Revised

M. Tech. Syllabus (2022)

[Information Technology]

Department of Information Technology,

North-Eastern Hill University,

Shillong - 793 022

Meghalaya

Table of Contents

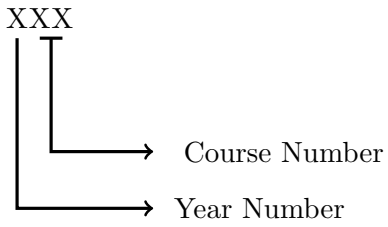
1. Syllabus Scheme

1.1 Coding Used in the Syllabus

IT - Information Technology
ITO - IT Open Course

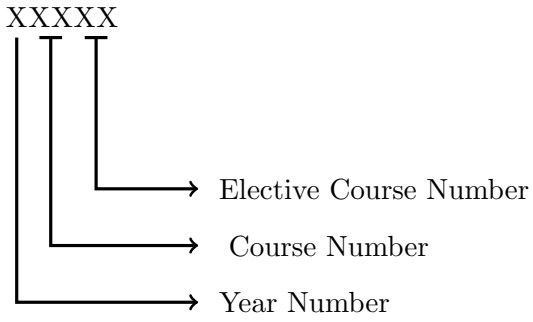
1.1.1 Course Coding for *Core Courses (IT-XXX)*

Three Digit Numeric Numbers used in Course Code (e.g. IT - 500 Mathematical Foundation of Information Science):



1.1.2 Course Coding for *Elective Courses(IT-XXXXX)*:

Five Digit Numeric Numbers Used in Course Code (e.g. IT – 50201 Advanced Database Systems)



1.2 Semester: I

Branch: *Information Technology* **Year:** I **Semester:** I

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-500	Mathematical Foundation of Information Science	3	1	0	20	20	40	60	100	4
2	IT - 501	Advanced Data Structures & Algorithms	3	1	0	20	20	40	60	100	4
3	IT - 502xx	Discipline Specific Elective Course Elective - I	3	1	0	20	20	40	60	100	4
4	IT - 503xx	Generic Elective Course (Multidisciplinary) Elective - II	3	1	0	20	20	40	60	100	4
5	IT - 504	Advanced Data Structures Lab	-	-	3	20	-	20	30	50	2
6	IT - 505	System Software Lab	-	-	3	20	-	20	30	50	2
		Total	**12**	**4**	**6**	120	80	**200**	**300**	**500**	20

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *22* **Total Marks:** *500* **Total Credits:** *20*

Elective - I

1. IT - 50201 Advanced Database Systems
2. IT - 50202 Advanced Computer Networks
3. IT - 50203 Theory of Computation

Elective - II

1. IT - 50301 Cyber Security
2. IT - 50302 Data Analytics
3. IT - 50303 Optimization Techniques

1.3 Semester: II

Branch: *Information Technology* **Year:** I **Semester:** II

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT - 506	Computer System Architecture	3	1	0	20	20	40	60	100	4
2	IT - 507	Computational Intelligence	3	1	0	20	20	40	60	100	4
3	IT - 508xx	Discipline Specific Elective Course Elective - III	3	1	0	20	20	40	60	100	4
4	IT - 509	Research Methodology & Proposal Writing	3	1	0	20	20	40	60	100	4
5	IT - 510xx	Skill Enhancement Course Elective - IV	3	1	0	20	20	40	60	100	4
6	IT - 511	Computational Intelligence Lab	-	-	3	20	-	20	30	50	2
7	IT - 512xx	Discipline Specific Elective Course Elective - V	-	-	3	20	-	20	30	50	2
		Total	**15**	**5**	**6**	140	100	**240**	**360**	**600**	24

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *26* **Total Marks:** *600* **Total Credits:** *24*

Elective - III

1. IT - 50801 Distributed Systems
2. IT - 50802 Object Oriented Modelling Design
3. IT - 50803 Data Mining

Elective - IV

1. IT - 51001 Internet of Things
2. IT - 51002 Multimedia & Animation
3. IT - 51003 Advanced Internet Technologies

Elective - V

1. IT - 51201 Advanced Database Lab
2. IT - 51202 Internet of Things Lab
3. IT - 51203 Data Analytics Lab

1.4 Semester: III

Branch: *Information Technology* **Year:** II **Semester:** III

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Theory			**L**	**T**	**P**	**TA**	**PR1/CT**	**ST**	**ESE**	**TOT**	
Practical/Design/Laboratory/Seminar											
1	IT - 600xx	Discipline Specific Elective Course Elective - VI	3	1	0	20	20	40	60	100	4
2	IT - 601xx	Discipline Specific Elective Course Elective - VII	3	1	0	20	20	40	60	100	4
3	IT - 602xx	Discipline Specific Elective Course Elective - VIII	3	1	0	20	20	40	60	100	4
4	IT - 603	Dissertation - Part I*	-	-	18	60	60	120	180	300	12
		Total	**9**	**3**	**18**	**120**	**120**	**240**	**360**	**600**	24

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
PR1 - 1^{st}Prsentation **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *30* **Total Marks:** *600* **Total Credits:** *24*

Elective - VI

1. IT - 60001 Advanced Wireless Networks
2. IT - 60002 Machine Learning
3. IT - 60003 Image Processing & Computer Vision

Elective - VII

1. IT - 60101 Game Theory
2. IT - 60102 Natural Language Processing
3. IT - 60103 Computational Biology

Elective - VIII

1. IT - 60201 Quantum Computing
2. IT - 60202 Pattern Recognition
3. IT - 60203 Advanced Cryptography

1.5 Semester: IV

Branch: *Information Technology* **Year:** II **Semester:** IV

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Theory			**L**	**T**	**P**	**PR2**	**PR3**	**ST**	**ESE**	**TOT**	
Practical/Design/Laboratory/Seminar											
1	IT - 604	Dissertation - Part II*	-	-	24	80	80	160	240	400	16
1	IT - 604	Viva-Voce	-	-	-	-	-	-	100	100	4
		Total	**-**	**-**	**24**	**80**	**80**	**160**	**340**	**500**	20

L - Lecture **T -** Tutorial **P -** Practical **PR2 -** 2^{nd} Prsentation
PR3 - 3^{rd} Prsentation **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *24* **Total Marks:** *500* **Total Credits:** *20*

*Evaluation of Dissertation shall be a continuous process comprising of two components:

- *Internal Evaluation*: Assesment by the Teacher and a Presentation,
- *External Evaluation*: Final Presentation and Report.

2. Detail Syllabus

L	-	T	-	P		
3	-	1	-	0	=	4

2.1 First Semester

2.1.1 IT - 500 Mathematical Foundation of Information Science

Course Code	:	*IT − 500*
Course Name	:	*Mathematical Foundation of Information Science*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Algebraic Structure: Groups and Subgroups, Homomorphism Theorems, Cosets and Normal Subgroups, Lagrange's Theorem, Rings, Finite fields, Polynomial Arithmetic, Quadratic Residues.

