Games - Mechanism Design and Auction Theory - Applications in Traffic Management, Wireless Networks, and Blockchain Systems.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand fundamental game theory concepts, including types of games and strategic interactions.
CO2	Represent and solve sequential games using extensive form and backward induction.
CO3	Analyze repeated games and determine long-term strategic interactions using the Folk Theorem.
CO4	Explore learning-based approaches and computational complexity in game theory.
CO5	Apply game theory concepts to real-world applications in economics, networks, and cybersecurity.

Text Books:

1. M. J. Osborne, An Introduction to Game Theory, 3rd ed. Oxford, U.K.: Oxford Univ. Press, 2019.
2. R. Gibbons, A Primer in Game Theory, 2nd ed. Pearson Education, 2020.
3. R. B. Myerson, Game Theory: Analysis of Conflict, 3rd ed. Cambridge, MA: Harvard Univ. Press, 2018.

Reference Books:

1. D. Fudenberg and J. Tirole, Game Theory, 3rd ed. Cambridge, MA: MIT Press, 2020.
2. Y. Shoham and K. Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, 3rd ed. Cambridge, U.K.: Cambridge Univ. Press, 2022

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	1	2	1	2	2	2
CO2	3	3	3	3	2	1	1	1	2	1	2	1	2	2	2
CO3	3	3	2	3	2	1	2	1	2	1	2	1	3	3	3
CO4	3	3	2	3	3	1	2	1	2	1	2	1	3	3	3
CO5	3	3	3	3	3	2	3	2	3	2	2	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS382	Number of Hours/Week	3			
Semester	VIII (PSE IX)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	SEMANTIC WEB TECHNOLOGY			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To learn Web Intelligence. • To learn Knowledge Representation for the Semantic Web. • To learn Ontology Engineering. • To learn Semantic Web Applications, Services and Technology. • Apply Semantic Web Technologies in Real-World Applications 						
UNIT	TOPICS				HOURS	
I	Introduction: Introduction to Semantic Web, the Business Case for the Semantic Web, XML and Its Impact on the Enterprise.				9	
II	Web Services: Uses, Basics of Web Services, SOAP, UDDI, Orchestrating Web Services, Securing Web Services, Grid Enabled and Semantic Web of Web Services				9	
III	Resource Description Framework: Features, Capturing Knowledge with RDF. XML Technologies: XPath, The Style Sheet Family: XSL, XSLT, and XSL FO, XQuery, XLink, XPointer, XInclude, XMLBase, XHTML, XForms, SVG				9	
IV	Taxonomies and Ontologies: Overview of Taxonomies, Defining the Ontology Spectrum, Topic Maps, Overview of Ontologies, Syntax, Structure, Semantics, and Pragmatics, Expressing Ontologies Logically, Knowledge Representation.				9	
V	Semantic Web Application: Semantic Web Services, e-Learning, Semantic Bioinformatics, Enterprise Application Integration, Knowledge Base. Semantic Search Technology: Search Engines, Semantic Search, Semantic Search Technology, Web Search Agents, Semantic Methods, Latent Semantic Index Search, TAP, Swoogle.				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the characteristics of Semantic Web.
CO2	Apply SOAP and UDDI to web services
CO3	Handle multiple web services using Orchestration
CO4	Create documents using XML
CO5	Construct and use Ontologies

Text Books:

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley Interscience.

Reference Books:

1. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, Wiley Publishing
2. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J.Davies, R.Studer, P.Warren, John Wiley & Sons
3. Semantic Web and Semantic Web Services - Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group)

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	1	2	2	3	2	3	2	1	1
CO2	3	3	3	3	3	2	2	2	3	2	2	2	3	2	3
CO3	3	3	2	2	3	2	3	3	3	3	3	3	2	2	2
CO4	2	3	3	2	3	2	2	2	2	3	2	3	2	3	2
CO5	3	3	2	3	3	3	3	3	3	3	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code			BTCS
Course Code	25BTCS383	Number of Hours/Week			3
Semester	VIII (PSE IX)	Max. Marks			100
Year	IV	Credits			3
Programme Specific Elective					
Course Title	GPU COMPUTING			L	T
				3	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours					
COURSE OBJECTIVES:					
The main learning objective of this course is to prepare the students to:					
<ul style="list-style-type: none"> • Understand the architecture and programming model of modern GPUs. (Remembering, Understanding) • Learn parallel computing concepts and how to optimize performance using GPU acceleration. (Understanding, Applying) • Develop CUDA-based parallel programs to solve computationally intensive problems. (Applying, Analyzing) • Analyze the efficiency of parallel algorithms and their execution on GPU hardware. (Analyzing, Evaluating) • Optimize and implement real-world applications using GPU computing techniques. (Evaluating, Creating). 					
UNIT	TOPICS				HOURS
I	Introduction to GPU Computing Evolution of parallel computing, Introduction to GPUs and their architecture, CPU vs GPU- Parallelism and Performance Benefits, Overview of CUDA and OpenCL, Applications of GPU computing in scientific computing, AI, and gaming.				9
II	CUDA Programming Basics Introduction to CUDA programming model, CUDA architecture- Threads, Blocks, and Grids, Memory hierarchy- Global, Shared, and Local memory, CUDA programming- Kernel functions and launching mechanisms, Synchronization and performance considerations.				9
III	Advanced CUDA and Optimization Memory optimization techniques, CUDA streams and concurrency, Use of shared memory for performance improvement, Profiling and debugging CUDA applications, Introduction to Thrust library.				9
IV	OpenCL and Alternative GPU Frameworks OpenCL architecture and execution model, Writing OpenCL kernels and host programs, Comparing CUDA and OpenCL, Introduction to Vulkan and Metal for GPU computing, Multi-GPU programming and interoperability.				9

