Course Outline
&
Syllabus
of
Master of Science
(Information Technology)

2- years Full Time Programme

Magadh University, BodhGaya
824234

Course Outline and Syllabus

of

Master of Science (Information Technology)

Paper Code	Paper Name	Marks Ext./Int.	Credit
Semester-I			
MIT-101	Object Oriented Programming using Java	80+20	4
MIT-102	Operating Systems	80+20	4
MIT-103	Data Communication and Computer Network	80+20	4
MIT-L1	Lab	80+20	4
MIT- NC1*	Technical Communication *		0
	Total	**320+80**	**16**
Semester-II			
MIT-201	Data Structure and Algorithms	80+20	4
MIT-202	Database Management Systems	80+20	4
MIT-203	Theory of Automata	80+20	4
MIT-L2	Lab	80+20	4
MIT- NC2*	Introduction to Computer Programming through C*		
	Total	**320+80**	**16**
Semester- III			
MIT-301	Artificial Intelligence	80+20	4
MIT-302	Data Science using Python	80+20	4
MIT-3XX	Elective I Any one elective from the list of electives offered by the Department	80+20	4
MIT-L3	Lab	80+20	4
	Total	**320+80**	**16**
Semester – IV			
MIT-4XX	Elective II Any one elective from the list of electives offered by the Department	80+20	4
MIT-4XX	Elective III Any one elective from the list of electives offered by the Department	80+20	4
MIT-400	Major Project	80+20	4
MIT- L4	Lab	80+20	4
	Total	**320+80**	**16**
	Grand Total	**1600**	**64**

*Qualifying papers (Non - Credit)

List of Electives

Elective -I

1. MIT-303 - Mathematics for Computer Science
2. MIT-304 - Multimedia and Animation
3. MIT-305 -Software Engineering
4. MIT-306 -Cyber Security
5. MIT-307 - Operation Research

Elective – II

1. MIT-411 Data Mining
2. MIT-412 Machine Learning
3. MIT-413 Compiler Design
4. MIT-414 Mobile Computing
5. MIT-415 Software Quality Assurance and Testing

Elective -III

1. MIT-421 Deep learning
2. MIT-422 Web Technologies
3. MIT-423 E-Commerce
4. MIT-424 Digital Image Processing
5. MIT-425 Blockchain Technology

Semester-I

MIT-101 Object Oriented Programming using Java

Programming Concepts: program, identifiers, variables, constants, primitive data types, expressions, control statements, structured data types, arrays, functions.
Object Oriented Concepts: Abstraction, encapsulation, objects, classes, methods, constructors, inheritance, polymorphism, static and dynamic binding, overloading, Abstract classes, Interfaces and Packages.
File Handling: Byte Stream, Character Stream, File I/O Basics, File Operations, Serialization.

Exception handling: Throw and Exception, Throw, try and catch Blocks, Multiple Catch Blocks, Finally Clause, Throwable Class, Types of Exceptions, java.lang Exceptions, Built-In Exceptions.

Readings:

1. James Gosling, Bill Joy, Guy L. Steele Jr, Gilad Bracha, Alex Buckley, **The Java Language Specification, Java SE 7 Edition**, Addison-Wesley, 2013**.**
2. Cay S. Horstmann, Core Java - Vol. I – Fundamentals, 10th Edition, Pearson, 2017**.**
3. Deitel & Deitel, **Java-How to Program** (9th ed.), Pearson Education, 2012.
4. Richard Johnson, An Introduction to Java Programming and Object-Oriented Application Development, **Thomson Learning,** 2006.
5. Herbert Schildt, Java: The Complete Reference, 10th Edition, McGraw-Hill Education, 2018.

MIT-102 Operating Systems

Introduction: Operating System as a resource manager, operating systems services, system calls, operating system classifications, operating systems architectures.

Processor Management: Process overview, process states and state transition, multi-programming, multi-tasking, levels of schedulers and scheduling algorithms, Process Synchronization-Critical section and mutual exclusion problem, classical process synchronization problems, deadlock prevention, Multithreading.

Memory Management: absolute and relative code, address translation, memory management techniques- partition, paging, segmentation, virtual memory, Static and dynamic

memory management.

Device Management: Goals of I/O software, Design of device drivers- interrupt service routines, upper half of kernel software, lower half of kernel software.

File Management: Overview of file management system, disk space management, directory structures, file sharing and protection, access control lists, protection models.

Readings:

1. Silberschatz, Galvin,and Gagne, **Operating Systems concepts** , Wiley ,2009.
2. Gary Nutt, Nabendu Chaki, Sarmistha Neogy, **Operating Systems: A Modern Approach (3rd ed.)**, Addison Wesley, 2009.
3. D.M. Dhamdhere, **Operating Systems: A Concept Based Approach (2nd ed.)**, Tata McGraw- Hill, 2007.

