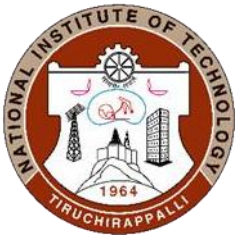

Computer Applications

MINOR Courses

[with effect from 2024 – 2025 onwards]

DEPARTMENT OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI.

LIST OF MINOR COURSES

Students who have registered for **Minor in Computer Applications** can opt to study any 5 of the courses listed below.

Sl. No.	Course Code	Course Title	Credits
1.	CAMI10	Mathematical Foundations of Computer Science	3
2.	CAMI11	Operating Systems	3
3.	CAMI13	Data Base Management Systems	3
4.	CAMI14	Data Structures and Applications	3
5.	CAMI15	Data Mining Techniques	3
6.	CAMI16	Data Analytics	3
7.	CAMI17	Design and Analysis of Algorithms	3
8.	CAMI18	Unix and Shell Programming	3
9.	CAMI19	Information Security	3
10.	CAMI20	Big Data Analytics	

Course Code	**:**	CAMI10
Course Title	**:**	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To acquire skills in solving mathematical and logical problems.
CLO2	To comprehend mathematical principles and logic.
CLO3	To understand fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science

Course Content

Set Theory: Sets and operations-properties - power set - methods of proof – relations -types of relations - functions – types of functions – properties of functions.

Mathematical Logic: Propositions and logical operators —- Equivalences and implications – connectives –PCNF-DCNF.

Groups, Rings and Fields: Introduction-Algebraic Structures- Groups- Abelian Group, Order- Cyclic Group- Rings- Fields.

Basic Number Theory : Basic Notions-Prime Number Theorem- GCD- Euclidean algorithm, Solving $ax + by = d$, Congruence- The Chinese Remainder Theorem- Modular Exponentiation- Fermat and Euler- Primitive Roots- Inverting Matrices Mod n- Square Roots Mod n.

Graph Theory: Definitions and basic results - Representation of a - Trees - Cycles - Properties - Paths and connectedness - Sub graphs - Graph Isomorphism - Operations on graphs – cut sets - Spanning Trees- Euler circuits- Hamiltonian graphs.

References:

1. Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, 7th Edition, McGraw-Hill, 2012.
2. Mahima Ranjan Adhikari and Avishek Adhikari, “Basic Modern Algebra with Applications”, Springer, 2014.
3. Kolman, Busby and Ross, “Discrete Mathematical Structures”, 6th Edition, PHI, 2009.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Apply the concepts of discrete mathematics in the modeling and design of computational problems.

Course Code	**:**	CAMI11
Course Title	**:**	OPERATING SYSTEMS
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To introduce basic concepts and features of OS.

Course Content

Operating System concepts- OS Structure –Services-System calls – Process management-Process Concept-Operations on process. Process scheduling- Scheduling algorithms.

Inter-process communication- Process synchronization- critical-section problem– Semaphores– critical regions. Threads- Multithreading models.

Memory management-Buddy system-Paging-segmentation-Virtual Memory –Demand paging-Page replacement algorithms – Allocation of frames – Thrashing-Working set model

Files and Directories - Files System structure- Implementation –File allocation methods-Free space management.

I/O systems – I/O interface –Kernel I/O subsystem. Disk scheduling algorithms- Disk management-Swap space management

References:

1. Silberschatz, Galvin and Gagne, “Operating System Concepts”, 9th Edition, John Wiley & Sons Inc., 2013.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, 3rd Edition, Prentice-Hall of India, 2007
3. SibsankarHaldar, Alex A.Aravind, “Operating systems”, Pearson Education, 2009.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Use system calls to interact with OS
CO2	Synchronize multiple processes and handle issues in synchronization
CO3	Implement memory management techniques
CO4	Implement algorithms in secondary storage and file management techniques

Course Code	**:**	CAMI13
Course Title	**:**	DATABASE MANAGEMENT SYSTEMS
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To learn different database models and design of databases and to study query languages.

Course Content

File System versus DBMS – Advantages – Database Languages.ER-Model: Entities – Relationships – Additional Features of ER Model – Conceptual Design with ER Model

Relational Model – Keys - Constraints – Querying – Views - Relational Algebra – Relational Calculus – SQL

File Organization-Fixed Length records-Variable length records – Organization of records in files – Sequential –Clustering.

Indexing – Ordered Indices - B + Tree Index files – Hashing- Static Hashing-Dynamic hashing.

