



ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

B. TECH.
COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
FIFTH SEMESTER



STUDY AND EVALUATION SCHEME

B.TECH. COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

III Year: V SEMESTER

S. No.	Subject Code	Subject name	L	T	P	Sessional Assessment			SEE	Subject Total	Credit
						MST	TA	Total			
THEORY SUBJECT											
1	TCS501	Artificial Intelligence	3	1	0	15	15	30	70	100	4
2	TCS502	Operating System	3	1	0	15	15	30	70	100	4
3	TCSM051 - 054	Departmental Elective-I	3	1	0	15	15	30	70	100	4
4	TCSM501	Machine Learning	3	1	0	15	15	30	70	100	4
5	THM501	Constitution of India	2	0	0	15	15	30	70	100	0
6	TGP501	General Proficiency	-	-	-	-	-	50	0	50	0
PRACTICAL/DESIGN/DRAWING											
7	TCS551	Artificial Intelligence Lab	0	0	2	15	15	30	70	100	1
8	TCS552	Operating System Lab	0	0	2	15	15	30	70	100	1
9	TCS553	Mini Project or Internship Assessment	0	0	4	15	15	30	70	100	2
		Total	11	3	8					800	20

TCSM051 - 054	Departmental Elective - I
TCSM-051	Object - Oriented Design and Modeling
TCSM-052	Digital Image Processing
TCSM-053	Cloud Computing
TCSM-054	Internet of Things



**ARTIFICIAL INTELLIGENCE
(TCS501)**

COURSE OUTCOMES (COs):

CO1	Understand different types of AI agents.
CO2	apply various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms).
CO3	Understand the fundamentals of knowledge representation, reasoning, and machine learning techniques and apply them to real world problems.
CO4	Student should be aware of techniques used for classification and clustering.
CO5	Apply simple knowledge-based systems using languages like LISP, Prolog, and AI tools like JESS.
Unit	Topic
I	Introduction to Artificial Intelligence, Brief history, Various approaches to AI, Areas of application, Simulation of sophisticated and Intelligent Behavior in different area, Problem solving in games, natural language processing, automated reasoning, and visual perception, Knowledge and its role in AI, Heuristic algorithm versus solution guaranteed algorithms, Introduction to soft computing.
II	Representing problems in state space, informed versus uninformed search, Production System Model, Evaluation of the Production System, Depth First Search and Breadth First Search, Heuristics, Heuristic Search Techniques: Hill Climbing, Best First search, A* Algorithm, Branch and Bound, Cryptarithmic Problem, Means End Analysis, AO* Algorithm, Game Playing: MINMAX Search, Alpha-Beta Pruning, Heuristic Estimation.
III	Knowledge Representation and Reasoning: Propositional Logic, First Order Predicate Logic, Graphs, Associative Network, Semantic Networks, Conceptual Dependencies, Frames, Scripts, Horn Clauses, Introductory Examples from PROLOG, Case Grammar Theory, Production Rules Knowledge Base, The Interface System, Forward and Backward Deduction, Inference System in Propositional and Predicate Logic, Reasoning under Uncertainty.
IV	Understanding Natural Languages, Various Approaches of NLP, Parsing techniques, Context free and transformational grammars, Transition nets, Augmented transition nets, Fillmore's grammars, Grammar free analyzers, Sentence generation, and translation, Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine Perception, Object Identification, Speech Recognition.
V	Expert Systems: Architecture of Expert System, Representing and using domain knowledge, Expert System Shell, Explanation System, Knowledge Acquisition System, Case study of Existing Expert Systems like DENDRAL, MYCIN, Development of a small Expert System using programming Languages and tools like LISP, PROLOG, JESS.

Text Book (s):

1. N. J. Nilsson, "Artificial Intelligence: A New Synthesis", Elsevier Publications, Standard Edition, 1998.
2. I. Bratko, —Prolog: Programming for Artificial Intelligence, Addison-Wesley Educational Publishers, 2011.
3. M. Tim Jones, —Artificial Intelligence: A Systems Approach (Computer Science) II, Jones and Bartlett Publishers, Inc.; First Edition, 2008
4. Charnick, "Introduction to A.I.", Addison Wesley, 1985.
5. Rich and Knight, "Artificial Intelligence", McGraw-Hill Publication, 3rd Edition, 2017.
6. Gerhard Weiss, —Multi Agent Systems, Second Edition, MIT Press, 2013.



