



ST. JOSEPH'S
COLLEGE OF ENGINEERING
AND TECHNOLOGY,
- PALAI -
AUTONOMOUS

Choondacherry P.O., Pala, Kottayam - 686579
Kerala, India



SYLLABUS

B.Tech.

COMPUTER SCIENCE AND ENGINEERING

2024 SCHEME

SEMESTER 5 & 6

FIFTH SEMESTER (July-December)

Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure					Total Marks		Credits	Hrs./ Week
						L	T	P	R	SS	CIE	ESE		
1	A	24SJPCST501	PC	PC	Computer Networks	3	1	0	0	5	40	60	4	4
2	B	24SJPCST502	PC	PC	Design and Analysis of Algorithms	3	1	0	0	5	40	60	4	4
3	C	24SJPCST503	PC	PC	Machine Learning	3	0	0	0	4.5	40	60	3	3
4	D	24SJPCST504	PC- PBL	PB	Microcontrollers	3	0	0	1	5.5	60	40	4	4
5	E	24SJPECST52N	PE	PE	PE-2	3	0	0	0	4.5	40	60	3	3
6	I*	24SJCHUM506	HMC	IC	Constitution of India (MOOC)	-	-	-	-	2	-	-	1	-
7	L	24SJPCCSL507	PCL	PC	Networks Lab	0	0	3	0	1.5	50	50	2	3
8	Q	24SJPCCSL508	PCL	PC	Machine Learning Lab	0	0	3	0	1.5	50	50	2	3
9	R/M/H		VAC		Remedial/Minor/Honours Course	3	1	0	0	5			4*	4*
	S5/S6	Industrial Visit (Maximum 6 Days are permitted, Not exceeding more than 4 Working Days) /Industrial Training												
Total										30 / 35			23/27*	24/28*

***No Grade Points will be awarded for the MOOC course and I slot course.**

Industrial Training:

Students who are not participating in the industrial visit must attend industrial training during that period.

PROGRAM ELECTIVE 2: 24SJPECST52N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
E	24SJPECST521	Software Project Management	3-0-0-0	3	3
	24SJPECST522	Artificial Intelligence	3-0-0-0		3
	24SJPECST523	Data Analytics	3-0-0-0		3
	24SJPECST524	Data Compression	3-0-0-0		3
	24SJPECST526	Digital Signal Processing	3-0-0-0		3
	24SJPECST527	Computer Graphics and Multimedia	3-0-0-0		3
	24SJPECST528	Advanced Computer Architectures	3-0-0-0		3
	24SJPECST520	Industry Elective	3-0-0-0		3
	24SJPECST525	Data Mining	3-0-0-1		5/3
	24SJPECST529	Advanced Graph Algorithms	3-0-0-1		5/3

SIXTH SEMESTER (January-June)

Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure					Total Marks		Credits	Hrs/Week
						L	T	P	R	SS	CIE	ESE		
1	A	24SJPCST601	PC	PC	Compiler Design	3	1	0	0	5	40	60	4	4
2	B	24SJPCST602	PC	PC	Advanced Computing Systems	3	0	0	0	4.5	40	60	3	3
3	C	24SJPECST63N	PE	PE	PE-3	3	0	0	0	4.5	40	60	3	3
4	D	24SJPCST604	PC-PBL	PB	Fundamentals of Cyber Security	3	0	0	1	5.5	60	40	4	4
5	F	24SJGAEST605	ESC	GC	Design Thinking and Product Development (Group Specific Syllabus)	2	0	0	0	3	40	60	2	2
6	O#	24SJOE--T61N /24SJIE--T61N	OE/ILE	OE	OE/ILE-1	3	0	0	0	4.5	40	60	3	3
7	L	24SJPCCSL607	PCL	PC	Systems Lab	0	0	3	0	1.5	50	50	2	3
8	P	24SJPCSP608	PWS	PC	Mini Project: Socially Relevant Project	0	0	0	3	3	50	50	2	3
9	R/ M/ H		VAC		Remedial/Minor/Honours Course	3	0	0	0	4.5			3*	3*
S5/ S6		Industrial Visit (Maximum of 6 Days are permitted, Not exceeding more than 4 Working Days) /Industrial Training												
Total										32 / 36		23/26*	25/28*	

Open Electives/Industry Linked Electives are applicable to CS Students

Industrial Training:

Students who are not participating in the industrial visit must attend industrial training during that period.

PROGRAM ELECTIVE 3: 24SJPECST63N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
C	24SJPECST631	Software Testing	3-0-0-0	3	3
	24SJPECST632	Deep Learning	3-0-0-0		3
	24SJPECST633	Wireless and Mobile Computing	3-0-0-0		3
	24SJPECST634	Advanced Database Systems	3-0-0-0		3
	24SJPECST636	Digital Image Processing	3-0-0-0		3
	24SJPECST637	Fundamentals of Cryptography	3-0-0-0		3
	24SJPECST638	Quantum Computing	3-0-0-0		3
	24SJPECST639	Social Engineering and Human Centric Threats	3-0-0-0		3
	24SJPECST635	Cloud Computing	3-0-0-1		5/3
	24SJPECST630	Mobile Application Development	3-0-0-1		5/3

Open Electives offered to other branches
OPEN ELECTIVE 1: 24SJOECST61N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
O	24SJOECST611	Data Structures	3-0-0-0	3	3
	24SJOECST612	Data Communication	3-0-0-0		3
	24SJOECST613	Foundations of Cryptography	3-0-0-0		3
	24SJOECST614	Machine Learning for Engineers	3-0-0-0		3
	24SJOECST615	Object Oriented Programming	3-0-0-0		3



SEMESTER S5

COMPUTER NETWORKS

(Common to CS/AD/CA)

Course Code	24SJPCST501	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the core concepts of computer networking.
2. To develop a big picture of the internetworking implementation on Linux-based systems.
3. To impart an overview of network management concepts.

Module No.	Syllabus Description	Contact Hours
1	Overview of the Internet, Protocol layering (Book 1 Ch 1) Application Layer: Application-Layer Paradigms, Client-server applications - World Wide Web and HTTP, FTP. Electronic Mail, DNS. Peer-to-peer paradigm - P2P Networks, Case study: BitTorrent (Book 1 Ch 2)	6
2	Transport Layer: Services, Protocols, UDP, TCP (Book 1 Ch 3). <i>Hands-on: Sockets Introduction, Elementary TCP Sockets, TCP Client/Server Example, I/O Multiplexing: The select and poll Functions (Book 2 Ch 3 to 6), Elementary UDP Sockets (Book 2 Ch 8), Advanced I/O Functions (Book 2 Ch 14)</i> Network Layer: Introduction, Network-layer protocols, IP Addressing, Unicast routing, Multicast routing - Multicasting Basics, Intra domain and inter-domain routing, Next generation IP (Book 1 Ch 4), Congestion Control, Quality of Service (Book 1 Ch 8) <i>Hands-on: Linux Kernel Implementation of Routing Table and Caches, Routing Cache Implementation Overview, Adding new entry in the Routing Table using ip command (Book 3 Ch 14)</i>	20
3	Data-Link Layer: Data link control (DLC), Flow Control, Error Control, Multiple access protocols (MAC), Link-layer addressing, Ethernet protocol, Connecting devices (Book 1 Ch 5) Wireless LANs, Mobile IP (Book 1 Ch 6) <i>Hands-on: Datalink Provider Interface, SOCK_PACKET and PF_PACKET (Book 2 Ch 29)</i>	
4	SNMP, ASN.1 (Book 1 Ch 9) Physical Layer: Data and signals, Digital transmission, Analog transmission, Bandwidth utilization, Transmission media (Book 1 Ch 7)	6

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the internetworking design in terms of protocol stack and the role of various application layer protocols	K2
CO2	Illustrate the functions of the transport layer from connectionless and connection-oriented perspectives	K3
CO3	Identify how the network layer achieves host-to-host connectivity and caters to the diverse service requirements of the host applications	K3
CO4	Explain the nuances of the data link layer design and demonstrate the various data link link layer protocols	K3
CO5	Describe the fundamental characteristics of the physical layer and understand how the physical layer supports the functionalities of the top layers	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓									✓
CO2	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓						✓
CO4	✓	✓		✓							✓
CO5	✓	✓									✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks: A Top-Down Approach	Behrouz A Forouzan	McGraw Hill	SIE, 2017
2	Unix Network Programming, Volume 1: The Sockets Networking API	W. Richard Stevens, Andrew M. Rudoff, Bill Fenner	Pearson Education	3/e, 2004
3	TCP/IP Architecture, design, and implementation in Linux	Sameer Seth M. Ajaykumar Venkatesulu	Wiley	1/e, 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networking: A Top-Down Approach Featuring Internet	J. F. Kurose and K. W. Ross	Pearson Education	8/e, 2022
2	Computer Networks, A Systems Approach	L. L. Peterson and B. S. Davie	Morgan Kaufmann	5/e, 2011

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://nptel.ac.in/courses/106105183

SEMESTER S5

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code	24SJPCST502	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

- To gain a foundational understanding of algorithms and their analysis.
- To develop problem-solving skills using various algorithm design paradigms like divide and conquer, dynamic programming, etc.
- To understand the concepts of tractable and intractable problems, and different complexity classes (P, NP, NP-hard, NP-complete).

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Algorithms – Characteristics, Criteria for Analyzing Algorithms; Time and Space Complexity - Best, Worst, and Average Case Complexities; Asymptotic Notations- Asymptotic Notations - Big-Oh (O), Big - Omega (Ω), Big-Theta (Θ), Little-oh (o) and Little- Omega (ω) and their properties; Time and Space Complexity Calculation of simple algorithms; Analysis of Recursive Algorithms -Recurrence Equations, Solution of Recurrence Equations : Iteration Method, Recursion Tree Method, Substitution method and Master's Theorem (proof not expected)	11

2	Disjoint Sets - Disjoint set operations, Union and find algorithms, Analysis of union by rank with path compression, Connected components of a Graph; Graphs – Representations, Traversals: BFS, DFS and their analysis, Strongly Connected Components; Topological Sorting. Divide and Conquer Strategy – Control Abstraction, Merge Sort, Strassen’s Matrix Multiplication, Analysis Balanced Search Trees - AVL Trees (Insertion and deletion operations with all rotations in detail, algorithms not expected)	11
3	Greedy Strategy - Control Abstraction, Fractional Knapsack, 0/1 knapsack problem; Minimum Cost Spanning Tree – Kruskal’s and Prim’s, Analysis; Shortest Path Problem – Dijkstra’s Algorithm, Analysis; Dynamic Programming -Control Abstraction, Matrix Chain Multiplication, Analysis; All Pairs Shortest Path Algorithm - Floyd-Warshall Algorithm, Analysis; Backtracking - Control Abstraction, N – Queens Problem & Algorithm.	11
4	Branch and Bound - Control Abstraction, Travelling Salesman Problem, Algorithm; Complexity - Tractable and Intractable Problems; Complexity Classes: P, NP, NP- Hard and NP-Complete Classes; NP Completeness proof - Clique Problem and Vertex Cover Problem; Approximation algorithms - Bin Packing; Randomized Algorithms - Definitions of Monte Carlo and Las Vegas algorithms; Randomized version of Quick Sort algorithm with analysis.	11

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none">• Each question carries 9 marks.• Two questions will be given from each module, out of which 1 question should be answered.• Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Analyze any given algorithm and express its time and space complexities in asymptotic notations.	K4
CO2	Solve the recurrence equations using Iteration, Recurrence Tree, Substitution and Master's Method to compute time complexity of algorithms.	K3
CO3	Illustrate the operations of advanced data structures like AVL trees and Disjoint sets.	K3
CO4	Illustrate the representation, traversal and different operations on Graphs.	K3
CO5	Demonstrate Divide-and-conquer, Greedy Strategy, Dynamic programming, Branch-and Bound and Backtracking algorithm design techniques.	K2
CO6	Classify a problem as computationally tractable or intractable, and discuss strategies to address intractability.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓							✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓								✓
CO5	✓	✓	✓	✓							✓
CO6	✓	✓	✓	✓							✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Algorithms	T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein,	Prentice-Hall India	4/e, 2018
2	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran,	Orient Longman Universities Press	2/e, 2008
3	Computer Algorithms, Introduction to Design and Analysis	Sara Baase and Allen Van Gelder	Pearson Education	3/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Design and Analysis of Algorithms	Michael T. Goodrich Roberto Tamassia	Wiley	1/e, 2021
2	Algorithm Design	Jon Kleinberg, Eva Tardos	Pearson Education	1/e, 2005
3	Algorithms	Robert Sedgewick, Kevin Wayne	Pearson Education	4/e, 2011
4	Fundamentals of Algorithmics	Gilles Brassard, Paul Bratley	Pearson Education	1/e, 1996
5	The Algorithm Design Manual	Steven S. Skiena	Springer	2/e, 2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/106/106106131/
2	https://www.coursera.org/learn/dynamic-programming-greedy-algorithms
3	https://online.stanford.edu/courses/soe-ycaalgorithms1-algorithms-design-and-analysis-part-1
4	https://online.stanford.edu/courses/soe-yca0001-algorithms-design-and-analysis-part-2



SEMESTER 5

MACHINE LEARNING

(Common to CS/AD/CA/CC)

Course Code	24SJPCST503	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To impart the fundamentals principles of machine learning in computer and science.
2. To provide an understanding of the concepts and algorithms of supervised and unsupervised learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to ML :- Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Parameter Estimation - Maximum likelihood estimation (MLE) and maximum a posteriori estimation (MAP), Bayesian formulation. Supervised Learning :- Feature Representation and Problem Formulation, Role of loss functions and optimization Regression - Linear regression with one variable, Linear regression with multiple variables : solution using gradient descent algorithm and matrix method.	9
2	Classification - Logistic regression, Naïve Bayes, KNN, Decision Trees – ID3, Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation Evaluation measures – Classification - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC). Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.	9
3	SVM – Linear SVM, Idea of Hyperplane, Maximum Margin Hyperplane, Non-linear SVM, Kernels for learning non-linear functions Neural Networks (NN) - Perceptron, Neural Network - Multilayer feed-forward network, Activation functions, (Sigmoid, ReLU, Tanh), Back propagation algorithm.	9

4	Unsupervised Learning Clustering - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, K-means clustering Dimensionality reduction - Principal Component Analysis, Multidimensional scaling Ensemble methods - bagging, boosting; Resampling methods - Bootstrapping, Cross Validation. Practical aspects - Bias-Variance tradeoff.	9
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Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate Machine Learning concepts and basic parameter estimation methods.	K2
CO2	Demonstrate supervised learning concepts (regression, classification).	K3
CO3	Illustrate the concepts of Multilayer neural network and Decision trees	K3
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques	K3
CO5	Use appropriate performance measures to evaluate machine learning models	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓									
CO2	✓	✓		✓	✓						
CO3	✓	✓		✓	✓						
CO4	✓	✓		✓	✓						✓
CO5		✓		✓	✓				✓		

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	4/e, 2020
2	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki Wagner Meira	Cambridge University Press	1/e, 2016
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1/e, 1998

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Applied Machine Learning	M Gopal	McGraw Hill	2/e, 2018
2	Machine Learning using Python	Manaranjan Pradhan U Dinesh Kumar	Wiley	1/e, 2019
3	Machine Learning: Theory and Practice	M.N. Murty, V.S. Ananthanarayana	Universities Press	1/e, 2024

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://nptel.ac.in/courses/106106202

SEMESTER S5

MICROCONTROLLERS

(Common to CS/CC)

Course Code	24SJPBCST504	CIE Marks	60
Teaching Hours/Week (L:T:P:R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the ARM architecture and ARM-based microcontroller architecture.
2. To impart knowledge on the hardware and software components to develop embedded systems using STM32 microcontrollers.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to ARM Cortex-M Architecture:- Overview of Embedded Systems, Applications of Embedded Systems, Introduction to Embedded C, Microcontrollers vs. Microprocessors, Classification of processors, Overview of ARM Cortex-M Series, Introduction to the Cortex-M23 and Cortex-M33 processors and the Armv8-mArchitecture, ARM Core Features: Registers, Memory, and Bus Architecture, Comparison with previous generations of Cortex-M processors.	9
2	STM32 Microcontroller Overview and Peripheral Programming:- Introduction to STM32 Family, STM32U575 Features and Specifications, Power Management and Low-Power Features Libraries, Introduction to Integrated Development Environment and HAL, Writing, and Debugging Your First Program(LED Interfacing), Interfacing Seven-Segment Display, LCD Display, and Matrix Keypad, Relay Interfacing, Analog to Digital Conversion: Potentiometer, temperature sensor, LDR, Microphone, Digital to Analog Conversion: Simple DAC Output Generation, Generating a Sine Wave, Audio Signal Generation, Interrupt Handling, Timer and Counter Applications: Basic Timer Configuration, Timers as Counters, Timer-Based Real-Time Clock (RTC)	11

3	Communication Protocols and USB:- Serial port terminal Application, Serial communication (USART, I2C, SPI, CAN), Interfacing an I2C Temperature Sensor and Displaying Data on an LCD, writing to and Reading from an SPI-based EEPROM, Configuring and Implementing CAN Communication between Multiple STM32U575 Microcontrollers, Creating a USB HID Device for Keyboard / Mouse Emulation.	10
4	IoT, Wireless Communication, and RTOS:- Introduction to IoT, IoT Architecture, Protocols (MQTT, CoAP), IoT Security Principles and Common Threats Wireless Communication: Interfacing GSM (Call, SMS, Internet), Bluetooth Communication Basics, LoRa Communication Basics and Applications, Designing an IoT-Based Home Automation System, Introduction to RTOS Concepts, FreeRTOS with STM32: Task Creation, Scheduling, and Management, RTOS Timers, Delays, and RTC Integration, Inter-task Communication: Queues and Semaphores. Trust Zone Technology: Introduction to ARM Trust Zone, Trust Zone Architecture and Features, Secure and Non-Secure Worlds: Configuration and Management, Implementing Trust Zone in STM32U575, Advanced Debugging and Optimization: Code and Memory Optimization Techniques, Debugging Strategies and Tools	14

Suggestion on Project Topics

- Identify real world problems requiring hardware solutions and develop them using peripheral devices. Some of the examples would be - Home automation, Small home/office security system, ARM based voice response system etc.

