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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

VI Semester

Scheme & Syllabus of B.E. Programme

Artificial Intelligence and Data Science

(2024 Scheme)

Core Values

Spiritual, **J**udicious, **C**ommitment, **I**ntegrity, **T**rustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

A+ NAAC

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV, AE) and NAAC with 'A+' grade, QS – I Gauge Gold Rated

SCHEME OF TEACHING AND EXAMINATION – B.E. – Artificial Intelligence & Data Science

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

VI Semester

Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours / Week			Examination				
					L	T	P	SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BAD601	Optimization techniques for Data Science	PCC	AD	3	2	0	3	50	50	100	4
2	BAD602	Computer Networks	IPCC	AD	3	0	2	3	50	50	100	4
3	BXX623x	Professional Elective Course-II	PEC	AD	3	0	0	3	50	50	100	3
4	BXX624x	Professional Elective Course – III	PEC	AD	3	0	0	3	50	50	100	3
5	BXX645x	Open Elective Course-I	OEC	AD	3	0	0	3	50	50	100	3
6	BAD636	Major Project Phase – I	PROJ	AD	0	0	4	3	100	-	100	2
7	BADL607	DevOps	PCCL	AD	0	0	2	3	50	50	100	1
8	BCE608	Competency Enhancement Course-4	NCMC	CDCAC	0	2	0	-	100	-	100	0
9	BIK609	Indian Knowledge System	NCMC	Any Dept	1	0	0	-	100	-	100	0
10	BNS610	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	100	-	100	0
	BPE610	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO610	Yoga		Yoga Teacher								
	BMU610	Music		Music Teacher								
									700	300	1000	20

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV:

Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Professional Elective Course – II			
Course Code	**Course Name**	**Course Code**	**Course Name**
BCS623A	Blockchain Technology	BAD623C	Statistical Machine Learning for Data Science
BAD623B	Theory of Computation	BAD623D	Quantum AI
Open Elective Course – I			
Course Code	**Course Name**	**Course Code**	**Course Name**
BCS645A	Introduction to Data Structures	BIS645C	Mobile Application Development
BCS645B	Fundamentals of Operating Systems	BCI645D	Introduction to Artificial Intelligence
Professional Elective Course – III			
BAD624A	Time Series Analysis	BAD624C	Prompting Engineering
BAD624B	Artificial Neural Network	BAD624D	Adversarial Attacks and Robust ML

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2024-25 may please be referred.

National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work

Semester: VI						
Optimization Techniques for Data Science						
Course Code	:	**BAD601**		**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	AI. Machine Learning, Automata Theory
Knowledge on Fundamental Concepts	Grammar, Programming languages, Natural Language
Knowledge on Connected Tools (If any)	NLTK

Course Learning Objectives: This course will enable the students to	
CLO1	Broadly understand major algorithms used in graph theory and discrete optimization.
CLO2	Understand linear programming, convex programming, and duality.
CLO3	Broadly understand machine learning, including supervised, unsupervised, and reinforcement learning.
CLO4	Understand foundational material in linear algebra and multivariate calculus required for data science.
CLO5	Understand foundational material in probability and statistics.
CLO6	Broadly understand heuristic search, constraint programming, and graphical models.

Module – 1	**08Hrs**
Introduction to Optimization: Definition, Need for optimization algorithms, Optimization Process, Basic Optimization Problem, Constraints, Handling huge matrices in Python, Mathematical Formulation, Example: A Transportation Problem **One-Dimensional Search Methods:** Golden Section Search, Fibonacci Search **Textbook 1: Ch. 1, Ch. 2.**	
Module – 2	**08Hrs**
Approaches of optimization: Continuous versus Discrete Optimization, Constrained and Unconstrained Optimization, Global and Local Optimization, Stochastic and Deterministic Optimization Convexity **Convex optimization:** Convex Functions, Convex Optimization Problems **Textbook 1: Ch. 4.**	
Module – 3	**08Hrs**
Gradient Descent: Variants of Gradient Descent: Projected, Stochastic, Proximal, Accelerated, Coordinate Descent, Cauchy's steepest descent method, Newton's Method – Optimization in practice, conjugate gradient method **Function optimization:** interpolation, extrapolation **Textbook 1: Ch. 5, 6.**	
Module – 4	**08Hrs**
Optimizing Model Performance Using Optimization Algorithms: Batch Normalization, Grid Search, RMSProp optimizer Random Search, derivative- free optimization algorithms **Hyperparameter Tuning:** Evolution algorithms, Bayesian optimization **Textbook 1: Ch. 8, Ch. 10.**	
Module – 5	**08Hrs**

Particle Swarm Optimization: Particle Swarm Optimization (PSO) Algorithm, PSO System Parameters, Particle Swarm Optimization versus Evolutionary Computing. **Ant colony Optimization:** The Invisible Manager, The Pheromone, Ant Colonies and Optimization, Ant Colonies and Clustering, Applications **Textbook 2: Chapters: Ch. 13, 16**

Course Outcomes: After completing the course, the students will be able to	
CO1	**Implement** optimization strategies for single-variable and multi-variable mathematical functions
CO2	**Examine** the structure of search spaces and assess optimality using various parameter tuning methods
CO3	**Evaluate** population-based metaheuristic algorithms inspired by social behavior for solving complex engineering problems.
CO4	**Utilize** advanced optimization techniques to derive efficient solutions for real-world computational problems.
CO5	**Assess** the effectiveness of machine learning optimization algorithms using hyperparameter tuning and convergence performance metrics.

Text Books	
1	Algorithms for Optimization, Mykel J. Kochenderfer Tim A. Wheeler, MIT Press Cambridge,2019, ISBN: 9780262039420
2	Computational Intelligence an Introduction, Andries P. Engelbrecht, John Wiley & Sons, Ltd,2002, ISBN: 9780470848708
Reference Books	
1	Numerical Optimization, Jorge Nocedal Stephen J. Wright, Second Edition, Springer,2006
2	An Introduction to Optimization, Edwin K. P. Chong, Stanislaw H. Zak, Second Edition, John Wiley & Sons, Ltd, 2004

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106106245

CO – PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	3	-	-	-	1	-	2
CO2	3	3	2	3	3	-	-	-	1	-	2
CO3	3	3	3	3	3	2	1	1	2	2	3
CO4	3	3	3	3	3	2	1	1	2	2	3
CO5	3	3	3	3	3	2	1	1	2	2	3

Semester: VI						
Computer Networks						
Course Code	:	BAD602		**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 + 10-12 Lab slots		**SEE**	:	50 Marks
Course Type	:	IPCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	**Internet of Things**
Knowledge on Fundamental Concepts	**Basics of computer**
Knowledge on Connected Tools (If any)	**NS2, NS3**

Course Learning Objectives: This course will enable the students to	
CLO1	Study the TCP/IP protocol suite, switching criteria and Medium Access Control protocols for reliable and noisy channels.
CLO2	Learn network layer services and IP versions.
CLO3	Discuss transport layer services and understand UDP and TCP protocols.
CLO4	Demonstrate the working of different concepts of networking layers and protocols.
CLO5	Understand the architecture and working principles of application layer protocols.