**OPERATING SYSTEM
(TCS502)**

COURSE OUTCOMES (COs):	
CO 1:	Understand the fundamental concepts and components of operating systems.
CO 2:	Analyze and apply CPU scheduling and process management techniques.
CO 3:	Identify and manage deadlock situations using prevention, avoidance, detection, and recovery methods.
CO 4:	Understand and apply memory management techniques, including paging and segmentation.
CO 5:	Describe and manage file systems and I/O operations, including disk scheduling and RAID configurations.
Unit	Topic
I	Introduction to Operating Systems Computer system overview, concept of an operating system, batch system, multiprogramming, multiprocessing, multi user, time sharing, personal system, real time system, general system architecture, operating system services, system calls, system structure, Approaches to OS design and implementation: Microkernel, Layered, Kernel Approach.
II	CPU Scheduling: Concept of process, process states, process state transitions, process control block, threads, mutual exclusion and synchronization, Schedulers, Scheduling Concepts, Performance Criteria, Scheduling Algorithms, Inter process communication Deadlock Problem, Deadlock Characterization, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Methods for Deadlock Handling.
III	Inter-process Communication: Race conditions, Critical sections, Mutual exclusion, Critical-section problem, and Algorithmic approach to implementing critical sections, Hardware support for process synchronization, Semaphores, Mutexes, and Monitors. Classic Problems of Synchronization: Producers-consumers with bounded buffers problem, Readers-writers problem, Dining-philosophers problem.
IV	Memory Management: Introduction, Logical and Physical Address Space, Swapping, Contiguous Memory Allocation, Fragmentation, Paging, Structure of Page Table, Segmentation, Segmentation with Paging. Virtual Memory: Demand Paging, Performance of Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.
V	File system: File Concept, Access Methods, Directories, Mounting of File-System, File-System Structure, File-System Implementation, Allocation Methods. I/O Devices, and I/O Subsystems, I/O Buffering, Disk Storage and Disk Scheduling, Disk Management, RAID.

Text Book (s):

1. Operating system, Galvin & Silberschatz, 7th Edition, John Willey 2004
2. Operating Systems-A Concept Based Approach, Dhamdhare, TMH 2006
3. Dhananjay M. Dhamdhare, "Operating Systems A Concept-Based Approach", TMH
4. Operating System Concepts, Ekta Walia, Khanna Book Publishing 2020
5. Operating Systems –A Design Oriented Approach, Crowley, TMH, 2001



DEPARTMENTAL ELECTIVE - I
(TCSM051-054)
OBJECT ORIENTED DESIGN AND MODELING
(TCSM051)

COURSE OUTCOMES (COs):	
CO 1:	Analyse information systems in real-world settings and use an object-oriented method for analysis and design.
CO 2:	Understand features of object-oriented design such as encapsulation, polymorphism, inheritance, and UML.
CO 3:	Understand and prepare different types of UML diagrams like use case diagrams, interaction diagrams, nested state diagrams, state chart diagrams, activity diagram etc.
CO 4:	Understand and appreciate the use of Design Patterns in the Software Development.
CO 5:	Understand the core and advance Java Programming features and apply them in complex problem solving.
Unit	Topic
I	Object Oriented Design and Modeling: Object oriented fundamentals, Objects and Classes, Object-oriented Design Process, importance of modeling, principles of modeling, OOAD Methods, Software Development Life Cycle, Introduction to Unified Process, Introduction to UML: UML Terminology, conceptual model of the UML, Use of UML in Unified Process.
II	Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams, Links and Associations, Link Attributes and Link Classes, Generalization and Inheritance, Aggregation and Composition, Qualified Association, Handling multiplicity in Object creation, Abstract Classes, Specifying constraints in Class Diagrams,
III	Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages, Use Case Modeling: Use Cases and Use Case Diagrams.
IV	Behavioral Modeling: Interactions and Interaction Diagrams, Use-Case Realization: Scenario, Events Trace Diagram, Collaboration Diagrams, State Chart Diagrams, Nested State Diagrams, Activity Diagrams, Advanced Behavioral Modeling Concepts, Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams.
V	Elementary Design Patterns, The MVC Architecture Pattern, Features of Elegant Software Design: Elegant variable, Elegant Classes, Elegant Methods, Elegant Packages, Introduction to Object Oriented Software Quality Metrics.