MIT-103 Data Communication and Computer Network

Data Communication Techniques: Theoretical basis of data communication, analog and digital signals, time domain and frequency domain analysis, frequency spectrum and bandwidth, asynchronous and synchronous transmission, data encoding and modulation techniques, baseband and broadband transmission, pulse code modulation, baud rate and bitrate of a channel, multiplexing- FDM & TDM, transmission medium, transmission errors – error detection techniques.

Network Classification and Network services: Local Area Networks, Metropolitan Area Networks, Wide Area Network, wireless networks, internetworking and Internet, business and home applications, mobile user services.

Network Architecture and Reference Models: Layered network architectures, protocol hierarchies, interface and services, ISO-OSI reference model, TCP/IP reference model, Internet protocol stack.

Datalink Layer Functions and Protocols: Framing, flow-control, error recovery protocols, Data link layer of internet-PPP protocol.

Medium Access Sublayer: CSMA/CD protocol and Ethernet, husband switches, fast Ethernet, gigabit Ethernet, CSMA/CA protocol and WLAN.

Network and transport layers functions and protocols: Network switching mechanisms- Circuit switching, packet switching, routing and congestion control, TCP/IP protocol architecture.

Network Applications: File transfer protocol, electronic mail, World Wide Web

Readings:

1. A S Tanenbaum, **Computer Networks**, 5th Edition , Pearson Education India, 2013
2. Behrouz A Forouzan, **Data Communications and Networking**, 5th edition, McGraw Hill Education, 2017.

MIT-NC1 Technical Communication

Communication: Animal Communication and human communication, Communication Models, verbal and non-verbal communication, speech and writing

Interpersonal and business communication: message structure, barriers.
Technical writing: scientific and technical writing; formal and informal writing; report, letter, memorandum, notice, agenda, and minutes, oral presentation**.**
Job application for a technical post: Structure, content, Resume.

Report writing: topic, assumptions, hypothesis, overview, analysis and discussion, conclusion, appendices, references.

Digital Communication: Using Internet for communication in the workplace; Different strategies, structure, content, and language with special reference to the difference between British and American usage, abbreviations (such as asap, btw, aka) and use of non-verbal symbols such as smileys.
Language Comprehension: Summarizing, Reading Comprehension, short composition, tenses, common errors.

Readings:

1. Victoria Fromkin, Robert Rodman and Nina Hyams, **An Introduction to Language** (7^{th} ed.), Thomson Learning, 2002.
2. Leech Thomas, **How to prepare, stage, and deliver winning presentations** (3^{rd}ed.), American Management Association,2004.
3. Carol M. Lehman, and Debbie D. Dufrene, **Business Communication** (14^{th} ed.), South-Western Educational Pub, 2004.
4. H. A. Murphy, H. W. Hildebrandt and J. P. Thomas, **Effective Business Communication** (7^{th} ed.), McGraw-Hill, New York, 1997.
5. Larry L. Barker, **Communication** (6^{th} ed) , Prentice Hall, Englewood Cliffs, New Jersey,1993
6. Elizabeth Tebeaux and Sam Dragga, **The Essentials of Technical Communication** (2^{nd} ed.), Oxford University Press, 2012
7. Caroline Tagg, **Exploring Digital Communication: Language in Action,** Routledge, New York, 2015.

Semester-II

MIT-201 Data Structure and Algorithm

Basic data Structures: Primitive Data Types, Abstract Data Types, Arrays - Static and Dynamic, 2D Arrays, Linked Lists - Single, Doubly-linked, Circular; Stacks and Queues using arrays and linked lists

Trees: Binary Tree, Binary Search Tree, Height Balanced Trees: AVL/RB Tree, 2-3Trees, B and B+ Trees.

Review of Growth of Functions

Iterative Algorithms: Searching and Sorting Techniques - Linear search, Binary search, insertion sort – time complexity and proof of correctness.

Divide and Conquer: Recurrence Relation, Master's Theorem, Recursion Trees; Binary Search, Merge sort and Quick sort – time complexity and proof of correctness.

Lower bounding techniques: Decision Trees.

Greedy Algorithms: Minimum Spanning Trees – Prim's algorithm, Kruskal Algorithm, Shortest Path Problem – Djikstra's algorithm.

Dynamic Programming: Knapsack problem, Shortest Paths.

Introduction to Complexity Classes: P, NP, NP-Hard, NP-Complete.

Readings:

1. Goodrich, M., Tamassia, R. and Mount D, **Data Structures and Algorithms in C++/Java**, 2nd Edition, 2016, Wiley.
2. J. Kleinberg and E.Tardos, **Algorithm Design**, 1st Edition 2013., Pearson Education India,
3. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, **Introduction to Algorithms**, 3rd Edition, 2010, Prentice-Hall of India Learning Pvt. Ltd.