Module – 1	**08Hrs**
Introduction: Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: Transmission media, Guided Media, Unguided Media: Wireless. Switching: Packet Switching and its types. **Textbook: Ch. 1.1 - 1.3, 2.1 - 2.3, 7.1 – 7.3, 8.3.**	
Module – 2	**08Hrs**
Data Link Layer: Error Detection and Correction: Introduction, Block Coding, Cyclic Codes. Data link control: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control. Media Access Control: Random Access, Controlled Access. Check Sum and Point to Point Protocol **Textbook: Ch. 10.1-10.4, 11.1 -11.4, 12.1 - 12.2**	
Module – 3	**08Hrs**
Network Layer: Network layer Services, Packet Switching, IPv4 Address, IPv4 Datagram, IPv6 Datagram, Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR, Unicast Routing protocols: RIP, OSPF, BGP, Multicasting Routing-MOSPF **Textbook: Ch. 18.1, 18.2, 18.4, 22.2,20.1-20.3, 21.3.2**	
Module – 4	**08Hrs**
Introduction to Transport Layer: Introduction, Transport-Layer Protocols: Introduction, User Datagram Protocol, Transmission Control Protocol: services, features, segments, TCP connections, flow control, Error control, Congestion control. **Textbook: Ch. 23.1- 23.2, 24.1-24.3.4, 24.3.6-24.3.9**	
Module – 5	**08Hrs**
Introduction to Application Layer: Introduction, Client-Server Programming, Standard Client Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Domain Name System (DNS), TELNET, Secure Shell (SSH) **Textbook: Ch. 25.1-25.2, 26.1-26.6**	

Practical component

1	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth, and find the number of packets dropped.
2	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3	Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
4	Develop a program for error detecting code using CRC-CCITT (16- bits).
5	Develop a program to implement a sliding window protocol in the data link layer.
6	Develop a program to find the shortest path between vertices using the Bellman-Ford and path vector routing algorithm.
7	Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
8	Develop a program on a datagram socket for client/server to display the messages on client side, typed at the server side.
9	Develop a program for a simple RSA algorithm to encrypt and decrypt the data.
10	Develop a program for congestion control using a leaky bucket algorithm.

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the fundamentals of computer networks.
CO2	Apply the concepts of computer networks to demonstrate the working of various layers and protocols in communication network.
CO3	Analyze the principles of protocol layering in modern communication systems.
CO4	Demonstrate various Routing protocols and their services using tools such as Cisco packet tracer.
CO5	Analyze the functionality of application layer protocols in supporting client-server communication and Internet services.

Text Books	
1	Data Communications and Networking, Behrouz A. Forouzan, 5th Edition, Tata McGraw-Hill, 2013, ISBN: 9780073376226.
Reference Books	
1	Computer Networks – A Systems Approach, Larry L. Peterson and Bruce S. Davie, 4th Edition, Elsevier, 2019.
2	Computer and Communication Networks, Nader F. Mir, 2nd Edition, Pearson Education, 2015.
3	Data and Computer Communication, William Stallings, 10th Edition, Pearson Education, Inc., 2014.

Web links and Video Lectures (e – Resources)	
1	https://www.digimat.in/nptel/courses/video/106105183/L01.html
2	http://www.digimat.in/nptel/courses/video/106105081/L25.html
3	https://nptel.ac.in/courses/10610

CO – PO MAPPING

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

Semester: VI						
Blockchain Technology						
Course Code	:	BCS623A		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Data Structures and Algorithms, Computer Networks, Cryptography Fundamentals
Knowledge on Fundamental Concepts	Understanding of distributed systems, cryptographic hashing, consensus mechanisms, and peer-to-peer networks
Knowledge on Connected Tools (If any)	MetaMask, Ganache, and Hyperledger

Course Learning Objectives: This course will enable the students to	
CLO1	To Understand Blockchain terminologies with its applications. Design
CLO2	To learn working principles of Blockchain and methodologies used in Bitcoin
CLO3	To gain knowledge on Ethereum Network, Wallets, Nodes, Smart contract & Dapps
CLO4	To learn blockchain Based Application Architecture using Hyperledger and the Smart Contract Lifecycle

Module – 1	**08Hrs**
Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, Various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain. **Test Book 1**: **Chapter-1**	
Module – 2	**08Hrs**
Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization. Cryptographic primitives: Symmetric cryptography, Asymmetric cryptography, Public and private keys, Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD),Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA). **Test Book 1**: **Chapter 2, Chapter 3**	
Module – 3	**08Hrs**
Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block , The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates,	

Oracles, Smart Oracles, Deploying smart contracts on a blockchain, **Test Book 1**: **Chapter-4, Chapter 6**

Module – 4	**08Hrs**
Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network. Hands-on: Clients and wallets –Geth. **Test Book 1: Chapter 7**	

Module – 5	**08Hrs**
Hyperledger, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth lake, Corda. **Test Book 1**: **Chapter 9**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the Blockchain terminologies with its applications. Design
CO2	Illustrate the working principles of Blockchain and the Smart Contract Lifecycle
CO3	Demonstrate the principles and methodologies used in Bitcoin
CO4	Develop Ethereum Network, Wallets, Nodes, Smart contract and DApps.
CO5	Make use of Hyperledger in Blockchain Based Application Architecture.

Text Books	
1	"Mastring BlockChain", Imran Bashir, Third Edition, Packt – 2020, ISBN: 9781839213199

Reference Books	
1	Mastering Bitcoin: Programming the Open Blockchain – Andreas M. , O'rielly – 2017.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106104220
2	https://www.geeksforgeeks.org/blockchain/
3	https://www.tutorialspoint.com/blockchain/index.htm

CO-PO MAPPING

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

Semester: VI						
Theory of Computation						
Course Code	:	BAD623B		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 hours		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Discrete Mathematics, Design and Analysis of Algorithms, Data Structures
Knowledge on Fundamental Concepts	Foundational logic, set theory, formal reasoning
Knowledge on Connected Tools (If any)	**NA**

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce core concepts in Automata and Theory of Computation.
CLO2	Identify different Formal Language Classes and their Relationships.
CLO3	Learn concepts of Grammars and Recognizers for different formal languages.
CLO4	Prove or disprove theorems in automata theory using their properties.
CLO5	Determine the decidability and intractability of Computational problems.

Module – 1	**08Hrs**
Introduction to Finite Automata, Structural Representations, Automata and Complexity. The Central Concepts of Automata Theory. Deterministic Finite Automata, Nondeterministic Finite Automata, An Application: Text Search, Finite Automata with Epsilon-Transitions. **Text Book 1: Chp1- 1.1, 1.5, Chp2- 2.2,2.3,2.4,2.5**	
Module – 2	**08Hrs**
Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be Regular. Closure Properties of Regular Languages, Equivalence and Minimization of Automata, Applications of Regular Expressions **Text Book 1: Chp3- 3.1, 3.2 (Except 3.2.1), 3.3, Chp4-4.1, 4.2, 4.4**	
Module – 3	**08Hrs**
Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages, Ambiguity in Grammars and Languages, Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata. **Text Book 1: Chp5-5.1, 5.2, 5.4, Chp6-6.1,6.2,6.3.1,6.4**	
Module – 4	**08Hrs**
Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages. **Text Book 1: Chp7- 7.1, 7.2, 7.3**	
Module – 5	**08Hrs**
Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Undecidability: A Language That Is Not Recursively Enumerable. **Text Book 1: Chp8- 8.1,8.2, 8.3,8.4, Chp9-9.1, 9.2**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the fundamentals of automata theory to write DFA, NFA, Epsilon-NFA and conversion between them.
CO2	Prove the properties of regular languages using regular expressions.
CO3	Design context-free grammars (CFGs) and pushdown automata (PDAs) for formal languages.
CO4	Design Turing machines to solve the computational problems.
CO5	Illustrate the concepts of decidability and undecidability.