Database Design – Pitfalls in Relational Database Design – Functional Dependencies – Decomposition – Normalization – I to V Normal Forms

References:

1. Raghu Ramakrishnan and Johannes Gehrke, “Data Base Management Systems”, 3rd Edition, McGraw-Hill, 2003.
2. Silberschatz, Korth and Sudarshan, “Data Base System Concepts”, McGraw-Hill, 6th Edition, 2010.
3. C. J. Date, “An Introduction to Database Systems”, 8th Edition, Addison-Wesley, 2003.
4. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, 5thEdition, Pearson Education/Addison Wesley, 2007.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Illustrate the features of DBMS & Models for designing databases
CO2	Describe the nuances of Data retrieval methods
CO3	Apply normalization techniques in DB design

Course Code	**:**	CAMI14
Course Title	**:**	DATA STRUCTURES AND APPLICATIONS
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To introduce different data structures; searching and sorting techniques and their applications.

Course Content

Linear data Structures – Arrays, Structures, Linked Lists – Singly, Doubly, Circular, XOR, VList, Skip, Jump List, Stack: Definition and examples, Representing Stacks - Queues: Definition and examples, priority queue, Deque, IRD, ORD – Applications of Stack, Queue and Linked Lists- Hashing

Binary Trees – Binary Tree Representations – node representation, internal and external nodes, implicit array representation - Operations on binary trees – Binary tree Traversals - Representing Lists as Binary Trees

Graphs – Representation – Linked representation of Graphs – Graph Traversals.

Single-source shortest path algorithms – Bellman-Ford algorithm and Dijkstra's algorithm- Transitive closure -Topological sort

Basic sorting techniques – selection sort, bubble sort, insertion sort and merge sort – Basic Search Techniques – linear search and binary search –Search Trees – Tree searching

References:

1. S. Lipschutz and G.A.V. Pai, “Data Structures”, Tata McGraw-Hill,2010.
2. M.A.Weiss, “Data Structures and Problem Solving using Java”, 4th Edition, Addison Wesley,2009.
3. P. Brass, “Advanced Data Structures”, Cambridge University Press,2008.
4. M.J.Augestein, Y.Langsam and A.M. Tenenbaum, “Data Structures using Java", Pearson Education, 2004.
5. R. Kruse and C.L. Tondo, “Data Structures and Program Design in C”, 2nd Edition, Prentice Hall,1996.
6. T.A.Standish, “Data structures, Algorithms and Software principles in C”, Addison Wesley, 1994.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Use linear and nonlinear data structures to solve real-time problems
CO2	Apply basic searching and sorting techniques in different application domains

Course Code	**:**	CAMI15
Course Title	**:**	DATA MINING TECHNIQUES
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To introduce concepts of data mining techniques and its applications in knowledge extraction from databases.

Course Content

Data mining – Motivation – Importance - DM Vs KDD - DM Architecture - Data Types – DM Tasks –DM System Classification - Primitives of DM - Data Mining Query Language - DM Metrics - DM Applications - DM Issues – Social Implications of DM

Data Pre-processing: Summarization - Data cleaning - Data Integration and Transformation - Data Reduction - Discretization and Concept Hierarchy Generation

Mining Frequent Patterns – Frequent Item set Mining Methods. Classification: Classification by Decision Tree Induction – Bayesian Classification – Rule based Classification - Prediction – Accuracy and Error Measures

Cluster Analysis – Types of Data in Cluster Analysis – Categorization of clustering Methods – Partition Methods - Outlier Analysis – Mining Data Streams – Social Network Analysis – Mining the World Wide Web

Data Warehousing: OLTP Vs OLAP - Multidimensional Data Model -DW Architecture Efficient Processing of OLAP queries - Metadata repository – DWH Implementation – OLAM

References:

1. JiaweiHan ,MichelineKamber, "Data Mining: Concepts and Techniques", 2nd Edition, Elsevier India Private Limited,2008.
2. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education, 2012.
3. K.P.Soman, ShyamDiwakar, V.Ajay, “Insight into Data Mining Theory & Practice, Prentice Hall India,2012,
4. G.H.Gupta, “Introduction to Data Mining with Case Studies”, 2nd Edition, PHI.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Explain the concepts in data mining and KDD, recognizing issues in Data Mining
CO2	Practice the pre-processing operations of Data
CO3	Define the methodologies in Data interpretation, transformation and reduction
CO4	Perform Association Rule Mining, Classify and Cluster the data sets into groups

Course Code	**:**	CAMI16
Course Title	**:**	DATA ANALYTICS
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To understand the data analytics approaches
CLO2	To apply various data analytics techniques for decision making problems

Course Content

Introduction: Data Analytics- Data collection- integration- management- modelling- analysis-visualization-prediction and informed decision making. General Linear Regression Model, Estimation for β, Error Estimation, Residual Analysis.