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks (8x2 =16 marks) 	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 subdivisions. Each question carries 6 marks (4x6 = 24 marks)	40

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Explain the architectural features and instructions of the ARM microcontrollers.	K2
CO2	Develop applications involving interfacing of external devices and I/O with ARM microcontroller.	K3
CO3	Use various communication protocols of interaction with peer devices and peripherals.	K3
CO4	Demonstrate the use of a real time operating system in embedded system applications.	K3
CO5	Apply hardware security features of ARM in real world applications.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓	✓						✓
CO5	✓	✓	✓	✓							✓

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors	Joseph Yiu	Newnes - Elsevier	3/e, 2014
2	Mastering STM32	Carmine Noviello	Learnpub	2/e, 2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	ARM System Developer's Guide	Andrew N. Sloss, Dominic Symes, Chris Wright	Morgan Kaufman	1/e, 2008
2	Embedded System Design with Arm Cortex-M Microcontrollers	Cem Ünsalan, Hüseyin Deniz Gürhan Mehmet Erkin Yücel	Springer	1/e, 2022
3	Introduction to ARM® Cortex-M Microcontrollers	Jonathan W. Valvano	Self-Published	5/e, 2014

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches



SEMESTER S5

NETWORKS LAB

Course Code	24SJPCCSL507	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To provide hands-on experience in network programming using Linux System calls and network monitoring tools.
2. To comprehend the implementation of network protocols and algorithms, and configuration of network layer services using network simulators.

A minimum of ten experiments must be completed as part of the course requirements.

Expt. No.	Experiments
Warm up	
1	Familiarize Linux networking commands - ifconfig, ifplugstatus, iftop, ping, ip, traceroute, mtr, netstat, whois, nmap, nmcli, speedtest-cli, bmon, nslookup, tcpdump*
Wireshark based	
2	<p>Start your web browser and clear the browser's cache memory. Open Wireshark and start capturing. Then visit any webpage of your choice. Type http in the filter field of the Wireshark and click Apply so that only HTTP messages are displayed. After enough packets have been captured, select the Capture from the pull-down menu and select Stop to stop capturing.*</p> <p>Using the captured information, determine the following:</p> <ol style="list-style-type: none"> (a) the source IP address and destination IP address of the first GET message (b) the medium format, the language, the encoding, and the character set that the client can accept. (Use the first GET message) (c) the URL of the website and the user agent (Use the first GET message) (d) the source IP address and destination IP address of the first response message (e) the status codes for the first response message. (f) when the HTML file that you are retrieving was last modified at the server

	<p>(g) value of the content-length field of the first response message</p> <p>(h) how long it took from the time the GET message was sent until the response message was received.</p> <p>(Use the timestamps of a GET message and that of the corresponding response message. By default, the time column's value is the amount of time in seconds since Wireshark tracing began.)</p> <p>(i) the HTTP version of your browser.</p>
3	<p>Compose an e-mail and address it to yourself, but do not send it yet. Open the Wireshark and start capturing. Go to your e-mail user agent and send the e-mail. In the Wireshark window, type smtp in the filter field and click Apply. Stop capturing and save the captured file.</p> <p>Using the captured information, answer the following:</p> <p>(a) All SMTP packets have the same two IP addresses. Which one is the IP address of your computer? Which host does the other IP address represent?</p> <p>(b) All SMTP packets have the same two port numbers. Which one is the port number of the SMTP client process? In which range is the client port number?</p> <p>(c) What is the port number of the SMTP server process?</p> <p>(d) Examine the SMTP commands or SMTP response codes in each SMTP packet and write down their meanings.</p> <p>(e) There is an IMF packet that is encapsulated inside an SMTP packet. What is the content of this packet?</p>
4	<p>First, clear the DNS record from the cache memory of your computer. For this, use ipconfig/flushdns on Windows or systemd-resolve --flush-caches on Linux. Next, clear your browser's cache memory. Open the Wireshark and start capturing. In your browser visit your college website. Wireshark starts to capture packets. Type dns in the filter field and press Apply so that only DNS messages are displayed. Stop capturing and save the captured file.</p> <p>Using the captured information, answer the following questions:</p> <p>(a) Locate the first DNS query message resolving your college website. What is the packet number (This “packet number” is assigned by Wireshark for listing purposes only; it is NOT a packet number contained in any real packet header.) in the trace for the DNS query message?</p> <p>(b) Is this query message sent over UDP or TCP?</p> <p>(c) Now locate the corresponding DNS response to the initial DNS query. What is the packet number in the trace for the DNS response message? Is this response message received via UDP or TCP?</p> <p>(d) What are the source and destination port numbers for the DNS query message?</p>

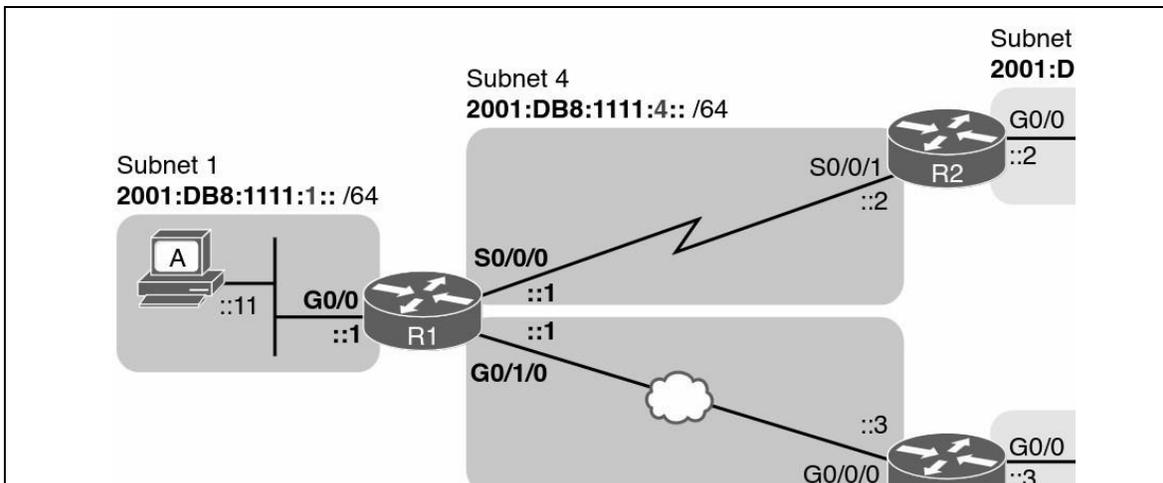
	<p>(e) What are the source and destination port numbers for the DNS response message?</p> <p>(f) To what IP address is the DNS query message sent?</p> <p>(g) What is the query message ID number? What is the response message ID number? What is the purpose of this field?</p> <p>(h) What is the length of the flag field in a DNS message?</p> <p>(i) Which bit in the flag field determines whether the message is a query or a response?</p> <p>(j) Which bits are used only in the response message? What is the function of these bits in the response message?</p> <p>(k) How many question records, answer records, authority records, and additional records are present in the query message?</p> <p>(l) How many question records, answer records, authority records, and additional records are present in the response message?</p>
Socket programming based (shall be implemented using Java Language)	
5	<p>Client-Server communication using TCP:- The client inputs an integer N and creates a square matrix of order N by populating the matrix with random numbers in the range [1,50]. It then sends the matrix to the server which identifies the matrix type (upper triangular, lower triangular, diagonal). The server then informs the type (as a string) to the client which it prints.</p>
6	<p>Client-Server communication using UDP:- You are very good at communicating in the “new generation” English language with all sorts of abbreviations like tbh, ig, etc. Now design a client-server application as follows: The client inputs a new-generation English sentence from the user and sends it to the server. The server then translates the received sentence to formal English and sends the translated sentence back to the client which it prints.</p> <p><u>Sample string sent to the server</u></p> <p>Really idc about this stupid server as it is of no use irl but atm, I will design one, tbf to the professor.</p> <p><u>Translated string sent back to the client</u></p> <p>Really I don't care about this stupid server as it is of no use in real life but at the moment, I will design one, to be fair to the professor.</p> <p>You may consider only the following abbreviations: tbh, ig, tbf, atm, irl, lol, asap, omg, ttyl, idk, nvm</p>
7	<p>Implement a multi-user chat server using TCP as the transport layer protocol.</p>
8	<p>Implement a concurrent Time Server application using UDP to execute the program at a remote server. The client sends a time request to the server which sends its system time</p>

	back. The client then displays the received time value.
9	Develop a concurrent file server that will provide the file requested by the client if it exists. If not, the server sends an appropriate message to the client. The server should also send its process ID (PID) to clients for displaying along with the file contents or with the message.
10	Develop a packet-capturing application using raw sockets.
Cisco's Packet tracer based	
11	<p>Familiarizing router commands</p> <ul style="list-style-type: none"> (a) Knowing the current mode (user or privileged), switching to privileged mode (b) Switching to configuration mode (c) Obtaining router information such as type, OS, memory stats, interface details etc. (d) Viewing the status of any routing protocols currently configured (e) Showing the routing table (f) Saving the running configuration (g) Viewing the command history (h) Viewing the router clock (i) Viewing the list of hosts (j) Displaying the statistics for all the interfaces (Both detailed and brief views) (k) Knowing the controller type (DTE or DCE) (l) Configuring serial and ethernet interfaces - enabling the interface, setting IP address, mask, and clock rate

ROUTER	INTERFACE
2621	F0/0
2501 A	E0
2501 A	S0
2501 B	E0
2501 B	S0
2501 B	S1
2501 C	S0

Figure 1: A sample network along with the interface addresses (all interfaces use a /24 mask)

12a	Set up static routing for the network shown in Figure 1. Once the routes are set up, display the routing table and verify the connectivity using ping .
12b	Implement RIPv2 routing for the network shown in Figure 1. Once the routes are set up, display the routing table and verify the connectivity using ping .
12c	Implement OSPF routing for the network shown in Figure 1. Once the routes are set up, display the routing table and verify the connectivity using ping .
13	<p>You are the network administrator of your college. The college is assigned a network address 140.80.0.0. There are 20 subnets in your college network. The Central Computing Facility (CCF) resides in the 4th subnet. The department of CSE is organizing an inter-department hackathon for which the registration closed yesterday. The registration was through the hackathon website hosted on a server which is assigned the 7th address in the 16th subnet. As the network administrator, your job now is to block students from accessing the hackathon website from CCF.</p> <p>[The server provides other services than the website hosting as well. Make sure you block only the website access. Other services should not be denied.]</p>
14	Figure 2 shows an IPv6-based network. Interconnect the different subnets using RIPng.



Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

Note: Students are instructed to submit only the fair record for both Continuous Internal Evaluation (CIE) and End Semester Examinations (ESE). Rough records are not required.

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the working of application layer protocols by analyzing the pertinent headers in actual data packets captured using network monitoring tools.	K3
CO2	Exploit the client server paradigm to develop real time networking applications using transport layer protocols.	K3
CO3	Employ IPv4 and IPv6 addressing, subnetting to efficiently design networks.	K3
CO4	Simulate core networking concepts using a network simulator.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓						✓
CO2	✓	✓	✓	✓		✓					✓
CO3	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓						✓

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Unix Network Programming, Volume 1: The Sockets Networking API	W. Richard Stevens, Andrew M. Rudoff, Bill Fenner	Pearson Education	3/e, 2004
2	CCNA Cisco certified network associate study guide Exam 640-802 6	Todd Lammle	Wiley	6/e, 2007
3	Beej's Guide to Network Programming: using Internet Sockets	Brian "beej Jorgensen" Hall	Amazon Digital Services	2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks: A Top-Down Approach	Behrouz A Forouzan	McGraw Hill	SIE, 2017
2	Computer Networking: A Top-Down Approach Featuring Internet	J. F. Kurose and K. W. Ross	Pearson Education	8/e, 2022

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://nptel.ac.in/courses/106106091

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 5
MACHINE LEARNING LAB

(Common to CS/CA)

Course Code	24SJPCCSL508	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

- To give the learner a practical experience of the various machine learning techniques and be able to demonstrate them using a language of choice.

A minimum of ten experiments must be completed as part of the course requirements.

Expt. No.	Experiments
1	Implement linear regression with one variable on the California Housing dataset to predict housing prices based on a single feature (e.g., the average number of rooms per dwelling). Tasks: <ul style="list-style-type: none"> ● Load and preprocess the dataset. ● Implement linear regression using both gradient descent and the normal equation. ● Evaluate the model performance using metrics such as Mean Squared Error (MSE) and R-squared. ● Visualize the fitted line along with the data points.
2	Implement polynomial regression on the Auto MPG dataset to predict miles per gallon (MPG) based on engine displacement. Compare polynomial regression results with linear regression. Tasks: <ul style="list-style-type: none"> ● Load and preprocess the dataset. ● Implement polynomial regression of varying degrees. ● Compare the polynomial regression models with linear regression using metrics such as MSE and R-squared. ● Visualize the polynomial fit.
3	Implement Ridge and Lasso regression on the Diabetes dataset. Compare the performance of these regularized models with standard linear regression. Tasks: <ul style="list-style-type: none"> ● Load and preprocess the dataset. ● Implement Ridge and Lasso regression. ● Tune hyperparameters using cross-validation. ● Compare performance metrics (MSE, R-squared) with standard linear regression.

4	<p>Estimate the parameters of a logistic regression model using MLE and MAP on the Breast Cancer Wisconsin dataset. Compare the results and discuss the effects of regularization.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the dataset. • Implement logistic regression with MLE. • Apply MAP estimation with different regularization priors (L1 and L2 regularization). • Compare the performance and parameter estimates with MLE and MAP.
5	<p>Use MLE and MAP to estimate the parameters of a multinomial distribution on the 20 Newsgroups dataset. Explore the impact of different priors on the estimation.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the dataset. • Implement MLE for multinomial distribution parameter estimation. • Apply MAP estimation with various priors (e.g., Dirichlet priors). • Compare results and evaluate the effect of different priors.
6	<p>Implement a logistic regression model to predict the likelihood of a disease using the Pima Indians Diabetes dataset. Compare the performance with and without feature scaling.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Pima Indians Diabetes dataset. • Implement logistic regression for binary classification. • Evaluate model performance with and without feature scaling. • Analyze metrics such as accuracy, precision, recall, and F1-score.
7	<p>Implement a Naïve Bayes classifier to categorize text documents into topics using the 20 Newsgroups dataset. Compare the performance of Multinomial Naïve Bayes with Bernoulli Naïve Bayes.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the 20 Newsgroups dataset. • Implement Multinomial Naïve Bayes and Bernoulli Naïve Bayes classifiers. • Evaluate and compare the performance of both models using metrics such as accuracy and F1-score. • Discuss the strengths and weaknesses of each Naïve Bayes variant for text classification.
8	<p>Implement the K-Nearest Neighbors (KNN) algorithm for image classification using the Fashion MNIST dataset. Experiment with different values of K and analyze their impact on model performance.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Fashion MNIST dataset. • Implement KNN for multi-class classification. • Experiment with different values of K and evaluate performance. • Discuss the impact of different K values on model accuracy and computational efficiency.

9	<p>Implement a Decision Tree classifier using the ID3 algorithm to segment customers based on their purchasing behavior using the Online Retail dataset. Analyze the tree structure and discuss the feature importance.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Online Retail dataset. • Implement Decision Tree using the ID3 algorithm. • Visualize the decision tree and analyze feature importance. • Discuss how the tree structure helps in understanding customer behavior.
10	<p>Implement and compare Logistic Regression and Decision Trees on the Adult Income dataset for predicting income levels. Evaluate both models based on performance metrics and interpretability.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Adult Income dataset. • Implement both Logistic Regression and Decision Trees. • Compare the models based on metrics such as accuracy, precision, recall, and F1- score. • Discuss the interpretability of both models and their suitability for the dataset.
11	<p>Implement a Linear Support Vector Machine (SVM) to classify the Iris dataset. Visualize the decision boundary and discuss how the margin is determined.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Iris dataset. • Implement a Linear SVM for binary classification (e.g., classify Setosa vs. Non- Setosa). • Visualize the decision boundary and margin. • Discuss the concept of the margin and how it influences classification.
12	<p>Implement and compare the performance of SVM classifiers with linear, polynomial, and RBF kernels on the Fashion MNIST dataset. Analyze the advantages and disadvantages of each kernel type.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Fashion MNIST dataset. • Implement SVM with linear, polynomial, and RBF kernels. • Compare the classification performance for each kernel. • Discuss the strengths and weaknesses of each kernel type.
13	<p>Implement and train a Multilayer Feed-Forward Network (MLP) on the Wine Quality dataset. Experiment with different numbers of hidden layers and neurons, and discuss how these choices affect the network's performance.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Wine Quality dataset. • Design and implement an MLP with varying architectures (different hidden layers and neurons). • Train and evaluate the network. • Discuss the impact of architecture choices on performance.

14	<p>Implement and compare the performance of a neural network using different activation functions (Sigmoid, ReLU, Tanh) on the MNIST dataset. Analyze how each activation function affects the training process and classification accuracy.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the MNIST dataset. • Implement neural networks using Sigmoid, ReLU, and Tanh activation functions. • Train and evaluate each network. • Compare training times, convergence, and classification accuracy.
15	<p>Implement and perform hyperparameter tuning for a neural network on the Fashion MNIST dataset. Experiment with different learning rates, batch sizes, and epochs, and discuss the impact on model performance.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Fashion MNIST dataset. • Experiment with different hyperparameters (learning rate, batch size, epochs). • Train and evaluate the network. • Discuss how hyperparameter choices affect model performance.
16	<p>Implement and compare hierarchical (agglomerative) and partitional (K-means) clustering algorithms on the Mall Customers dataset. Discuss the strengths and weaknesses of each method based on clustering results and evaluation metrics.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Mall Customers dataset. • Apply both hierarchical (agglomerative) and K-means clustering. Compare results using metrics such as inertia, silhouette score, and clustering visualization. • Discuss the advantages and disadvantages of each clustering method.
17	<p>Implement and apply K-means clustering to the Digits dataset. Experiment with different numbers of clusters and evaluate the clustering results using metrics such as inertia and silhouette score. Analyze how the choice of K affects clustering performance.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Digits dataset. • Implement K-means clustering with various numbers of clusters. • Evaluate clustering performance using inertia and silhouette score. Analyze the impact of the number of clusters on clustering quality.
18	<p>Implement bootstrapping and cross-validation on the Iris dataset. Compare the model performance metrics (e.g., accuracy, F1-score) obtained using these resampling methods. Discuss the advantages and disadvantages of each method.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Iris dataset. • Implement bootstrapping to generate multiple samples and evaluate the model. • Implement k-fold cross-validation and evaluate the model. • Compare the performance metrics and discuss the pros and cons of each resampling method.

19	<p>Implement bagging and boosting ensemble methods on the Titanic dataset. Compare the performance of both methods in terms of accuracy, precision, recall, and F1-score. Discuss how each method improves model performance and their respective strengths and weaknesses.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Titanic dataset. • Implement bagging using a base classifier (e.g., decision tree) and evaluate performance. • Implement boosting using a boosting algorithm (e.g., AdaBoost) and evaluate performance. • Compare performance metrics and discuss the strengths and weaknesses of each method.
20	<p>Investigate the bias-variance tradeoff using polynomial regression on the Boston Housing dataset. Plot the training and validation errors for various polynomial degrees and discuss the tradeoff between bias and variance.</p> <p>Tasks:</p> <ul style="list-style-type: none"> • Load and preprocess the Boston Housing dataset. • Implement polynomial regression with varying degrees. • Plot training and validation errors for each degree. • Discuss the bias-variance tradeoff and its impact on model performance.

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

Note: Students are instructed to submit only the fair record for both Continuous Internal Evaluation (CIE) and End Semester Examinations (ESE). Rough records are not required.

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*

- *Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Understand complexity of Machine Learning algorithms and their limitations;	K2
CO2	Understand modern notions in data analysis-oriented computing;	K2
CO3	Apply common Machine Learning algorithms in practice and implement their own.	K3
CO4	Performing experiments in Machine Learning using real-world data.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓		✓	✓						✓
CO2	✓	✓		✓	✓						✓
CO3	✓	✓	✓	✓	✓			✓	✓		✓
CO4	✓	✓	✓	✓	✓			✓	✓		✓

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	4/e, 2020
2	Machine Learning using Python	Manaranjan Pradhan U Dinesh Kumar	Wiley	1/e, 2019
3	Machine Learning: Theory and Practice	M.N. Murty, V.S. Anathanarayana	Universities Press	1/e, 2024

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki Wagner Meira	Cambridge University Press	1/e, 2016
2	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1/e, 1998
Video Links (NPTEL, SWAYAM...)				
No.	Link ID			
1	https://archive.nptel.ac.in/courses/106/105/106105152/			
2	https://archive.nptel.ac.in/courses/106/106/106106139/			
3	https://nptel.ac.in/courses/106106202			

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted



PROGRAM ELECTIVE II

SEMESTER 5

SOFTWARE PROJECT MANAGEMENT

(Common CS/CA/AD)

Course Code	24SJPECST521	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To learn the techniques to effectively plan, manage, execute, and control projects within time and cost targets with a focus on Information Technology and Service Sector.
2. To learn agile project management techniques such as Scrum and DevOps.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Project scheduling and feasibility study :- Project Overview and Feasibility Studies - Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal; Project Scheduling - Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.	8
2	Resource Scheduling, Cost Control and Project management Features :- Cost Control and Scheduling - Project Cost Control (PERT/Cost), Resource Scheduling & Resource Levelling; Project Management Features – Risk Analysis, Project Control, Project Audit and Project Termination.	8
3	Agile Project Management :- Agile Project Management - Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL); Other Agile Methodologies - Introduction to XP, FDD, DSDM, Crystal.	9

4	Scrum and DevOps in project management :- Scrum - Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study; DevOps - Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test-Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case Study.	11
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Understand how effectively plan, and schedule projects within time and cost targets	K2
CO2	Apply project estimation and evaluation techniques to real world problem	K3
CO3	Discuss different Agile Project Methodologies	K2
CO4	Apply various SCRUM practices in project management.	K3
CO5	Demonstrate the techniques used in DevOps.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

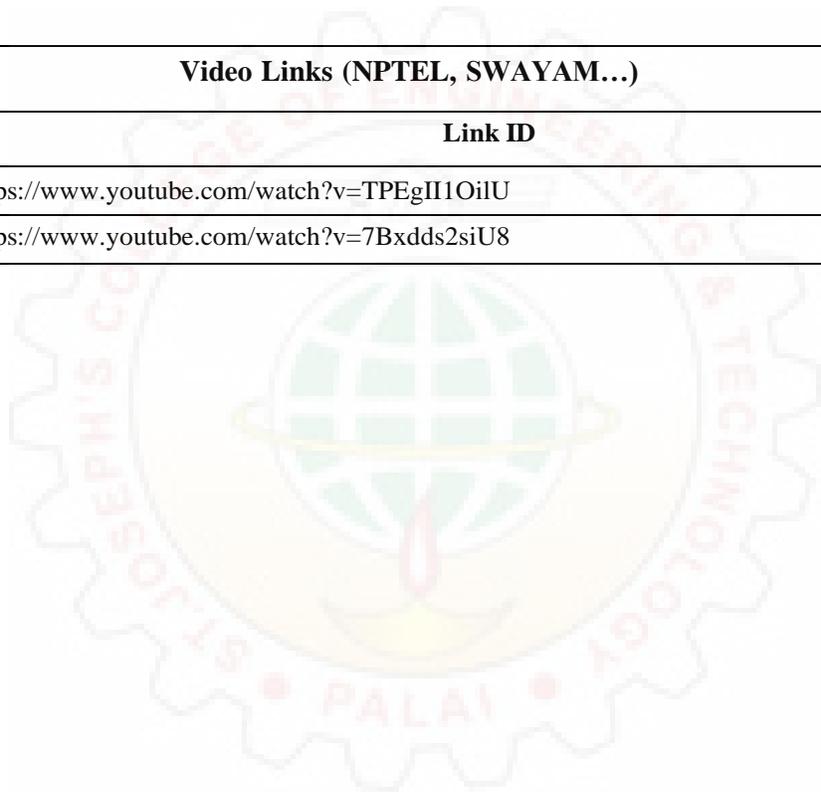
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓							✓	✓
CO2	✓	✓	✓							✓	✓
CO3	✓	✓	✓							✓	✓
CO4	✓	✓	✓							✓	✓
CO5	✓	✓	✓							✓	✓

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Succeeding with Agile: Software Development Using Scrum	Mike Cohn	Addison-Wesley	1/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Agile Product Management with Scrum	Roman Pichler	Addison-Wesley	1/e, 2010
2	Agile Project Management with Scrum	Ken Schwaber	Microsoft Press	1/e, 2004

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://www.youtube.com/watch?v=TPEgII1OiuU
2	https://www.youtube.com/watch?v=7Bxdds2siU8



SEMESTER S5

ARTIFICIAL INTELLIGENCE

Course Code	24SJPECST522	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To lay a solid foundation of the important abstractions, techniques, and reasoning for intelligent systems.
2. To enable the learners to understand the basic principles of Reinforcement Learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Artificial Intelligence: - Introduction, Foundation and history of AI Agents and Environments; The concept of rationality; The nature of environments, Structure of agents. Problem solving Agents Well-defined problems and solutions, Formulating problems; Example problems- vacuum world, 8-puzzle, 8-queens.	8
2	Searching: - Depth First Search, Breadth First Search, Iterative Deepening Search. Heuristic Search strategies - Heuristic functions, the effect of heuristic accuracy on performance; Generate and test, Greedy best first search, A* algorithm, Constraint satisfaction problems, Adversarial search - Games, Optimal Decision in games, The minimax algorithm, Alpha-beta pruning.	10
3	Knowledge-Based Agents: - The Wumpus World, Logic, Propositional Logic, Reasoning Patterns in Propositional Logic, First order logic, Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining.	8
4	Reinforcement Learning: - Learning from Rewards, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, Apprenticeship and Inverse Reinforcement Learning, Applications of Reinforcement Learning	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain how intelligent agents can solve problems.	K2
CO2	Use the different types of search methods to solve various problems.	K3
CO3	Formulate knowledge representation and examine resolution in propositional logic and first order logic.	K3
CO4	Utilize reinforcement learning techniques to create intelligent agents.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓							✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	AI – A Modern Approach	Stuart Russel, Peter Norvig	Pearson Education	4/e, 2021
2	Artificial Intelligence	Kevin Knight, Elaine Rich, Shivashankar B. Nair	Tata McGraw-Hill	3/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Artificial Intelligence and Expert Systems	Dan W. Patterson	Pearson Education	1/e, 2015
2	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	George F. Luger	Pearson Education	6/e, 2009
3	Artificial Intelligence : Making a System Intelligent	Nilakshi Jain	Wiley	1/e, 2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=X_Qt0U66aH0
2	https://www.youtube.com/watch?v=te1K8on1Pk0
3	https://www.youtube.com/watch?v=SEJhMO1IXZs
4	https://youtu.be/YaPSPu7K9S0?si=DizMPIZ9uVSy50iG

SEMESTER S5

DATA ANALYTICS

Course Code	24SJPECST523	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To help the learner to understand the basic concepts of data analytics.
2. To cover the mathematics for data analytics, predictive and descriptive analytics of data, classification, clustering and text analytics
3. To enable the learners to perform data analysis on a real-world scenario using appropriate tools.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Data Analytics: Analytics process Model, Analytical Model Requirements, Data Analytics Life Cycle Overview: Probability Calculus-Probability Distributions: Hypothesis Testing-Basic definitions Proximity Measures-Data Objects, Attribute types, Dissimilarity and Similarity Measures.	8
2	Association of Two Variables: - Summarizing the distribution of Two Discrete variables, Contingency tables for Discrete data, Joint, Marginal and Conditional Frequency Distributions, Graphical Representation of two nominal or ordinal variables, Measures of Association for Two Discrete variables, Association between ordinal and continuous variables, Visualization of variables from different scales.	9
3	Statistical Description of data: -Central tendency, Dispersion Range, Quartiles, Variance, Standard Deviation and Interquartile Range. Data Preprocessing Cleaning, Integration, Reduction, Transformation, Discretization. Mining Frequent Patterns: Associations, Co-relations and Apriori Algorithms. Classification: General Approach to classification, ID3, Attribute selection measures, Naïve Bayesian Classification. Clustering-KMeans, Agglomerative versus Divisive Hierarchical Clustering, BIRCH, DBSCAN	9

4	Text Processing: - Boolean retrieval, Example IR Problem, inverted index, processing Boolean queries, tokenization, stemming, phrase queries, vector space model, finite automata and language model, query likelihood model, naïve bayes text classification.	9
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Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination- 1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the key concepts of Data Analytics	K2
CO2	Apply appropriate techniques to convert raw data into suitable format for practical data analytics tasks	K3
CO3	Extend the concept of association rule mining in real world scenario	K3
CO4	Select appropriate clustering and classification algorithms for various application and extend data analytics methods to new domains of data.	K4
CO5	Understand the basics of text analytics and text classification.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓			✓				✓		✓
CO2	✓	✓		✓	✓				✓		✓
CO3	✓	✓	✓	✓	✓				✓		✓
CO4	✓	✓	✓	✓	✓				✓		✓
CO5	✓	✓	✓	✓	✓				✓		✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Statistics and Data Analysis	Christin Heumann and Michael Schomaker	Springer	1/e,2016
2	Datamining Concepts and Techniques	Jiawei Han and Micheline Kamber	Springer	3/e, 2012

Reference Book				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to information Retrieval	Christopher D Manning, Raghavan, P Schutze.H	Cambridge University Press	1/e,2008
2	Mining Text Data	Charu C Aggarwal, Cheng Xiang Zhai	Springer	1/e,2012
3	Analytics in a Big Data World: The Essential Guide to Data Science and in Business Intelligence and Analytic Trends	Bart Basens	John Wiley	1/e,2013
4	Introduction in Data Mining	Pang -Ning Tan, Michael Steinbach and Vipin Kumar	Pearson Education	1/e,2007

No.	Link ID
1	https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs15/
2	https://onlinecourses.swayam2.ac.in/cec19_cs01/preview

SEMESTER S5

DATA COMPRESSION

Course Code	24SJPECST524	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce students to basic applications, concepts, and techniques of Data Compression.
2. To develop skills for using recent data compression software to solve practical problems in a variety of disciplines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Compression Techniques :- Data Compression Approaches - Variable-Length Codes, Run-Length Encoding, Space - Filling Curves, Dictionary-Based Methods, Transforms, Quantization. Huffman Encoding - Huffman Decoding, Adaptive Huffman Coding, Facsimile Compression. Run Length Encoding (RLE), RLE Text compression, Dictionary based Coding- LZ77, LZ78, LZW and Deflate: Zip and Gzip compression.	10
2	Advanced Techniques :- Arithmetic Coding - The Basic Idea, Implementation, Underflow; Image Compression- Introduction, Approaches to Image Compression, History of Gray Codes, Image Transforms, Orthogonal Transforms, The Discrete Cosine Transform, Intermezzo: Statistical Distributions, JPEG, Human Vision and Color, The Wavelet Transform, Filter Banks, WSQ, Fingerprint Compression	10
3	Video Compression :- Video Compression - Analog video, Digital Video, Motion Compensation. MPEG standards MPEG, H.261	8
4	Audio Compression :- Audio Compression - Companding, The Human Auditory System, Heinrich Georg Barkhausen, Linear Prediction, μ -Law and A-Law Companding, Shorten	8

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the fundamental approaches in data compression techniques	K2
CO2	Illustrate various classical data compression techniques	K3
CO3	Illustrate various text and image compression standards	K3
CO4	Describe the video compression mechanisms to reduce the redundancy in video	K3
CO5	Understand the fundamental principles of audio data compression	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓									✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓								✓
CO5	✓	✓									✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	A Concise Introduction to Data Compression	David Salomon	Springer	1/e, 2008
2	Data compression: The Complete Reference	David Salomon	Springer	3/e, 2004
3	Introduction to Data Compression	Khalid Sayood	Morgan Kaufman	1/e, 2003

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fractal and wavelet Image Compression techniques	Stephen Welstead,	PHI	1/e, 1999
2	Multimedia System	Sleinreitz	Springer	1/e, 2006
3	The Data Compression Book	Mark Nelson, Jean-loup Gailly	BPB Publications	1/e, 1996

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	An Introduction to Information Theory by Prof. Adrish Banerjee zt IIT Kanpur https://onlinecourses.nptel.ac.in/noc22_ee49/preview

SEMESTER 5

DIGITAL SIGNAL PROCESSING

(Common to CS/CA)

Course Code	24SJPECST526	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	24SJPECST416	Course Type	Theory

Course Objectives:

1. To teach the concept of DFT and apply it for filtering data sequences.
2. To educate on the algorithms for complexity reduction in the computation of DFT.
3. To teach the theory of FIR and IIR filters and to design FIR filters.
4. To get exposed to the basic idea of some of the important techniques for designing efficient VLSI architectures for DSP.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition of a digital signal processing system, Sampling, Sampling rate, DFT and IDFT (Properties of DFT). Linear Convolution using Circular Convolution, Convolution of long data sequences- Overlap add method, overlap save method. Linear filtering methods based on DFT – FFT (DIT- FFT only) – efficient computation of the DFT of a 2N point real sequences – correlation – use of FFT in linear filtering and correlation, Symmetries in the DFT	9
2	Types of transfer functions- Ideal filters, Zero phase and linear phase transfer functions, Types of linear phase FIR transfer functions; Simple digital filters: Simple FIR digital filters (Low pass and high pass), Simple IIR digital filters (Low pass and high pass), All pass and minimum phase transfer function Design of FIR filter : window based design (Rectangular, Hamming, Hanning windows). Applications of DSP-Spectral analysis of sinusoidal signals.	8

3	Realization structures for FIR filters- direct, cascade, parallel. IIR Filter realization structures (Direct form I, II, cascade and Parallel and transposed structures); Computational accuracy in DSP implementation- Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementation - A/D conversion error, DSP computational error, D/A Conversion error.	9
4	<p>FFT and FIR Filter realization on a fixed point processor -finite word length effects - Quantization, rounding and truncation, overflow and scaling. DSP Algorithm representations, data flow, control flow, signal flow graphs, block diagrams - Loop bound, iteration bound, critical path - Pipelining, parallel processing, low power architectures - Retiming, folding and unfolding techniques, applications.</p> <p>Hands-on : -</p> <ul style="list-style-type: none"> ● FPGA based hardware realization of the FFT algorithm, circular convolution, IIR and FIR filter structures using iVerilog. ● To realize different DSP algorithms including basic multiply accumulation and shifting operations on a fixed point processor. ● Analyze the effect of the finite word length by implementing the FFT algorithm and FIR filters by using fixed point coefficient representation in different formats like Q7, Q15 etc. ● Design an FIR low pass filter using MATLAB/SCILAB and check how it filters a speech signal by recording it and playing the result. 	10

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 Marks)</p>	<ul style="list-style-type: none">• Each question carries 9 marks.• Two questions will be given from each module, out of which 1 question should be answered.• Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept of DFT and apply it for determining the spectral information of data sequences.	K2
CO2	Apply algorithms for complexity reduction in the computation of DFT.	K3
CO3	Use the theory of FIR and IIR filters and be able to design FIR filters using the window method.	K3
CO4	Build the IIR and FIR filter transfer functions using suitable structures	K3
CO5	Identify the effect of finite word length on DSP algorithm implementation	K3
CO6	Utilize the low power architectures for implementing the DSP algorithms	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓							✓
CO6	✓	✓	✓				✓				✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Signal Processing [Modules 1,2,3]	S. Salivahanan	McGraw Hill	10/e, 2019
2	Digital Signal Processing: A Computer - Based Approach [Modules 2]	Sanjit K.Mitra	McGraw Hill	4/e, 2013
3	VLSI Signal Processing Systems, Design and Implementation [Module 4]	Keshab K. Parhi	Wiley	1/e, 2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Signal Processing	John G. Prokakis, Dimitris K Manolakis	Pearson	4/e, 2007
2	Introduction to Digital Signal Processing	Johnny R Johnson	Pearson	1/e, 2015
3	Mathematics of the Discrete Fourier Transform (DFT): with Audio Applications	Julius O. Smith III	W3K Publishing	2/e, 2007
4	Digital Signal Processing : Fundamentals, Techniques and Applications	Juan Zhang	Nova Science Publishers	1/e, 2016
5	Fast Fourier Transform Algorithms for Parallel Computers (Vol 2)	Daisuke Takahashi	Springer	1/e,

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/108/101/108101174/
2	https://methodist.edu.in/web/uploads/files/DSP%20NOTES.pdf

SEMESTER 5

COMPUTER GRAPHICS & MULTIMEDIA

(Common to CS/CA/AD)

Course Code	24SJPECST527	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide strong technological concepts in computer graphics including the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications.
2. To give a good understanding of the multimedia frameworks for audio/video domains and different compression algorithms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Computer graphics - Basics of Computer Graphics and its applications. Video Display devices - LED, OLED, LCD, PDP and FED and reflective displays. Random and Raster scan displays and systems. Line and Circle drawing Algorithms - Line drawing algorithms- Bresenham's algorithm, Liang-Barsky Algorithm, Circle drawing algorithms - Midpoint Circle generation algorithm, Bresenham's Circle drawing algorithm.	10
2	Geometric transformations - 2D and 3D basic transformations - Translation, Rotation, Scaling, Reflection and Shearing, Matrix representations and homogeneous coordinates. Filled Area Primitives - Scan line polygon filling, Boundary filling and flood filling.	8
3	Transformations and Clipping Algorithms - Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms. Three-dimensional graphics - Three-dimensional viewing pipeline. Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm.	8

4	<p>Fundamental of Multimedia - Introduction to Multimedia, Authoring and Tools, Graphics and Image Data Representations, Popular File Formats, Fundamental Concepts and types of Video, Basics of Digital Audio and its types.</p> <p>Compression Methods - Lossless Compression Algorithms- Run-Length Coding, Arithmetic Coding. Lossy Compression Algorithms- Transform Coding. JPEG and JPEG-LS Standard Image Compression, H.261. Video Compression Technique.</p>	9
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Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the principles of computer graphics and displays	K2
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms	K3
CO3	Illustrate 2D and 3D basic transformations and matrix representation	K3
CO4	Demonstrate different clipping algorithms and 3D viewing pipeline.	K3
CO5	Summarize the multimedia features and specific compression algorithms	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓							✓
CO5	✓	✓	✓								✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Graphics: Algorithms and Implementations	D. P. Mukherjee, Debasish Jana	PHI	1/e, 2010
2	Computer Graphics with OpenGL	Donald Hearn, M. Pauline Baker and Warren Carithers	PHI	4/e, 2013
3	Fundamentals of Multimedia	Ze-Nian Li and Mark S. Drew	Pearson	2003

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Flat Panel Displays	Jiun-Haw Lee, I-Chun Cheng, Hong Hua, Shin Tson Wu	Wiley	1/e, 2020
2	Computer Graphics and Multimedia	ITL ESL	Pearson	1/e, 2013
3	Computer Graphics	Zhigang Xiang and Roy Plastock	McGraw Hill	2/e, 2000
4	Principles of Interactive Computer Graphics	William M. Newman and Robert F. Sproull	McGraw Hill	1/e, 2001
5	Procedural Elements for Computer Graphics	David F. Rogers	McGraw Hill	1/e, 2017
6	Computer Graphics	Donald D Hearn, M Pauline Baker	Pearson	2/e, 2002

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1, 2, 3	Computer Graphics By Prof. Samit Bhattacharya at IIT Guwahati https://onlinecourses.nptel.ac.in/noc20_cs90/preview
4	Web Based Technologies and Multimedia Applications by Prof. P. V. Suresh at Indira Gandhi National Open University https://onlinecourses.swayam2.ac.in/nou20_cs05/preview

SEMESTER 5

ADVANCED COMPUTER ARCHITECTURES

Course Code	24SJPECST528	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the advanced processor architectures including parallelism concepts in Programming of multiprocessor and multicomputers.
2. To provide detailed understanding about data flow in computer architectures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction – The impact of hardware and software technology trends Self review – Instruction set Architecture, Memory addressing, addressing modes Class of Computers, Concept of Computer Hardware and Organization (P15, 5th Edition) Measuring, Reporting and Summarizing Performance, Benchmarks – the need for bench mark to compare performance , Desktop and Server Amdahl’s Law, Processor Performance Equation-	9
2	Review the basic Concepts of Parallel Processing and Pipelining Instruction Level Parallelism, data dependencies and hazards Different types of dependences, Compiler Techniques for ILP, Branch Prediction – Correlating branch predictor Dynamic Scheduling – Idea, Introduction to Tomasulo’s scheme. Register Renaming Hardware Speculation, Reorder Buffers Multiple issue and static scheduling, VLIW –	9
3	Data Level Parallelism. Vector Processors – How do they work, Memory Banks, Stride, Scatter Gather. SIMD-comparison with vector GPU, Comparison of loops in C vs CUDA NVIDIA GPU Memory structure Vector Processor vs GPU, Multimedia SIMD computers vs GPU Multiprocessor Architecture, Centralized shared memory architecture Cache coherence and snooping protocol (Implementation details – not required). Performance of Symmetric Shared-Memory Processors. Distributed Shared Memory and Directory based protocol – basics. Synchronization – Basic Hardware Primitives. Memory Consistency Models – Sequential and relaxed -	12

	introduction to NUMA	
4	Warehouse Scale Computers – Goals and requirements. Programming frameworks for Batch processing – Map reduce and Hadoop Computer Architecture of Warehouse-scale computers Moore’s Law, Dennard Scaling, Dark Silicon and the transition towards Heterogeneous Architectures Asymmetric multi-core architecture – Static and Dynamic (Overall idea, example processors) Functional Heterogeneous Multicore architecture – GPUs, Accelerators, Reconfigurable Computing [Beyond the textbook – Identify the processor used in your PC and mobile phone. Study about its architecture, is it homogeneous or heterogeneous, does it use GPUs, what information can you gather about it from the manufacturer’s website – Discuss in the class]	12

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Enumerate the different classes of computers and where they are used in everyday life.	K2
CO2	Compute the effect of hardware/software enhancements on the speedup of a processor using Amdahl's law.	K3
CO3	Interpret possible dependencies that can cause hazards in a given block of code.	K3
CO4	Summarize different strategies followed to ensure Instruction Level Parallelism.	K2
CO5	Compare different strategies followed to ensure Instruction Level Parallelism and different strategies followed to ensure Data Parallelism.	K3
CO6	Illustrate the need for memory consistency models and cache coherence protocols and explain the principle behind it.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

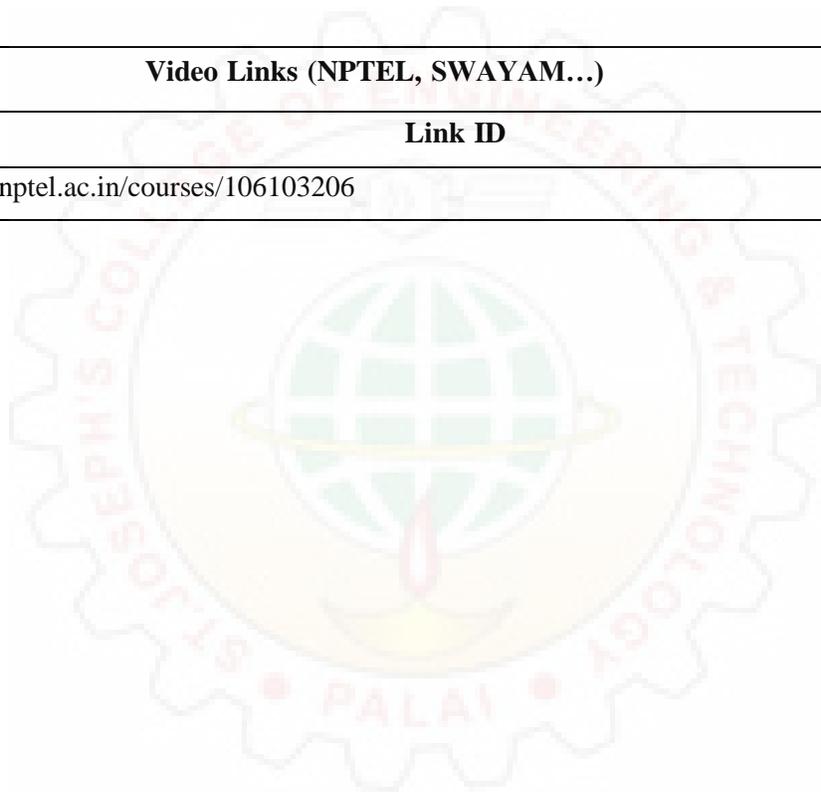
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓							✓
CO6	✓	✓	✓	✓							✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer architecture: A Quantitative Approach.	Hennessy, J. and Patterson, D	Morgan Kaufman	5/e, 2012
2	The Dark Side of Silicon: Energy Efficient Computing in the Dark Silicon Era	Kanduri, Anil, et al.	Springer	1/e, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Architecture	Gérard Blanchet Bertrand Dupouy	Wiley	1/e, 2013
2	Advanced Computer Architectures	Sajjan C Shiva	Taylor & Fancis	1/e, 2018
3	Computer Architecture	Charles Fox	no starch press	1/e, 2024

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://nptel.ac.in/courses/106103206



SEMESTER 5

DATA MINING

(Common to CS/CA)

Course Code	24SJPECST525	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide a thorough understanding of the key processes and concepts involved in data mining and data warehousing within application domains.
2. To enable students to understand the different data pre-processing techniques, fundamentals and advanced concepts of classification, clustering, association rule mining, text mining and web mining, and apply these techniques in real-world scenarios

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Data Mining Fundamentals: - Data Mining - concepts and applications, Knowledge Discovery in Database Vs Data mining, Architecture of typical data mining system, Data Mining Functionalities Data warehouse - Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema, OLAP Operations, Data Warehouse Architecture.	8
2	Data Preprocessing: - Data Preprocessing - Need of data preprocessing, Data Cleaning- Missing values, Noisy data, Data Integration and Transformation. Data Reduction - Data cube aggregation, Attribute subset selection, Dimensionality reduction, Numerosity reduction, Discretization and concept hierarchy generation.	9
3	Classification And Clustering: - Classification - Introduction, Decision tree construction principle, Information Gain, Gini index, Decision tree construction algorithm - ID3, Neural networks, back propagation, Rule-Based Algorithms - Generating Rules from a DT, Generating Rules from a Neural Net. Clustering - Introduction to clustering, distance measures, Clustering Paradigms, Partitioning Algorithm - k means, Hierarchical Clustering, DBSCAN	9

4	Association Rule Analysis and Advanced Data Mining: - Association Rule Mining - Concepts, Apriori algorithm, FP Growth Algorithm. Web Mining - Web Content Mining, Web Structure Mining- Page Rank, Web Usage Mining- Preprocessing, Data structures, Pattern Discovery, Pattern Analysis. Spatial Mining - Spatial Queries, Spatial Data Structures, Thematic Maps, Image Databases.	10
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Criteria for Evaluation (Evaluate and Analyse): 20 marks

Students must be asked to identify problems involving large datasets and identify the right solution from the concepts already learned. A comparison of the results with a similar approach also needs to be performed to assess the Knowledge Level 5.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks) 	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the key process of data mining and data warehousing concepts in application domains.	K2
CO2	Apply appropriate pre-processing techniques to convert raw data into suitable format for practical data mining tasks	K3
CO3	Illustrate the use of classification and clustering algorithms in various application domains	K3
CO4	Comprehend the use of association rule mining techniques	K3
CO5	Explain advanced data mining concepts and their applications in emerging domains	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓									✓
CO2	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓	✓						✓
CO5	✓	✓									✓

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data Mining Concepts and Techniques	JaiweiHan, Micheline Kamber	Elsevier	3/e, 2006
2	Data Mining: Introductory and Advanced Topics	Dunham M H	Pearson Education	1/e, 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Data Mining	Pang-Ning Tan, Michael Steinbach	Addison Wesley	1/e, 2014
2	Data Mining: Concepts, Models, Methods, and Algorithms	Mehmed Kantardzic	Wiley	2/e, 2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/ykZ-_UGcYWg?si=qiqynQyjI1sNNiHE
2	https://youtu.be/NSxEiohAH5o?si=ZIJHMiRvpFcNQNMA
3	https://youtu.be/VsYKqOokgaE?si=rgndBZqpzB29LUGg
4	https://youtu.be/N_whCVtfL9M?si=VPMH9NP4vdAaiuPe

SEMESTER S5

ADVANCED GRAPH ALGORITHMS

Course Code	24SJPECST529	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NA	Course Type	Theory

Course Objectives:

1. To gain proficiency in designing and implementing sophisticated graph algorithms for analyzing large-scale networks, and apply these techniques to real-world problems such as social network analysis and transportation optimization.
2. To develop the ability to critically evaluate and enhance advanced graph algorithms for dynamic and evolving graphs, using real-world case studies to illustrate their application and performance in complex scenarios.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<p>Maximum Flow Algorithms - Dinic's Algorithm, Push-Relabel Algorithm. Applications - network bandwidth allocation, data center resource management.</p> <p>Minimum Cost Flow - Capacity Scaling Algorithm. Applications - transportation logistics, network routing with cost constraints.</p> <p>Assignments:</p> <p>1. Network Bandwidth Allocation - Optimize bandwidth allocation in a communication network using Dinic's Algorithm.</p> <p>Implement Dinic's Algorithm to solve a network flow problem where you are given a communication network represented as a directed graph with capacities on edges. Your goal is to maximize the flow from a source node to a sink node. Use a real-world network dataset (e.g., a telecommunications network with nodes and link capacities).</p>	9

	<p>2. Logistics Optimization - Optimize the transportation of goods in a supply chain network using the Capacity Scaling Algorithm. Use the Capacity Scaling Algorithm to address a logistics problem where you need to minimize transportation costs in a supply chain network. The network is represented as a graph where nodes represent locations (warehouses, distribution centers, etc.), and edges represent transportation routes with associated costs. Use a dataset representing a supply chain network with nodes, edges, and costs.</p>	
2	<p>Strongly Connected Components (SCC) - Tarjan's Algorithm, Kosaraju's Algorithm. Applications - analyzing web page link structures, understanding connected components in social networks. Dynamic Graph Connectivity - Dynamic connectivity algorithms, Applications - real-time network monitoring, dynamic route planning.</p> <p>Assignments:</p> <ol style="list-style-type: none"> 1. Web Page Link Analysis - Objective: Analyze strongly connected components (SCC) in a web graph using Tarjan's Algorithm. Implement Tarjan's Algorithm to find SCCs in a web graph where nodes represent web pages and edges represent hyperlinks. SCCs help in understanding the structure of the web and identifying clusters of interconnected pages. Use a real-world web graph dataset with nodes and edges. 2. Dynamic Route Planning - Manage and analyze routes in a transportation network that evolves over time using dynamic connectivity algorithms. Implement dynamic connectivity algorithms to handle a transportation network where edges and nodes may be added or removed over time. The goal is to maintain and update the connectivity information efficiently. Use a dataset representing a transportation network with dynamic updates. 	9
3	<p>Graph Matching - Edmonds' Algorithm for finding maximum matchings. Applications - job assignment, network design. Graph Coloring - Colorings for special classes of graphs (e.g., planar graphs, interval graphs). Applications - frequency assignment in wireless networks, scheduling problems.</p> <p>Assignments:</p> <ol style="list-style-type: none"> 1. Job Assignment Optimization - Solve job assignment problems using Edmonds' Algorithm. Implement Edmonds' Blossom Algorithm to address job assignment problems where you need to match workers to jobs in a way that maximizes the overall efficiency or minimizes the cost. Use a dataset with job assignments and associated costs or efficiencies. 2. Frequency Assignment - Allocate frequencies in wireless communication systems using graph coloring techniques. Apply graph coloring techniques to allocate frequencies to transmitters in a wireless communication network to avoid interference. The goal is to minimize the number of frequencies used while ensuring that adjacent transmitters do not use the same frequency. Use a dataset representing a network of transmitters with potential interference. 	9

4	<p>Graph Partitioning and Community Detection - Kernighan-Lin Algorithm, Spectral Partitioning. Applications - social network community detection, large-scale data clustering.</p> <p>Parameterized Algorithms for Graph Problems - Fixed-parameter tractability for vertex cover, feedback vertex set. Applications - network security, bioinformatics.</p> <p>Assignments:</p> <ol style="list-style-type: none"> 1. Social Network Community Detection - Detect communities in a social network using the Kernighan-Lin Algorithm. Apply the Kernighan-Lin Algorithm to detect communities in a social network where nodes represent individuals and edges represent relationships. The goal is to find clusters of highly interconnected individuals. Use a social network dataset with nodes and edges representing social connections. 2. Network Security Analysis - Identify critical nodes in a network using parameterized algorithms to assess network security. Use parameterized algorithms to identify critical nodes and vulnerabilities in a network. These nodes are crucial for the network's connectivity, and their removal would impact the network's security and robustness. Use a dataset representing a network with nodes and edges, along with possible vulnerabilities. 	9
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**Course Assessment Method (CIE: 40 marks, ESE: 60 marks)
Continuous Internal Evaluation Marks (CIE):**

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Assignment evaluation pattern:

- Correctness and Accuracy (30%) - Correct Solution and Implementation.
- Effectiveness and Efficiency (25%) - Algorithm Efficiency and Performance Metrics.
- Analytical Depth (25%) - Problem Understanding and Solution Analysis.
- Justification and Comparisons (20%) - Choice Justification and Comparative Analysis.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop and implement advanced algorithms for network flow, graph connectivity, and matching, and evaluate their performance on real- world datasets.	K3
CO2	Analyze and compare the efficiency and effectiveness of various graph algorithms, including those for network optimization and community detection.	K4
CO3	Apply advanced graph algorithms to solve practical problems such as network optimization, job assignment, and frequency allocation, demonstrating their utility in real-world scenarios.	K3
CO4	Formulate and solve complex graph-related problems using appropriate algorithms, including those for graph traversal, minimum spanning trees, and network security analysis.	K5
CO5	Critically assess the strengths and limitations of different graph algorithms, and effectively communicate findings and recommendations through detailed reports and presentations.	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓						✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein	The MIT Press Cambridge	4/e 2023
2	Algorithms	Robert Sedgewick and Kevin Wayne	Addison-Wesley	4/e, 2023
3	Graph Algorithms	Shimon Even	Cambridge University Press	2/e, 2011
4	Graph Theory	Reinhard Diestel	Springer	4/e, 2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	A Guide to Graph Algorithms	Mingyu Xiao and Ton Kloks	Springer Verlag, Singapore;	1 st , 2022
2	Network Science	Albert-László Barabási and Márton Pósfai	Cambridge University Press	1 st , 2016
3	Modern Graph Theory	Bela Bollobas	Springer-Verlag New York Inc	1 st , 1998
4	Network Flows: Theory, Algorithms, and Applications	Ravindra Ahuja, Thomas Magnanti, and James Orlin	Pearson	1 st , 1993
5	Introduction to Graph Theory	Douglas B. West	Pearson	2 nd , 2020
6	Modern Graph Theory Algorithms with Python: Harness the power of graph algorithms and real-world network applications using Python	Colleen M Farrelly and Franck Kalala Mutombo	Packt Publishing	2024

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_cs48/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs48/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs48/preview
4	https://onlinecourses.nptel.ac.in/noc21_cs48/preview



SEMESTER S6
COMPILER DESIGN
(Common to CS/CC)

Course Code	24SJPCST601	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	NA	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of the compiler construction process through its various phases viz. lexical analysis, parsing, semantic analysis, code generation, and optimization.
2. To introduce compiler construction tools like Lex and YACC and use them in lexical analysis and parsing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - Compiler Structure, The Front End; The Optimizer; The Back End. Scanners - Recognizing Words, Regular Expressions, From Regular Expression to Scanner: Implementing Scanners. <i>Hands-on: Recognizing Words with Lex, Regular Expressions in Lex</i>	8
2	Parsing - Introduction, Expressing Syntax, Top-Down Parsing - Transforming A Grammar: Eliminating Left Recursion; Left-Factoring To Eliminate Backtracking, Recursive Descent Parsers, Table-Driven LL(1) Parsers	10
3	Bottom-Up Parsing - Shift Reduce Parser, The LR(1) Parsing Algorithm, Building LR(1) Tables, Errors in the Table Construction, Reducing the Size of LR (1) Tables. <i>Hands-on: Building a calculator with YACC</i> Intermediate Representations: An IR Taxonomy, Graphical IRs - Syntax-Related Trees, Graphs; Linear IRs , Three-Address Code . Syntax-Driven Translation: Introduction, Translating Expressions, Translating Control-Flow Statements	14

4	Code generation: Code Shape - Arithmetic Operators, Boolean and Relational Operators, Control-Flow Constructs (Conditional Execution, Loops and Iteration), Procedure Calls Code Optimization - Introduction, Opportunities for Optimization, Scope Of Optimization Local Optimization: Local Value Numbering, Tree-Height Balancing Regional Optimization:, Loop Unrolling Global Optimization: Finding Uninitialized Variables with Live Sets, Global Code Placement	14
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Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use lexical analysis techniques to build a scanner for a given language specification. (Cognitive Knowledge Level: Apply)	K3
CO2	Construct parse trees for input programs using parsing algorithms and detect syntactic errors. (Cognitive Knowledge Level: Apply)	K3
CO3	Develop semantic analysis techniques to check program correctness. (Cognitive Knowledge Level: Apply)	K3
CO4	Build intermediate code representations by applying intermediate code generation techniques. (Cognitive Knowledge Level: Apply)	K3
CO5	Optimize generated code using code optimization strategies to improve performance. (Cognitive Knowledge Level: Apply)	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

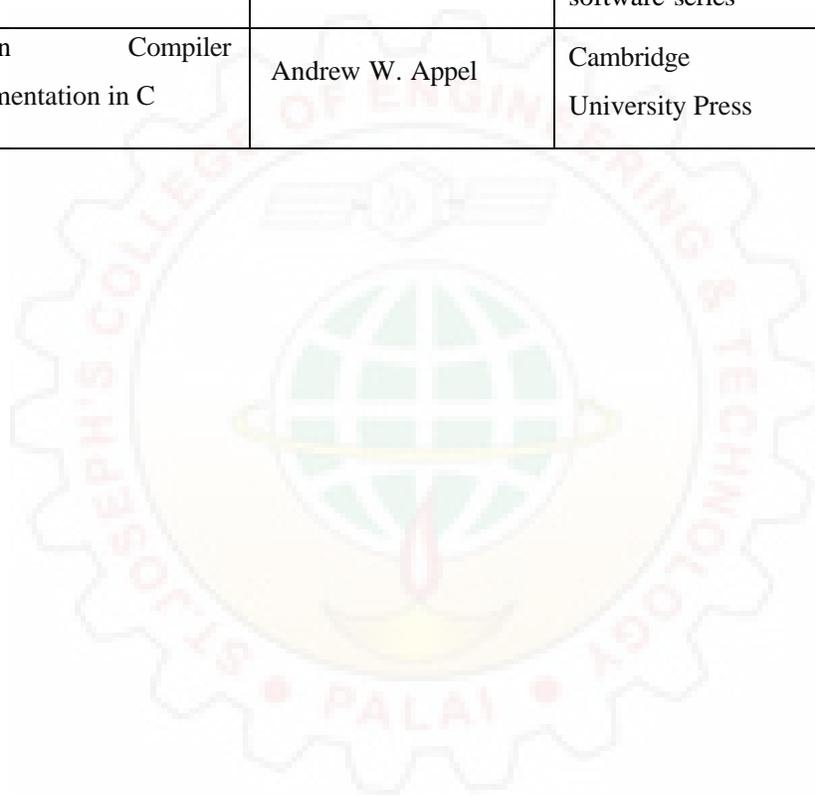
CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓						✓
CO2	✓	✓	✓		✓						✓
CO3	✓	✓	✓		✓						✓
CO4	✓	✓	✓		✓						✓
CO5	✓	✓	✓		✓						✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering a Compiler	Keith D. Cooper, Linda Torczon	Elsevier Science	3/e, 2023
2	Lex and YACC	John R. Levine, Tony Mason, Doug Brown	O' Reily	2/e, 1992

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Compilers – Principles Techniques and Tools	Aho A.V., Ravi Sethi and D. Ullman.	Addison Wesley,	2/e, 2010.
2	Compiler Construction - Principles and Practice	Kenneth C Louden	Thomson Learning	1/e, 2007
3	Compiler Design in C	Allen Holub	Prentice-Hall software series	1/e, 1990
4	Modern Compiler Implementation in C	Andrew W. Appel	Cambridge University Press	2/e, 2004



SEMESTER S6

ADVANCED COMPUTING SYSTEMS

Course Code	24SJPCST602	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	NA	Course Type	Theory

Course Objectives:

1. To introduce the computational models prevalent in modern distributed systems.
2. To provide the concepts of computer clusters, virtualization, cloud computing, microservices and containers.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Distributed System Models and Enabling Technologies:- The age of internet computing:- – High performance and high throughput computing, Centralized, Parallel, Distributed and Cloud Computing. Design objectives of HPC and HTC. IoT and Cyber Physical systems. Technologies for Network-Based systems:- Multicore CPUs and Multithreading Technologies. GPU Computing. Virtual Machines. System models for distributed and cloud computing:- Clusters, Grids, P2P Systems, Clouds.	7
2	Computer Clusters :- Clustering for massive parallelism:- Design objectives, Design Issues – Ensuring high availability, Cluster families. Cluster Architecture. GPU Clusters – Components. Computer Clusters – Design principles – Single System Image features. High availability through redundancy. Fault tolerant cluster configurations, checkpoint and recovery techniques. Cluster Job and Resource Management:- – Job Scheduling methods, Job management system – administration, job types, migration schemes.	11
3	Virtualization:- Introduction, Virtualization at different levels and their comparison. VMM design requirements, OS level virtualization. Virtualization structures and mechanisms. CPU, Memory and I/O Virtualization. Virtual clusters and resource management. Live VM migration steps, migration of memory, files and network resources.	9

4	<p>Cloud Computing, Microservices and Containers:- Cloud Computing and Service models:- Private, Public and Hybrid clouds. Cloud Design objectives and Cost Model. Infrastructure-as-a-Service, Platform-as-a-Service, Software-as-a-Service. Microservices:- – Introduction, advantages and disadvantages. Interprocess Communication – Types of interactions, Protocol, Standard and Message Format, Discovery Service, API Gateway, Service Registry Containers – Comparison of Virtual Machines and Containers. Introduction to Docker. Case Study - Docker Containers – Architecture, Components, Examples.</p>	9
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Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the key enabling technologies for network-based systems, including multicore CPUs, multithreading, GPU computing, and virtualization, and how these technologies contribute to the performance and efficiency of distributed systems.	K3
CO2	Use computer cluster architectures, ensuring high availability, fault tolerance, and massive parallelism. They will also learn to implement effective job and resource management strategies within cluster environments.	K4
CO3	Explain various levels of virtualization, including CPU, memory, and I/O virtualization, and understand the design requirements and mechanisms of Virtual Machine Monitors (VMMs).	K2
CO4	Articulate the differences between private, public, and hybrid cloud models, and understand the design objectives and cost considerations associated with different cloud models.	K4
CO5	Explain microservices architecture, its advantages and disadvantages, and the principles of interprocess communication. They will also learn about the role of containers in modern computing, with a specific focus on Docker, including its architecture, components, and practical applications through case studies.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓		✓							✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Distributed and Cloud Computing: From Parallel Processing to the Internet of Things	Kai Hwang, Geoffrey C. Fox, Jack Dongarra	Morgan Kaufmann	1/e, 2013
2	Microservices and Containers	Parminder Singh Kocher	Addison-Wesley	1/e, 2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Patterns of Distributed Systems	Unmesh Joshi	Pearson Education	1/e, 2024
2	Cluster Computing, Grid Computing, Cloud and Virtualization	Deepa Kalavikatte	DSK Publisher	1/e, 2020
3	Cloud and Distributed Computing: Algorithms and Systems	Rajiv Misra, Yashwant Singh Patel	Wiley	1/e, 2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc24_cs118/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs131/preview

SEMESTER S6

FUNDAMENTALS OF CYBER SECURITY

Course Code	24SJPBCST604	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To learn the security terminologies along with familiarization of web-based attacks and the vulnerability assessment tools for real time practices
2. To help learners to perform network analysis and learns the measures to handle security breaches at the system level

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Information Security Introduction, Threats to Information Systems, Cyber Security and Security risk analysis, Information Gathering- Reconnaissance, Recon, Software Vulnerabilities- Buffer Overflow, Stack Overflow, Format String, Vulnerability Assessment and Penetration Testing- Burpsuite, Metasploit.	10
2	Network Security: Network Security Terminologies, DoS, DDoS, ARP Spoofing and Session Hijacking, Capturing the Network Traffic- Promiscuous Mode, Flooding, DHCP Redirection, Redirection and Interception with ICMP. Port Scanning- TCP and UDP, Port Scanning Tools- Nmap, SuperScan, Wireshark- Analysing and Filtering Traffic	12
3	Web Security Web Attacks- SQL Injection Attacks, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), Domain Name System- Security Issues with DNS, DNS attacks, DNSSEC, OWASP ZAP, WebGoat, Damn Vulnerable Web Application (DVWA), Website Mirroring, HTRACK, Email Security- Email risks, Protocols, Operating safely when using email.	12
4	System Security: Windows Security: Attacks against windows system, Installing applications, Authentication and access control, Upgrades and Patches, Operating Windows safely, Windows Defender Firewall. Linux Security- Attacks in Linux system, Physical security, Controlling the configuration, Authentication and access control, Upgrades and Patches, Operating Linux safely, SELinux.	10

Suggestion on Project Topics

Network Traffic Monitoring and Analysis using Wireshark:

- Development: Capture network traffic in a controlled environment using Wireshark.
- Security Analysis & Fixing: Analyze captured traffic to identify potential vulnerabilities (e.g., plaintext passwords) and recommend security enhancements.

OWASP ZAP (Zed Attack Proxy) Security Testing Framework:

- Development: Create a web application with some common vulnerabilities.
- Security Analysis & Fixing: Use OWASP ZAP to perform security testing on the application, identify vulnerabilities, and then fix these issues by implementing secure coding practices.

Web Application Vulnerability Identification Using Burp Suite:

- Development: Develop a simple web application with common security flaws, such as SQL injection, XSS, and broken authentication mechanisms.
- Security Analysis & Fixing: Use Burp Suite to scan the application, identify vulnerabilities, and analyze the attack surface. Afterward, secure the application by fixing these vulnerabilities and re-running the scan to verify the fixes.

Penetration Testing Framework Using Metasploit:

- Development: Set up a vulnerable virtual environment using tools like Metasploitable or create your own vulnerable system or network services.
- Security Analysis & Fixing: Use Metasploit to exploit the system, demonstrate various attacks like privilege escalation, and then apply patches, configuration changes, and security best practices to mitigate the discovered vulnerabilities.

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks (8x2 =16 marks) 	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 subdivisions. Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Use assessment tools for vulnerability testing	K3
CO2	Use various security tools to study web based attacks	K3
CO3	Identify the network based attacks using network monitoring tools	K3
CO4	Illustrate the system security measures used for windows and Linux operating systems	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓						✓
CO2	✓	✓	✓		✓						✓
CO3	✓	✓	✓		✓						✓
CO4	✓	✓	✓		✓						✓
CO5	✓	✓	✓		✓						✓

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Build Your Own Security Lab	Michael Gregg	Wiley	1/e, 2008
2	Network security and Cryptography	B. Menezes	Cengage	1/e, 2010
3	Shellcoder's Handbook: Discovering and Exploiting Security Holes	Chris Anley, John Heasman, Felix Lindner, Gerardo Richarte	Wiley	2/e, 2007
4	Network Security Bible	Eric Cole, Ronald Krutz, James W Conley	Wiley	1/e, 2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cryptography and Network Security	Behrouz A Forouzan	Tata McGraw-Hill.	3/e, 2015
2	The Complete Reference: Information Security	Mark Rhodes-Ousley	McGraw-Hill	2/e, 2012

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs85/preview
3	https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
4	

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S6

DESIGN THINKING AND PRODUCT DEVELOPMENT

Course Code	24SJGAEST605	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	60
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To guide students through the iterative stages of design thinking, including empathizing with users, defining problems, ideating solutions and developing Proof of Concepts (PoC) and technical feasibility studies.
2. To promote the development of critical thinking skills by engaging students in integrative inquiry, where they ask meaningful questions that connect classroom knowledge with real-world applications.
3. To equip students with the ability to involve in product design considering the sustainability, inclusivity, diversity and equity aspects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of design thinking and product development: Overview of stages of product development lifecycle; Design thinking -Definition-Design thinking for product innovation; Bringing social impact in ideation-Identifying societal needs-understanding multi-faceted issues-community engagement and empathetic design- technological innovation meeting societal needs; Understanding and Bridging the divide using Human Centered Design (HCD); Designing for inclusivity in product development-embracing user diversity - Long term impact - sustainability encompassing environmental, economic and social dimensions; Technology Readiness Level in the Innovation Life-cycle; Performing a self-check on innovative ideas - Originality of idea-	6

	<p>understanding innovation landscape - patentability - understanding the economic landscape - Unique Selling Proposition (USP) - Repeatability and Manufacturability - Sustainability - Leveraging business models for comprehensive analysis</p>	
2	<p>Empathize: Design thinking phases; Role of empathy in design thinking; Methods of empathize phase - Ask 5 Why/ 5 W+H questions; Empathy maps - Things to be done prior to empathy mapping - Activities during and after the session; Understanding empathy tools - Customer Journey Map - Personas.</p> <p>Define: Methods of Define Phase: Storytelling, Critical items diagrams, Define success.</p>	6
3	<p>Ideation : Stages of ideation; Techniques and tools - Divergent thinking tools - Convergent thinking tools - Idea capturing tools; Cross-industry inspiration; Role of research in ideation - Market research - consumer research - leveraging research for informed ideation; Technological trends - navigating the technological landscape - Integrating emerging technologies; Feasibility studies - technical, economic, market, operational, legal, and ethical feasibility; Ideation session- techniques and tips.</p> <p>Proof of Concept (PoC): Setting objectives; Risk assessment; Technology scouting; Document and process management; Change management; Knowledge Capture; Validating PoC; Story telling in PoC presentation</p>	6
4	<p>Design: Navigating from PoC to detailed design; Developing Specification Requirement Document (SRD)/Software Requirement Specification (SRS); Design for manufacturability; Industrial standards and readability of code; Design to cost; Pre-compliance; Optimized code; Design Failure Mode and Effects Analysis (DFMEA); Forecasting future design changes.</p> <p>Prototyping: Alpha prototypes; Beta prototypes; Transition from design to prototype; Goals and expectations for Alpha and Beta prototypes; Effective strategies for maintaining timeline in prototyping; Testing and refining Alpha prototypes; Transitioning to Beta prototypes.</p> <p>Pilot build: Definition and purpose of a pilot build; setting objectives; Identification and selection of manufacturing partner for pilot build; Testing procedures in pilot build; Scaling from pilot build to full-scale production / implementation.</p>	6

	<p>Experiential Innovation Platforms: Hackathons and Ideathons - Definition, Features, Types, Benefits, Key Differences Between Hackathons and Ideathons</p> <p>(Reference: https://medium.com/@zettabyte_pte_ltd/whats-the-difference-between-a-hackathon-and-an-ideathon-263c37335847)</p>	
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignments	Internal Examination	Reflective Journal and Portfolio	Total
5	20	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Empathize to capture the user needs and define the objectives with due consideration of various aspects including inclusivity, diversity and equity	K5

CO2	Ideate using divergent and convergent thinking to arrive at innovative ideas keeping in mind the sustainability, inclusivity, diversity and equity aspects.	K5
CO3	Engage in Human Centric Design of innovative products meeting the specifications	K5
CO4	Develop Proof of Concepts (PoC), prototypes & pilot build of products and test their performance with respect to the Specification Requirement Document.	K4
CO5	Reflect on professional and personal growth through the learnings in the course, identifying areas for further development	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

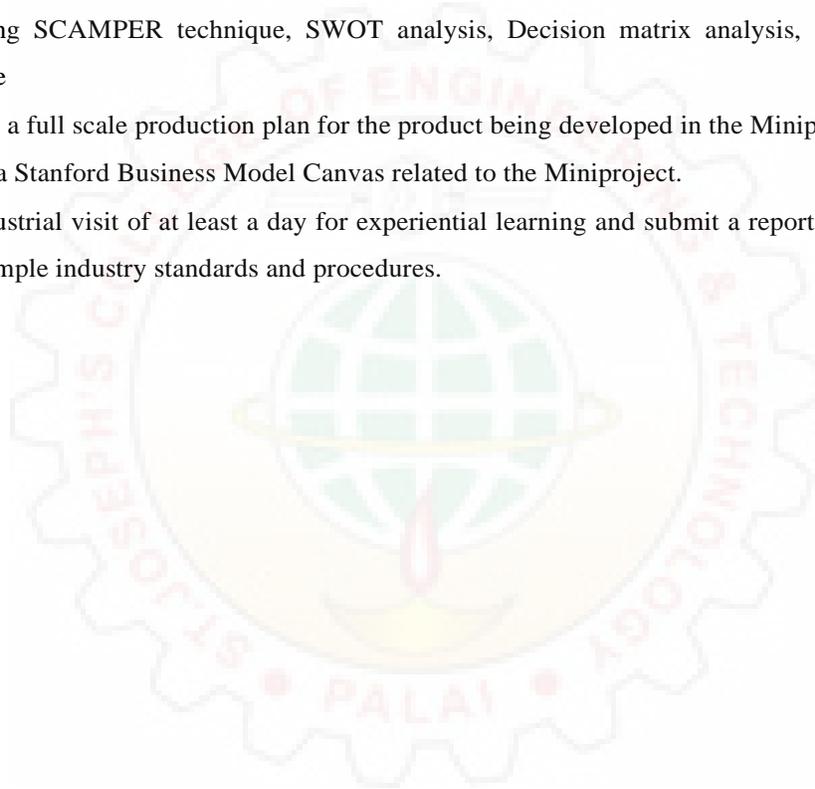
Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Product Sense: Engineering your ideas into reality	Dr. K R Suresh Nair	NotionPress.com	2024
2	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	Harper Collins Publishers Ltd.	2009
3	Design Thinking for Strategic Innovation	Idris Mootee	John Wiley & Sons Inc.	2013

Sample Assignments:

1. Evaluate and prepare a report on how the aspects including inclusivity, diversity and equity are taken into consideration during the empathize and define phases of the Miniproject course.

2. Evaluate and prepare a report on how the aspects including sustainability, inclusivity, diversity and equity are taken into consideration during the ideate phase of the Miniproject course.
3. Evaluate and prepare a report on how User-Centric Design (UCD) is used in the design and development of PoC of the product being developed in the Miniproject course.
4. Prepare a plan for the prototype building of the product being developed in the Miniproject course.
5. Report on the activities during the empathize phase including the maps & other materials created during the sessions.
6. Report on the activities during the define phase including the maps & other materials created during the sessions.
7. Report of all the ideas created during the ideation phase of the Miniproject course through the tools including SCAMPER technique, SWOT analysis, Decision matrix analysis, six thinking hats exercise
8. Prepare a full scale production plan for the product being developed in the Miniproject course.
9. Create a Stanford Business Model Canvas related to the Miniproject.
10. An industrial visit of at least a day for experiential learning and submit a report on the learnings, for example industry standards and procedures.



SEMESTER S6

SYSTEMS LAB

Course Code	24SJPCCSL607	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To introduce the fundamental concepts of compiler design, including lexical analysis, syntax analysis, and code generation.
2. To equip students with practical skills to design and implement the components of a compiler using tools like LEX and YACC.
3. To teach students the basic and advanced techniques of virtual machine instantiation and management using open-source hypervisors / public cloud platforms.

Expt. No.	Experiments
1	Design and implement a lexical analyzer using C language to recognize all valid tokens in the input program. The lexical analyzer should ignore redundant spaces, tabs and newlines. It should also ignore comments.
2	Write a lex program to display the number of lines, words and characters in an input text.
3	Generate a YACC specification to recognize a valid arithmetic expression that uses operators +, -, *, / and parenthesis.
4	Implementation of Calculator using LEX and YACC
5	Convert the BNF rules into YACC form and write code to generate abstract syntax tree.
6	Write a program to find First and Follow of any given grammar.
7	Design and implement a recursive descent parser for a given grammar.
8	Construct a Shift Reduce Parser for a given language.
9	Write a program to perform constant propagation.

10	Implement Intermediate code generation for simple expressions.
11	Implement the back end of the compiler which takes the three address code and produces assembly language instructions that can be assembled and run using a corresponding assembler. The target assembly instructions can be simple move, add, sub, jump etc.
12	Instantiation of VMs with image file using open-source hypervisors / public cloud platforms.
13	Virtual machine Cluster set up using open-source hypervisors / public cloud platforms.
14	Setting host name for virtual machine nodes in cluster and ssh set up for remote login.

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

Note: Students are instructed to submit only the fair record for both Continuous Internal Evaluation (CIE) and End Semester Examinations (ESE). Rough records are not required.

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.

Endorsement by External Examiner: The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement lexical and syntax analyzer using the tools LEX and YACC	K3
CO2	Develop Top-Down and Bottom-Up parsers.	K3
CO3	Implement intermediate code for expressions.	K3
CO4	Experiment with a cluster of virtual machines in a virtualized environment.	K3
CO5	Demonstrate the data sharing and communication between virtual machines.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓					✓	✓
CO2	✓	✓	✓	✓	✓				✓	✓	✓
CO3	✓	✓	✓	✓	✓				✓	✓	✓
CO4			✓	✓	✓				✓	✓	✓
CO5					✓				✓	✓	✓

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering a Compiler	Keith D. Cooper Linda Torczon	Katey Birtcher	3/e, 2023
2	Lex and Yacc	John R Levine, Tony Mason & Doug Brown	O'Reilly Media, Inc	2/e, 2013
3	Distributed and Cloud Computing: From Parallel Processing to the Internet of Things	Kai Hwang, Jack Dongarra, Geoffrey C. Fox	Morgan Kaufman	1/e, 2018
4	Virtual Machines	Manan Shah, Charusmita Shah	Lambert Academic Publishing	1/e, 2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Compilers Principles Techniques and Tools	Aho A Ravi Sethi and J D Ullman	Addison Wesley	2/e, 2013
2	Compiler Construction Principles and Practice	Kenneth C Louden	Cenage Learning Indian Edition	1/e, 2007
3	System programming and operating system	D M Dhamdhare	Tata McGraw Hill & Company	1/e, 2013
4	The Theory and Practice of Compiler Writing	Tremblay and Sorenson	Tata McGraw Hill & Company	1/e, 1985

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105190/
2	https://www.virtualbox.org/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 6
MINI PROJECT

Course Code	24SJPC CSP608	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:0:3	ESE Marks	50
Credits	2	Exam Hours	NA
Prerequisites (if any)	None	Course Type	Project

Preamble: The objective of this course is to apply the fundamental concepts of Computer Science principles for the effective development of an Socially relevant application/research project. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems. The students are expected to design and develop a software/hardware project to innovatively solve a real-world problem.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Identify technically and economically feasible problems of social relevance (Cognitive Knowledge Level: Apply)
CO2	Identify and survey the relevant literature for getting exposed to related solutions (Cognitive Knowledge Level: Apply)
CO3	Perform requirement analysis and identify design methodologies and develop adaptable and reusable solutions of minimal complexity by using modern tools and advanced programming techniques (Cognitive Knowledge Level: Apply)
CO4	Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)
CO5	Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Split-up of Continuous Internal Evaluation : 50 Marks

Attendance	05 marks
Project Guide	15 marks
Project Report	10 marks
Evaluation by the Committee	20 marks
Total	50 marks

(Will be evaluating the level of completion and completion of Functionality /specifications, presentation, oral examination, work knowledge and involvement)

Split-up of End Semester Examination: 50 Marks

The marks will be distributed as

Presentation	: 20 marks
Demonstration	: 20 marks
Viva	: 10 marks.
Total	: 50 marks.

Course Plan

Student Groups with 3 or 4 members should identify a topic of interest (Socially relevant) in consultation with Project Coordinator/Guide. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carry out the design/fabrication or develop codes/programs to achieve the objectives. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted with the Head of the Department or a senior faculty, Mini Project

coordinator and project guide as the members. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The product/application has to be demonstrated for its full design specifications.

Guidelines for the Report preparation

A bonafide report on mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 30.

- Use Times New Roman font for the entire Report – Chapter / Section Title –Times New Roman 18, Bold; Heading 2 – Times New Roman 16, Bold; Heading 3 – Times New Roman 14, Bold; Body- Times New Roman12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter / Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.
- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table
- Suggestive order of documentation:
 - i. Top Cover
 - ii. Title page
 - iii. Certification page
 - iv. Acknowledgement
 - v. Abstract
 - vi. Table of Contents
 - vii. List of Figures and Tables
 - viii. Chapters
 - ix. Appendices, if any
 - x. References/Bibliography



PROGRAM ELECTIVE III

SEMESTER S6

SOFTWARE TESTING

(Common to CS/CA/AD)

Course Code	24SJPECST631	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To Cultivate proficiency in software testing methodologies and techniques.
2. To Foster expertise in software testing tools and technologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Software Testing & Automation:- Introduction to Software Testing - Concepts, importance of testing, software quality, and real-world failures (e.g., Ariane 5, Therac 25); Software Testing Processes - Levels of thinking in testing; Testing Terminologies - Verification, validation, fault, error, bug, test cases, and coverage criteria; Types of Testing - Unit, Integration, System, Acceptance, Performance (stress, usability, regression), and Security Testing; Industry Trends - AI in test case automation, Introduction to GenAI in testing; Testing Methods - Black-Box, White-Box, and Grey- Box Testing; Automation in Testing - Introduction to automation tools (e.g., Selenium, Cypress, JUnit); Case Study- Automation of Unit Testing and Mutation Testing using JUnit.	8
2	Unit Testing, Mutation Testing & AI-Driven Automation:- Unit Testing- Static and Dynamic Unit Testing, control flow testing, data flow testing, domain testing; Mutation Testing- Mutation operators, mutants, mutation score, and modern mutation testing tools (e.g., Muclipse); JUnit Framework - Automation of unit testing, frameworks for testing in real-world projects; AI in Testing - GenAI for test case generation and optimization; Industry Tools - Application of AI-driven testing tools in automation and predictive testing; Case Study - Mutation testing using JUnit, AI-enhanced test case automation.	8

3	Advanced White Box Testing & Security Testing:- Graph Coverage Criteria - Node, edge, and path coverage; prime path and round trip coverage; Data Flow Criteria - du paths, du pairs, subsumption relationships; Graph Coverage for Code - Control flow graphs (CFGs) for complex structures (e.g., loops, exceptions); Graph Coverage for Design Elements - Call graphs,; Security Testing - Fundamentals, tools (OWASP, Burp Suite), and their role in protecting modern applications; Case Study - Application of graph based testing and security testing using industry standard tools.	10
4	Black Box Testing, Grey Box Testing, and Responsive Testing:- Black Box Testing - Input space partitioning, domain testing, functional testing (equivalence class partitioning, boundary value analysis, decision tables, random testing); Grey Box Testing - Introduction, advantages, and methodologies (matrix testing, regression testing, orthogonal array testing); Performance Testing - Network latency testing, browser compatibility, responsive testing across multiple devices (e.g., BrowserStack, LambdaTest); Introduction to PEX - Symbolic execution, parameterized unit testing, symbolic execution trees, and their application; GenAI in Testing - Advanced use cases for predictive and responsive testing across devices and environments; Case Study- Implementation of black-box, grey-box, and responsive testing using PEX and AI-driven tools.	10

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks (8x3 =24 marks) 	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Demonstrate the ability to apply a range of software testing techniques, including unit testing using JUnit and automation tools.	K2
CO2	Illustrate using appropriate tools the mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods.	K3
CO3	Explain and apply graph coverage criteria in terms of control flow and data flow graphs to improve code quality.	K2
CO4	Demonstrate the importance of black-box approaches in terms of Domain and Functional Testing	K3
CO5	Illustrate the importance of security, compatibility, and performance testing across devices.	K3
CO6	Use advanced tools like PEX to perform symbolic execution and optimize test case generation and also leverage AI tools for automated test case prediction and symbolic execution with PEX.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓						✓
CO2	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓	✓							✓
CO5	✓	✓	✓		✓						✓
CO6	✓	✓	✓	✓	✓						✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Software Testing.	Paul Ammann, Jeff Offutt	Cambridge University Press	2/e, 2016
2	Software Testing and Quality Assurance : Theory and Practice	Kshirasagar Naik, Priyadarshi Tripathy	Wiley	1/e, 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Software Testing	Ron Patten	Pearson	2/e, 2005
2	Software Testing: A Craftsman's Approach	Paul C. Jorgensen	CRC Press	4/e, 2017
3	Foundations of Software Testing	Dorothy Graham, Rex Black, Erik van Veenendaal	Cengage	4/e, 2021
4	The Art of Software Testing	Glenford J. Myers, Tom Badgett, Corey Sandler	Wiley	3/e, 2011

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/101/106101163/
2	https://archive.nptel.ac.in/courses/106/101/106101163/
3	https://archive.nptel.ac.in/courses/106/101/106101163/
4	https://archive.nptel.ac.in/courses/106/101/106101163/
5	https://junit.org/

SEMESTER S6
DEEP LEARNING

Course Code	24SJPECST632	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	NA	Course Type	Theory

Course Objectives:

1. To give the learner an understanding about the foundations of Deep Learning architecture and applications
2. To equip the learner with the necessary skills to set-up neural network architecture and use it for real time problem solution.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient descent, Curse of Dimensionality, Deep feedforward networks.	8
2	Machine Learning and Deep learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications.	9
3	CNN-Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, Alexnet – Applications. Recurrent Neural Networks, Bidirectional RNNs, Encoder – decoder sequence to sequence architectures – BPTT for training RNN, Long Short Term Memory Networks.	10
4	Computer Vision - Speech Recognition - Natural language Processing, Case studies in classification, Regression and deep networks. Regularized Autoencoder, stochastic Encoders and Decoders, Contractive Encoders. GAN and its variants, Transfer Learning Techniques and Applications.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Construct fundamental neural network architectures and algorithms, including Multilayer Perceptron and Back-propagation and address the Curse of Dimensionality in the context of deep learning models.	K3
CO2	Apply machine learning and deep learning techniques, including representation learning, activation functions, and unsupervised models like RBMs and autoencoders.	K3
CO3	Build various deep learning architectures, including feed-forward networks, Convolutional Neural Networks (CNNs) and RNNs and their applications in real-world problems.	K3
CO4	Apply unsupervised learning techniques such as Autoencoders and Generative Adversarial Networks (GANs) to solve complex problems in computer vision and speech recognition.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓						✓
CO2	✓	✓	✓		✓						✓
CO3	✓	✓	✓		✓		✓				✓
CO4	✓	✓	✓		✓						✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	1/e, 2016
2	Neural Networks and Deep Learning	Michael A. Nielsen	Determination Press,	2/e, 2015
3	Learning Deep Architectures for AI	Yoshua Bengio	Now Publishers Inc	1/e, 2009
4	Deep Learning: A Practitioner's Approach	Josh Patterson, Adam Gibson	O'Reilly	1/e, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks	Umberto Michelucci	Apress	1/e, 2018
2	Deep Learning with Keras	Antonio Gulli, Sujit Pal	Packt	1/e, 2017
3	Deep Learning with Python	Francois Chollet	Manning	1/e, 2017
4	Deep Learning	M Gopal	Pearson	1/e, 2022
5	The Science of Deep Learning	Iddo Drori	Cambridge Univeristy Press	1/e, 2021

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106105215 (Week 4)
2	https://nptel.ac.in/courses/106105215 (Week 5)
3	https://nptel.ac.in/courses/106105215 (Week 8)
4	https://nptel.ac.in/courses/106105215 (Week 10,11 and 12)



SEMESTER S6

WIRELESS AND MOBILE COMPUTING

Course Code	24SJPECST633	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To enable the learners to acquire advanced concepts on wireless communication systems and mobile ad-hoc networks.
2. To impart the basics of mobile computing, architecture of wireless transmission systems and next generation networks
3. To Learn the communication protocols, various architectures and security features used in mobile computing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Wireless LAN – Advantages, Design Goals, and Applications, Modes – Infrastructure vs. Ad-hoc, IEEE 802.11 System and Protocol Architecture and Standards (a/b/g/n/ac), Physical Layer and MAC Layer, Wi-Fi Direct, Bluetooth and Bluetooth Low Energy (BLE), Overview of IoT Wireless Technologies – ZigBee and LoRa.	9
2	Introduction to mobile computing – Functions, Middleware and Gateways, Application and services. Mobile computing architecture – Internet: The Ubiquitous network, Three-tier architecture for Mobile Computing, Design considerations for mobile computing, Cloud and Edge Support for Mobile Computing.	8
3	Spread spectrum – Direct sequence, Frequency hopping. Medium Access Control – Space Division Multiple Access (SDMA), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA). Satellite Systems – Basics, Applications, Geostationary Earth Orbit (GEO), Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Routing, Localization, Handover. Telecommunication Systems - Global System for Mobile Communication (GSM), LTE, and 5G Overview.	9

4	Mobile network layer – Mobile Internet Protocol (IP), Dynamic Host Configuration Protocol (DHCP), Mobile ad-hoc networks – Routing, Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV), Ad-hoc routing protocols; Mobile transport layer – Traditional Transmission Control Protocol (TCP), Improvements in Classical TCP; Security issues in mobile computing - Information security, Security techniques and algorithms, Security models.	10
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Explain the various mobile computing applications, services, design considerations and architectures	K2
CO2	Describe the various technology trends for next generation cellular wireless networks and use the spreading concept on data transmission	K2
CO3	Summarize the architecture of various wireless LAN technologies	K2
CO4	Identify the functionalities of mobile network layer & transport layer and various security issues in mobile computing	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

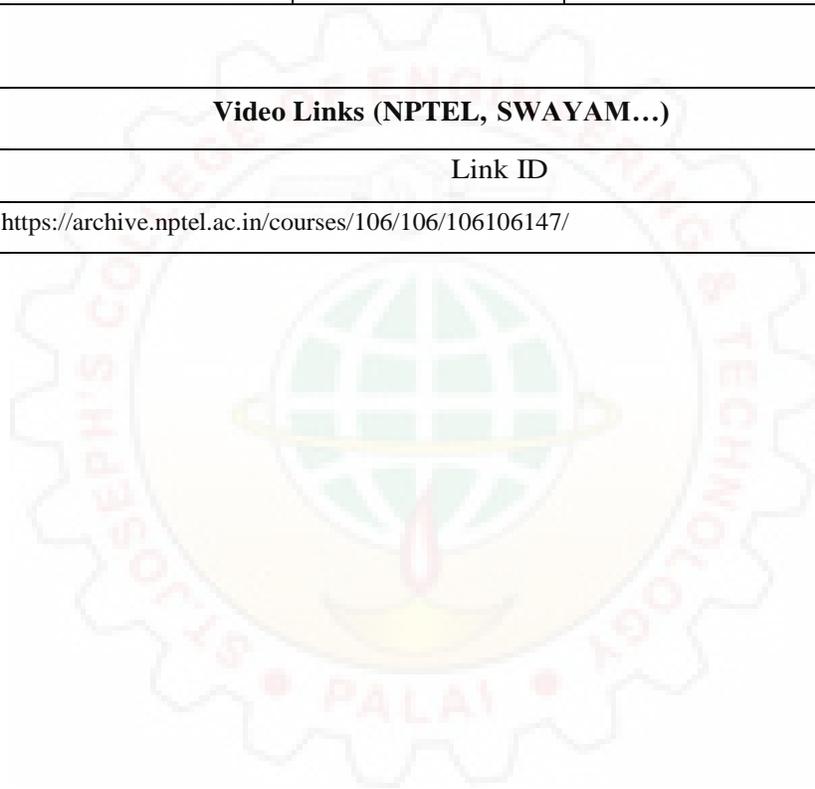
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓								✓
CO5	✓	✓	✓								✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mobile Computing Technology - Application and Service Creation	Asoke K. Talukder, Hasan Ahmad, Roopa R Yavagal	McGraw Hill	2/e, 2010
2	Mobile Communications	Jochen Schiller	Pearson	2/e, 2000
3	Fundamentals of 5G Mobile Networks	Jonathan Rodriguez	Wiley	1/e, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mobile Computing	Raj Kamal	Oxford University Press	2/e, 2011
2	Computer Networks,	Andrew S. Tanenbaum	PHI	3/e, 2003
3	Wireless Communications Principles and Practice	Theodore S. Rappaport	PHI	2/e, 2004
4	Fundamentals of Networking and Communication	Curt M. White	Cengage learning	7/e, 2013

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/106/106/106106147/



SEMESTER S6

ADVANCED DATABASE SYSTEMS

(Common to CS/ AD)

Course Code	24SJPECST634	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs: 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To learn the fundamentals of data modeling, query processing, and design in advanced databases and study the working principles of distributed databases.
2. To learn emerging databases such as XML and NoSQL.
3. To enable the student to use tools, methodologies, and skills for working successfully with databases in today's global, data driven business model.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Query Processing and Optimization - Measures of query cost, Algorithms for Selection with cost analysis, Algorithms for Join with cost analysis, Evaluation of expressions; Heuristics in Query Optimization - Optimization of Relational Algebra expressions; Physical Database Design and Tuning - Introduction to Physical Database Design, Overview of Database Tuning, Tuning the Conceptual Schema, Tuning Queries and Views.	9
2	Distributed Databases - Distributed Systems, Introduction, Architecture, Distributed Database Concepts, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control; Query Processing and Decomposition - Query Processing Objectives, Characterization of Query Processors, Layers of Query Processing, Query Decomposition, Localization of Distributed Data.	9
3	XML and Non Relational Databases - Introduction to Semi Structured Data and XML Databases, XML Data Model – XSD, and XML Schema, XML Presentation, XPath Queries, XQuery; NoSQL Databases - CAP Theorem, Document based; MongoDB Operation - Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding, Deployment; Cassandra - Data Model, Key Space, Table Operations, CRUD Operations.	9

4	Graph database - Introduction, Data Modelling with Graphs, Building a Graph Database application, Data Modeling, Predictive Analysis with Graph Theory; Depth and Breadth First Search; Path-Finding with Dijkstra's Algorithm; Graph Theory and Predictive Modeling	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Apply various measures for query processing and optimization, and apply techniques to tune database performance.	K3
CO2	Explain the architecture and fundamental concepts of distributed databases.	K2
CO3	Utilize semi-structured data, XML, and XML queries for effective data management	K3
CO4	Utilize NoSQL database systems to manage and manipulate data in real-time applications	K3
CO5	Develop advanced skills in graph database concepts, covering data modeling, application building, and the application of graph theory for predictive analysis and modeling.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓		✓						✓
CO4	✓	✓	✓		✓						✓
CO5	✓	✓	✓		✓				✓	✓	✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Database Systems	Ramez Elmasri, Shamkant B. Navathe	Pearson	7/e, 2017
2	Database System Concepts	A. Silberschatz, H. Korth, S. Sudarshan	McGraw-Hill	7/e, 2021
3	Database Management Systems	R. Ramakrishnan, J. Gehrke	McGraw Hill	3/e, 2018
4	Graph Databases	Ian Robinson, Jim Webber & Emil Eifrem	O'Reilly	2/e, 2015
5	Database Systems	T. M. Connolly, C. Begg	Pearson	6/e, 2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data	W. Lemahieu, S. vanden Broucke and B. Baesens	Cambridge University Press	1/e, 2018
2	Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems	M. Kleppmann	O'Reilly	1,e2017
3	Database Systems: The Complete Book	Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom	Prentice Hall	2/e, 2009
4	Next generation databases: NoSQL, newSQL, and big data. Apres.	Guy Harrison	Apress	1/e, 2015
5	Foundations of Multidimensional and Metric Data Structures	Hanan Samet	Morgan Kaufmann	1/e, 2006

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	CAP Theorem https://nptel.ac.in/courses/106104189
2	Advanced database Queries https://archive.nptel.ac.in/courses/106/104/106104021
3	Database design https://archive.nptel.ac.in/courses/106106093/
4	Introduction to modern application development https://archive.nptel.ac.in/courses/106/106/106106156



SEMESTER 6

DIGITAL IMAGE PROCESSING

(Common to CS/CA)

Course Code	24SJPECST636	CIE Marks	40
Teaching Hours/Week (L:T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide foundational concepts of digital image representation, processing, and analysis, including image digitization, color theory, and various data structures, to effectively manipulate and analyze digital images.
2. To help the learner develop the ability to implement advanced image processing techniques, such as image segmentation, edge detection, and image compression, while critically evaluating the performance and quality of these methods in practical applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	The image, its representation and properties - Image representations, Image digitization, Sampling, Quantization, Digital image properties, Metric and topological properties of digital images, Histograms, Entropy, Visual perception of the image, Image quality, Noise in images; Color images - Physics of color, Color perceived by humans, Color spaces, Color constancy; Data structures for image analysis - Levels of image data representation, Traditional image data structures - matrices, Chains, Topological data structures - Relational structures, Hierarchical Data Structures, Pyramids, Quadtrees, Other pyramidal structures.	9
2	Image pre-processing - Pixel brightness transformations-, Position-dependent brightness correction, Gray-scale transformation, Geometric Transformations - Pixel coordinate transformations, Brightness interpolation. Local pre-processing, Image Smoothing, Edge detectors, Zero-crossings the second derivative, Scale in Image Processing, Canny Edge Detection, Parametric Edge Models, Edges Multi-spectral images, Line detection by local pre-processing operators, Detection of corners(interest points), Image Restoration - Degradations that are easy to restore, Inverse Filtering, Wiener Filtering	8

3	Image Segmentation - Thresholding, Threshold Detection Methods-Optimal thresholding, Multi-spectral thresholding, Edge-based segmentation, Edge Image Thresholding, Edge Relaxation, Border Tracing, Border Detection As Graph Searching, Border Detection As Dynamic Programming, Hough Transforms, Border Detection Using Border location information, Region construction from borders, Region-based segmentation - Region merging, Region Splitting - Splitting and Merging, Watershed segmentation Matching, Template Matching, Control Strategies Templating, Evaluation Issues In Segmentation	9
4	Image Transforms - Discrete Cosine Transform, Wavelet transform, Eigen- analysis, Singular value decomposition, Principal component analysis Radon Transform; Image Compression - Image data Properties, Discrete Image Transforms in Image data compression, Predictive compression methods, Vector quantization, Hierarchical and Progressive Compression methods, Comparison of Compression Methods, JPEG and MPEG image compression JPEG still image compression, JPEG-2000 compression, MPEG full-motion video compression.	10

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 Marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)
At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Understand the properties of monochrome and colour images and the data structures for image analysis	K2
CO2	Apply different preprocessing techniques to visualize image enhancement	K3
CO3	Understand the concept of image segmentation and various techniques used	K2
CO4	Understand the various transforms used for image processing	K2
CO5	Understand the concept of image compression and apply various image compression techniques	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓							✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Image Processing, Analysis and Machine Vision	Milan Sonka, Vaclav Hlavac, Roger Boyle	Cengage	4/e, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Digital Image Processing	Anil K. Jain	Pearson	1/e, 2015
2	Digital image Processing	Ralph Gonzalez, Richard Woods	Pearson	4/e, 2018
3	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	McGraw Hill	2/e, 2020

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/117/105/117105135/
2	https://archive.nptel.ac.in/courses/106/105/106105032/



SEMESTER S6

FUNDAMENTALS OF CRYPTOGRAPHY

(Common to CS/AD)

Course Code	24SJPECST637	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To develop a foundational understanding of mathematical concepts in cryptography,
2. To gain comprehensive knowledge of cryptographic methods.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Number Theory - Divisibility and The Division Algorithm, The Euclidean Algorithm, Modular Arithmetic : The Modulus, Properties of Congruences, Modular Arithmetic Operations, The Extended Euclidean Algorithm, Primitive Roots, Existence of Primitive Roots for Primes, Fermat's Theorem, Euler's Totient Function, Euler's Theorem, Testing for Primality : Miller–Rabin Algorithm, A Deterministic Primality Algorithm, Discrete Logarithms, Chinese Remainder Theorem.	10
2	Security Attacks; Security Services; Security Mechanisms; Fundamental Security Design Principles; Cryptography - Symmetric Cipher Model, Substitution Techniques, Transposition techniques; Traditional Block Cipher Structure.	8
3	The Data Encryption Standard - DES Encryption & Decryption, Avalanche Effect, Strength of DES; Advanced Encryption Standard - AES Structure; Stream Ciphers; RC4; Principles of Public-Key Cryptosystems – Public - Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, The RSA Algorithm, Description of the Algorithm; Diffie–Hellman Key Exchange.	10

4	Cryptographic Hash Functions - Applications of Cryptographic Hash Functions, Secure Hash Algorithm (SHA), SHA-3; MAC; MD5; Digital Signatures. Key Management and Distribution - Symmetric Key Distribution; X.509 certificates; PKI.	8
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply number theory concepts in data security	K3
CO2	Explain the cryptographic concepts and apply the classical encryption methods for data confidentiality	K3
CO3	Describe the symmetric and asymmetric ciphers used for information security	K2
CO4	Explain the algorithms used for authentication and integrity	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓							✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓								✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cryptography & Network Security: Principles and practice	William Stallings	Pearson	7/e, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cryptography & Network Security	Behrouz A. Forouzan	McGraw Hill	3/E, 2007
2	Security in Computing	Charles P. Pfleeger, Shari L. Pfleeger, Jonathan Margulies	Prentice Hall	5/e, 2015
3	A Classical Introduction to Cryptography: Applications for Communications Security	S. Vaudenay	Springer	1/e, 2009
4	Introduction to Cryptography: Principles and Applications	H. Delfs, H. Knebl	Springer-Verlag	1/E, 2002
5	A Computational Introduction to Number Theory and Algebra	Victor Shoup	Cambridge University Press	2/e, 2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/111/101/111101137/
2	https://nptel/courses/video/106105031/L17.html
3	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

SEMESTER S6

QUANTUM COMPUTING

(Common to CS/AD)

Course Code	24SJPECST638	CIE Marks	40
Teaching Hours/Week (L:T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To give an understanding of quantum computing against classical computing.
2. To understand fundamental principles of quantum computing, quantum algorithms and quantum information.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of Basics Concepts Review of linear algebra, Principles of quantum mechanics, Review of Information theory, Review of Theory of Computation-Models for computation, The analysis of computational problems [Text 1 - Ch 1, 2; Text 2-Ch 3.1,3.2,11.1,11.2]	9
2	Introduction to Quantum Information Qubit – Bloch sphere representation, Multiple qubit states, Quantum logic gates – single qubit and multi-qubit, Quantum circuits, Density operator, Quantum entanglement. [Text 1 - Ch 3, 4; Text 2 – Ch 2.4, 4]	9
3	Quantum Algorithms: - Simple Quantum Algorithms, Quantum Integral Transforms, Grover's Search Algorithm and Shor's Factorization Algorithm. [Text 1 - Ch 5,6,7,8]	9
4	Quantum Communication: - Von Neumann entropy, Holevo Bound, Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels, Quantum Key Distribution. [Text 2 - Ch 11.3, Ch 12.1 - 12.6]	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course, students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Explain the concept of quantum computing against classical computing.	K2
CO2	Illustrate various quantum computing algorithms.	K2
CO3	Explain the latest quantum communication.	K2
CO4	Experiment with new algorithms for quantum computing.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								✓
CO2	✓	✓	✓								✓
CO3	✓	✓	✓								✓
CO4	✓	✓	✓								✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Quantum Computing : From Linear Algebra to Physical Realizations	Mikio Nakahara Tetsuo Ohmi	CRC Press	1/e, 2008
2	Quantum Computation and Quantum Information	Michael A. Nielsen & Isaac L. Chuang	Cambridge University Press	1/e, 2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Quantum Computing for Programmers	Robert Hundt	Cambridge University Press	1/e, 2022
2	Quantum Computing for Everyone	Chris Bernhardt	MIT Press	1/e, 2020
3	An Introduction to Practical Quantum Key Distribution [paper]	Omar Amer Vaibhav Garg Walter O. Krawec	IEEE Aerospace and Electronic Systems Magazine	March 2021
4	Quantum communication [paper]	Nicolas Gisin & Rob Thew	Nature Photonics	March 2007

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/106/106/106106232/
2	https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-cy31/

SEMESTER S6

SOCIAL ENGINEERING AND HUMAN CENTRIC THREATS

Course Code	24SJPECST639	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Create personal awareness and social responsibility towards the society
2. Equip students on social competencies to become self-reliant, resourceful and industrious
3. Gain knowledge on social entrepreneurship and design social business plan
4. Apply knowledge, passion and skills in the pursuit of humanitarian goals

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Social Engineering Fundamentals Introduction to Social Engineering –Importance – Social Ethics – Vision & Mission towards society – Social Change – Individual Social Responsibility (ISR), UNSDGs – Relevance & impact of SDGs	8
2	Psychological principles Trust, authority, reciprocity, scarcity, fear, urgency; Attack vectors: phishing, spear phishing, vishing, smishing, whaling, impersonation, pretexting, baiting, pretexting, tailgating; Human error as a vulnerability. Case studies of major social engineering breaches	8
3	Human-Centric Threats Insider threats: malicious insiders, negligent insiders, compromised insiders, Behavioural and cognitive biases in cybersecurity, Social media exploitation and online profiling, Human factor in password security and authentication. Threat landscape: corporate, government, and personal domains	8
4	Detection and Mitigation Identifying social engineering attempts, Security awareness programs and training methods, Technical defences vs. human defences, Role of policies, access control, and incident response, Ethical, legal, and societal implications of human-centric threats	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24 marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamentals of social engineering and its psychological underpinnings.	K2
CO2	Analyze different types of human-centric threats and their impacts.	K3
CO3	Evaluate case studies of real-world social engineering incidents.	K3
CO4	Design mitigation techniques to reduce risks from social and insider threats.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓				✓	✓				✓
CO2	✓	✓		✓		✓	✓				✓
CO3	✓	✓		✓	✓	✓	✓		✓		✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Social Engineering: The Science of Human Hacking	Christopher Hadnagy	Wiley	2018
2	The Art of Deception: Controlling the Human Element of Security	Kevin D. Mitnick & William L. Simon	Wiley	2002

Reference Book				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Social Engineering: The Art of Human Hacking	Christopher Hadnagy	Wiley	2011

SEMESTER 6

CLOUD COMPUTING

(Common to CS/CA)

Course Code	24SJPECST635	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To learn fundamentals of cloud and configure cloud environments, deploy virtual machines, and work with containerization tools, gaining practical skills.
2. To learn to identify and address common security threats in cloud environments, implementing best practices to ensure the safety and compliance of applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - Limitations of Traditional Computing & solution, Three Layers of Computing, Factors behind Cloud Service Adoption; Evolution and Enabling Technologies of Cloud; Benefits and Challenges; [Text 2] Fundamental Concepts and Models - Roles and Boundaries, Cloud Characteristics, Cloud Delivery Model (-Infrastructure-as-a-Service (IaaS), Platform-as-a-Service(PaaS),Software-as-a-Service(SaaS),XaaS (Anything-as-a-service)), Cloud Deployment Models-(Public cloud, Community cloud, Private cloud, Hybrid cloud.) [Text 1] Introduction to Cloud Providers (AWS, Azure, Google Cloud). Hands on - Cloud Account Setup and Virtual Machine Deployment - Create accounts on a cloud provider and deploy virtual machine instances, and document the process and inferences.	8
2	Cloud-Enabling Technology - Networks and Internet Architecture, Cloud Data Center Technology, Modern Virtualization, Multitenant Technology, Service Technology and Service APIs; Understanding Containerization - Influencers, Fundamental Virtualization and Containerization, Understanding Container Images, Multi-Container Types. [Text 1] Hands on - Hypervisor and Containers installation - Install hypervisors and deploy VMs on local machines.	10

3	Resource Management - Resource Pooling, Sharing, Provisioning; Scaling in Cloud and the Strategies; Storage and File System - Challenges; Cloud Native File System, Deployment models, Storage Types, Popular Cloud Storages. Map Reduce – Hadoop Library from Apache, HDFS, Pig Latin High Level Languages, Apache Spark [Text 2] Hands on - Use Map-reduce to implement basic big data applications such as word count.	9
4	Understanding Cloud Security - Basic Security Terminology, Basic Threat Terminology, Threat Agents, Common Threats; Other Considerations - Flawed Implementations, Security Policy Disparity, Contracts, Risk Management. [Text 1] Hands on : Identify possible attacks of any selected cloud applications and suggest/implement solutions/policies for mitigation.	7

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Ways of assessing at

1. Analyze level - Analyze performance of traditional models (Hardware, Application, Computing / security models) against that in the cloud.
2. Evaluate level - Derive conclusions on the cloud programming / computing / security models based on standard performance evaluation criteria.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks) 	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. Each question carries 9 marks. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Evaluate the limitations of traditional computing models and recognize the factors driving cloud service adoption and compare between various cloud delivery and deployment models.	K5
CO2	Demonstrate proficiency in cloud-enabling technologies, including modern virtualization and containerization	K3
CO3	Examine the resource management within the cloud, including resource pooling, scaling strategies, and storage management and utilize tools like MapReduce for processing big data applications.	K4
CO4	Identify potential security threats in cloud environments and apply appropriate security measures to mitigate these risks.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓						✓
CO2	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓							✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cloud Computing: Concepts, Technology, Security, and Architecture	Thomas Erl	Pearson	2/e, 2023
2	Cloud Computing	Sandeep Bhowmik	Cambridge University Press	1/e, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cloud Computing : Theory and Practice	Dan C. Marinescu	Morgan Kaufman	3/e, 2023
2	Cloud Computing: A Hands-On Approach	Arshdeep Bahga and Vijay Madisetti	Universities Press	1/e, 2014
3	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola S.Thamarai Selvi	Morgan Kaufman	1/e, 2013
4	Cloud Computing : A Practical Approach	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter	McGraw Hill	1/e, 2010

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105167/

SEMESTER 6

MOBILE APPLICATION DEVELOPMENT

(Common to CS/CA)

Course Code	24SJPECST630	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To equip students with a thorough understanding of mobile application development fundamentals, including platforms (iOS and Android) and architectures (MVC, MVVM, BLoC).
2. To instill proficiency in Flutter and Dart: Enable students to use Flutter effectively for cross-platform development and the Dart programming language to create responsive, user-friendly mobile applications.
3. To prepare students for real-world scenarios by teaching app security, testing, CI/CD, and deployment processes, culminating in the development and deployment of a complete mobile application project.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of Mobile Application Development: Introduction to Mobile Application Development, Overview of Mobile Platforms: iOS and Android, Introduction to Flutter: History, Features, and Benefits, Setting Up the Flutter Development Environment, Mobile App Architectures (MVC, MVVM, and BLoC), Basics of Dart Programming Language, Introduction to Git and Version Control Assignments/Projects: Set up the Flutter environment and create a simple "Hello World" application. (<i>Use Git: cloning, committing, pushing, and pulling</i>) <i>Milestone 1: Develop a basic app with a simple UI and basic functionality.</i>	9

2	<p>User Interface Design and User Experience: Principles of Mobile UI/UX Design, Designing Responsive UIs with Flutter, Using Flutter Widgets: StatelessWidget and StatefulWidget, Layouts in Flutter: Container, Column, Row, Stack, Navigation and Routing in Flutter, Customizing UI with Themes and Styles, Introduction to Material Design and Cupertino Widgets</p> <p>Assignments/Projects: Design and implement a user interface using Flutter widgets. <i>Milestone 2:</i> Enhance the project from Module 1 with a multi-screen UI, navigation, and customized themes.</p>	9
3	<p>Advanced Flutter Development: State Management in Flutter: Provider, Riverpod, and BLoC Networking in Flutter: HTTP Requests, JSON Parsing, RESTful APIs Data Persistence: SQLite, SharedPreferences, Hive Asynchronous Programming with Dart: Futures, async/await, and Streams Integrating Device Features: Camera, GPS, Sensors Working with Firebase: Authentication, Firestore, Cloud Functions</p> <p>Assignments/Projects: Develop an app with state management and data persistence. <i>Milestone 3:</i> Enhance the project with state management, data persistence, and integration with a RESTful API or Firebase.</p>	9
4	<p>Industry Practices and App Deployment: Advanced UI Components and Animations, App Security Best Practices, Testing and Debugging Flutter Applications, Continuous Integration/Continuous Deployment (CI/CD) with Flutter, Publishing Apps to Google Play Store and Apple App Store, Industry Trends and Future of Mobile Development with Flutter</p> <p>Assignments/Projects: Add advanced UI components and animations to the project, Implement security measures in the Flutter application, Conduct thorough testing and debugging of the developed app. <i>Milestone 4:</i> Complete the project, integrating all features and preparing it for deployment.</p>	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Analyze

Key Actions: Differentiate, Organize, Attribute

Metrics and Examples:

1. Code Review and Refactoring:

- a. Task: Students are given a piece of code to analyze and refactor for better performance or readability.
- b. Metric: Ability to identify inefficient or redundant code and provide optimized solutions.

Example: Analyzing a complex UI widget tree and reorganizing it for better performance and maintainability.

2. Design Pattern Identification:

- a. Task: Students are asked to identify and apply appropriate design patterns for given scenarios.
- b. Metric: Correct identification and application of design patterns like Singleton, Factory, or BLoC in their projects.

Example: Analyzing an app's state management needs and choosing between Provider and BLoC patterns.

3. Bug Diagnosis:

- a. Task: Students are given a buggy piece of code to analyze and debug.
- b. Metric: Ability to use debugging tools and techniques to locate and fix bugs.

Example: Analyzing asynchronous code to identify and resolve race conditions or memory leaks.

Evaluate

Key Actions: Check, Critique, Judge

Metrics and Examples:

1. Code Quality Assessment:

- a. Task: Students review each other's code and provide constructive feedback.
- b. Metric: Ability to critically evaluate code quality based on readability, efficiency, and adherence to best practices.

Example: Peer review sessions where students critique the structure and efficiency of each other's Flutter code.

2. UI/UX Design Evaluation:

- a. Task: Students evaluate the user interface and user experience of their peers' applications.
- b. Metric: Ability to judge UI/UX designs based on usability, accessibility, and aesthetics.

Example: Conducting usability testing sessions and providing feedback on navigation flow, design consistency, and user engagement.

3. Project Presentation and Defense:

- a. Task: Students present their projects and justify their design and implementation choices
- b. Metric: Ability to articulate design decisions, defend architectural choices, and respond to critical questions.

Example: End-of-module presentations where students explain their choice of state management, navigation strategy, and performance optimizations.

Integration into the Syllabus - Example Use Cases

Basic Mobile Application Development

- Analyze: Evaluate different mobile app architectures (MVC, MVVM, BLoC) and choose the best fit for a given project scenario.
- Evaluate: Critically assess the setup and configuration of the Flutter development environment for potential improvements.

User Interface Design and User Experience

- Analyze: Analyze the responsiveness and usability of designed UIs, identifying potential bottlenecks.
- Evaluate: Critique the effectiveness of navigation and routing within the app.

Advanced Flutter Development

- Analyze: Break down the integration process of advanced features (state management, networking) and evaluate their impact on app performance.
- Evaluate: Judge the robustness of data persistence solutions and asynchronous programming implementations.

Industry Practices and App Deployment

- Analyze: Analyze the app's security measures and their effectiveness in protecting user data.
- Evaluate: Evaluate the completeness and readiness of the app for deployment based on industry standards and best practices.

Example Evaluation Rubrics

Analyze:

Criterion	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Identification of Code Inefficiencies	Identifies all inefficiencies and provides optimal solutions	Identifies most inefficiencies and provides good solutions	Identifies some inefficiencies with basic solutions	Struggles to identify inefficiencies or provide solutions
Application of Design Patterns	Correctly applies design patterns with a clear rationale	Applies design patterns with minor issues	Applies design patterns with significant issues	Incorrectly applies or fails to apply design patterns

Evaluate:

Criterion	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Code Quality Assessment	Provides thorough, insightful feedback with constructive suggestions	Provides good feedback with some constructive suggestions	Provides basic feedback with limited constructive suggestions	Provides minimal or unhelpful feedback
UI/UX Design Evaluation	Provides detailed critique with actionable insights	Provides good critique with some actionable insights	Provides basic critique with limited actionable insights	Provides minimal or no critique

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 =24marks) 	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain mobile application development using Flutter and different mobile platforms.	K2
CO2	Apply principles of effective mobile UI/UX design, Create responsive user interfaces using Flutter features.	K3
CO3	Experiment effectively with state in Flutter application, networking and data persistence.	K4
CO4	Apply security best practices in mobile app development, test, and debug Flutter applications effectively.	K5
CO5	Set up CI/CD pipelines for Flutter projects and deploy mobile apps to Google Play Store and Apple App Store.	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓	✓						✓
CO5	✓	✓	✓	✓	✓						✓

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Flutter Cookbook	Simone Alessandria	Packt	2/e, 2023
2	Flutter for Beginners	Alessandro Biessek	Packt	1/e, 2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Flutter in Action	Eric Windmill	Manning	1/e, 2019
2	Flutter and Dart: Up and Running	Deepti Chopra, Roopal Khurana	BPB	1/e, 2023
3	Managing State in Flutter Pragmatically	Waleed Arshad	Packt	1/e, 2021
4	Ultimate Flutter Handbook	Lahiru Rajeendra Mahagamage	Orange House	1/e, 2023

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://www.youtube.com/watch?v=VPvVD8t02U8