Text Books	
1	Introduction to Automata Theory, Languages and Computation, John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Second Edition, Pearson. ISBN-13: 978-0321455369.
Reference Books	
1	Automata,Computability and complexity, Elain Rich, 1st Edition, Pearson Education,2018.
2	Theory of Computer Science, K.L.P Mishra, N Chandrashekaran , 3rd Edition, PHI,2012.

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/106/105/106105196/
2	https://archive.nptel.ac.in/courses/106/106/106106049/
3	https://nptelvideos.com/course.php?id=717

CO – PO MAPPING

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

Semester: VI					
Statistical Machine Learning for Data Science					
Course Code	:	**BAD623C**	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40	**SEE**	:	50 Marks
Course Type	:	PEC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Data perprocessing, Data Manipulation, Regression
Knowledge on Fundamental Concepts	NumPy, Pandas, Matplotlib, Seaborn, R programming
Knowledge on Connected Tools (If any)	R studio, jupyter notepad.

Course Learning Objectives: this course will enable the students to	
CLO1	Understand Exploratory Data Analysis
CLO2	Explain Data and Sampling Distributions
CLO3	Analyse Statistical experiments and perform significance testing
CLO4	Demonstrate how to perform regression analysis on the data
CLO5	Explain Discriminant Analysis on the data.

Module 1	**8 Hrs**
Exploratory Data Analysis: estimates of locations and variability, exploring data distributions, exploring binary and categorical data, exploring two or more variables. **Textbook : Chapter 1**	
Module 2	**8 Hrs**
Data and Sampling Distributions: Random sampling and bias, selection bias, sampling distribution of statistic, bootstrap, confidence intervals, data distributions: normal, long tailed, student's-t, binomial, Chi-square, F distribution, Poisson and related distributions. **Textbook : Chapter 2**	
Module 3	**8 Hrs**
Statistical Experiments and Significance Testing: A/B testing, hypothesis testing, resampling, statistical significance & p-values, t-tests, multiple testing, degrees of freedom. **Textbook : Chapter 3**	
Module 4	**8 Hrs**
Multi-arm bandit algorithm, power and sample size, factor variables in regression, interpreting the regression equation, Regression diagnostics, Polynomial and Spline Regression. **Textbook : Chapter 3 & 4**	
Module 5	**8 Hrs**
Discriminant Analysis: Covariance Matrix, Fisher's Linear discriminant, Generalized Linear Models, Interpreting the coefficients and odd ratios, Strategies for Imbalanced Data. **Textbook : Chapter 5**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyse data sets using techniques to estimate variability, exploring distributions, and investigating relationships between variables.
CO2	Apply random sampling, confidence intervals, and recognize various data distributions on datasets.
CO3	Perform significance testing and identify statistical significance.
CO4	Apply regression analysis for prediction, interpret regression equations, and assess regression diagnostics.
CO5	Perform discriminant analysis on the varieties of datasets.

Text Book	
1	"Practical Statistics for Data Scientists", Peter Bruce, Andrew Bruce and Peter Gadeck, 2nd edition, O'Reilly Publications, 2020, ISBN-13: 978-1492072942.

Reference Books	
1	Introductory Statistics with R (Statistics and Computing) Dalgaard, Peter (Author) English (Publication Language) 267 Pages - 02/10/2004 (Publication Date) - Springer (Publisher) Read more at: https://examupdates.in/statistics-with-r-programming-notes/
2	Statistics: An Introduction using R Crawley, Michael J. (Author) English (Publication Language) 342 Pages - 03/11/2005 (Publication Date) - Wiley–Blackwell (Publisher) Read more at: https://examupdates.in/statistics-with-r-programming-notes/
3	A Handbook of Statistical Analyses using R RC Press Hothorn, Torsten (Author) English (Publication Language) 304 Pages - 06/25/2014 (Publication Date) - Chapman and Hall/CRC (Publisher) Read more at: https://examupdates.in/statistics-with-r-programming-notes/

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106105239
2	https://nptel.ac.in/courses/127101233

CO PO MAPPING

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

Semester : VI					
Quantum AI					
Course Code	:	**BAD623D**	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40	**SEE**	:	50 Marks
Course Type	:	PEC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Artificial Intelligence
Knowledge on Fundamental Concepts	Python Programming skills
Knowledge on Connected Tools (If any)	Spider, Pytroch

Course Learning Objectives: this course will enable the students to	
CLO1	To get acquainted with the principles of quantum computing and the usage of Linear algebra in Quantum Computing
CLO2	To understand the Architecture of Quantum computing and solve examples of Quantum Fourier Transforms
CLO3	To understand the concepts of basic and advanced Quantum Algorithms and apply them to various problems.
CLO4	To study quantum machine learning and apply these to develop hybrid solutions.
CLO5	To study the Quantum Theory with Fault-Tolerant Quantum techniques.

Module 1	**8 Hrs**
Overview of Quantum Computation: Single qubit gates, Multiple qubit gates, Measurements in bases Vs computational basis, Quantum circuits, Qubit copying **circuit, Example:** Bell states & quantum teleportation. Basics of Linear Algebra: Hilbert Spaces, Products and Tensor Products, Matrices, Graphs, and Sums Over Paths, Example**.** **Text Book 1: Ch. 1 (Qubits), Ch. 2 (Quantum gates), Ch. 4 (Bell states)** **Text Book 2: Ch. 1 & 2 (Linear Algebra basics)** **Text Book 3: Ch. 1 & 2**	
Module 2	**8 Hrs**
The Framework of Quantum Mechanics: The State of a Quantum System, Time-Evolution of a Closed System, Composite Systems, Mixed States and General Quantum Operations, Universal Sets of Quantum Gates, Quantum measurement and quantum entanglement **The quantum Fourier transform and its Applications-** The quantum Fourier transform, Phase estimation, order-finding and factoring, General applications of the quantum Fourier transform-Period-finding, Discrete logarithms, The hidden subgroup problem **Text Book 1: Ch. 2 (Quantum evolution), Ch. 5 (Mixed states), Ch. 5.1–5.4 (QFT)** **Text Book 3: Ch. 3**	
Module 3	**8 Hrs**
Quantum Algorithms: Probabilistic Versus Quantum Algorithms, Phase Kick-Back, The Deutsch Algorithm, The Deutsch–Jozsa Algorithm, Simon's Algorithm, Shor's Algorithm, Factoring Integers, Grover's Algorithm **Quantum Machine Learning:** Quantum Enhanced Machine Learning: Quantum Algorithms for Linear Algebra, Regression, Clustering, Nearest Neighbour Search, Classification. **Text Book 1: Ch. 6 (Quantum algorithms), Ch. 7 (Shor), Ch. 8 (Grover)** **Text Book 2: Ch. 4 (Shor), Ch. 5 (Grover)** **Text Book 4: Overview sections**	
Module 4	**8 Hrs**
Quantum Machine Learning: Quantum Boosting, Quantum Support Vector Machines, Quantum Neural Networks, Variational Quantum Algorithms.	