Tests of significance - ANOVA, 't' test, Forward, Backward, Sequential, Stepwise, and all possible subsets, Dummy Regression, Logistic Regression, and Multi-collinearity.

Discriminant Analysis-Two group problem, Variable contribution, Violation of assumptions, Discrete and Logistic Discrimination, The k-group problem, multiple groups, Interpretation of Multiple group Discriminant Analysis solutions.

Principal Component Analysis-Extracting Principal Components, Graphing of Principal Components, Some sampling Distribution results, Component scores, Large sample Inferences, Monitoring Quality with principal Components.

Factor Analysis-Orthogonal Factor Model, Communalities, Factor Solutions and rotation. Machine learning: supervised learning (rules, trees, forests, nearest neighbour, regression)- optimization (gradient descent and variants)- unsupervised learning.

References:

1. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", fifth Edition, Pearson Education, 2002.
2. Hastie, Trevor, et al. "The elements of statistical learning". Springer, 2009.
3. Montgomery, Douglas C., and George C. Runger, "Applied statistics and probability for engineers", John Wiley & Sons, 2010

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Apply various data analytics techniques for decision making problems.

Course Code	**:**	CAMI17
Course Title	**:**	DESIGN AND ANALYSIS OF ALGORITHMS
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To learn about Time Complexity and various algorithmic design methodologies.

Course Content

Algorithms as technology – Analyzing and Designing algorithms – Asymptotic notations – Recurrences – Methods to solve recurrences – Heap Sort - Quick Sort – Sorting in linear time – Radix sort – Selection in linear time.

Divide and conquer methodology – Multiplication of large integers – Strassen's matrix multiplication – Greedy method – Prim's algorithm – Kruskal's algorithm – algorithm for Huffman codes.

Dynamic Programming – Elements – Matrix-chain multiplication –Computing a binomial coefficient – Floyd-Warshall algorithm – Optimal binary search tree – Memory functions.

Backtracking – N-Queens problem – Hamiltonian circuit problem – Subset sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem.

NP-hard and NP-complete problems – Definitions and Properties – Reducibility – Cook's Theorem (without proof) – Clique decision problem – Node cover problem – K-coloring problem

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009.
2. Robert Sedgewick and Philippe Flajolet, "An Introduction to the Analysis of Algorithms", 2nd Edition, Addison-Wesley, 2013
3. Jon Kleinberg and ÉvaTardos, "Algorithm Design", Addison-Wesley, 2005.
4. George T. Heineman, Gary Pollice and Stanley Selkow, "Algorithms in a Nutshell", O'Reilly Media, 2008.
5. SanjoyDasgupta, Christos Papadimitriou and UmeshVazirani,"Algorithms", McGraw-Hill,2006.
6. E.Horowitz, S.Sahni, and S.Rajasekaran, "Computer Algorithms", 2nd edition, Silicon Press,2007.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Analyze the complexity of polynomial algorithms.
CO2	Apply various design strategies for solving problems
CO3	Distinguish NP hard and NP complete problems from other problems

Course Code	**:**	CAMI18
Course Title	**:**	UNIX AND SHELL PROGRAMMING
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To learn the UNIX operating system concepts and shell programming

Course Content

Introduction – UNIX Environment –Structure – Accessing UNIX –Common Commands – Basic Editors: Concepts –Modes –Editor Commands

File Systems: File names –File Types –Regular Files –Directories –File System Implementation -Operations Unique to directories and regular files –Security and File Permission

Introduction to Shells: UNIX Session –Standard Streams –Redirection –Pipes –Command Line Editing -Job Control – Aliases –Variables -Shell/Environment Customization

Filters: Concatenating –Sorting –Translating Characters – Duplicate Lines –Character Count –Comparing Files. Communications: User commands –Electronic mail –Remote Access – File Transfer

C Shell Programming: Basic Scripts –Expressions –Decision Making Selections –Special Parameters –Argument Validation –Debugging Scripts –Signals –Scripting Techniques