Discrete Mathematics: Fundamental principles of Counting, Pigeonhole Principle, Countable and uncountable Sets, Principle of Inclusion and Exclusion, Derangements, Equivalence relations and partitions, Partial order, Lattices and Boolean algebra, Generating functions, Recurrence relations, Solution of recurrences.

Graph Theory: Representation of Graphs, Euler Tours, Planar Graphs, Isomorphism, Hamilton Circuits and Euler Cycles, Hamiltonian Graphs, Euler's Formula, Applications of Kuratowski's Theorem, Graph Colouring, Chromatic Polynomials, Trees, Weighted Trees, Shortest Path Algorithms, Spanning Trees, The Max-flow Min-cut theorem.

Text Books:

1. R. P. Grimaldi, *Discrete and Combinatorial Mathematics: An Applied Introduction*, 3/e, Addison-Wesley, New Delhi, 1994.
2. B. Kolman and R.C. Busby, *Discrete Mathematical Structures for Computer Science*, PHI, New Delhi, 1994.
3. J. Clark and D. A. Holton, *A First Look at Graph Theory*, Allied Publishers (World Scientific), New Delhi, 1991.
4. C. L. Liu, *Elements of Discrete Mathematics*, McGraw Hill, 2/e, Singapore, 1985.

2.1.2 IT - 501 Advanced Data Structures & Algorithms

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT − 501*
Course Name	:	*Advanced Data Structures & Algorithms*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Dictionaries : Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Trees: Binary Search Trees, AVL Trees, m-way search tree, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees, Application to MST.

Graph : Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

The BoyerMoore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Books/References:

1. Cormen, Leiserson, Rivest, Stein, *Introduction to Algorithms.*
2. Aho, Hopcroft, Ullman, *The Design and Analysis of Computer Algorithms.*
3. Kleinberg and Tardos, *Algorithm Design.*

2.1.3 IT - 50201 Advanced Database Systems

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT − 50201*
Course Name	:	*Advanced Database Systems*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Review of relational database and functional dependencies; closure; its correctness. Query Processing operations such as Join; Selection; Sort; expression evaluation. Normalization using functional dependencies; Lossless Decomposition; Boyce-Codd Normal Form; 3NF; Normalization using multi-valued dependencies; 4NF; 5NF.

Information Retrieval Systems; Multidimensional Indexes; Data Cubes; Grid Files; R-trees. Document oriented Databases: Background of NoSQL; XML document; Structure of XML Data; XML Document Schema; Querying and Transformation; Storage of XML Data.

Concurrency Control Mechanism: Protocols; Multiple Granularity; Multi-version schemes; Deadlock handling; Recovery; Correctness of interleaved execution; Locking and management of locks; 2PL; deadlocks; multiple level granularity; Concurrency Control on B+ trees; Optimistic Concurrency Control.

Distributed Databases: Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed Query processing; Distributed transactions; Distributed Concurrency control and Recovery. Distributed Databases: Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations. Temporal databse.

Books/References:

1. Silberschatz and Korth, *Database system concepts*, McGraw Hill.
2. Elmasri and Navathe, *Fundamentals of database systems*, Narosa Publishing Co.
3. R. Ramakrishnan, J. Gehrke, *Database Management Systems*, McGraw Hill, 2004.

2.1.4 IT - 50202 Advanced Computer Networks

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 50202*
Course Name	:	*Advanced Computer Networks.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction: Network architecture, computer networks and protocols design principles- ISO/OSI and TCP/IP protocol suits. *Bridging and switching:* concept of bridging, bridging algorithms, Ethernet switches, virtual LANs, Flow control mechanisms in networks, MAC protocols for various advanced networks, Case studies: Fast and Gigabit Ethernet

Routing algorithms: Intradomain and Interdomain routing, Distance Vector Routing, Link State Routing, Multicast Routing, Case studies: Routing Information Protocol, Open Source Path First, Border Gateway Protocol, IP Multicasting

IPv6: Why IPv6?, IPv6 Addressing, IPv6 Protocol, Transition from IPv4 to IPv6, Extensions and options, Neighbour discovery, Auto-configuration, IPv6 Routing. Application Programming Interface for IPv6

Mobility in networks: Ubiquitous networking and nomadicity; mobility in the Internet; location independent networking, Mobile IP

Transport Protocols: Basic protocols-TCP, UDP, SCTP; TCP extensions for high-speed networks, Transaction-oriented applications, Other new options in TCP, TCP Congestion Control, Congestion Avoidance Mechanism

Quality of Service in the Internet: Protocols and architectures- scheduling, shaping, Intserv, Diff-serv, RSVP

Books/References:

1. Kurose and Ross, *Computer Networking: A Top-Down Approach*, Morgan Kaufmann Series, 2008.
2. Peterson and Davie, *Computer Networks: A Systems Approach*, 2nd ed., Morgan Kaufmann, 2011.
3. W. R. Stevens, *TCP/IP Illustrated, Volume 1: The protocols*, Addison Wesley, 1994.
4. G. R. Wright, *TCP/IP Illustrated, Volume 2: The Implementation*, Addison Wesley, 1995.
5. W. R. Stevens, *TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols*, Addison Wesley, 1996.

2.1.5 IT - 50203 Theory of Computation

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT − 50203*
Course Name	:	*Theory of Computation*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Regular language: Equivalence of regular grammar and FA; Properties of Regular Languages (RL), Proving Languages not to be Regular, Pumping Lemma for RLs. Applications of the Pumping Lemma. Closure Properties of RLs. *Finite Automata*: Introduction Finite Automata (FA); Equivalence of finite state machines (DFA, NFA, TG). FAs with output, Minimization of FA.

Context Free Languages: Derivation and languages. Simplification of context free grammars: Normal forms for context free grammars, CNF, and GNF. Applications of Context-Free Grammars. Non determinism vs. ambiguity in CFLs. Closure properties of CFLs. *Push Down Automata*: Acceptance by a Push Down Automata; Equivalence of PDA's and CFG's. Multi stack PDA.

Turing Machine: Definition, notation and Example of Turing Machine (TM). Computable languages and functions; Church Turing hypothesis; Universal TM; Multitape TM; Equivalence of One-Tape and Multitape TM, Nondeterministic TMs.