Classical Error Correction: The Error Model Encoding, Error Recovery, The Classical Three-Bit Code, Fault Tolerance. **Text Book 4: Sections on quantum classifiers, variational algorithms** **Text Book 1: Ch. 10 (Quantum error correction)** **Text Book 3: Ch. 5 (Quantum error correction overview)**	
Module 5	**8 Hrs**
Quantum Information: Quantum Teleportation, Quantum Dense Coding, Quantum Key Distribution, Noise and error models in quantum systems, Quantum cryptography and secure communication **Quantum Problem Solving:** Heuristic Search, Quantum Tree Search, Quantum Production System, Tarrataca's Quantum Production System **Text Book 1: Ch. 12 (Quantum cryptography), Ch. 2.3 (Teleportation)** **Text Book 5: Ch. 3 (Quantum Production Systems), Ch. 5 (Quantum Search & Logic)**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand quantum requirements and formulate design solutions using quantum circuits.
CO2	Illustrate applicable solutions in one or more application domains using a quantum architecture that integrates ethical, social, and legal concerns.
CO3	Apply the Advanced Quantum Algorithms on real time problem.
CO4	Analyze the quantum machine learning algorithms and their relevant application.
CO5	Analyze quantum information processing & its relevant algorithms.
CO6	Evaluate suitable algorithms for AI problems

Text Book	
1	"Quantum Computation and Quantum Information", Nielsen, M. & Chuang I., 2002
2	"Quantum Algorithms via Linear Algebra: A Primer", Lipton and Reagan
3	"Introduction to Quantum Computing", Kaye, LaFlamme and Mosca's
4	"Quantum Machine Learning", Biamonte, J. et al., Nature, 2017
5	"Principles Of Quantum Artificial Intelligence", Andreas Wichert

Reference Books	
1	"Quantum computing: A gentle introduction", Rieffel, E. G. & Polak W. H., MIT Press, 2011
2	"A quantum approximate optimization algorithm", Farhi, E., Goldstone, J. & Gutmann, S., arXiv preprint arXiv:1411.4028, 2014
3	"Elementary Linear Algebra", Kuttler, 2012.
4	"Graph Algorithms in the Language of Linear Algebra", Kepner and Gilbert, 2011
5	"Artificial Intelligence: A modern approach", Russell, S. & Norvig, P., 4th edition, Pearson Education, 2021

Web links and Video Lectures (e – Resources)	
1	http://mmrc.amss.cas.cn/tlb/201702/W020170224608149940643.pdf
2	https://arxiv.org/pdf/1611.09347.pdf
3	http://mmrc.amss.cas.cn/tlb/201702/W020170224608150244118.pdf
4	https://www.researchgate.net/publication/282378154_FPGA-based_quantum_circuit_emulation

5	https://www.microsoft.com/enus/quantum/development-kit

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3								
CO2			3			3	3				
CO3	3	3	3	3	3						
CO4	3	3	3	3	3						
CO5	3	3	3	3	3						
CO6	3	3	3	3	3						

Semester: VI						
TIME SERIES ANALYSIS						
Course Code	**:**	**BAD624A**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Probability and statistics, Linear algebra, calculus.
Knowledge on Fundamental Concepts	Random variables and distributions, Time Series Basics, Modeling concepts, Estimation techniques, Forecasting Principles, residual analysis, cointegration and nonstationarity
Knowledge on Connected Tools (If any)	Software tools: R (with packages like forecast, TSA, tseries), Python (especially libraries like statsmodels, pandas, scikit-learn, numpy), MATLAB (useful for state-space and signal models), Excel (for basic time series data visualization and forecasting). Statistical Tools: ACF (Autocorrelation Function) & PACF (Partial ACF), Ljung-Box Test, Unit root tests (ADF, KPSS) Graphical Analysis: Time series plotting, residual plots, correlograms

Course Learning Objectives: This course will enable the students to	
CLO1	Learn the importance of time series analysis on the data.
CLO2	Identify approaches to handle linear stationary and non-stationary models.
CLO3	Analyse ways of model building and parameter estimation.
CL04	Recognize methods to handle multivariate time series data.

Module – 1	**08Hrs**
Introduction, Five Important Practical Problems, **Autocorrelation Function and Spectrum of Stationary Processes:** Autocorrelation Properties of Stationary Models, Spectral Properties of Stationary Models, **Linear Stationary Models:** General Linear Process, Autoregressive Processes, Moving Average Processes, Mixed Autoregressive--Moving Average Processes. **Ch. 1.1, Ch. 2.1,2.2 Ch. 3.1,3.2,3.3,3.4**	
Module – 2	**08Hrs**
Linear Nonstationary Models: Autoregressive Integrated Moving Average Processes, Three Explicit Forms for the ARIMA Model, Integrated Moving Average Processes. **Forecasting :** Minimum Mean Square Error Forecasts and Their Properties, Calculating Forecasts and Probability Limits, Examples of Forecast Functions and Their Updating, Use of State-Space Model Formulation for Exact Forecasting **Ch. 4.1,4.2,4.3, Ch. 5.1,5.2,5.3,5.4,5.5.**	
Module – 3	**08Hrs**
Model Identification: Objectives of Identification, Identification Techniques, Initial Estimates for the Parameters, Model Multiplicity. **Parameter Estimation:** Study of the Likelihood and Sum-of-Squares Functions, Nonlinear Estimation, Some Estimation Results for Specific Models, Likelihood Function Based on the	

State-Space Model, Estimation Using Bayes' Theorem **Ch. 6.1,6.2,6.3,6.4 Ch. 7.1,7.2,7.3,7.4,7.5.**	
Module – 4	**08Hrs**
Model Diagnostic Checking: Checking the Stochastic Model, Overfitting, Diagnostic Checks Applied to Residuals, Use of Residuals to Modify the Model, **Analysis of Seasonal Time Series**: Parsimonious Models for Seasonal Time Series, Some Aspects of More General Seasonal ARIMA Models, Structural Component Models and Deterministic Seasonal Components, Regression Models with Time Series Error Terms. **Ch. 8.1,8.2,8.3 Ch. 9.1,9.2,9.3,9.4,9.5**	
Module – 5	**08Hrs**
Multivariate Time Series Analysis: Stationary Multivariate Time Series, Vector Autoregressive Models, Vector Moving Average Models, Vector Autoregressive--Moving Average Models, Forecasting for Vector Autoregressive--Moving Average Processes, State- Space Form of the VARMA Model, Nonstationary and Cointegration **Ch. 14.1,14.2,14.3,14.4,14.5,14.6,14.8**	

Course Outcomes: After completing the course, the students will be able to	
CO1	**Apply** the fundamental concept of Time series analysis for Autocorrelation Function and spectrum on linear stationary models.
CO2	**Develop** non-linear stationary models and perform forecasting.
CO3	**Identify** models and estimate the various parameters .
CO4	**Recognize** ways to perform model diagnostic checking and analyze the seasonal time series
CO5	**Analyze** multivariate time series data.