MIT-202 Database Management Systems

Basic Concepts: Data modeling for a database, abstraction and data integration, three level architecture of a DBMS.

Database Design: Entity Relationship model, Extended Entity Relationship model.

Relational Model & Relational Data Manipulations: Relation, conversion of ER diagrams to relations, integrity constraints, relational algebra, relational domain & tuple calculus.

Structured Query Language: DDL, DML, Views, Embedded SQL.

Relational Database Design Concepts: Functional dependencies, determining keys, normalization-, lossless join and dependency preserving decomposition.

Transaction Management: ACID properties, Concurrency Control in databases, transaction recovery.

Introduction to NoSQL databases, XML databases.

Readings:

1. A. Silberschatz, H. Korth and S. Sudarshan**, Database System Concepts,** 6th Edition**,** McGraw Hill, 2014.
2. R. Elmasri and S. B. Navathe, **Fundamentals of Database Systems**, 7th Edition, Pearson, 2016.
3. R. Ramakrishnan and J. Gehrke, **Database Management Systems,** 3rd Edition, McGraw Hill, 2014.

MIT-203 Theory of Automata

Introduction: Alphabets, strings, and languages.

Finite Automata and Regular Languages: Deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems about CFGs.

Readings:

1. J. E. Hopcroft, R. Motwani, and J. D. Ullman, **Introduction to Automata Theory, languages, and computation**, 2016.
2. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, **Elements of the Theory of Computation** (2nd ed.), Pearson Education, 2015
3. P. Linz, **Introduction to Automata Theory, Languages, and Computation**, Jones & Bartlett, 2016.

MIT-NC2 Introduction to Computer Programming through C

Programming Principles: Introduction to Computers, HIW and S/W components - Block diagram- Applications of Computer Algorithms - Flowcharts - Structured programming, Modular programming.

Syntax: Character Set - Constants and Variables - Data types and sizes - Declarations - Arithmetic Operators - Relational & Logical operators - Type conversions - Increment & Decrement operators - Bit-wise operators - Assignment operators and Expressions - Conditional Expressions - Precedence and Order of evaluation- Statements and Blocks - Input - Output operations - Simple Programs.

Control structures and Scope rules: Go to Statement - If, If-else, ff-else-if & Switch statements While, Do-while, For loops Array's – 1D & 2D, Multidimensional arrays - Functions - Functions returning single value.

Pointer concepts: Storage classes - Scope rules - Pointers - Address Arithmetic - Pointers and Arrays - Functions returning multiple values - String handling.

Advanced features and file handling: Structures and Unions - Arrays of structures Pointers to structures - Self-referential structures – Type def - Unions - Bit-Fields - Memory allocation - File Handling - Command Line arguments Preprocessor directives.

Readings

1. Darnell & Margolis "**ANSI C -A Systematic programming Approach**", Narosa
2. B.W. Kerninghan, D.M.flitchie," **The C Programming Language**", 2" Edition, 1995, PHI.
3. Mike Banahon, Declan Brady and Mark Doran. "**The C Book**", 2nd Edition, 1991, Addison Wesley
4. Yashwant Kanetkar," **Let us C**", 1st edition 1991, BPB Pub
5. Yashwant Kanetkar," **Pointers in C''**, 1st edition 1991. BPL3 Pub

Semester-III

MIT-301 Artificial Intelligence

Introduction: Introduction to artificial intelligence, background and applications, Turing test, rational agents, intelligent agents, structure, behaviour and environment of intelligent agents.

Knowledge Representation: Propositional logic, first order predicate logic, resolution principle, unification, semantic nets, conceptual dependencies, frames, scripts, production rules, conceptual graphs.

Reasoning with Uncertain Knowledge: Uncertainty, non-monotonic reasoning, truth maintenance systems, default reasoning and closed world assumption, Introduction to probabilistic reasoning, Bayesian probabilistic inference, introduction to fuzzy sets and fuzzy logic, reasoning using fuzzy logic.

Problem Solving and Searching Techniques: Problem characteristics, production systems, control strategies, breadth first search, depth first search, hill climbing and its variations, heuristics search techniques: best first search, A* algorithm, constraint satisfaction problem, means-end analysis.

Game Playing: introduction to game playing, min-max and alpha-beta pruning algorithms.

Prolog Programming: Introduction to Programming in Logic (PROLOG), Lists, Operators, basic Input and Output.

Readings:

1. Rich, E. & Knight,K. (2012). **Artificial Intelligence**. 3rd edition. Tata McGraw Hill.
2. Russell, S.J. & Norvig, P. (2015) **Artificial Intelligence - A Modern Approach**. 3rd edition. Pearson Education
3. Kaushik, S. (2011). **Artificial Intelligence**. Cengage Learning India

MIT-302 Data Science using Python

Introduction: Introduction to Data Science, Exploratory Data Analysis and Data Science Process, Motivation for using Python for Data Analysis, Introduction of Python shell iPython and Jupyter Notebook.

Essential Python Libraries: NumPy, pandas, matplotlib, SciPy, scikit-learn, statsmodels

Getting Started with Pandas: Arrays and vectorized computation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics,

Data Loading, Storage and File Formats

Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, Interacting with Web APIs, Interacting with Databases

Data Cleaning and Preparation: Handling Missing Data, Data Transformation, String Manipulation

Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting.

Data Visualization matplotlib: Basics of matplotlib, plotting with pandas and seaborn, other python visualization tools

Data Aggregation and Group operations: Group by Mechanics, Data aggregation, General split-apply-combine, Pivot tables and cross tabulation

Advanced Pandas: Categorical Data, Advanced GroupBy Use, Techniques for Method Chaining

Readings

1. McKinney, W.(2017). **Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython,** 2nd edition. O'Reilly Media.
2. O'Neil, C., and Schutt, R. (2013), **Doing Data Science: Straight Talk from the Frontline,** O'Reilly Media

Elective-I

MIT-303 Mathematics for Computer Science

Linear Algebra: Introduction to Vector space, Subspace, Linear Independence and Dependence, Basis and Dimensions, Convex set, Rank of a matrix, System of linear equations, Orthogonal bases, Projection, Gram-Schmidt orthogonality process, Linear Mappings, Kernel and Image space of a linear map, Matrix associated with linear map, Eigenvalues and Eigenvectors, PCA, SVD, Applications in Data Reduction, Text Analysis and Image Processing.

Probability and Statistics: Review of Probability Theory, Conditional Probability, Independent events, Bayes' theorem and it application in data analysis, Descriptive Statistics, Exploratory data analysis, Coefficient of variation, Skewness, Kurtosis, Data visualization, Scatter diagram, Grouped data, Histograms, Ogives, Percentiles, Box Plot

Random variable: Introduction to random variable, Discrete random variables (Bernoulli, Binomial, Multinomial, Poisson, Geometric, Negative Binomial), Continuous random

variables (Uniform, Exponential, Normal, Gamma), Expectation, variance, Conditional probability and conditional expectation, Central Limit Theorem, Markov and Chebyshev's inequality.

Readings:

1. Serge Lang, **Introduction to Linear Algebra,** 2nd Edition, Springer, 1986.
2. Gilbert Strang, **Introduction to Linear Algebra**, 4th Edition, Wellesley-Cambridge Press, 2009.
3. Sheldon M. Ross, **Probability Models for Computer Science**, Academic Press, 2002.
4. Ernest Davis, **Linear Algebra and Probability for Computer Science Applications**, CRC Press, 2012.
5. Kishor S. Trivedi, Probability and Statistics with Reliability, **Queuing and Computer Science Applications**, John Wiley, 2016.
6. Richard Cotton, **Learning R: a step by step function guide to data analysis,** O'reilly (SPD), Sixth edition reprint, 2017.

MIT-304 Multimedia and Animation

Multimedia: Introduction to multimedia, multimedia components, uses of multimedia, multimedia applications, virtual reality.
Text: Fonts and faces, using text in multimedia, font editing and design tools, hypermedia and hypertext.
Images: Still images – bitmaps, vector drawing, 3D drawing and rendering, natural light and colors, computerized colors, color palettes, image file formats.
Sound, Video and Animation: Digital audio, MIDI audio, MIDI vs digital audio, audio file formats, how video works, analog video, digital video, video file formats, video shooting and editing, principles of animation, animation techniques, animation file formats.
Internet and Multimedia: WWW and HTML, multimedia on the web – web servers, web browsers, web page makers and site builders. Unit 6 Making Multimedia: Stages of a multimedia project, requirements to make good multimedia, Hardware peripherals connections, memory and storage devices, multimedia software and authoring tools.

Readings:

1. Vaughan, T. (2017). **Multimedia: Making It Work**, (9th edition). McGraw Hill Education.
2. Andleigh, K., & Thakkar, K. (2015). **Multimedia System Design** (1st edition). Pearson Education India.
3. Keyes, J. (2000). **The Ultimate Multimedia Handbook**. TMH.
4. Steinmetz, R., & Naharstedt, K. (2012). **Multimedia Computing, Communications Applications**. Pearson.

MIT-305 Software Engineering

Software Engineering: The software crisis, principles of software engineering, programming- in-the-small vs. programming-in-the-large.
Software process: The software lifecycle, the waterfall model and variations, risk-driven approaches, introduction to evolutionary and prototyping approaches, agile process models, system classifications.
Project management: Relationship to lifecycle, project planning, project control, project organization, risk management, cost models, configuration management, version control, quality assurance, metrics.
Software requirements: Requirements analysis, functional and non-functional requirements elicitation, analysis tools, requirements definition, requirements specification, static and dynamic specifications, requirements review.
Software design: Design for reuse, design for change, design notations, design evaluation and validation.
Implementation and Maintenance: Programming standards and procedures, modularity, data abstraction, static analysis, unit testing, integration testing, regression testing, verification and validation, tools for testing, fault tolerance, The maintenance problem, the nature of maintenance, planning for maintenance**.**

Readings:

1. R.S. Pressman, **Software Engineering: A Practitioner's Approach** (7^{th} ed.), McGraw-Hill, 2010.
2. I. Sommerville, **Software Engineering** (10^{th} ed.), Pearson Education, 2015.
3. R. Mall, **Fundamentals of Software Engineering** (4^{th} ed.), Prentice-Hall of India, 2014.
4. K. K. Aggarwal and Y. Singh, **Software Engineering** (3^{rd} ed.), New Age International Publishers, 2008.
5. P. Jalote, **An Integrated Approach to Software Engineering** (3^{rd}ed.), Narosa Publishing House, 2005.
6. N.S. Godbole, **Software Quality Assurance: Principles and Practice for Students**, Alpha Science International Limited, 2004.

MIT-306 Cyber Security

Introduction: Cyberspace, Internet, Internet of things, Cyber Crimes, cyber criminals, Cyber security, Cyber Security Threats, Cyber laws and legislation, Law Enforcement Roles and Responses.

Network Attacks: Network Threat Vectors, MITM, OWAPS, ARP Spoofing, IP & MAC Spoofing, DNS Attacks, SYN Flooding attacks, UDP ping-pong and fraggle attacks, TCP

port scanning and reflection attacks, DoS, DDOS. Network Penetration Testing Threat assessment, Penetration testing tools, Penetration testing, Vulnerability Analysis, Threat matrices, Firewall and IDS/IPS, Wireless networks, Wireless Fidelity (Wi-Fi), Wireless network security protocols, Nmap, Network fingerprinting, BackTrack, Metasploit.

Introduction to SCADA (supervisory control and data acquisition) Understanding SCADA security policies, SCADA Physical and Logical Security, Understanding differences between physical and logical security, Define perimeter controls and terms, Define various security zones, Understand communication cyber threats, Understand firewall, architectures.

Introduction to Malware, Malware Analysis: Static Analysis, Code Review, Dynamic Analysis, Behavioral analysis of malicious executable, Sandbox Technologies, Reverse-engineering malware, Defeat anti-reverse engineering technique, automated analysis, intercepting network connections, Network flow analysis, Malicious Code Analysis, Network analysis, Anti-disassembling techniques, Identifying assembly logic structures with a disassemble, Malware Handling: Malicious Documents and Memory Forensics - Reverse engineering of malicious executable using memory forensic techniques, Analyze malicious Microsoft Office (Word, Excel, PowerPoint) and Adobe PDF documents, Analyzing memory to assess malware characteristics and reconstruct infection artifacts. Using memory forensics to analyze rootkit infections, Legal & Ethical Issues - Reinforce understanding and the application of discipline specific legal and ethical issues, Reverse Engineering Malware (REM) Methodology.

Readings:

1. Peter W. Singer and Allan Friedman, **Cybersecurity and Cyberwar**, Oxford University Press, 2014
2. Jonathan Clough, **Principles of Cybercrime**, Cambridge University Press, 2015
3. Jie Wang, Zachary A. Kissel**, Introduction to Network Security: Theory and Practice**, Wiely, 2016.
4. Michael Bazzell, **Open Source Intelligence Techniques: Resources for Searching and Analyzing Online Information**, 2nd edition, Create Space Independent Publishing Platform, 2014.
5. Robert Radvanovsky, Jacob Brodsky, **Handbook of SCADA/Control Systems Security**, CRC Press, 2013.
6. Ed Skoudis , Lenny Zeltser, **Malware: Fighting Malicious Code**, Prentice Hall Series in Computer Networking and Distributed, 2003
7. Michael Sikorski, Andrew Honig, **Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software** 2012, No Starch Press, San Fransisco

MIT-307 Operation Research

Introductory Linear Algebra: System of linear equations, Matrices, Rank and Determinant of a matrix, linearly dependent and independent vectors, Basis of a matrix.
Linear programming-I: Optimization Problems, Introduction to LP Formulation, Convex sets, Extreme points, Geometry of Linear Programs, Basic feasible solutions (BFS), Neighborhoods, Local and global optima, Profitable Column, Pivoting, Simplex Algorithm with initial BFS, Graphical method
Linear programming-II: Degeneracy and Bland's Anticycling rule (Definition), Simplex Algorithm without initial BFS, Artificial variable techniques – two phase method, M-Charnes method, special cases in LPP.
Duality: Definition of the dual problem, primal-dual relationships, economic interpretation of duality, complementary slackness conditions.
Transportation Models: Transportation Algorithm, Assignment model, Hungarian Method
Introduction to Queuing Models: Elements of Queuing Model, Exponential distribution, Poisson Distributions, Poisson Queuing Models, Single Server model, Multiple Server model
Introduction to Markov Chains: Introduction to Markov chains, transition probabilities, classification of states, Steady state probabilities, Absorbing states

Reference Books

1. G. Hadley: **Linear Programming**. Narosa, 2002 (reprint)
2. A. Ravindran, D. T. Phillips and James J. Solberg: **Operations Research-Principles and Practice**, John Wiley & Sons, 2005.
3. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 8th Edition, 2008.
4. F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata McGraw Hill. 2010.

Semester-IV

Elective-II

MIT-411 Data Mining

Overview: The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

Data pre-processing: Data cleaning, Data transformation, Data reduction, Discretization

Classification: Supervised learning/mining tasks, Decision trees, Decision rules, Bayesian classification, Instance-based methods, Evaluation and Validation methods.

Clustering: Basic issues in clustering, k-means clustering, expectation maximization, Hierarchical clustering, Density-based methods, Cluster Validation methods and metrics

Association Rule Mining: Frequent item sets, closed and maximal item sets, Apriori algorithm for association rule mining.

Readings:

1. P. Tan, M. Steinbach and V. Kumar, **Introduction to Data Mining**, Addison Wesley, 2016.
2. Jiawei Han and Micheline Kamber, **Data Mining: Concepts and Techniques** (3nd ed.), Morgan Kaufmann, 2011.
3. Charu C Agrawal, **Data Mining: The Textbook**, Springer, 2015.
4. Luis Torgo, **Data Mining with R Learning with Case Studies,** Second Edition, CRC Press, 2017.
5. Robert Layton, **Learning Data Mining with Python**, Second Edition

MIT-412 Machine Learning

Introduction: Basic definitions, Hypothesis space and inductive bias, Bayes optimal classifier and Bayes error, Occam's razor, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

Regression: Linear regression with one variable, linear regression with multiple variables, gradient descent, logistic regression, over-fitting, regularization. performance evaluation metrics, validation methods.

Classification: Decision trees, Naive Bayes classifier, k-nearest neighbor classifier, perceptron, multilayer perceptron, neural networks, back-propagation algorithm, Support Vector Machine (SVM), Kernel functions.

Clustering: Approaches for clustering, distance metrics, K-means clustering, expectation

maximization, hierarchical clustering, performance evaluation metrics, validation methods.

Readings:

1. Alpaydin, Ethem, **Introduction to machine learning,** MIT press, 2014.
2. Christopher, M. Bishop, **Pattern Recognition And Machine Learning**, Springer-Verlag, 2016.
3. Shai Shalev-Shwartz, Shai Ben-David, **Understanding Machine Learning: From Theory to Algorithms,** Cambridge Press,2014.
4. Michalski, Ryszard S., Jaime G. Carbonell, and Tom M. Mitchell, **Machine learning: An artificial intelligence approach**, Springer Science & Business Media, 2013.

MIT-413 Compiler Design

Lexical and Syntactic Analysis: Review of regular languages, design of a lexical analyzer generator, context free grammars, syntactic analysis: top down parsing: recursive descent and predictive parsing, LL(k) parsing; bottom up parsing: LR parsing, handling ambiguous in bottom up parsers.

Syntax directed translation: Top down and bottom up approaches, data types, mixed mode expression; subscripted variables, sequencing statement, subroutines and functions: parameters calling, subroutines with sideeffects.
Code generation, machine dependent and machine independent optimization techniques.

Readings:

1. Alfred V. Aho, Ravi Sethi, D. Jeffrey Ulman, Monica S. Lam, **Principles, Techniques and Tools**, Pearson Education India, 2nd edition, 2013.
2. A.V. Aho, M. S. Lam, R. Sethi and J. D. Ullman, **Compilers,** Pearson, 2016.
3. Dick Grune, Kees van Reeuwijk, Henri E .Bal, Ceriel J.H. Jacobs, K Langendoen, **Modern Compiler Design,** Springer, 2012.

MIT-414 Mobile Computing using Android

Introduction: Review to JAVA & OOPS Concepts, History of Android, Introduction to Android Operating Systems, Android Development Tools, Android Architecture, Android components including activities, view and view group, services, content providers, broadcast receivers, intents, parcels, instance state.

User Interface Architecture: application context, intents: explicit intents, returning results from activities, implicit intents, intent filter and intent resolution, and applications of implicit intents, activity life cycle, activity stack, application's priority and its process' states, fragments and its life cycle

User Interface Design: Layouts, optimizing layout hierarchies, form widgets, text fields, button control, toggle buttons, spinners, images, menu, dialog.

Broadcast receivers, notifications and services: Broadcast sender, receiver, broadcasting events with intents, listening for broadcasts with broadcast receivers, broadcasting ordered intents, broadcasting sticky intents, pending intents, creating notifications, setting and customizing the notification tray UI. Create, start, and stop services, binding services to activities, using asynctasks to manage background processing, handler, looper andrunnable

Database and Content provider: SQLite, Content Values and Cursors, creating SQLite databases, querying a database, adding, updating, and removing rows, Creating Content Providers, implement content provider's queries and its usage.

Readings:

1. Griffiths, D., & Griffiths, D., (2015). **Head First Android Development**, O'reillyMedia.
2. Meier, R.,(2012). **Professional Android™ 4 Application Development**. John Wiley & Sons, Inc.

Additional Resources:

1. Murphy, M. L. (2018). **The Busy Coder's Guide to Android Development**, Commons Ware
2. Phillips, B., Stewart, C., Hardy, B. & Marsicano, K. (2015). **Android Programming**: **The Big Nerd Ranch Guide**, Big Nerd Ranch. Guides.
3. Sheusi, J. C. (2013). **Android Application Development for Java Programmers**, Cengage Learning.

MIT-415 Software Quality Assurance and Testing

Introduction: Concept of Software quality, product and process quality, software quality metrics, quality control and total quality management, quality tools and techniques, quality standards, defect management for quality and improvement.

Designing software quality assurance system: Statistical methods in quality assurance, fundamentals of statistical process control, process capability, Six-sigma quality.

Testing: Test strategies, test planning, functional testing, stability testing and debugging techniques

Reliability: Basic concepts, reliability measurements, predictions and management.

Readings:

1. N.S. Godbole, **Software Quality Assurance: Principles and Practice for the New Paradigm (2nd Ed.)**, Narosa Publishing, 2017.
2. G. Gordon Schulmeyer (4th eds.), **Handbook of Software Quality Assurance Artech House**, Inc, 2008.
3. G. O'Regan, **A Practical Approach to Software Quality**, Springer Verlag, 2002.
4. Daniel Galin, **Quality Assurance: From theory to implementation,** Pearson

Education Ltd., 2004
5. Glenford J. Myers, **The Art of Software Testing (2nd ed.)**, John Wiley, 2004.
6. D. Graham, E.V. Veenendaal, I. Evans and R. Black, **Foundations of Software Testing**, Thomson Learning, 2007.

Elective-II

MIT-421 Deep Learning

Introduction: Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.

Neural Networks: Feedforward neural networks, deep networks, regularizing a deep network, model exploration, and hyper parameter tuning.

Convolution Neural Networks: Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.

Sequence Modeling: Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architectures, deep recurrent networks, LSTMnetworks

Autoencoders: Undercomplete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders anddecoders.

Structuring Machine Learning Projects: Orthogonalization, evaluation metrics, train/dev/test distributions, size of the dev and test sets, cleaning up incorrectly labeled data, bias and variance with mismatched data distributions, transfer learning, multi-task learning.

Readings:

1. Bunduma, N. (2017). **Fundamentals of Deep Learning**. O'reilly Books.
2. Heaton, J.(2015). **Deep Learning and Neural Networks**, Heaton Research Inc.

Additional Readings:

1. Goodfellow, I. (2016). **Deep Learning**. MIT Press
2. Deng, L., & Yu, D. (2009). **Deep Learning: Methods and Applications** *(Foundations and Trends in Signal Processing).* Publishers Inc.
3. Hall, M.L, (2011). **Deep Learning**. VDMVerlag.

MIT-422 Web Technologies

Introduction: Introduction to Networking, TCP/IP, DNS, Internet and its Evolution, World Wide Web, Web 2.0, Web 3.0, network communication protocols (HTTP/HTTPS, SMTP, IMAP, POP, FTP), client-server architecture, web applications architecture, application and web servers, web clients.

Front-end Development: Introduction to HTML5, HTML elements, HTML tags, lists, tables, frames, forms, basics of XHTML, CSS style sheets, DOM, XML,XSLT

Client-Side Programming: JavaScript basic syntax, variables & data-types, literals, functions, objects, arrays, built-in objects, event handling, modifying element style, document trees.

Server-Side Programming: Creation of dynamic content, server-side programming using Java Servlets, Web Services, session management, introduction to JSP and server-side scripting, accessing MySQL / Oracle database from front-end.

Web Security, Cookies and Authentication: Security threats, Security risks of a website, Web attacks and their prevention, Web security model, Setting, accessing and destroying cookies, Anonymous Access, Authentication by IP address and Domain, Integrated Windows Authentication, Digital signatures, Digital certificates, Firewalls.

Readings:

1. Jeffery C. Jackson, **Web Technologies: A Computer Science Perspective**, Pearson Education India, 2007.
2. Achyut Godbole and Atul Kahate, **Web Technologies: TCP/IP, Web/Java Programming, and Cloud Computing** (3rd ed.), McGraw-Hill Education, 2013.
3. Roger S Pressman and David Lowe, **Web Engineering: A Practitioner's Approach,** TMH, 2017.
4. Mark Pilgrim, **HTML5: Up and Running**, O'Reilly, Google Press, 2010.
5. Jim Keogh, **J2EE: The Complete Reference**, McGraw Hill Education, 2017.

MIT-423 E-Commerce

Introduction: Introduction to networking technologies, Network Protocols, Client Server architecture, Two-tier architecture, Three-tier architecture, MVC architecture.

Building Blocks of E-Commerce: Software technologies for building E-Commerce applications, Distributed Objects, Remote Method Invocation (RMI), introduction to CORBA, Web services.

Security of E-Commerce Transactions: Review of cryptographic tools, authentication, signatures, observers, anonymity, privacy, traceability, key certification, management and escrow.

Payment Protocols and Standards: Smart card, e-cash, e-wallet, electronic money and electronic payment systems, crypto-currency payments, business models for e-commerce, electronic marketplaces, auctions and other market mechanisms, design of auctions, content

optimization algorithms for marketplaces, multi-agent systems.

Global E-Commerce and Law: Cyber law in India, comparative evaluation of Cyber laws of certain countries.

Readings:

1. P.T. Joseph, S.J., **E-Commerce: An Indian Perspective** (5th ed.), Prentice-Hall of India, 2015.
2. Efraim Turban, Jae Kyu Lee, Dave Klng, Judy McKay, Peter Marshall, **Electronic Commerce: A Managerial Perspective** (5th ed.), Pearson, 2008.
3. M.L. Liu, **Distributed Computing: Principles and Applications**, Pearson, 2004.
4. Stuart Jacobs, **Engineering Information Security**, IEEE Press, Wiley, 2011.
5. R. Orfali and Dan Harkey, **Client/Server Programming with Java and CORBA** (2nd ed.), John Wiley & sons, 1998.
6. Michael Wooldridge, **An Introduction to MultiAgent Systems (**2nd ed.)

MIT-424 Digital Image Processing

Introduction: Digital Image Fundamentals: Brightness, Adaptation and Discrimination, Light and Electromagnetic Spectrum, Image Sampling and Quantization, Some Basic Relationships between Pixels Types of images.

Spatial Domain Filtering: Some Basic Intensity Transformation Functions, Histogram Equalization, Spatial Correlation and Convolution, Smoothening Spatial Filters: Low pass filters, Order Statistics filters; Sharpening Spatial Filters: Laplacian filter

Filtering in Frequency Domain: The Discrete Fourier Transformation (DFT), Frequency Domain Filtering: Ideal and Butterworth Low pass and High pass filters, DCT Transform (1D, 2D).

Image Restoration: Image Degradation/Restoration Process, Noise models, Noise Restoration Filters

Image Compression: Fundamentals of Image Compression, Huffman Coding, Run Length Coding, JPEG.

Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transformation, Basic Morphological Algorithms.

Image Segmentation: Point, Line and Edge Detection, Thresholding, Region Based Segmentation.

Readings

1. Gonzalez, R. C., & Woods, R. E. (2017). **Digital Image Processing**. 4th edition. Pearson Education.
2. Jain, A. K. (1988). **Fundamentals of Digital Image Processing**. 1st edition Prentice Hall of India.

Additional Readings

1. Castleman, K. R. (1995.). **Digital Image Processing**. 1st edition. Pearson Education
2. Gonzalez, R. C., Woods, R. E., & Eddins, S. (2004). **Digital Image Processing using MATLAB**. Pearson Education Inc.
3. Schalkoff, D. (1989). **Image Processing and Computer Vision**. 1st edition. John Wiley and Sons.

MIT-425 Blockchain Technology

Introduction: Basic ideas behind blockchain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required

Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Introduction to Bitcoin Blockchain

Bitcoin Blockchain and scripts, Use cases of Bitcoin Blockchain scripting language in micropayment, escrow etc Downside of Bitcoin – mining .

Alternative coins – Ethereum and Smart contracts , IOTA

The real need for mining – consensus – Byzantine Generals Problem, and Consensus as a distributed coordination problem – Coming to private or permissioned blockchains – Introduction to Hyperledger

Permissioned Blockchain and use cases – Hyperledger, Corda

Uses of Blockchain in E-Governance, Land Registration, Medical Information Systems, and others

Readings

1. Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, '**Blockchain Technology: Cryptocurrency and Applications**', Oxford University Press, 2019.
2. Josh Thompson, **Blockchain: The Blockchain For Beginners Guide To Blockchain Technology And Leveraging Blockchain Programming**, CreateSpace Independent Publishing Platform