Computability and Decidability: Decision Problems; Decidability and undecidability; unsolvable problems; Halting Problem of Turing Machines; Rice theorem. *Computational Complexity*: Resource-constrained computation. Time Complexity: notion of complexity classes, classes P NP; NP-complete; Boolean satisfiability, NP-Completeness of CSAT and 3SAT; NP- Levin Theorem

Books/References:

1. Cohen, D. I., Cohen, D. I., *Introduction to computer theory (Vol. 2)*, New York.
2. Wiley. John E. Hopcroft, Jeffery Ullman, *Introduction to Automata theory, Languages computation*, Narosa publishers.
3. E.V. Krishnamurthy, *Introductory Theory of computer science*

2.1.6 IT - 50301 Cyber Security

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT − 50301*
Course Name	:	*Cyber Security*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Cyber Security: Cyber-attacks, Defense strategies and Techniques: Access Control: Authentication and Authorization, Data Protection, Prevention and Detection, Response, Recovery & Forensics

Basics of Cryptography: Symmetric and Asymmetric key Cryptography, cryptographic Hash function, Digital signature schemes.

Network Security Essentials: Security at different layers: IPSec protocol, SSL Protocol, authentication and key management protocols, Wireless LAN security, cellphone security.

Software Vulnerabilities and attacks: Phishing, Buffer Overflow, Format String Attack, Cross-site Scripting, SQL injection, SYN flooding attack, DNS cache poisoning attack.

*Access Control in Operating Syste*m: Preliminaries: Discretionary Access Control, Mandatory Access Control, Role based access control

Firewalls: Packet Filtering Firewalls, Proxy-Server based Firewall, Policies and firewall configurations: Case studies of personal firewalls: architecture, commands.

Intrusion Prevention and Detection: Types of Intrusion Detection System (IDS): Anomaly vs. Signature based IDS, DDoS attack prevention/Detection, Malware Detection, port and vulnerability scanning, Packet Sniffing, Intrusion detection and penetration testing using different open-source tools.

Electronic Payment: Secure Electronic Transaction protocol.

Books/References:

1. Bernard Menezes and R. Kumar, *Cryptography, Network Security and Cyber Laws*, Cengage Learning, 2028.
2. William Stallings, *Network Security Essentials, Applications and Standards*, Pearson Education,2018

2.1.7 IT - 50302 Data Analytics

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT − 50302*
Course Name	:	*Data Analytics.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Data and Representation: Introduction to Statistics, Collection of data, classification and tabulation of data, Types of data: Primary data, Secondary data, Presentation of data Diagrammatic and Graphical Representation: Histogram, frequency curve, frequency polygon, stem and leaf chart.

Correlation and Regression: Bivariate normal distribution, types, importance, methods of measuring correlation-scatter diagram, Karl Pearson's Coefficient of Correlation and Spearman's rank Correlation. Regression lines, Difference between regression and correlation, uses of Regression.

Data Mining, Clustering And Applications: Introduction to Data Mining, Cluster Analysis, Categorization of Major Clustering Methods, Kmeans, Partitioning Methods – Hierarchical Methods - Density-Based Methods, Data Mining Applications.

*Association Rule Mining And Classificatio*n: Mining Frequent Patterns, Associations and Correlations, Mining Various Kinds of Association Rules, Classification and, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Backpropagation, Support Vector Machines.

Books/References:

1. Mood, A. M., Graybill, F. A. And Boes, D.C., *Introduction to the Theory of Statistics*, McGraw Hill.
2. Biswas and Srivastava, *A textbook, mathematical Statistics*, 1st Edition, Narosa Publishing House, New Delhi.
3. J. Han and M. Kamber, *Data Mining: Concepts and Techniques.* 2nd ed. Elsiver-2006.
4. M. H. Dunham, *Data Mining: Introductory and Advanced Topics.* Pearson Education. 2001.
5. I. H. Witten and E. Frank, *Data Mining: Practical Machine Learning Tools and Techniques.* Morgan Kaufmann. 2000.

2.1.8 IT - 50303 Optimization Techniques

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT − 50303*
Course Name	:	*Optimization Techniques.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Optimization Techniques, Optimal Problem Formulation: Design Variables, Constraints, Objective function,Variable bounds,Engineerinf Optimization Problem, examples of a few engineering optimization problems, classification of optimization algorithms

Single variable optimization algorithms: Optimality Criteria, Bracketing Methods, Region Elimination Methods,Point Estimation Method, Gradient Based Method

Multivariable Optimization algorithms: Optimality Criteria, Unidirectional Search,Direct Search Methods,Gradient based methods

Constrained optimization algorithms: Kuhn-Tucker Condition, Lagrangian Duality Theory, Transformation Methods, Sensitivity Analysis, Direct search for Constrained Optimization,Feasible Direction Method,Quadratic Programming, Generalized Reduced Gradient Method, Gradient Projection Method, specialized and non traditional Optimization Algorithms: Integer Programming,Geometric Programming, Genetic Algorithms, Simulated annealing.

Books/References:

1. Kalyanmoy Deb, *Optimization for Engineering Design Algorithms & Examples*, PHI, 2nd Edition,2012.
2. Martins & Ning, *Engineering Design Optimization*, Electronic Edition,2021

2.1.9 IT - 504 Advanced Data Structures Lab

L	-	T	-	P		
0	-	0	-	3	=	3

Course Code	:	*IT – 504*
Course Name	:	*Advanced Data Structures Lab*
Contact Hours per Week	:	*3(Three) Practical*
Marks Distribution	:	*Sessional Works = 20, End Semester Examination = 30.*
Questions to be Set	:	*10 (Ten) (Practical)*
Questions to be Answered	:	*Any ONE allotted on lottery basis*
Duration of End Semester Examination	:	*3 Hours (Practical).*

Sample Experiments

1. Implementation of different Hashing techniques
2. Implementation of different collision avoidance techniques in Hashing
3. Implementation of different Binary search tree and AVL tree
4. Implementation of Red Black Trees
5. Implementation of BFS and DFS
6. Implementation of Dijkasra's algorithm
7. Implementation of Huffman Coding Algorithm,
8. Implementation to solve Longest Common Subsequence Problem (LCS)

Books/References:

1. Cormen, Leiserson, Rivest, Stein,*Introduction to Algorithms.*
2. Aho, Hopcroft, Ullman, *The Design and Analysis of Computer Algorithms*
3. Kleinberg and Tardos, *Algorithm Design.*
4. Cormen, Leiserson, Rivest, Stein, *Introduction to Algorithms*

2.1.10 IT - 505 System Software Lab

L	-	T	-	P		
0	-	0	-	3	=	3

Course Code	:	*IT – 505*
Course Name	:	*System Software Lab*
Contact Hours per Week	:	*3(Three) Practical*
Marks Distribution	:	*Sessional Works = 20, End Semester Examination = 30.*
Questions to be Set	:	*10 (Ten) (Practical)*
Questions to be Answered	:	*Any ONE allotted on lottery basis*
Duration of End Semester Examination	:	*3 Hours (Practical).*

Sample Experiments

1. Program to implement mutual exclusion using semaphore (C in Unix environment).
2. Program to synchronise thread using Mutex lock (Threads in Unix/Java threads).
3. Implementation of data transmissions (MATLAB/Python).
4. Implementation of Image transmissions (MATLAB/Python).
5. Creation of a console application (Visual Studio).
6. Creation of a Forms application (Visual Studio).
7. Web page design and validation using html, css, javascript (Netbeans/notepad).
8. Implementation of web application using JSP/PHP (Netbeans).

(Note: The contents may be adapted to software practices and trends at the time of offering the course. Hence the contents in parenthesis are simply examples and not strict requirements.)

Books/References:

1. Downey, A. B., & Mayfield, C. (2019). *Think Java: How to think like a computer scientist.* O'Reilly Media..
2. Stroustrup, B. (2000). *The C++ programming language.* Pearson Education India.
3. Hunt, B. R., Lipsman, R. L., & Rosenberg, J. M. (2014). *A guide to MATLAB: for beginners and experienced users.* Cambridge university press.
4. VanderPlas, J. (2016). *Python data science handbook: Essential tools for working with data.*, O'Reilly Media, Inc."
5. Griffiths, I., Flanders, J., & Sells, C. (2003). *Mastering Visual Studio. NET.*, O'Reilly Media, Inc.".
6. Bates, C., Web Programming Building Internet Applications. John Wiley &; Sons, 2002.

2.2 Second Semester

L	-	T	-	P		
3	-	1	-	0	=	4

2.2.1 IT - 506 Computer System Architecture

Course Code	:	*IT – 506*
Course Name	:	*Computer System Architecture*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Fundamental Processors – instruction set architecture; single-cycle, FSM, and pipelined processor microarchitecture; resolving structural, data, control, and name hazards; and analyzing processor performance.

Fundamental Memories – memory technology; direct-mapped vs. associative caches; write-through vs write-back caches; memory protection, translation, and virtualization; FSM and pipelined cache microarchitecture; and analyzing memory performance. Memory synchronization, consistency, and coherence.

Integrating Processors, Memories, and Networks – processor and L1 cache interface; banked memory systems; message-passing systems; shared-memory systems.

Advanced Processors – superscalar execution, out-of-order execution, register renaming, memory disambiguation, branch prediction, speculative execution; multithreaded, VLIW, and SIMD processors

Books/References:

1. J. L. Hennessy and D. A. Patterson, *Computer Architecture: A Quantitative Approach*, 5th ed. 2012.
2. D. M. Harris and S. L. Harris, *Digital Design and Computer Architecture*, 2nd ed. 2012.

2.2.2 IT - 507 Computational Intelligence

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT − 507*
Course Name	:	*Computational Intelligence*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Artificial Intelligence, Strategies for state space search, Data driven and goal driven search, Depth First and Breadth First Search, DFS with Iterative Deepening, Heuristic Search- Best First Search, A* Algorithm, Problem reduction search, AO* Algorithm, Constraint Satisfaction, Using heuristics in games- Minimax Search, Alpha Beta Procedure.

Knowledge representation - Propositional logic, Predicate Calculus, Theorem proving by Resolution, Answer Extraction, AI Representational Schemes- Semantic Nets, Conceptual Dependency, Scripts, Frames. Fuzzy Sets, Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Decision Making.

Artificial Neural Network, McCulloch and Pitts Neural Networks, Hebb's learning, Adaline, Perceptron, Multilayer feed forward network, Back propagation, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Reinforcement Learning.

Local Search, Simulated Annealing, Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning, The Genetic Algorithm-Genetic Programming, Overview of Expert System Technology-Rule based Expert Systems, Introduction to PROLOG and LISP.

Books/References:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, Neuro, *Fuzzy and Soft Computing*, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic:Theory and Applications*, Prentice Hall, 1995.
3. S. Haykin, *Neural Networks*, Pearson Education, 2ed, 2001.
4. D. E. Goldberg, Addison-Wesley, *Genetic Algorithms in Search and Optimization, and Machine Learning*, 1989.
5. Jang, Sun, & Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI.
6. Chin-Teng Lin & C. S. George Lee, *Neural Fuzzy Systems*, Prentice Hall PTR.
7. Klir Yuan, *Fuzzy Sets and Fuzzy Logic*, PHI, 1997.

2.2.3 IT - 50801 Distributed Systems

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT – 50801*
Course Name	:	*Distributed Systems*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 25, End Semester Examination = 75.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Characterization of Distributed Systems, Design issues and user requirements. Interprocess Communication-Synchronous and Asynchronous, Client-server communication, Group communication. Remote procedure Call & Design issues.

Message Ordering Snapshots: Message ordering paradigms; Causal order (CO); Total order. Global state and snapshot recording algorithms: Introduction System model and definitions; Snapshot algorithms for FIFO channels. Time stamping using Physical Logical Clocks.

Distributed mutual exclusion algorithms: Introduction; Preliminaries; Lamport's algorithm; Ricart-Agrawala algorithm; Maekawa's algorithm; Suzuki–Kasami's broadcast algorithm. Deadlock detection in distributed systems: Introduction; System model; Preliminaries; Models of deadlocks; Knapp's classification; Algorithms for the single resource model, the AND model and the OR model.

Shared data and Transactions, Distributed Shared Memory, Distributed consensus; Distributed transactions, concurrency control. Recovery and Fault Tolerance. Security-Design issues and case studies

Books/References:

1. Coulouris, Dollimore and Kindberg, *Distributed Systems-Concepts and Design*, Pearson Education Asia
2. Tanenbaum, *Distributed Systems: Principles and Paradigms*, Pearson Education
3. P K Sinha, *Distibuted Operating System*, PHI, IEEE Press

2.2.4 IT - 50802 Object Oriented Modeling & Design

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 50802*
Course Name	:	*Object Oriented Modeling & Design*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional = 25, End Semester = 75.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to class and object concepts; Association; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; State Modeling: Events, States, Transitions and Conditions, State Diagrams, State diagram behaviour.

Rumbaugh methodology; OMT; Booch methodology, Jacobson methodology; patterns; Unified approach. Process Overview: Development stages; Development life Cycle; System Conception: Devising a system concept; preparing a problem statement.

Introduction; UML; Meta model; Analysis and design; more information. Outline Development Process: Overview of the process-Inception; Elaboration-construction; refactoring patterns transmission; iterative development; use cases.

Object Oriented Design axioms; Class visibility; refining attributes; Methods; Access layer; OODBMS; class mapping view layer.

Books/References:

1. Grady Booch et al, *Object-Oriented Analysis and Design with Applications, 3rd Edition, Pearson Education*, 2007.
2. Brahma Dathan, Sarnath Ramnath, *Object-Oriented Analysis, Design, and Implementation*, Universities Press, 2009.
3. Simon Bennett, Steve McRobb and Ray Farmer, *Object-Oriented Systems Analysis and Design Using UML*, 2nd Edition, Tata McGraw-Hill, 2002.

2.2.5 IT - 50803 Data Mining

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT – 50803*
Course Name	:	*Data Mining.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 25, End Semester Examination = 75.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Data Mining, Data Clustering: Partitioning, Hierarchical, Density-based, Grid Based and Model Based Methods.

Classification & Prediction: Decision Tree Techniques, Back-Propagation Method, Bayesian Method

Association Rule Mining Techniques: Frequent Itemset Generation, Apriori, Horizontal Method, Sampling Approach, Hashing Approach; Dynamic Association Rule Mining;

Mining of Complex Types of Data: Mining of Spatial Databases, Multimedia Databases, Time-series and sequence Data, Text Databases, WWW Data;

Text/Reference Books:

1. J. Han and M. Kamber. Data Mining, *Concepts and Techniques.* 2nd ed. Elsiver-2006.
2. M. H. Dunham. Data Mining, *Introductory and Advanced Topics.* Pearson Education. 2001.
3. I. H. Witten and E. Frank. Data Mining, *Practical Machine Learning Tools and Techniques.* Morgan Kaufmann. 2000.
4. D. Hand, H. Mannila and P. Smyth. *Principles of Data Mining. Prentice-Hall.* 2001.
5. A K Pujari. *Data Mining Techniques*, University Press.

2.2.6 IT - 509 Research Methodology & Proposal Writing

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT − 509*
Course Name	:	*Research Methodology & Proposal Writing*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction: What is a research problem?, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation

Effective literature studies approaches: analysis Plagiarism, Research ethics

Effective technical writing: how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Report Writing: pre-writing considerations, thesis writing, formats of report writing, formats of publications in research journals, use of standard tools like LaTeX.

Books/References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Halbert, "Resisting Intellectual Property", Taylor Francis Ltd., 2007.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

2.2.7 IT - 51001 Internet of Things

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT – 510001*
Course Name	:	*Internet of Things.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Concept of Computer Communication- OSI layers, TCP/IP, IPV4 addressing and challenges, IPV6 addressing

Introduction to Internet of Things: Basic IoT architecture and its components (devices and gateways), Machine to Machine (M2M) communication, IoT Protocol Stack- PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART, ZWave, Bluetooth Low Energy, Network Layer- 6LoWPAN, 6TiSCH, RPL, CORPL,Transport Layer- TCP, UDP, SCTP, Session Layer- HTTP, CoAP, AMQP, MQTT

Case studies on IoT Applications: smart cities, health care, agriculture, Industrial IoT, Industry 4.0, Sensing and Actuating Devices, Sensor Classification, Sensor Performance and Types, Microcontrollers and single board computers for sensor nodes, edge, and gateway nodes (ESP8266, NodeMCU, TI-CC3200, Raspberry Pi etc.).

Communication Technologies for various IoT applications: Case Studies on communication technologies- IEEE 802.11ah, 6LoWPAN, Zigbee, BLE, SIGFOX, LORA, NB-IoT; Software Defined Networks (SDN) and Network Function Virtualization (NFV) for IoT Networks.

Cloud Architecture and Computing: evolution and features, Various Service architectures- Device registration, Remote diagnostics, Fog Architecture and Computing- Fog protocols, Open source IoT platforms

Research challenges in IoT technologies: Interoperability Issues- Syntactic and semantic interoperability, Web of things, IoT and AV, Holoportation

Books/References:

1. S. Misra, A. Mukherjee & A. Roy, *Introduction to IoT*, CRC Press, Jan 2022
2. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, *Cloud Computing: Concepts, Technology & Architecture*, Arcitura Education, 2013.
3. Vijay Madisetti, Arshdeep Bahga, *Internet of Things A Hands-On- Approach*, Universities Press, 2015.

2.2.8 IT - 51002 Multimedia and Animation

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 51002*
Course Name	:	*Multimedia and Animation*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction and Elements of Multimedia and Animation: Introduction to Multimedia, Characteristics of Multimedia Presentation, Multimedia Architecture and Components, Visual Display System, Text: Types, Font, Unicode Standard, Text Compression, Image: Types, Image Processing, Standards, Specification, Device Independent Color Models, Gamma Correction, Video: Video Signal Transmission, Signal Formats, Broadcasting Standards, Digital Video Standards, Audio: Acoustics, Characteristics of Sound – Elements of Audio System: Microphone, Amplifier, Loudspeaker, Audio Mixer, Digital Audio, MIDI, Animation: Key Frames and Tweening Techniques – 2D and 3D Animation.

Multimedia Systems: Compression Types and Techniques: CODEC, GIF Coding Standards, JPEG, MPEG, Multimedia Database System, Hardware Support for Multimedia, Real Time Protocols, Play Back Architectures, Synchronization, Hypermedia Concepts and Design, Digital Copyrights.

Multimedia Tools and Application Developments: Authoring Tools: Features and Types, Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, Sound Editing Tools, Digital Movie Tools. Software Life Cycle, ADDIE Model, Conceptualization, Content Collection, Story Board, Script, Authoring Metaphors, Testing, Report Writing, Documentation.

Books/References:

1. Ranjan Parekh, *Principles of Multimedia*, Second Edition, McGraw-Hill Education, 2017.
2. Tay Vaughan, *Multimedia: Making It Work*, Ninth Edition, McGraw-Hill, 2014.
3. Ralf Steinmetz, Klara Nahrstedt, *Multimedia: Computing, Communications and Applications*, Prentice Hall, 1995.
4. Paul Dietel, Harvey Dietel, Abbey Dietel, *Internet World Wide Web How to Program*, Fourth Edition, Prentice Hall, 2008.
5. Fred Halsall, *Multimedia Communications: Applications, Networks, Protocols and Standards*, Pearson Education, 2002.

2.2.9 IT - 51003 Advanced Internet Technologies

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 51003*
Course Name	:	*Advanced Internet Technologies*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Internet technology: evolution of the internet. TCP/IP: addressing and routing. Internet applications: file transfer protocol, Telnet, Email, Chat, World Wide Web, hypertext transfer protocol.

Introduction to web technologies: web architectures. Client side scripting: HTML; DOM; CSS; JavaScript and jQuery. Server side scripting: Servlet; JSP; PHP; MySQL.

XML processing, AJAX, JSON, Node.Js, SpringBoot, web deployment. Overview of web services. Web application development: search engine; web crawlers; e-commerce portal.

Web Security Concepts: HTTP Authentication; Compare and Contrast; Application Types (BASIC, DIGEST, FORM and Client CERT). Security Implementation: Retrieving Authentication Information; SQL injection; Form Based Custom authorization; Retrieving SSL authentication.

Books/References:

1. Joseph B. Miller, *Internet Technologies and Information Services*, 2nd Edition, Greenwood Publishing Group, 2014.
2. Scobey, P., & Lingras, P., *Web Programming and Internet Technologies: An E-commerce Approach.* Jones & Bartlett Publishers, 2016.
3. Freire, M., & Pereira, M., *Encyclopedia of Internet technologies and applications.* IGI Global, 2007.
4. Bates, C., *Web Programming Building Internet Applications.* John Wiley & Sons, 2002.

2.2.10 IT - 511 Computational Intelligence Lab

L	-	T	-	P		
0	-	0	-	3	=	3

Course Code	:	*IT – 511*
Course Name	:	*Computational Intelligence Lab*
Contact Hours per Week	:	*3(Three) Practical*
Marks Distribution	:	*Sessional Works = 20, End Semester Examination = 30.*
Questions to be Set	:	*10 (Ten) (Practical)*
Questions to be Answered	:	*Any ONE allotted on lottery basis*
Duration of End Semester Examination	:	*3 Hours (Practical).*

Sample Experiments :

1. Implement BFS/DFS algorithm in Matlab/Python
2. Implement A* algorithm in Matlab/Python
3. Implement XOR function using McCulloch-Pitts neuron in Matlab/Python
4. Implementation of Perceptron Neural Network System in Matlab/Python
5. Implementation of Adaline Neural Network System in Matlab/Python
6. Implementation of fuzzy Inferencing System in Matlab/Python
7. Implementation of Fuzzy Logic Controller in Matlab/Python
8. Implementation of Genetic Algorithm in Matlab/Python
9. Implementation of LeNet in Matlab/Python
10. Implementation of AlexNet in Matlab/Python

Books/References:

1. Jyh Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, *Neuro:Fuzzy and Soft Computing, Prentice*, Hall of India, 2003.
2. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic:Theory and Applications*, Prentice Hall, 1995.

2.2.11 IT - 51201 Advanced Database Lab

L	-	T	-	P		
0	-	0	-	3	=	3

Course Code	:	*IT – 51201*
Course Name	:	*Advanced Database Lab*
Contact Hours per Week	:	*3(Three) Practical*
Marks Distribution	:	*Sessional Works = 20, End Semester Examination = 30.*
Questions to be Set	:	*10 (Ten) (Practical)*
Questions to be Answered	:	*Any ONE allotted on lottery basis*
Duration of End Semester Examination	:	*3 Hours (Practical).*

Sample experiment list:

1. Familiarization with any preferred DBMS – creation and manipulation of tables.
2. Advanced SQL statement execution using nested queries.
3. ER Modeling and Converting E-R model into relational model.
4. Database Design and Normalization
5. Implementation of server side pages and verifying the normalization
6. Accessing Databases from Programs using JDBC
7. Building Web Applications using PHP & MySQL
8. Indexing and Query Processing
9. Query Evaluation Plans
10. Reading and parsing .xml file
11. Concurrency and Transactions
12. Data Analytics using Hadoop

Books/References:

1. Silberschatz and Korth, *Database system concepts*, McGraw Hill.
2. Elmasri and Navathe, *Fundamentals of database systems*, Narosa Publishing Co.
3. R. Ramakrishnan, J. Gehrke, *Database Management Systems*, McGraw Hill, 2004

2.2.12 IT - 51202 Internet of Things Lab

L	-	T	-	P		
0	-	0	-	3	=	3

Course Code	:	*IT − 51202*
Course Name	:	*Internet of Things Lab*
Contact Hours per Week	:	*3(Three) Practical*
Marks Distribution	:	*Sessional Works = 20, End Semester Examination = 30.*
Questions to be Set	:	*10 (Ten) (Practical)*
Questions to be Answered	:	*Any ONE allotted on lottery basis*
Duration of End Semester Examination	:	*3 Hours (Practical).*

List of Sample Experiments:

1. Attaching a sensor and an actuator
   - Pick a sensor and an actuator and find or create code that will display the sensed data on the PC
   - Attach the sensor using a breadboard.
   - Create a program that displays data from the sensor in regular intervals in a compact format.
2. Attach a radio unit to the board. The radio uses the SPI bus. Identify and connect the appropriate pins. Take care of interference between the sensor and the radio
   - Obtain the libraries required for the radio module.
   - Study the radio communication module operation by inspecting the sample code
   - Check the operation of the communication at the gateway.
3. Bootstrapping the sensor and the actuator
   - Combine the code of the sensor and the radio communication. Send the data retrieved from the sensor to the gateway.
   - Add code created for the actuator to the existing code
4. Designing IoT use-cases for applications such as i) Smart Lighting ii) Intelligent Traffic systems iii) Smart Parking iv) Smart water management, v) Moisture monitoring, vi) Environmental temperature monitoring using sensors, actuators and microcontrollers.
5. Simulate a 6LoWPAN network stack using Contiki-cooja Simulator and analyze the performance of RPL routing protocol
6. Implement sensor data visualization and talkback feature of Thingspeak cloud using ESP 8266 device
7. Configure RaspberyPi wireless AP through SDN controller and analyze the performance of the network
8. Create a smart home hub using RasoberryPi and SDN controller
9. Integrate COAP protocol over NS-3 IEEE 802.11ah
10. MQTT communication
    - Study the MQTT protocol. Examine the components of the protocol.
    - Create a connection from an MQTT capable device/software with an MQTT broker then send and receive data using it.
    - Send and receive messages to/from the virtual device.
11. Compare COAP and MQTT with respect to their overhead and reliability performance to find which appropriate protocol for various applications (implement over the Linux environment)
12. Programmable ESP 8266 for elderly monitoring - control multiple functionalities - sensing and actuating with a limited number of GPIOs (The motive is to keep a single device with multiple functions. Reduce weight, improve mobility etc.)

Books/References:

1. Andy King, *Programming the Internet of Things: An Introduction to Building Integrated, Device-to-Cloud IoT Solutions*
2. Rajkumar Buyya, Amir Vahid Dastjerdi, *Internet of Things. Principles and Paradigms*
3. Codes from Github, Techhub etc.

2.2.13 IT - 51203 Data Analytics Lab

L - T - P
0 - 0 - 3 = 3

Course Code	:	*IT – 51203*
Course Name	:	*Data Analytics Lab*
Contact Hours per Week	:	*3(Three) Practical*
Marks Distribution	:	*Sessional Works = 20, End Semester Examination = 30.*
Questions to be Set	:	*10 (Ten) (Practical)*
Questions to be Answered	:	*Any ONE allotted on lottery basis*
Duration of End Semester Examination	:	*3 Hours (Practical).*

1. Implementation of Linear Regression, Logistic Regression
2. Implementation of different Classification methods.
3. Implementation of Artificial Neural Networks
4. Implementation of different clustering techniques
5. Implementation of different rule mining methods
6. Implement the following file management tasks in Hadoop: -Adding files and directories - Retrieving files - Deleting files
7. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm. - Find the number of occurrence of each word appearing in the input file(s) - Performing a MapReduce Job for word search count (look for specific keywords in a file)
8. Perform and analysis different data mining tasks in WEKA.

Books/References:

1. J. Han and M. Kamber. Data Mining: Concepts and Techniques. 2nd ed. Elsiver-2006.
2. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001.
3. I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
4. Mood, A. M., Graybill, F. A. And Boes, D.C. : Introduction to the Theory of Statistics, McGraw Hill.
5. Biswas and Srivastava – A textbook, mathematical Statistics, Ist Edition, Narosa Publishing House, New Delhi.

2.3 Third Semester

L	-	T	-	P		
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2.3.1 IT - 60001 Advanced Wireless Networks

Course Code	:	*IT – 60001*
Course Name	:	*Advanced Wireless Networks*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Fundamentals of Wireless Networks: Wireless Signals and its propagation in various environments, Components of Wireless Communication System, Issues of wireless communication, Cellular Networks: concepts, evolution, architecture, Issues and challenges, various communication models

Wireless Mesh networks (WMN): Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing: Self Configuration and Auto Configuration

Wireless Sensor Networks (WSN): Sensor Network architecture, MAC Protocols for Sensor Networks – Characteristics of MAC protocols in Sensor networks: Contention free MAC Protocols- characteristics-Traffic Adaptive Medium Access, Low energy Adaptive Clustering - Contention based MAC Protocols, Power-Aware Multi-Access protocols, Routing in Wireless Sensor Networks-Routing Challenges, Flooding, Flat Based Routing– Hierarchical Routing

Rural Wireless Network: Possible unique requirements for developing country users: Low-cost, Low-power, Alternative network architectures, Co-design of infrastructure and device, advantages for cost and functionality, Use of 802.11 in the developing world

Books/References:

1. C. Siva Ram Murthy and B.S.Manoj, “Ad hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2004
2. Feng Zhao and Leonidas Guibas, “Wireless Sensor Networks”, Morgan Kaufman Publishers, 2004
3. C.K.Toh, “Adhoc Mobile Wireless Networks”, Pearson Education, 2002
4. Research papers.

2.3.2 IT - 60002 Machine Learning

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT − 60002*
Course Name	:	*Machine Learning*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction: Types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Supervised Learning (Regression/Classification), Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes, Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods

Unsupervised Learning, Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Introduction to Statistical Learning Theory, Ensemble Methods, Boosting, Bagging, Random Forests, Neural Network: Perceptron, multilayer network, backpropagation.

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning, Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Bayesian Learning.

Books/References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Tom Mitchell. Machine Learning. First Edition, McGraw- Hill, 1997.
5. Ethem Alpaydin Introduction to Machine Learning, Edition 2,

2.3.3 IT - 60003 Image Processing and Computer Vision

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 60003*
Course Name	:	*Image Processing and Computer Vision.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Digital Image Processing, basic concept of image formation and representation, steps in digital image processing, elements of digital image processing, relationship between pixels, image transformation.

Image enhancement: spatial domain filtering and spatial domain filtering; sharpening; contrast enhancement; restoration. Image segmentation: point; line and edge detection; thresholding; clustering; region growing. Image compression: Image Compression models; error-free compression; Lossy compression; Image compression standards.

Overview of Computer Vision, feature extraction in images, image classification techniques, object detection, object recognition, semantic segmentation.

Introduction to machine learning, types of machine learning techniques: supervised and unsupervised techniques. Introduction to deep learning; convolutional neural networks. Applications of machine learning in computer visions.

Books/References:

1. Rafael C., Gonzalez Woods R.E., Digital Image Processing, Third edition, Pearson, 2013.
2. Jain A.K, Fundamentals of Digital Image Processing, Prentice Hall, Englewood Cliffs, 2002.
3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2022.
4. David A. Forsyth, Jean Ponce, Computer Vision-A Modern Approach, Pearson Education, 2015.

2.3.4 IT - 60101 Game Theory

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT − 60101*
Course Name	:	*Game Theory*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, payoffs, strategies, pure strategy Nash equilibrium, dominant strategies

Mixed-Strategy Nash Equilibrium pure and mixed strategy Nash equilibria,Iterative removal of strictly dominated strategies, minimax strategies and the minimax theorem for zero-sum game, correlated equilibria

Extensive-Form Games: Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium, introduction to imperfect-information games, mixed versus behavioural strategies.

Repeated Games: Repeated prisoners dilemma, finite and infinite repeated games, limited-average versus future-discounted reward, folk theorems, stochastic games and learning.

Bayesian Games: General definitions, ex ante/interim Bayesian Nash equilibrium.

Coalitional Games: Transferable utility cooperative games, Shapley value, Core, applications

Books/References:

1. A Course in Game Theory by M. J. Osborne and A. Rubinstein, MIT Press.
2. An Introduction to Game Theory by M. J. Osborne, Oxford University Press.
3. Algorithmic Game Theory by N. Nisan, T. Rougharden, E. Tardos and V. V. Vazirani, Cambridge University Press.
4. Fun and Games: A Text on Game theory by K. Binmore, AIBS publisher

2.3.5 IT - 60102 Natural Language Processing

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT – 601102*
Course Name	:	*Natural Language Processing.*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction, Text Processing, and Morphology: Introduction to NLP, Various stages of NLP, The Ambiguity of Language, Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.

*Language Modelling and Word Sense Disambiguatio*n: Words: Collocations, Frequency, Mean and Variance, Hypothesis testing: The t-test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: N-gram Models over Sparse Data.

Preliminaries of Disambiguation, Supervised Disambiguation: Bayesian classification, An information theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus-based disambiguation, Disambiguation based on translations in a second-language corpus.

Markov Model and POS Tagging: Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

Syntax and Semantics: Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.

Books/References:

1. Christopher D. Manning and Hinrich Schutze, "Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
2. Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.
3. Nitin Indurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
4. James Allen, "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
5. Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018

2.3.6 IT - 60103 Computational Biology

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 60103*
Course Name	:	*Computational Biology*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Nature and scope of life science: Branches of life sciences, Characteristics of life, Levels of Organization, Origin of life, Biochemical evolution- evolution of Proteins and Nucleotide.

Cell Biology: The cell as basic unit of life - Prokaryotic cell and Eukaryotic cell, Cell Structure and Function-cell membrane, cell organelles, Cell Division; Mitosis Meiosis.

Chromosome-Genome-Genes-Databases: Bio-molecules- DNA, RNA, Protein and amino acids, Chargaff's Rules, Codon bias, GC content. Central Dogma: Replication, Transcription, Translation, Post transcriptional post translational modifications, RNA processing, RNA splicing and RNA editing. Sense/coding and anti-sense/template strands, Genetic code, wobble hypothesis. Introduction to DNA and Protein sequencing, Human Genome Project, Bioinformatics databases, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, Gene Bank, DDBJ; Secondary nucleotide sequence databases. Proteins and Databases: Protein structure and function, Protein Primary structure, Amino acid residues, Secondary, Tertiary, Quaternary Structure of Protein, Protein sequence databases-SwissProt/ TrEMBL, PIR, Sequence motif databases -Pfam, PROSITE, Protein structure databases, Protein Data Bank-SCOP, CATH, KEGG, Chembank, Sequence, structure and function relationship

Computational Biology Algorithms: Suffix Trees, Pair-wise alignment, Sequence Alignment Heuristics, Multiple Sequence Alignment, Hidden Markov Models, RNA Secondary Structure, Bioinformatics Tools, Gene Finding, Phylogeny, Physical Mapping, Genome Rearrangements, DNA Chips and Clustering, Protein Structure, Linkage Analysis, Bayesian Networks, Stochastic Context Free Grammars, Algorithms for deep sequencing (Next Generation Sequencing), Module Identification in Networks, Expectation Maximization and Baum Welch, Gene finding and regulatory sequence analysis. – – – – – – – – – – – – – – – – – –

Books/References:

1. Gerald Karp, Cell and Molecular Biology – Concepts and Experiments, 2008, Wiley International Student Version.
2. Durbin, Richard, Sean R. Eddy, et al. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1998.

2.3.7 IT - 60201 Quantum Computing

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT – 60201*
Course Name	:	*Quantum Computing*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Quantum Computation: Quantum bits, Bloch sphere presentation of a qubit, multiple qubits.
Background Mathematics and Physics, Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.
Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.
Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search. Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation

Books/References:

1. Quantum Computation & Quantum Information, (10th Ann Ed), by Nielsen and Chuang ISBN: 9781107002173
2. Quantum Computer Science: An Introduction, by N. D. Mermin, ISBN: 9780521876582, CAMBRIDGE UNIV PRESS

2.3.8 IT - 60202 Pattern Recognition

L	-	T	-	P		
3	-	1	-	0	=	4

Course Code	:	*IT – 60202*
Course Name	:	*Pattern Recognition*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction: Basic pattern recognition tasks; The basic structure of a pattern recognition system; Three learning paradigms; The sub-problems of pattern recognition; The nature of statistical pattern recognition; Comparing classifiers.
Bayes Decision Theory: General framework; Optimal decisions; Bayes maximum likelihood rule, Nearest Neighbor Classifiers Three approaches to classification: density estimation, regression and discriminant analysis;
Feature Selection: Algorithms for feature selection such as Branch and Bound, Sequential forward and backward selections, GSFS and GSBS, (L, R) algorithm.
Unsupervised learning and Clustering: Minimum within cluster distance criterion, k-means algorithm single linkage, complete linkage and average linkage algorithms etc. Principal Component Analysis

Books/References:

1. Theodoridis and Koutroumbas, “Pattern Recognition”, Academic Press, 2009.
2. TV. S. Devi and M. N. Murty, “Pattern Recognition: An Introduction”, University Press, 2011
3. R. O. Duda, P. E. Hart and D. G. Stork, “Pattern Classification”, Wiley, 2000.

2.3.9 IT - 60203 Advanced Cryptography

L - T - P
3 - 1 - 0 = 4

Course Code	:	*IT – 602023*
Course Name	:	*Advanced Cryptography*
Contact Hours per Week	:	*4(Four) Hours.*
Marks Distribution	:	*Sessional Works = 40, End Semester Examination = 60.*
Questions to be Set	:	*Eight.*
Questions to be Answered	:	*Any 5(Five).*
Duration of End Semester Examination	:	*3(Three) Hours.*

Introduction to Cryptography: Basic cryptographic primitives and security issues, Secret key cryptography, public key cryptography, Hybrid cryptography. Shannon's theory on Perfect secrecy, spurious keys and unicity distance.

Block Ciphers Stream Ciphers: Substitution and, Permutation Network, Linear cryptanalysis: Piling -up lemma, Linear approximation of S Box. Differential cryptanalysis, Description of DES and AES, security analysis, modes of block cipher, stream ciphers: correlation attack, algebraic attack.

Hash function and message authentication: security of hash function: Random Oracle model, Iterated Hash Function: Merkle-damgard construction, Message Authentication Code (MAC), authenticated encryption, unconditional MAC.

Pubic Key Cryptosystem: RSA Cryptosystem and factoring of Integers: Primality testing, factoring of integers, Implementation of RSA: attacks on RSA, semantic security of RSA, ElGamal cryptosystem and discrete logarithmic problem: algorithms for solving discrete logarithmic problem, Elliptic curves, properties of elliptic curves , pairing on Elliptic curves, ElGamal cryptosystem on elliptic curve, security analysis of ElGamal cryptosystem,

Signature schemes: RSA and ElGamal signature scheme, security requirements of signature schemes Entity authentication and key distribution and agreement schemes. Post Quantum Cryptography: Introduction: lattice based, code based, multivariate and hash-based schemes.

Miscellaneous topics: Identity based crypto system, pallier cryptosystem, copyright protection, bitcoin and blockchain technology. – – – – – – – – – – – – – – – – –

Books/References:

1. Cryptography Theory Practice, Stinson & Paterson, CRC press, 4th Edition
2. A Handbook of Applied Cryptography, Menzes etal, CRC Press

2.3.10 IT - 603 Dissertation-I

L	-	T	-	P		
0	-	0	-	18	=	18

Course Code	:	*IT – 603*
Course Name	:	*Dissertation-I*
Contact Hours per Week	:	*18(Eighteen) Hours.*
Marks Distribution	:	*Sessional Works =120, End Semester Examination = 180.*

Topics: Any topic related to cutting edge tecchnologies on Information and Communication Technology shall be chosen to prepare Dissertation.

Dissertation: A research dissertation will be submitted to cover (a) Literature review, (b) Methods and materials, (c) Results, (d) Discussion and (e) Conclusion, plus list of references and appendices.

2.4 Fourth Semester

L	-	T	-	P		
0	-	0	-	24	=	24

2.4.1 IT - 604 Dissertation-II

Course Code	:	*IT – 604*
Course Name	:	*Dissertation-II*
Contact Hours per Week	:	*24(Twenty Four) Hours.*
Marks Distribution	:	*Sessional Works = 160, End Semester Examination = 240.*

Topics: Any topic related to cutting edge tecchnologies on Information and Communication Technology shall be chosen to prepare Dissertation.

Dissertation: A research dissertation will be submitted to cover (a) Literature review, (b) Methods and materials, (c) Results, (d) Discussion and (e) Conclusion, plus list of references and appendices.

2.4.2 IT - 605 Viva-Voce

L	-	T	-	P		
0	-	0	-	0	=	0

Course Code : *IT – 605*
Course Name : *Viva-Voce*
Contact Hours per Week : *Nil.*
Marks Distribution : *Sessional Works = 0., End Semester Examination = 100.*