Text Books	
1	"Time Series Analysis – Forecasting and Control", George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, Wiley Publications , 2016. ISBN: 9781118675021.
Reference Books	
1	Introductory Time Series with R, Paul S.P. Cowpertwait and Andrew V. Metcalfe, Springer Verlag, New York, 2009.
2	Forecasting: Principles and Practice, Rob J. Hyndman and George Athanasopoulos, One line, Open Access Textbooks.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/103106123
2	https://www.youtube.com/watch?v=GE3JOFwTWVM
3	https://www.youtube.com/watch?v=tepxdcepTbY
4	https://www.youtube.com/watch?v=rDwczdWBlTA

CO – PO MAPPING

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2		2	2						2
CO2	3	3	2	2	2						2
CO3	3	3		3	3						2
CO4	3	2		3	2						2

CO5	3	3		3	3						3

Semester: VI						
Artificial Neural Network						
Course Code	**:**	**BAD624B**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**AI. Machine Learning, Automata Theory**
Knowledge on Fundamental Concepts	**Algorithms**
Knowledge on Connected Tools (If any)	**NLTK**

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of Artificial Neural Networks, learning methods, and various learning rules.
CLO2	Analyze and implement basic ANN models such as McCulloch-Pitts Neuron, Hebb Net, Perceptron, and Adaline.
CLO3	Design and implement Multilayer Perceptron (MLP) and Backpropagation algorithms for solving classification problems.
CLO4	Understand and apply Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART) networks for clustering and pattern recognition.
CLO5	Implement pattern association networks including Hopfield Networks and Bidirectional Associative Memory (BAM).

Module – 1	**08Hrs**
Basics of Artificial Neural Network and Learning Methods: Characteristics of the human brain, Neurons, Introduction to Artificial Neural Networks, Terminology, Models of ANN, Topology, Network Architectures, Knowledge Representation, Learning Process, Learning Tasks. Categories of learning - Hebbian learning, Perceptron Learning Rule, Delta Learning Rule, Generalized Delta Learning Rule, Competitive learning, Error-correction learning, Reinforcement learning, Stability and Convergence. **Textbook 3: Ch 1: 1.1 – 1.10**	
Module – 2	**08Hrs**
Basic ANN Models: McCulloch-Pitts Neuron, Architecture, Algorithm and Applications. Biases and Thresholds, Linear Separability. Hebb Net - Algorithm, Applications. Perceptron - Architecture, Algorithm, Applications. Perceptron Learning Rule Convergence Theorem. Adaline - Architecture, Algorithm, Applications. **Textbook 2: Ch 2: 2.1 – 2.7**	
Module – 3	**08Hrs**
Multilayer Perceptron's: Multi-Layered network architecture, Back propagation Algorithm, Applications, XOR problem, Replacing and Modifying Back propagation Algorithms Using Heuristics. Cover's Theorem on the Separability of patterns, The Interpolation Problem, Radial Basis Function Networks, Comparison of MLP and RBF Networks (Theory only). **Textbook 2: Ch 6: 6.1 – 6.8, Ch 7: 7.1 – 7.5**	
Module – 4	**08Hrs**

SOMs and ART Networks: Self-organizing maps - Building, Training, Evaluating, Interpreting and Visualizing a Self-organizing Map. Applications of Self Organizing Maps. Adaptive Resonance Theory -Stability Plasticity Dilemma, ART-1-Architeture, Algorithm, Applications. ART-2 – Architeture, Algorithm, Applications **Textbook 1: Ch 9: 9.1 – 9.8, Ch 10: 10.1 – 10.6**

Module – 5	**08Hrs**
Training Algorithms for Pattern Association: Introduction, Hetero associative neural network- Architecture, Applications. Auto Associative Net-Architecture, Applications. Iterative Auto Associative Net – Architecture, Applications. Discrete Hopfield Network. Bidirectional Auto-associative Memory – Architecture, Applications. **Textbook 2: Ch 5: 5.1 – 5.8**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize the basic concepts and the learning rules of ANN
CO2	Utilize the fundamental learning algorithms namely, Mc-Culloch Pitts, Hebb Perceptron and Adaline to solve real world problems.
CO3	Implement Back propagation learning algorithm, Generic Radial Basis Function network.
CO4	Demonstrate Self Organizing Maps and Adaptive Resonance Theory.
CO5	Implement training algorithms for pattern association.

Text Books	
1	Neural Networks, A comprehensive Foundation, Simon Haykin, Pearson Education, 2nd Edition, ISBN: 9788177587579.
2	Fundamentals of Artificial Neural Networks, architecture algorithm and applications , Laurene Faucett, ISBN: 9780133341867
3	Artificial Neural Networks, Yegnanarayana, Phi Learning, 2009, ISBN: 9788120312531.
Reference Books	
1	Neural networks for Pattern Recognition, Christopher M Bishop
2	Fundamentals of Artificial Neural Networks, Mohammad H Hassoun

Web links and Video Lectures (e – Resources)	
1	

CO – PO MAPPING

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

Semester : 06					
PROMPT ENGINEERING					
Course Code	**:**	**BAD624C**	**Credits**	**:**	03
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40 hours	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Introduction to Artificial Intelligence, Natural Language Processing
Knowledge on Fundamental Concepts	Basics of AI/ML, LLMs, NLP concepts, probability, and logic
Knowledge on Connected Tools (If any)	Familiarity with tools like ChatGPT, Bard, Midjourney, Python basics

Course Learning Objectives: this course will enable the students to	
CLO1	Understand the foundational concepts of generative AI, large language models, and the ethical implications in prompt design.
CLO2	Learn the principles and best practices of crafting effective prompts for various AI systems.
CLO3	Develop expertise in advanced prompt engineering techniques such as chain-of-thought, persona prompts, and multilingual prompting.
CLO4	Gain practical experience using tools like ChatGPT and Midjourney for real-world text and image generation tasks.

Module 1	**8 Hrs**
GENERATIVE AI FOUNDATIONS - Generative Models and Their Types - Understanding Large Language Models - Pre-training and Fine-tuning - Evolution from Traditional Programming to Generative Models - Introduction to 2024 tools - ChatGPT ,Bard , Gemini , Claude-2, Bing Image Creator, Midjourney, RunwayML (GEN-2), PIKA Video Generation - Ethics in Prompt Engineering.	
Module 2	**8 Hrs**
BASICS OF PROMPTING - Basic Principles for Interacting with A.I. - Intuition Behind Prompts -Understanding Prompts: Inputs, Outputs, and Parameters - Straightforward Prompts - Tabular Format Prompting - Missing Word Prompting - Preceding Question Prompting - Comparative Analysis Prompt Experiential Perspective Prompt - Everyday Functioning Prompts - Universal Prompt Structures Prompt Refinements- Prompt Size Limitations.	
Module 3	**8 Hrs**
ADVANCED PROMPT ENGINEERING TECHNIQUES - Prompt Patterns - The Persona Pattern- Zero-shot prompting -Few-shot prompting - Chain-of-Thought prompting - Active-prompt - Directional stimulus prompting - Graph prompting - Reverse-Engineered Prompt Generation -Multilingual and Multimodal Prompt Engineering	
Module 4	**8 Hrs**
PROMPT ENGINEERING WITH CHATGPT AND MIDJOURNEY - ChatGPT Prompts : Text to Text - Repository of Prompts - Insertion - Question Answering - Text Classification -Query Decomposition - Decision Making – Answer Engineering. Midjourney Prompts: Text to image prompts - Repository of prompts -Advanced prompts: Stylized and creative prompts, Chaos, Seed & Tile, Colour and Theme & Style, Aspect Ratio	