Text Book (s):

1. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education.
2. Mark Priestley: Practical Object-Oriented Design with UML, TATA Mc-GrawHill.
3. Meilir Page-Jones: Fundamentals of Object-Oriented Design in UML, Pearson Education.



DIGITAL IMAGE PROCESSING
(TCSM052)

COURSE OUTCOMES (COs):	
CO 1:	Understand the fundamentals of visual perception, image models, and sampling techniques.
CO 2:	Explore image enhancement techniques in the spatial domain, including basic gray level functions, histogram processing, and spatial filtering methods such as smoothing and sharpening.
CO 3:	Analyse the principles of image enhancement in the frequency domain, including Fourier transform, frequency domain filtering, and homomorphic filtering.
CO 4:	Understand the fundamentals of color image processing, including color models, transformations, and techniques for color enhancement and segmentation.
CO 5:	Understand the knowledge of image compression techniques, including different coding methods and standards, and apply these methods to optimize image storage and transmission.
Unit	Topic
I	Introduction and Fundamentals: Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain: Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.
II	Image Enhancement in Frequency Domain: Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Low-pass Filters; Sharpening Frequency Domain Filters – Gaussian High-pass Filters; Homomorphic Filtering.
III	Image Restoration: A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering– Band-pass Filters; Minimum Mean-square Error Restoration.
IV	Color Image Processing: Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening.
V	Image Compression: Fundamentals, image compression models, Compression methods: Huffman coding, Golomb Coding, Arithmetic Coding, LZW coding, Run-Length coding, Symbol based coding. Error-free compression, lossy predictive coding, image compression standards. Image Segmentation: Fundamentals, Point, Line and edge detection. Thresholding: foundation, Basic Global Thresholding, Otsu’s Method, Image smoothing to improve global thresholding.

Text Book (s):

1. Rafael C. Gonzalez, Richard E. Woods, Steven L., “Digital Image Processing Using MATLAB”, TMH.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI.



**CLOUD COMPUTING
(TCSM053)**

COURSE OUTCOMES (COs):	
CO 1:	Analyze the evolution, and underlying principles of cloud computing and its characteristics.
CO 2:	Evaluate client systems, networks, server systems, and security from a service perspective within cloud computing.
CO 3:	Understand the conceptual models and functionalities of Infrastructure.
CO 4:	Assess resource management techniques and security challenges associated with inter-cloud resource provisioning.
CO 5:	Use and Examine cloud computing platforms along with current trends and research.
Unit	Topic
I	Introduction To Cloud Computing: Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristic, cloud environment.
II	Cloud Computing Technology - Client systems, Networks, server systems and security from services perspectives; Accessing the cloud with platforms and applications; cloud storage.
III	Working with Cloud- Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities Software as a Service – conceptual model and working Technologies and Trends in Service provisioning with clouds.
IV	Resource Management and Security In Cloud: Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges
V	Case studies-Microsoft Azure, Google App Engine and Open-source clouds- Open-Nebula and Eucalyptus, Current trends and research.

Text Book (s):

1. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications, Cambridge.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach.
3. Dimitris N. Chorafas, Cloud Computing Strategies.



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INTERNET OF THINGS
(TCSM054)

COURSE OUTCOMES (COs):	
CO 1:	Understand the fundamental concepts of IoT, including its functionality and ecosystem.
CO 2:	Understand various IoT hardware components, including computing platforms, sensors, and actuators.
CO 3:	Understand Compare and contrast wireless communication protocols used in IoT, including Bluetooth, Wi-Fi, ZigBee, and cellular IoT.
CO 4:	Analyze IoT solution architecture models and their application in real-world scenarios.
CO 5:	Explore IoT applications and case studies across different industries fields.
Unit	Topic
I	Introduction to IoT: What is IoT, how does it work? Difference between Embedded device and IoT device, Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market.
II	Elements of IoT Hardware Components- Computing (Arduino, Raspberry Pi), Sensing, Actuation, I/O interfaces.
III	Communication Protocols used in IoT: Types of wireless communication, Major wireless Shortrange communication devices, properties, comparison of these devices (Bluetooth, WIFI, ZigBee, 6LoWPAN), Major wireless Long-range communication devices, properties, comparison of these devices (Cellular IoT, LPWAN).
IV	IoT Applications: Industrial Internet 4.0, Applications such as: Smart home, wearables, smart city, smart grid, connected car, connected health (digital health, telehealth, telemedicine), Smart Retail.
V	IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

Text Book (s):

1. Vijay Madiseti, Arshdeep Bahga, Internet of Things, "A Hands-on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
7. Cuno Pfister, Getting Started with the Internet of Things, O Reilly Media, 2011
8. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing, 2015



**MACHINE LEARNING
(TCSM501)**

COURSE OUTCOMES (COs):	
CO1:	Understand and explain the fundamental concepts of machine learning, including supervised, unsupervised, and reinforcement learning, and their applications in solving real-world problems.
CO2:	Apply various machine learning algorithms to build predictive models using appropriate datasets.
CO3:	Analyze and evaluate the performance of machine learning models using various metrics and improve model accuracy through various techniques.
CO4:	Implement and utilize machine learning libraries and frameworks to develop and deploy machine learning solutions in practical scenarios.
CO5:	To optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
Unit	Topic
I	Basic Concepts, Introduction to Machine Learning, Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning with applications and issues, A Formal Learning Model, The Runtime of Learning.
II	Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostic: debugging a learning algorithm, evaluating a hypothesis (Model selection), training/validating/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves, Accuracy and Error measures: classifier accuracy measures, predictor error measure, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, tradeoff between both, accuracy.
III	Decision Tree: representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifier: Bayes rule, Maximum Likelihood Estimation, case study, Support Vector Machine, Nearest Neighbor.
IV	Clustering: Unsupervised learning technique, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners.
V	Reinforcement Learning: Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments.

Text Book (s):

1. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2015.
2. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques Morgan Kaufmann 2005.
3. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.



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**CONSTITUTION OF INDIA
(THM501)**

COURSE OUTCOMES (COs):	
CO 1:	Identify and explore the basic features and modalities about Indian constitution.
CO 2:	Differentiate and relate the functioning of Indian parliamentary system at the centre and state level.
CO 3:	Differentiate different aspects of Indian Legal System and its related bodies.
CO 4:	Knowledge about Human Rights.
CO 5:	Knowledge about Professional Ethics.
UNIT	TOPICS
I	Constitution of India Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution, Preamble to the Indian Constitution Fundamental Rights & its limitations.
II	Fundamental Duties and Union Executives Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties. Union Executives — President, Prime Minister, Parliament, Supreme Court of India.
III	State Legislature and Electoral Process State Executives — Governor Chief Minister, State Legislature High Court of State, Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.
IV	Human Rights Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights — Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India, Powers and functions of Municipalities, Panchayats and Co - Operative Societies.
V	Professional Ethics Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Text Book(s):

1. J. N. Pandey, "Constitutional Law of India," Central Law Agency.
2. M. P. Jain, "Indian Constitutional Law," LexisNexis.
3. Granville Austin, "The Indian Constitution: Cornerstone of a Nation," Oxford University Press.
4. D. D. Basu, "Introduction to the Constitution of India," LexisNexis.
5. V. N. Shukla, "Constitution of India," Eastern Book Company.
6. H. M. Seervai, "Constitutional Law of India: A Critical Commentary," Universal Law Publishing.



**ARTIFICIAL INTELLIGENCE LAB
(TCS551)**

LIST OF THE EXPERIMENTS:

1. Write a python program to implement Breadth First Search Traversal
2. Write a python program to implement Water Jug Problem
3. Write a python program to remove punctuations from the given string
4. Write a python program to sort the sentence in alphabetical order
5. Write a program to implement Hangman game using python.
6. Write a program to implement Tic-Tac-Toe game using python.
7. Write a python program to remove stop words for a given passage from a text file using NLTK
8. Write a python program to implement stemming for a given sentence using NLTK
9. Write a python program to POS (Parts of Speech) tagging for the give sentence using NLTK
10. Write a python program to implement Lemmatization using NLTK
11. Write a python program to for Text Classification for the give sentence using NLTK
12. Design and Development of Expert System using JESS

Note: The instructor may add/ modify the list as per his/her wisdom for better hands on the students.



**OPERATING SYSTEM LAB
(TCS552)**

LIST OF THE EXPERIMENTS:

1. Implement CPU Scheduling Policies:
 - i. SJF
 - ii. Priority
 - iii. FCFS
 - iv. Multi-level Queue

2. Implement any file allocation technique:
 - Linked
 - Indexed
 - Contiguous

3. Implementation of contiguous allocation techniques:
 - i. Worst-Fit
 - ii. Best- Fit
 - iii. First- Fit

4. Calculation of external and internal fragmentation
 - i. Free space list of blocks from system
 - ii. List process file from the system

Note: The instructor may add/ modify the list as per his/her wisdom for better hands on the students.



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B. TECH.
COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
SIXTH SEMESTE



STUDY & EVALUATION SCHEME

**B.TECH. COMPUTER SCIENCE AND ENGINEERING
 (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)**

III Year: VI SEMESTER

S. No.	Subject code	Subject name	L	T	P	Sessional Assessment			SEE	Subject Total	Credit
						MST	TA	Total			
THEORY SUBJECT											
1	TCS601	Computer Networks	3	1	0	15	15	30	70	100	4
2	TCS602	Software Engineering	3	1	0	15	15	30	70	100	4
3	TCSM601	Natural Language Processing	3	1	0	15	15	30	70	100	4
4	TCSM061 - 064	Departmental Elective-II	3	0	0	15	15	30	70	100	3
5	TOE061 - 064	Open Elective –I	3	0	0	15	15	30	70	100	3
6	THM601	Indian Tradition, Culture and Society	2	0	0	15	15	30	70	100	0
7	TGP601	General Proficiency	-	-	-	-	-	50	0	50	0
PRACTICAL/DESIGN/DRAWING											
7	TCS651	Computer Networks Lab	0	0	2	15	15	30	70	100	1
8	TCS652	Software Engineering Lab	0	0	2	15	15	30	70	100	1
		Total	17	3	4					800	20

The internship (5 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII

TCSM061 - 064	Departmental Elective – II
TCSM-061	Robotics
TCSM-062	Data Science
TCSM-063	Recommender System
TCSM-064	Virtual Reality

TOE061 - 064	Open Elective - I
TOE-061	Remote Sensing
TOE-062	Bioterrorism and National Security
TOE-063	Quality Management
TOE-064	Soft Computing



**COMPUTER NETWORKS
(TCS601)**

COURSE OUTCOMES (COs):	
CO 1:	Understand fundamental concepts of computer network technology.
CO 2:	Comprehend various network topologies and protocols.
CO 3:	Examine the roles and functions of different network devices.
CO 4:	Analyze the architecture and principles underlying contemporary computer networks.
CO 5:	Understand future Internet requirements and their implications for computer network architecture.
Unit	Topic
I	Computer Networks and The Internet: Networks, Internet, Network Components, Network Categories, network edge, Network Core , Delay, Loss and throughput in Packet-Switched Networks, Protocol Layers and their Service Models.
II	Data Link Layer: Introduction to the link layer; Error Detection and Correction Techniques; Multiple Access links and Protocols; Switched local area networks.
III	Network Layer: Introduction; Virtual circuit and datagram networks; Router, Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing Algorithms; Routing in the Internet, Broadcast and Multicast Routing.
IV	Transport Layer: Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Principles of Reliable of Data Transfer; Connection-Oriented Transport: TCP; Principles of Congestion Control, TCP Congestion Control.
V	Application Layer: Principles of Network Applications, WWW and HTTP, Non-Persistent and Persistent Connections, Cookies, Web Caching, File Transfer, Remote Logging, Electronic Mail in the Internet, Domain Name System, Security: Introduction, Cryptography and Cryptanalysis, Public Key Cryptography Algorithms, RSA Algorithm, DES, Authentication and Authorization

Text Book (s):

1. A.S. Tanenbaum, DJ Wetherall, Computer Networks, Prentice-Hall, 2010. .
2. LL Peterson, BS Davie, Computer Networks: A Systems Approach, Morgan-Kauffman, 2011.
3. G. Keiser, "Local Area Networks", 2nd Edition, TMH 2002
4. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, PHI 2000
5. William Stallings, "Data & Computer Communication", PHI, 10th Edition 2013
6. B.A. Forouzan, "Data communications and networking", TMH, 5th Edition 2012
7. B.A. Forouzan, "Local Area Networks", TMH. 2002
8. B.A. Forouzan, "TCP/IP Protocol Suite", TMH. 2004



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**SOFTWARE ENGINEERING
(TCS602)**

COURSE OUTCOMES (COs):	
CO 1:	Understand and apply fundamental software engineering principles and practices in the design, development, and maintenance of software systems.
CO 2:	Develop and analyze software requirements specifications, ensuring they are complete, consistent, and feasible.
CO 3:	Design software architecture and components using appropriate modelling techniques, such as UML, to create effective and efficient software solutions.
CO 4:	Implement software systems using modern programming languages and development environments while adhering to best coding practices.
CO 5:	Conduct software testing and debugging to ensure software reliability, performance, and correctness.
Unit	Topic
I	Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.
II	Software Requirement Specifications (SRS). Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Attributes, Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.
III	Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halstead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.
IV	Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.
V	Software Maintenance and Software Project Management, Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Text Book (s):

1. Software Engineering: A Practitioner's Approach, Pressman Roger, TMH.
2. An Integrated Approach to Software Engineering, Pankaj Jalote. Narosa Pub.
3. Software Engineering Concepts: Richard Fairly, Tata McGraw Hill.
4. Schaum's Series, "Software Engineering", TMH
5. Ghezzi, Carlo and Others, "Fundamentals of Software Engineering", PHI
6. Alexis, Leon and Mathews Leon, "Fundamental of Software Engineering", Vikas
7. Sommerville, Ian, "Software Engineering", AWL



**NATURAL LANGUAGE PROCESSING
(TCSM601)**

COURSE OUTCOMES (COs):	
CO 1:	To learn the fundamentals of natural language processing
CO 2:	To understand the use of CFG and PCFG in NLP
CO 3:	To understand the role of semantics of sentences and pragmatic
CO 4:	To introduce speech production and related parameters of speech.
CO 5:	To show the computation and use of techniques such as short time fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
Unit	Topic
I	Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance. Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.
II	Context Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.
III	Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using
IV	Speech Fundamentals: Articulatory Phonetics – Production and Classification Of Speech Sounds; Acoustic Phonetics – Acoustics Of Speech Production; Review Of Digital Signal Processing Concepts; Short-Time Fourier Transform, Filter-Bank And LPC Methods.
V	Features, Feature Extraction and Pattern Comparison Techniques: Speech Distortion Measures– Mathematical and Perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion Using A Warped Frequency Scale, LPC, PLP And MFCC Coefficients, Time Alignment And Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths. Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-Estimation, Implementation Issues.

Text Book (s):

- Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Pub;, 2014.
- Steven Bird, Ewan Klein and Edward Loper —Natural Language Processing with Python, First Edition, OReilly Media, 2009.



DEPARTMENTAL ELECTIVE - II
(TCSM061-064)
ROBOTICS
(TCSM061)

COURSE OUTCOMES (COs):	
CO 1:	Understand the types, components, and classification of robots, including kinematic systems and control systems, while addressing social issues and safety in robotics.
CO 2:	Analyze robot kinematics and dynamics, focusing on translation and rotation representation, coordinate transformation, and dynamic modeling using Euler-Lagrange formulation.
CO 3:	Explore various sensors and vision systems used in robotics, including contact, proximity, position, and vision applications, with a focus on camera calibration and image formation geometry.
CO 4:	Apply control theories to robotics, including P, PD, PID, and advanced control laws, and understand the selection and function of various robot actuation systems.
CO 5:	Develop skills in control hardware and interfacing, focusing on embedded systems architecture, integration with sensors and actuators, and programming for robot applications.
Unit	Topic
I	Introduction to Robotics: Types and components of a robot, Classification of robots, closed-loop and openloop control systems, Kinematics systems; Definition of mechanisms and manipulators, social issues and safety.
II	Robot Kinematics and Dynamics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics, Dynamic Modelling: Equations of motion: Euler-Lagrange formulation
III	Sensors and Vision System: Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc, Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.
IV	Robot Control: Basics of control: Transfer functions, Control laws: P, PD, PID, Non-linear and advanced controls, Robot Actuation Systems: Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.
V	Control Hardware and Interfacing: Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications

Text Book (s):

1. Saha, S.K., "Introduction to Robotics, McGraw-Hill Higher Education, New Delhi.
2. Ghosal, A., "Robotics", Oxford, New Delhi.
3. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI.
4. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
5. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
6. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi.



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Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

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**DATA SCIENCE
(TCSM062)**

COURSE OUTCOMES (COs):	
CO 1:	Understand the core concepts of data science, including big data traits, web scraping techniques, and the distinctions between analysis and reporting.
CO 2:	Explore Python toolkits for data science such as Matplotlib, NumPy, Scikit-learn, and NLTK, and apply these tools to visualize data using various chart types.
CO 3:	Analyze mathematical foundations relevant to data science, including linear algebra, statistics, probability, and hypothesis testing, and apply these concepts to data analysis.
CO 4:	Assess machine learning models using metrics for classification errors and time series analysis.
CO 5:	Apply data science methodologies to real-world case studies such as weather forecasting, stock market prediction, object recognition, and real-time sentiment analysis, to draw actionable insights.
Unit	Topic
I	Introduction to Data Science: Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting.
II	Introduction to Programming Tools for Data Science : Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK, Visualizing Data: Bar Charts, Line Charts, Scatterplots, Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction.
III	Mathematical Foundations: Linear Algebra: Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation, Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, the Central Limit Theorem, Hypothesis and Inference.
IV	Machine Learning: Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks- Learning And Generalization, Overview of Deep Learning.
V	Case Studies of Data Science Application: Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

Text Book (s):

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
3. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
4. Jeeva Jose, "Machine Learning", Khanna Publishing House, Delhi.
6. Chopra Rajiv, "Machine Learning", Khanna Publishing House, Delhi.
5. Text Compression 1st Edition by Timothy C. Bell Prentice Hall.



**RECOMMENDER SYSTEMS
(TCSM063)**

COURSE OUTCOMES (COs):	
CO 1:	To understand basic techniques and problems in the field of recommender systems
CO 2:	To understand filtering algorithms and apply on recommendations.
CO 3:	To introduce different approaches of recommender systems
CO 4:	To apply algorithms and techniques to develop Recommender Systems that are widely used in the Internet industry.
CO 5:	To explore various types of recommender systems and develop state-of-the-art recommender systems.
Unit	Topic
I	Basic concepts for recommender systems: detailed taxonomy of recommender systems, Evaluation of recommender systems, Applications of recommendation systems, Issues with recommender system.
II	Collaborative filtering algorithms: User-based nearest neighbor recommendation, Item-based nearest-neighbour recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.
III	Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.
IV	Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders
V	Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies. Evaluating Recommender System: General properties of evaluation research, Evaluation designs, Evaluation on historical datasets.

Text Book (s):

1. Charu Aggarwal "Recommender Systems: The Textbook," First Edition, Springer.
2. Francesco Ricci, Lior Rokach, and Bracha Shapira "Recommender Systems Handbook," Springer.
3. Rounak Banik "Hands-On Recommendation Systems with Python," First Edition, Packet Publishing.
4. Kim Falk "Practical Recommender Systems," First Edition, Manning Publications.
5. Deepak Agarwal and Bee-Chung Chen "Statistical Methods for Recommender Systems," First Edition, Cambridge University Press.



**VIRTUAL REALITY
(TCSM064)**

COURSE OUTCOMES (COs):	
CO 1:	Understand the fundamentals and importance of data visualization.
CO 2:	Use various tools and software to create effective visualizations.
CO 3:	Design and evaluate visualizations based on best practices
CO 4:	Develop interactive visualizations and integrate them with data sources.
CO 5:	Analyze real-world visualizations and address ethical considerations.
Unit	Topic
I	Introduction to Virtual Reality: Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Color theory, Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.
II	Geometric Modeling: Geometric Modeling: Introduction, from 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.
III	Virtual Environment: Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in battenning, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.
IV	VR Hardware and Software: Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML
V	VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

Text Book (s):

1. John Vince, "Virtual Reality Systems", Pearson Education Asia.
2. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.
3. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill.
4. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science
5. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann.
6. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science.



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INDIAN TRADITIONS, CULTURE AND SOCIETY
(THS601)

COURSE OUTCOMES (COs):	
CO 1:	Understand contemporary issues by exploring historical roots and finding solutions.
CO 2:	Recognize the importance of the environment and contribute to sustainable development
CO 3:	Develop sensitivity towards Indian culture, tradition, and its diverse character.
CO 4:	Learn about holistic lifestyles from Yogic science and Sanskrit literature relevant to modern society.
CO 5:	Gain knowledge of the Indian Knowledge System, modern scientific perspectives, and principles of Yoga and holistic health.
Unit	Topic
I	Society State and Polity in India Ancient Indian state theories, stages of state formation, kingship, administration, political ideals, societal conditions, Purusārtha, Varnāshrama system, stages of life, marriage, gender representation, and challenges faced by women.
II	Indian Literature, Culture, Tradition, and Practices Evolution of scripts, Vedas, Upanishads, Ramayana, Mahabharata, Puranas, Buddhist and Jain literature, Kautilya's Arthashastra, regional literatures in Sanskrit, Telugu, Kannada, Malayalam, and Hindi, Persian and Urdu influences.
III	Indian Religion, Philosophy, and Practices Pre-Vedic and Vedic religions, Buddhism, Jainism, Indian philosophy systems, Shankaracharya, philosophical doctrines, Bhakti and Sufi movements, 19th-century socio-religious reforms, modern practices.
IV	Science, Management and Indian Knowledge System Ancient Indian contributions to astronomy, chemistry, mathematics, physics, agriculture, medicine, metallurgy, geography, biology, Harappan technologies, water management, textile technology, and trade.
V	Cultural Heritage and Performing Arts Ancient Indian architecture, sculptures, seals, coins, pottery, puppetry, dance, music, theatre, painting, martial arts, fairs and festivals, current arts developments, and Indian cinema.

Text Book (s)

1. A. L. Basham, "The Wonder That Was India," Sidgwick & Jackson.
2. C. N. Srinath, "Indian Culture and Civilization," National Book Trust.
3. Sisir Kumar Das, "A History of Indian Literature," Sahitya Akademi.
4. C. Sivaramamurti, "The Art and Architecture of India," National Book Trust.
5. John Keay, "India: A History," HarperCollins.
6. S. Radhakrishnan, "Indian Philosophy: A Historical Analysis," Oxford University Press.
7. R. C. Majumdar, "Cultural Heritage of India," Bharatiya Vidya Bhavan.
8. A. K. Bag, "The History of Indian Science, Technology, and Culture," Abhinav Publications.
9. Amrit Rai (ed.), "The Encyclopaedia of Indian Literature," Sahitya Akademi.
10. James Fergusson, "Indian Architecture: Hindu and Buddhist," Dover Publications.



**COMPUTER NETWORKS LAB
(TCS651)**

LIST OF THE EXPERIMENTS:

1. To learn basics of the packet tracer simulator tool.
2. Write a program in C to implement bit stuffing and character stuffing.
3. To connect the computers in Local Area Network and to detect collision of packets.
4. To configure DHCP and DNS server for a given network in packet tracer simulator tool.
5. Write a C program to get the MAC or Physical address of the system using ARP (Address Resolution Protocol) and to subnet a given network according to the requirements in packet tracer simulator tool. .
6. To configure router using command line. Also observe the datagram formats in packet tracer simulator tool.
7. To configure NAT for a given network in packet tracer simulator tool.
8. Write a program to implement TCP & UDP Sockets.
9. Write a C program to transmit a character, a string and a file from one computer to another using RS-232 cable and to configure static routing in packet tracer simulator tool.
10. To configure dynamic routing protocols in packet tracer simulator tool.

Note: The instructor may add/ modify the list as per his/her wisdom for better hands on the students.



SOFTWARE ENGINEERING LAB
(TCS652)

LIST OF THE EXPERIMENTS:

1. Introduction to Software Engineering Processes.
2. Basic steps required to create project and prepare it for data entry (project tasks, sequence the tasks and estimate task duration).
3. Setting up a project and establish the basic constraints that project will use for its calculation. Analyze the project from different views [Gantt Chart, Network Diagram, Flow Charts]
4. Identifying relationship among the different task and subtasks of the Project.
5. Explain how to enter resources and specific information in the Project and resources to specific tasks.
6. Case Study of the Project.

Note: The instructor may add/ modify the list as per his/her wisdom for better hands on the students.