V	Applications and Emerging Trends GPU acceleration in Deep Learning and AI (TensorFlow, PyTorch), Scientific computing and high-performance simulations, Real-time rendering and ray tracing, Introduction to Quantum Computing with GPUs, Future trends in GPU architectures.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Describe the fundamentals of GPU architecture and parallel computing models.
CO2	Explain the CUDA programming model and its application in GPU computing.
CO3	Implement CUDA programs for solving parallelizable problems.
CO4	Evaluate the performance of GPU-accelerated programs and optimize computation efficiency.
CO5	Design and develop GPU-based solutions for real-world scientific and engineering applications.

Text Books:

1. Bandyopadhyay, Avimanyu. Hands-On GPU Computing with Python: Explore the capabilities of GPUs for solving high performance computational problems. Packt Publishing Ltd, 2019.

Reference Books:

1. Tuomanen, Brian. Hands-On GPU Programming with Python and CUDA: Explore high-performance parallel computing with CUDA. Packt Publishing Ltd, 2018.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	2	0	2	0	0	1	0	0	0	1	0	0	0
CO2	1	2	0	0	0	1	2	0	3	0	1	2	2	1	3
CO3	2	0	0	0	0	0	2	0	0	0	0	1	2	2	1
CO4	2	2	2	0	1	2	0	0	3	0	0	1	1	0	0
CO5	2	0	2	0	0	1	0	1	0	0	0	0	0	2	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS384	Number of Hours/Week	3			
Semester	VIII (PSE X)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	RESOURCE CONSTRAINED ARTIFICIAL INTELLIGENCE			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand advanced concepts in resource constrained AI • To formulate artificial intelligence model with knowledge representation • To learn problem solving approaches through decision processes • To develop resource constrained AI model with the help of concepts such as searches, knowledge representation etc 						
UNIT	TOPICS				HOURS	
I	Introduction to AI and state space searches Introducing the structure and scope of the course; Brief introduction and history of AI; state space searches; informed and uninformed searches; local searches; adversarial searches;				9	
II	Knowledge representation in AI Different knowledge representation systems; syntax; semantics; forward chaining; Resolution; Reduction in satisfiability problems; SAT solvers; DPLL algorithms; Walk SAT algorithms				9	
III	Resource constrained AI Resource constraints – computational limit, storage limits, lack of data; resource constrained classification; resource allocation optimization problem; AI in low power edge devices; asymmetric exponent method; neural networks inference optimization – pruning, quantization, dynamic parameter limitation				9	
IV	Cluster analysis and hardware-aware execution Sparse partitioning around medoids; clustering of polygonal curves and time series; data aggregation for hierarchical clustering; matrix factorization with binary constraints; FPGA-based backpropagation engine for feedforward neural networks; processor specific code transformation; extreme multicore classification; optimization of ML on modern multicore systems				9	
V	Tiny Machine Learning ML to the edge devices; real time processing; instant decision making; local inference; reduction in data transfer; offline operation; cost reduction; privacy and security; applications – telematics devices, fraud detection, property risk analysis, retail operation and inventory management; Tiny ML vs IoT				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Describe the history behind artificial intelligence
CO2	Illustrate AI concepts in resource constrained environment
CO3	Demonstrate resource constrained model for edge devices
CO4	Infers difficulties in incorporating resource constrained ML
CO5	Develop tiny ML model for existing problems

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009
2. Katharina Morik and Peter Marwedel. Machine Learning under Resource constraints. De Gruyter. 2022