& Quality - Using Images as input prompt and Image weights - Blend & Remix Feature.	
Module 5	**8 Hrs**
PROMPT ENGINEERING USE CASES - Automating Emails and Social Media Posts - Content Generation: Blogs, Articles, and Reports -Task Delegation and Project Management -Customer Support: Enhancing Human-Agent Collaboration - Retail and E-commerce: AI-driven Personalization and Efficiency - Effective Communication Guidance for Interviews - Stress Related Interview Q's & A's - Enhancing Communication Skills: AI-Assisted Proofreading and Writing - Creating a Poster using Midjourney - Creating coloring book pages with GPT 4 & Midjourney V5.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Gain an understanding of the fundamentals of generative models and their evolution from traditional programming paradigms.
CO2	Develop proficiency in crafting effective prompts for interacting with AI systems across various applications.
CO3	Master advanced prompt patterns and techniques to generate sophisticated prompts for complex tasks efficiently.
CO4	Learn to leverage ChatGPT and Midjourney effectively for prompt engineering, enabling diverse text-to-text and text-to-image applications.
CO5	Apply prompt engineering techniques to automate tasks, enhance communication, and personalize experiences across different domains, such as customer support, content generation, and retail.

Text Book	
1	Padmaraj Nilagdi. A Hand book for Prompt Engineering, First Edition , 2024
2	James Phenix, Mike taylor, Prompt Engineering for Generative AI, O'Reilly Publications , First edition 2024, ISBN-13: 978-1098153434.

CO PO MAPPING

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3								3	
CO2	3	3								3	
CO3	3	3	3	3	3	2		1	2	3	2
CO4	3	3	3	3	3	2		1	2	3	
CO5	3	3	2	3	2	2	2	1	2	3	2

Semester: VI						
Adversarial Attacks and Robust ML						
Course Code	:	BAD624D		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Machine Learning, Deep Learning, Python Programming, Linear Algebra and Probability
Knowledge on Fundamental Concepts	Algorithms
Knowledge on Connected Tools (If any)	Jupyter notebook

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of adversarial machine learning, threat models, and security challenges in AI systems.
CLO2	Analyze different adversarial attack techniques against machine learning and deep learning models.
CLO3	Design robust machine learning models using defense mechanisms and adversarial training.
CLO4	Evaluate privacy attacks, poisoning attacks, and model extraction techniques on AI systems.
CLO5	Apply secure AI techniques for developing trustworthy and robust intelligent systems.

Module – 1	**08Hrs**
Fundamentals of Adversarial Machine Learning: Introduction to AI Security, Security Challenges in Machine Learning, Adversarial Machine Learning Overview, Threat Models, Attack Surface of Machine Learning Systems, Security Goals, Taxonomy of Adversarial Attacks, White-box, Black-box and Gray-box Attacks, Robustness, Explainability and Trustworthy AI. **Textbook 1: Ch 6:6.1-6.5, Ch 7: 7.1-7.12, Ch 11: 11.1-11.6**	
Module – 2	**08Hrs**
Adversarial Attacks: Adversarial Examples, Fast Gradient Sign Method (FGSM), Basic Iterative Method (BIM), Projected Gradient Descent (PGD), Carlini-Wagner Attack, DeepFool, Universal Adversarial Perturbations, Black-box Attacks, Transferability of Adversarial Examples, Physical Adversarial Attacks. **Textbook 2: Ch 2: 2.1 – 2.6**	
Module – 3	**08Hrs**
Robust Machine Learning: Adversarial Training, Robust Optimization, Defensive Distillation, Gradient Masking, Feature Squeezing, Randomized Smoothing, Certified Robustness, Robust Deep Neural Networks, Robustness Evaluation Metrics. **Textbook 2: Ch 4: 4.1 – 4.5**	
Module – 4	**08Hrs**
Data Poisoning and Privacy Attacks: Poisoning Attacks, Label Flipping, Backdoor Attacks, Trojan Attacks, Model Inversion, Membership Inference, Model Extraction, Data Leakage, Federated Learning Attacks, Privacy Preserving Machine Learning. **Textbook 3: Ch 5: 5.1 – 5.6**	
Module – 5	**08Hrs**

Secure and Trustworthy AI: Explainable AI (XAI), Secure Deep Learning, AI Safety, Robust Large Language Models, Adversarial Attacks on LLMs, AI Governance, Ethical AI, Secure AI Deployment, Case Studies in Autonomous Vehicles, Healthcare AI, Biometrics, Face Recognition, Malware Detection, Current Research Trends. **Textbook 7: Ch 7: 7.1 – 7.5**

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the fundamentals of adversarial machine learning, threat models, and AI security.
CO2	Analyze adversarial attacks on machine learning and deep learning models.
CO3	Design robust machine learning models using adversarial defense techniques.
CO4	Evaluate poisoning attacks, privacy attacks, and secure machine learning frameworks.
CO5	Develop trustworthy AI systems by applying robust machine learning techniques.

Text Books	
1	Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016, ISBN: 9780262035613.
2	Adversarial Machine Learning, Battista Biggio and Fabio Roli, Springer, 2024
3	Machine Learning Security, Nicolas Papernot, Patrick McDaniel, Battista Biggio and collaborators, Springer 2023
Reference Books	
1	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, Aurélien Géron, O'Reilly, 3rd Edition, 2023.
2	Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 4th Edition.

Web links and Video Lectures (e – Resources)	
1	MIT Introduction to Deep Learning (6.S191)
2	IBM Adversarial Robustness Toolbox (ART) Documentation

CO – PO MAPPING

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

Semester: VI						
Introduction to Data Structures						
Course Code	:	BCS645A		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	OEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Introduction to C Programming
Knowledge on Fundamental Concepts	Data types , Arrays ,Structures, Functions, Recursion
Knowledge on Connected Tools (If any)	Gcc, Code Blocks, Visual Studio

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of data structures.
CLO2	Analyze stack and queue data structures for problem-solving.
CLO3	Implement singly linked lists for basic operations and stack/queue structures.
CLO4	Analyze and construct expression trees for arithmetic expressions.
CLO5	Apply basic sorting and searching algorithms to organize and retrieve data efficiently.