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, “UNIX and Shell Programming “, 9th Edition, Cengage Learning, 2009.
2. SumitabhaDas,“UNIX Concepts and Applications”,8th Edition, Tata McGraw Hill, 2008
3. M G Venkateshmurthy: UNIX and Shell Programming, Pearson Education, 2005
4. Maurice J. Bach, “The Design of the Unix Operating System”, Indian Edition, PHI Learning Private Limited, 2011.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Explain the concepts of UNIX Operating System
CO2	Use various file and directory commands in UNIX Operating System
CO3	Write shell scripts for various tasks

Course Code	**:**	CAMI19
Course Title	**:**	INFORMATION SECURITY
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To study the concepts and requirements of Information Security.

Course Content

Information Security - Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, SDLC, Security SDLC

Cryptography: Classical Cryptography, Symmetric Cryptography, Public Key (Asymmetric cryptography), Modern Cryptography. Forensics: DRM technology (including watermarking and fingerprinting of images, video and audio), Steganography, Biometrics

Network Security: Network Protocols, Wireless Security (WiFi, WiMAX, Bluetooth, and cell phone), IDS and Network Intrusion Management

Application Security: Email Security, Web Security, and Database Security, Secure Software Development, VoIP Security

Information Security Threats: Viruses, Worms and other malware, Email Threats, Web Threats, RFID, Identity Theft, Data Security Breaches, Hacking Tools and Techniques

References:

1. W. Stallings, Cryptography and Network Security: Principles and Practice, 6th Edition, Prentice Hall, 2013
2. Neil Daswani, Christoph Kern, Anita Kesavan, " Foundations of Security: What Every Programme", APRESS, 2007.
3. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, 2003.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Explain the models of information security
CO2	Apply cryptography techniques to data
CO3	Simulate the various network security issues
CO4	Experiment with application security
CO5	Explore the nature and logic behind the various security threats on the web

Course Code	**:**	CAMI20
Course Title	**:**	BIG DATA ANALYTICS
Type of Course	**:**	MI
Prerequisites	**:**	-
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLOs)

CLO1	To get introduced to big data analytics and to understand the importance of big data.
CLO2	To get introduced with different approaches of exploiting big data sources such as social media, mobile devices and sensors through understanding methodologies of analyzing big data.
CLO3	To acquire knowledge of handling unstructured and semi-structured data using NoSQL database.

Course Content

Introduction: IT revolution, digital media, relationship among people, media and information, The fundamental structure of web, Social media as a platform, the framework of media, the paths of messages: transition and diffusion, Hadoop Framework.

Fundamentals: Search, Indexing and Memory, Handling Streams, Information and Language, Analyzing Sentiment and Intent, Databases and their Evolution, Big Data Technology and Trends, Different kinds of Analytics, Programming: Map-Reduce.

Communities: Observation and discrimination of the special crowds, (communities) living in the words of social media, methods and tools for identifying online communities (big data analytics), Clarifying the principles of embedding, concatenation and emergence operations in online society, Analysis of the different stages in the development of community.

NoSQL Databases: Evolution of Document Databases, Design and use of NoSQL databases, Storage and retrieval of unstructured data, NoSQL applications and query options, NewSQL.

Big Data Analytics: Classification, Clustering, and Mining, Information Extraction, Regression and Feature Selection, Reasoning: Logic and its Limits, Dealing with Uncertainty, Bayesian Inference, Forecasting, Neural Models, Deep Learning, and Research Topics.

References:

1. Philip (flip) Kromer and Dieterich Lawson, “Big Data for Chimps - A Guide to Massive-Scale Data Processing in Practice”, O'Reilly Media, 2014.
2. Viktor Mayer-Schonberger and Kenneth Cukier, “Big Data: A Revolution That Will Transform How We Live, Work, and Think”, Houghton Mifftlin Harcourt, 2013.
3. Tom White, “Hadoop: The Definitive Guide”, O'Reilly Media, 2012.
4. “Beginner’s guide to Big Data Analytics using R & Hadoop”, online course, Jigsaw Academy Education Private Limited, 2012.

Course Outcomes (COs)

At the end of the course student will be able to

CO1	Comprehend the concepts of big data analytics.
CO2	Build web-intelligence applications exploiting big data using new big data platforms based on the ‘map-reduce’ parallel programming framework.
CO3	Effectively use NoSQL database for storage and retrieval of big data.