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	0	3	0	1	0	3	2	0	0
CO2	3	2	3	3	0	2	0	0	0	2	0	1	0	3	3
CO3	3	1	2	2	0	2	0	0	0	2	1	1	1	1	3
CO4	3	1	2	2	0	2	0	0	0	2	1	1	0	1	2
CO5	2	2	3	3	3	1	3	3	3	2	2	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS385	Number of Hours/Week	3			
Semester	VIII (PSE X)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	WEB DATA MINING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- **Understand Data Mining Concepts and Functionalities:** Learn the foundational principles of data mining, including pre-processing techniques like cleaning, integration, reduction, and discretization, along with the architecture and classification of data mining systems.
- **Explore Association Rule Mining:** Study efficient algorithms for frequent item set mining, discover various types of association rules, and perform correlation and constraint-based analysis for meaningful data insights.
- **Master Classification and Prediction Techniques:** Analyze methods like decision trees, Bayesian classifiers, backpropagation, support vector machines, and ensemble techniques to develop accurate classification and prediction models.
- **Analyze Clustering Techniques and Outlier Detection:** Examine clustering methods, such as partitioning, hierarchical, density-based, and model-based techniques, and apply these methods to high-dimensional data and outlier analysis.
- **Mine Complex Data Types:** Explore multidimensional analysis and mining techniques for complex data objects, including spatial, multimedia, text, and web data, for advanced data mining applications.

UNIT	TOPICS	HOURS
I	Introduction: Basic Data Mining Tasks – Data Mining Versus Knowledge Discovery in Data Bases – Data Mining Issues – Data Mining Matrices – Social Implications of Data Mining – Data Mining from Data Base Perspective.	9
II	Neural Networks: Data Mining Techniques – a Statistical Perspective on data mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms.	9
III	Fuzzy Systems Classification: Introduction – Statistical – Based Algorithms – Distance Based Algorithms – Decision.	9
IV	Genetic Algorithm: Clustering Tree – Based Algorithms – Neural Network Based Algorithms – Rule Based Algorithms – Combining Techniques: Introduction – Similarity and Distance Measures – Outliers – Hierarchical Algorithms. Partitioned Algorithms.	9

V	Hybrid Systems: Association Rules: Introduction - Large Item Sets – Basic Algorithms – Parallel & Distributed Algorithms – Comparing Approaches – Incremental Rules – Advanced Association Rules .Techniques – Measuring the Quality of Rules.	9
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Course Outcomes

Upon successful completion of this course, the student will be able to:

CO1	Understanding Data Mining Techniques and their Applications
CO2	Mastery of Machine Learning Algorithms for Data Mining
CO3	Critical Analysis of Data Mining Issues and Social Implications
CO4	Expertise in Hybrid and Combined Data Mining Approaches
CO5	Application of Data Mining Techniques for Real-World Problems

Text Book:

1. Jiawei Han & Micheline Kamber, Data Mining Concepts & Techniques, 2011, 3rd Edition.

Reference Books:

1. Margaret H. Dunham, Data Mining Introductory and Advanced Topics, Pearson, Education 2003.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	1	3	2	2	1	3	2	2
CO2	3	3	3	2	3	3	2	2	3	3	3	2	3	3	3
CO3	2	2	3	3	2	3	3	2	3	2	3	2	2	3	2
CO4	3	3	2	3	3	3	3	3	3	3	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech CSE	Programme Code	BTCS			
Course Code	25BTCS386	Number of Hours/Week	3			
Semester	VIII (PSE X)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	GENERATIVE AI			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To explore classical and advanced concepts in generative AI • To equip different generative models in modern AI • To construct an existing problem into standard machine learning paradigm • To dealt with generative models for scalable machine learning. 						
UNIT	TOPICS				HOURS	
I	Introduction Introduction – artificial intelligence, machine learning, deep learning; intelligent agent and its environment; state space searches; informed and informed searches; adversarial searches; supervised and unsupervised learning; discriminative AI – classification, regression, clustering, dimensionality reduction, reinforcement learning;				9	
II	Generative AI Data generation; data transformation; data enrichment; boltzmann machines; gibbs sampling; restricted boltzmann machines; deep belief networks; deep boltzmann machines; autoencoders; varioational autoencoders; generative adversarial networks (GANs)				9	
III	Modern Generative AI Nash equilibrium; GANs applications – generating realistic images, image to image translation, super resolution, data augmentation, style transfer; contrastive language-image pretraining (CLIP); diffusion models; stable diffusion Tech; midjourney; autoregression;				9	
IV	Large Language Models Markov chains; rule based text generation; recurrent neural networks; long short-term memory networks; N-gram models; seq2seq; GAN for text generation; Transformers; tokenization; pretraining and fine tuning LLMs; prompt engineering; GPTs				9	
V	Ethical concerns and social implications Bias and fairness in AI generated data; data privacy, safety, security; mis information and misuse of generative AI; generative AI’s impact on jobs and industry; dependency on AI; environmental concerns; AI oversight and self regulations; multi tasking and multi sensory generative AI				9	

COURSE OUTCOMES:

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

CO1	Infers classical generative algorithms in AI
CO2	Execute classical ML approaches into generative machine learning
CO3	Implement generative models for ML applications
CO4	Validate the ML models to improve the performance
CO5	Develop an innovative generative AI model for existing problems

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009
2. Martin musiol. Generative AI. Wiley publications. 2024.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null