Module – 1	**08Hrs**
Introduction: Data and Information, Data Structure, Classification of Data Structures, Operations on Data Structure. Pointers: Pointer Concepts, Accessing Variables through Pointers, Pointer Applications, Dynamic Memory Allocation Functions **Arrays and Structures**: Arrays, One-Dimensional Arrays, Two-Dimensional Arrays, Initializing Two Dimensional Arrays, Multidimensional arrays, Structures and Unions, Declaring Structures, Giving Values to Members, Structure Initialization. **Text Book 1: Ch 1:** 1.2, **Ch 2:** 2.1-2.5,2.6-2.9	
Module – 2	**08Hrs**
Stacks: Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks, Infix to postfix conversion, Postfix expression evaluation. **Queues:** Introduction, Queue Operations, Queue Implementation using Arrays, Applications of Queues. **Text Book 1**: **Ch 3:**3.1-3.5, 3.6-3.8 , **Ch 4:**4.1-4.5	
Module – 3	**08Hrs**
Linked Lists: Introduction, Singly Linked List, Operations on Singly Linked Lists: Insert-Delete-Display, Implementation of Stacks and Queues using Linked List. **Test Book 1**: **Ch 5:**5.1-5.4,5.5-5.6	
Module – 4	**08Hrs**
Trees: Introduction, Basic Concepts, Representation of Binary Trees, Operations on Binary Trees: Insertion-Traversals-Searching-Copying a Tree, Binary Search Trees, Operations on Binary Search Trees: Insertion-Searching-Find Maximum and Minimum Value-Count Nodes, Expression Trees. **Test Book 1**: **Ch 6:**6.1-6.7,6.8-6.9,6.10	
Module – 5	**08Hrs**

Sorting: Introduction, Bubble Sort, Selection Sort, and Insertion Sort. **Searching:** Introduction, Linear Search, Binary Search. **Test Book 1**: **Ch 7:**7.1-7.4,**Ch 8:**8.1-8.3

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the concept of linear and nonlinear data structures.
CO2	Implement stack and queue concepts effectively to solve problems.
CO3	Analyze the practical uses of linked lists in various computing applications.
CO4	Design binary search trees to efficiently perform insertion, searching, deletion, and traversal operations.
CO5	Apply basic sorting and searching techniques to organize and retrieve data efficiently.

Text Books	
1	"Data Structures: A Pseudo-code approach with C", Gilberg & Forouzan, Cengage Learning, 2 nd edition, 2014, ISBN-10: 8131503143.

Reference Books	
1	"An Introduction to Data Structures with Applications", Jean-Paul Tremblay & Paul G. Sorenson, McGraw Hill, 2 nd edition, 2013.
2	"Fundamentals of Data Structures in C", Ellis Horowitz and Sartaj Sahni, Universities Press, 2 nd edition, ISBN-13: 978-8173714939, 2017.

Web links and Video Lectures (e – Resources)	
1	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
2	https://nptel.ac.in/courses/106/102/106102064/
3	https://nptel.ac.in/courses/106/105/106105171/
4	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
5	https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s

CO – PO MAPPING

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

Semester: VI						
Fundamentals of Operating System						
Course Code	**:**	BCS645B		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	OEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Computer Organization and Architecture, Programming in C.
Knowledge on Fundamental Concepts	Computer fundamentals, Arrays, Structures
Knowledge on Connected Tools (If any)	UNIX/Linux Environment

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the need of OS architecture and different types of OS.
CLO2	Illustrate the techniques for management of different system resources
CLO3	Analyze the different memory and file system management strategies.
CLO4	Demonstrate the virtual memory, paging and segmentation concepts.
CLO5	Analyze the importance of file system mechanisms.

Module – 1	**08Hrs**
Introduction: What operating systems do; Computer System organization; Computer System Organization, Computer System architecture; Operating System operations; Resource Management **Operating System Structures:** Operating System Services, User and Operating System interface; System calls, Application Program Interface, Types of system calls; **Text Book 1**:**Ch-1**: 1.1, 1.2, 1.3,1.4, 1.5, **Ch-2** : 2.1, 2.2 (2.2.1, 2.2.2), 2.3 (2.3.2, 2.3.3)	
Module – 2	**08Hrs**
Process Management: Process concept; Process scheduling; Operations on processes; Interprocess Communication. **Multi-threaded Programming:** Overview; Multithreading models, Thread Libraries Textbook 1: **Text Book 1**: **Ch-3:** 3.1-3.4, **Ch-4:** 4.1, 4.3 5, 4.4	
Module – 3	**08Hrs**

CPU Scheduling: Basic Concepts, Scheduling criteria, Scheduling algorithms, Thread Scheduling,
Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Semaphores; Classical problems of synchronization;

Text Book 1: **Ch-5:** 5.1, 5.2,5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4 **Ch-6:** 6.1, 6.2.,6.3, 6.6

Module – 4	**08Hrs**

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.
Memory Management: Background; Contiguous memory allocation; Paging; Structure of page table
Text Book 1: Ch-8: 8.1-8.8 **Ch-9:** 9.1-9.4 (9.4.1, 9.4.2)

Module – 5	**08Hrs**

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement;
File System Interface: File concept; Access methods; Directory Structure, Protection, File System Implementation: File System Structure, File System Operations,
File System Internals: File Systems, File System Mounting; Partition and Mounting, File sharing;

Text Book 1: **Ch-10:** 10.1-10.3, 10.4 (10.4.1, 10.4.2, 10.4.4.) **Ch-13**: 13.1, 13.2, 13.3 (13.3.1, 13.3.2, 13.3.3), 13.4 (13.4.1, 13.4.2) **Ch-15**: 15.1-15.4

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the structure and functionality of operating system
CO2	Illustrate the appropriate CPU scheduling algorithm for the given scenarios
CO3	Analyze the various techniques for process synchronization and deadlock handling.
CO4	Apply the different techniques for memory management
CO5	Demonstrate the importance of File System Mounting and File Sharing

Text Books	
1	Operating System, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Principles978–0–470–12872–5 8th edition, Wiley-India, 2015,

Reference Books	
1	"Natural Language Processing Recipes Unlocking Text Data with Machine Learning and Deep Learning using Python", Akshay Kulkarni, Adarsha Shivananda, Apress, 2019.
2	"Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", T V Geetha, Pearson, 2024.
3	"Information Storage and Retrieval systems", Gerald J. Kowalski and Mark.T. Maybury, Kluwer Academic Publishers.

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/106/105/106105214/

2	https://archive.nptel.ac.in/courses/106/102/106102132/

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	1	1	1		1						1
CO2	2	1	1		1						1
CO3	2	1	1		1						1
CO4	2	1	1		1						1
CO5	2	2	1		1						1

Semester: VI					
MOBILE APPLICATION DEVELOPMENT					
Course Code	**:**	BIS645C	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Java**
Knowledge on Fundamental Concepts	**Basic knowledge of Data, Database, Android**
Knowledge on Connected Tools (If any)	**Android Studio**

Course Learning Objectives: This course will enable the students to	
CLO1	Learn to setup Android application development environment
CLO2	Illustrate user interfaces for interacting with apps and triggering actions
CLO3	Interpret tasks used in handling multiple activities.
CLO4	Identify options to save persistent application data
CLO5	Appraise the role of security and performance in Android applications

Module – 1	**08 Hrs**
Get started, Build your first app, Activities, Testing, debugging and using support libraries **Text Book 1**	
Module – 2	**08 Hrs**
User Interaction, Delightful user experience, Testing your UI **Text Book 1**	
Module – 3	**08 Hrs**
Background Tasks, Triggering, scheduling and optimizing background tasks **Text Book 1**	
Module – 4	**08 Hrs**
All about data, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders **Text book 1**	
Module – 5	**08 Hrs**
Permissions, Performance and Security, Firebase and AdMob, Publish **Text Book 1**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Create, test and debug Android application by setting up Android development Environment
CO2	Implement adaptive, responsive user interfaces that work across a wide range of Devices.
CO3	Infer long running tasks and background work in Android applications
CO4	Demonstrate methods in storing, sharing and retrieving data in Android applications
CO5	Analyze performance of android applications and understand the role of permissions and security
CO6	Describe the steps involved in publishing Android application to share with the world

Text Books	
1	Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017.

Reference Books	
1	"Android Programming – Pushing the Limits", Erik Hellman, 1st Edition, Wiley India Pvt Ltd, 2014.
2	"Head First Android Development", Dawn Griffiths and David Griffiths, 1st Edition, O'Reilly SPD Publishers, 2015.
3	"Beginning Android Programming with Android Studio", J F DiMarzio, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.swayam2.ac.in/nou21_ge41/
2	https://nptel.ac.in/courses/106/106/106106156/

CO – PO MAPPING

CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	2	2	3			2	2	1	2
CO2	3	2	3	2	3	2		2	2		2
CO3	3	3	2	3	3			1	2		2
CO4	3	2	2	2	3			1	2		2
CO5	3	3	2	3	3	2	2	2	2		2
CO6	2	2	3	2	3	2		2	3	2	2

Semester: VI					
INTRODUCTION TO ARTIFICIAL INTELLIGENCE					
Course Code	**:**	**BCI645D**	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Computer Program
Knowledge on Fundamental Concepts	Background in linear algebra, data structures and algorithms, and probability
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundations of Artificial Intelligence, intelligent agents, problem formulation, and the characteristics of intelligent environments.
CLO2	Apply uninformed and informed search techniques, game-playing algorithms, and heuristic methods to solve AI problems efficiently.
CLO3	Analyze various knowledge representation techniques and reasoning methods for intelligent decision-making under certainty and uncertainty.
CLO4	Examine first-order logic, inference mechanisms, machine learning approaches, and reinforcement learning techniques for solving AI problems.
CL05	Illustrate the architecture, components, and real-world applications of expert systems and knowledge-based systems.

Module – 1	**08 Hrs.**
Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. **Textbook 1: Ch 1: 1.1–1.5, Ch 2: 2.1–2.4, Ch 3: 3.1–3.4**	
Module – 2	**08 Hrs.**
Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions **Textbook 1: Ch 3: 3.5–3.6, Ch 4: 4.1–4.7, Ch 5: 5.1–5.4, Ch 7: 7.1–7.5**	
Module – 3	**08 Hrs.**
Representation of Knowledge: Knowledge representation issues, predicate logic-logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules-based deduction systems. Reasoning under uncertainty, review of probability, Bayes' probabilistic interferences and dempstershafer theory. **Textbook 1: Ch 8: 8.1–8.5, Ch 9: 9.1–9.6, Ch 10: 10.1–10.5**	
Module – 4	**08**

	Hrs.
Logic concepts: First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning. **Textbook 2: Ch 1: 1.1–1.5, Ch 2: 2.2–2.7, Ch 3: 3.2, 3.3, 3.5, 3.6**	
Module – 5	**08 Hrs.**
Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells. **Textbook 2: Ch7: 7.1–7.2, 7.4, Ch 8: 8.3–8.5, Ch 9: 9.4–9.6**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the concepts of Artificial Intelligence, intelligent agents, and problem-solving methodologies
CO2	Apply search algorithms and game-playing techniques to solve complex AI problems.
CO3	Analyze knowledge representation and reasoning techniques for intelligent systems.
CO4	Apply logical inference, machine learning, and reinforcement learning concepts in AI applications.
CO5	Design and evaluate expert systems for real-world problem-solving.

Text Books	
1	Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson, 2022. **ISBN:** 9780134610993.
2	Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B. Nair, 3rd Edition (SIE), McGraw Hill Education. **ISBN:** 9781259029974.

Reference Books	
1	Artificial Intelligence: Structures and Strategies for Complex Problem Solving, George F. Luger, 6th Edition, Pearson. ISBN: 9789332581982.
2	Artificial Intelligence: A New Synthesis, Nils J. Nilsson, Morgan Kaufmann. ISBN: 9781558604674.

Web links and Video Lectures (e – Resources)	
1	https://ai.google/
2	https://swayam.gov.in/nd1_noc19_me71/preview

CO – PO MAPPING

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

Semester : 06					
DevOps					
Course Code	:	BADL607	**Credits**	:	01
Hours/Week (L:T:P)	:	0:0:2	**CIE**	:	50 Marks
Total Hours	:	28	**SEE**	:	50 Marks
Course Type	:	PCCL	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Unix Operating System, Cloud Computing
Knowledge on Fundamental Concepts	Basic Unix Commands, Networking Concepts
Knowledge on Connected Tools (If any)	AWS, GIT, JENKINS, MERN, K8S, DOCKER, ANSIBLE

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Course Level Objectives: Student able to	
CLO1	Introduce DevOps terminology, definition & concepts
CLO2	Understand the different Version control tools like Git, Mercurial
CLO3	Understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
CLO4	Understand Configuration management using Ansible
CLO5	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

Laboratory Programs

Sl.NO	**Experiments**
1	Introduction to Maven and Gradle: Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup
2	Working with Maven: Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins
3	Working with Gradle: Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation
4	Practical Exercise: Build and Run a Java Application with Maven, Migrate the Same Application to Gradle
5	Introduction to Jenkins: What is Jenkins?, Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use
6	Continuous Integration with Jenkins: Setting Up a CI Pipeline, Integrating Jenkins with Maven/Gradle, Running Automated Builds and Tests
7	Configuration Management with Ansible: Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook
8	Practical Exercise: Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins
9	Introduction to Azure DevOps: Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project
10	Creating Build Pipelines: Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports
11	Creating Release Pipelines: Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines
12	Practical Exercise and Wrap-Up: Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A

Course Outcomes: After completing the course, the students will be able to	
CO1	**Demonstrate** different actions performed through Version control tools like Git.
CO2	**Perform** Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins
CO3	**Create** building and run automating test cases using Maven & Gradle.
CO4	**Experiment** with configuration management using Ansible.
CO5	**Demonstrate** Cloud-based DevOps tools using Azure DevOps.

Web links and Video Lectures (e – Resources)	
1	https://www.geeksforgeeks.org/devops-tutorial/
2	https://www.javatpoint.com/devops
3	https://www.youtube.com/watch?v=2N-59
4	https://www.youtube.com/watch?v=87ZqwoFeO88

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

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- **Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.**
- **Promoting Excellence in Teaching, Training, Research and Consultancy.**
- **Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.**
- **Developing Entrepreneurial acumen to venture into Innovative areas.**

Department of Artificial Intelligence & Data Science

VISION

Nurturing AI & DS technocrats to be proficient in solving real-world problems

MISSION

- **Providing fundamentals to enhance niche expertise in AI & DS, cognitive computing, robotics and neural network architectures**
- **Enhancing the analytical and problem-solving abilities to meet the challenges of the future**
- **Training the students with the latest technology to become sustainable professionals**
- **Fostering a culture of collaboration and propagating industry-oriented innovations and research**
- **Establishing a stimulating learning environment to create value-based and**

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka