MTech.- IT (Information Security Management)

First Semester

S. No.	Code	Subject	L-T-P	Credits	Category
1.	MIS-101	Advanced Programming	3-0-2	4	DCC
2.	MIS-103	Secure Coding and Security Engineering	3-0-2	4	DCC
3.	MIS-105	Fundamentals of Information Security	3-0-2	4	DCC
4.	MCS-107	Data Structures and Algorithm Analysis	3-0-2	4	DCC
5	GEC-101	Generic Open Elective	2-0-0 1-1-0 0-0-4	2	GEC
6.	ROC-101	Research Methodology	3-0-0	3	ROC
		Total credits		21	

Second Semester

S. No.	Code	Subject	L-T-P	Credits	Category
1.	MIS-102	Advances in Machine Learning	3-0-2	4	DCC
2.	MIS-104	Applied Cryptography	3-1-0	4	DCC
3.	MIS-106	Cyber Security and Forensics	3-0-2	4	DCC
4.	DEC-1xx	Departmental Elective Course – 1	3-0-2 3-1-0 2-1-2	4	DEC
5.	DEC-1xx	Departmental Elective Course – 2	3-0-2 3-1-0 2-1-2	4	DEC
6	ROC-102	Research Ethics	3-0-0	3	ROC
		Total credits		23	

Third Semester

S. No.	Code	Subject	L-T-P	Credits	Category
1.	MIS-201	Ethical Hacking	3-0-2	4	DCC
2.	DEC-2xx	Departmental Elective-3	3-0-2 3-1-0 2-1-2	4	DEC
3.	DEC-2xx	Departmental Elective-4	3-0-2 3-1-0 2-1-2	4	DEC
4	GEC-201	General Open Elective	2-0-0 1-1-0 0-0-4	2	GEC
5	MIS-251	Dissertation - I	-	8	DCC
6	MIS-253	Internship	-	1	DCC
		Total credits		23	

Fourth Semester

S. No.	Code	Subject	L-T-P	Credits	Category
1.	MIS-252	Dissertation - II	-	20	DCC
		Total credits		20	

List of Departmental Elective Courses

Category	Course Code	Subject	Credits
Departmental Elective Course-1	MIS-108	Adv. Database Management Systems	3-0-2
	MIS-110	Introduction to Biometrics	3-0-2
	MIS-112	Computer Vision	3-0-2
	MIS-114	Blockchain Fundamentals	3-0-2
Departmental Elective Course-2	MCS-106	Probability and Random Processes	3-0-2
	MIS-118	Semantic Web	3-1-0
	MIS-120	Security Testing and Risk Management	3-0-2
	MIS-122	Natural Language Processing and Information Retrieval	3-0-2
Departmental Elective Course-3	MIS-203	Neural Network and Deep Learning	3-0-2
	MIS-205	Security Patterns	3-0-2
	MIS-207	Cryptographic Protocols and Algorithms	3-0-2
	MIS-209	Advanced Network Technology	3-0-2
Departmental Elective Course-4	MIS-211	Cyber Laws and Rights	3-1-0
	MIS-213	Security and Privacy in Social Networks	3-1-0
	MIS-215	Software Defined Networks	3-1-0
	MIS-217	Cloud Computing Architecture and Security	3-0-2

ADVANCES IN MACHINE LEARNING	
Course Code: MIS-102 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 2

Introduction:
Machine learning is the science of getting computers to act without being explicitly programmed. Many researchers also think it is the best way to make progress towards human-level AI. This course provides a broad introduction to machine learning, data mining, and statistical pattern recognition.

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of Machine Learning.
- To explain the strengths and weaknesses of different machine learning algorithms (relative to the characteristics of the application domain)
- To be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.

Pre-requisites:
Knowledge of Programming, Discrete Mathematics (Set Theory, Graph Theory, Logic), Basic Probability Theory and Statistics, and Data Structures and Algorithms

Course Outcomes:

- Gain a broad understanding of machine learning algorithms and their use in data-driven knowledge discovery and program synthesis.
- Identify, formulate and solve machine learning problems that arise in practical applications
- Obtain an understanding of the current state of the art in machine learning and be able to begin to conduct original research in machine learning.

Pedagogy:
Lecture delivery via discussions, whiteboard, slideshows, lab-work with case studies in Matlab/Python implementation

Contents

UNIT-I	12 Hours
Introduction to Machine Learning, Well Posed Problems, Machine Learning Process, Designing a Learning System, Types of Machine Learning, Application of Machine Learning, Prospectives and Issues In Machine Learning. Features, Feature Vectors, Feature Selection And Visualization, Testing ML Algorithms (Overfitting, Training, Testing, And Validation Sets, Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced Datasets, Measurement Precision), Turning Data into Probabilities (The Naïve Bayes' Classifier), Some Basic Statistics. The Brain And The Neuron, Neural Networks, The Perceptron, Linear Separability And Regression (Linear And Logistic Regression) , The Multi-Layer Perceptron, Forward And Back-error propogation, Radial Basis Functions And Splines. The Curse Of Dimensionality, Dimensionality Reduction, Principle Component Analysis, Linear Discriminant Analysis (LDA), Factor Analysis, Independent Components Analysis (ICA).	
UNIT-II	10 Hours
Probabilistic Learning, Gaussian Mixture Models, Nearest Neighbour Methods. Support Vector Machines- Optimal Separation, Kernels, Svm Algorithm And Extension. Learning With Decision Tree, ID3, CART, Ensembling Learning, Boosting, Bagging, Random Forest. Different Ways To Combine Classifiers. Optmization And Search Techniques – Going Downhill, Least-Squares Optimisation, Search Approaches (Exhaustive Search, Greedy Search, Hill Climbing).	
UNIT-III	9 Hours
Evolutionary Learning, Genetic Algorithm, GENERATING OFFSPRING, GENETIC PROGRAMMING, Particle Swam Optimization. Unsupervised Learning, Clustering, Mixture Models, K-Means Clustering, Hierarchical Clustering, Distributional Clustering, Self-Organising Map (SOM). Evaluation Parameters For Unsupervised Learning. Reinforcement Learning: State And Action Spaces, Action, Policy, Markov Decision Processes, The Difference Between SARSA And Q-Learning, Uses Of Reinforcement Learning.	
UNIT-IV	11 Hours
Markov Chain Monte Carlo (MCMC) Methods, Graphical Models, Bayesian Networks, Hidden Markov Models (HMMS), Tracking Methods. Advance Machine Learning Techniques - Gaussian Process Regression, Energetic Learning: The Hopfield Network, The Boltzmann Machine, Restricted Boltzmann Machine (RBM) Deep Learning- Deep Belief Networks(DBN), Convolution Neural Networks (CNN).	
Text Books	
1	Chapman & Hall, Machine Learning: An Algorithmic Perspective, CRCF Press, Second Edition, 2015
2	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2nd Edition, 2010
3	Tom Mitchell, Machine Learning, McGraw Hill, 2017
Reference Books	
1	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
2	Han, Jiawei, Jian Pei, and Micheline Kamber, Data Mining: Concepts and Techniques. Elsevier, 2011.

APPLIED CRYPTOGRAPHY	
Course Code: MIS-104 Contact Hours: L-3 T-1 P-0 Course Category: DCC	Credits: 4 Semester: 2

Introduction:

This course will introduce students to the basic building blocks of cryptography and applications of cryptographic protocols in real world. The focus will be on how cryptography and its application can maintain privacy and security in electronic communications and computer networks.

Course Objectives:

- To understand the fundamentals of Cryptography
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity

Pre-requisite: None

Course Outcome: Upon successful completion of this course, students will be able:

- To explain and use modern cryptographic methods (symmetric encryption, public key encryption, hash functions, key management, digital signatures, certificates)
- To implement and identify electronic mail security system, SSL/TLS and recent developments affecting security and privacy on the Internet.
- To apply and use cryptographic concepts to real world problems

Pedagogy

Emphasis on lab sessions where students will be given programming assignments to code in lab based on topics learnt in previous lectures.

Contents

UNIT-I	10 Hours
Course Introduction and terminology, Conventional Cryptography: Definitions, Classical encryption techniques, One time pad, Perfect Secrecy, DES, Triple DES, Finite fields, AES, Modes of Encryption	
UNIT-II	11 Hours
Asymmetric Cryptography: Number Theory, public key cryptography: RSA, ElGamal, and Elliptic Curve Cryptography, Diffie Hellman Key management , Digital Certificates: X.509	
UNIT-III	11 Hours
Stream Ciphers, LFSR based stream ciphers, Message Authentication Codes, Hash functions, Hash algorithms, Digital Signatures and Authentication Protocols, Firewalls	
UNIT-IV	10 Hours
Intrusion Detection, PGP, S/MIME, Kerberos, IPSec, SSL/TLS, Password Hashing and Management	

Text Books

1	W Stallings, “Cryptography and Network Security: Principles and Practice, 6/e”, Prentice Hall
2	B. Forouzan, D. Mukhopadhyay, "Cryptography and Network Security 2/e", Tata-McGraw Hill
3	Christof Paar, Jan Pelzl, “Understanding Cryptography: A textbook for students and practitioners, 1/e”, Springer
4	Bernard Menezes, “Network Security and Cryptography 2/e”, Cenege Learning

Reference Books

1	A. Menezes, P. van Oorschot, S. Vanstone. “Handbook of Applied Cryptography”, CRC press, 1997.
2	Douglas R. Stinson, “Cryptography: Theory and Practice 3/e”, CRC Press, 2006
3	B. Schneier. “Applied Cryptography”. Second Edition. John Wiley & Sons, Inc., 1996

CYBER SECURITY AND FORENSICS	
Course Code: MIS-106 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 2

Introduction:

Cyber Security and Cyber Forensics is the application of investigation and analysis techniques to gather and preserve evidence from a particular computing device in a way that is suitable for presentation in a court of law. This course provides for a broad introduction of cyber security and forensics concepts, industry best practices for information security and key security concepts that will protect an organization against fraud, data breaches and other vulnerabilities. It enables the students to gain in-depth knowledge in the field of Computer forensics & Cyber Crime.

Course Objectives:

- To maintain an appropriate level of awareness, knowledge and skill to allow students to minimize the occurrence and severity of information security incidents.
- To learn techniques used to detect, respond and prevent network intrusions.
- To identify and apply appropriate forensics tools to acquire, preserve and analyze system image.
- To protect information and information systems from unauthorized access, use, disclosure, disruption, modification or destruction in order to provide confidentiality, integrity and availability.
- Identify sources of evidentiary value in various evidence sources including network logs, network traffic and volatile data.

Pre-requisites: Knowledge of Computer Networking, Linux, UNIX, Understanding of Web Application Architecture and HTTP/HTTPS communication.

Course Outcomes: After completion of the course the students will be able to

- Learn investigation tools and techniques, analysis of data to identify evidence, Technical Aspects & Legal Aspects related to cyber crime.
- Apply fundamental computer theory in the context of computer forensics practices.
- Adhere to the ethical standards of the profession and apply those standards to all aspects of the study and practice of digital forensics.
- Know how to apply forensic analysis tools to recover important evidence for identifying computer crime.
- Evaluate the effectiveness of available digital forensics tools and use them in a way that optimizes the efficiency and quality of digital forensics investigations.
- Explain the role of digital forensics in the field of information assurance and cyber security and recognize the opportunities to benefit from and support the goals of those fields.

Pedagogy:
Lecture delivery via discussions, whiteboard, slideshows, lab-work with case studies' implementation.

Contents:

UNIT I	12 hrs
Introduction to Incident Response Process, Computer Security Incident, Goals of Incident response, Who is involved in Incident response, Incidence Response Methodology, Pre Incident preparation, Detection of Incidents, Initial response, Formulate a response strategy, Investigate the incident, Reporting and Resolution. Computer Forensics Fundamentals, Benefits of Computer Forensics, Computer Crimes, legal concerns and private issues. Live data collection from Windows systems. Live data Collection from Unix systems.	
UNIT II	10 hrs
Data Acquisition of digital evidence from electronic media, Acquisition tools, Evidence collection and preservation, Sources of Digital/Electronic Evidence, Computer Forensic Analysis and Validating Forensics Data, System Forensics: File signatures, volatile/non-volatile data, File formats, Metadata, existing system forensics tools. Network Forensics: Firewalls, Intrusion Detection System. Database Forensics.	
UNIT III	10 hrs
Windows Forensics: malware forensics. Mobile Device Forensics: Evidence in Cell Phone, PDA, Blackberry, iPhone, iPod, and MP3. Evidence in CD, DVD, Tape Drive, USB, Flash Memory, Digital Camera. Google Forensics: Analysis of search data/information gathered from various google services. Internet Forensics.	
UNIT IV	10 hrs
Email Analysis: investigating email crime and violations. Messenger Analysis: AOL, Yahoo, MSN, and Chats. Web investigation: IP tracking, Server logs, Domain records. Current Computer Forensics Tools: Software/Hardware Tools. An Indian perspective on digital forensics: Indian IT act, Cyber laws.	
Text books	
1. K Mandla, C. Prosise , Matt Pepe, Incident Response and Computer Forensics, McGraw Hill, 2nd Edition	
2. Chad Steel, "Windows Forensics", Wiley India, 2006	
3. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, Thomson Course Technology, ISBN: 0-619-21706-5.	
Reference books	
1. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Real Digital Forensics, Addison Wesley Pearson Education, 2005	
2. Nelson, Phillips Enfinger, Steuart, Computer Forensics and Investigations, CENGAGE Learning, 2004	
3. John R. Vacca, Computer Forensics, Computer Crime Investigation, Firewall Media, 2nd Edition, 2005.	

ADV. DATABASE MANAGEMENT SYSTEMS	
Course Code: MIS-108 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 2

Introduction: Students study the basic and fundamentals of Database Management Systems at UG level, where they covers basics of RDBMS, Normalization, SQL, Transaction Management and Concurrency control techniques. However, since the complexity and size of databases is continuously increasing, advanced approaches to store and manage the data is required.

Course Objectives:

- To learn advanced and complex queries in SQL
- To learn PL/SQL with an emphasis on Exceptions handling, Cursors, Triggers, Procedures, Functions and Packages in PL/SQL
- To learn new approaches and trends in Databases like OODBMS, DDBMS, Multimedia database Management Systems and Big Data approaches.

Pre-Requisite: Understanding of Database Concepts and SQL

Learning Outcomes: At the end of the course, students will be able to:

- Write appropriate programs (Procedures/Functions/Triggers) at Server side for better, efficient and secure application development.
- Implement various advanced concepts of Database management Systems like Object Oriented System, Distributed Database Systems and Multimedia Database Management Systems for database design.
- Understand and use the unstructured big data along with concepts like Hadoop, Map Reduce, NoSQL, Pig and Hive for management and analytics .

Pedagogy: The subject will be taught through lectures, presentations and working on case studies. Lab sessions will cover exercises on advanced SQL queries, PL/SQL programs, use of object oriented concepts in database designing along with hands on experiments on Big Data.

Contents

UNIT 1	(10 Hrs)
Fundamentals of Relational Model, Advanced SQL queries: Nested Queries, Joins, Correlated Queries, Views, Indexes, Sequence. PL/SQL: Exceptions, Cursors, Triggers, Functions, Procedures, Packages.	
UNIT II	(11 Hrs)
Indexing &Hashing, B+ Tree Index Files, B-Tree Index Files, Dynamic & Static Hashing, Query Processing, Measures of Query cost, Selection Operation, Sorting, Join operation, evaluation of expressions, Query Optimization, Estimating Statistics of Expression Results, Transformation of Relational Expressions, Materialized Views	
UNIT III	(11 Hrs)
Object Oriented and Object Relational Database Systems, Abstract Data Types, Varrying Array, Nested Tables. Distributed Databases, Homogeneous & Heterogeneous Databases, Distributed Data Storage, Distributed Transactions and their commit protocols, Concurrency Control in Distributed Data Bases, Decision Support Systems. Multimedia Databases, Mobile Data bases, Spatial Database.	
UNIT IV	(10 Hrs)
Big Data-Volume, Velocity, Variety, Veracity, Types and Sources of Big Data OLAP & RTAP, Data Exploration, Data Summaries, Data Visualization, Tools for Big Data Analytics, No SQL, Hadoop, Map Reduce, Gephi	
Text Books	
1.	Fundamentals of Database System, by Elmasri Ramez and Navathe Shamkant, Pearson, 7th Edition, 2017
2.	Big Data Analytics, Radha Shankarmani and M. Vijayalakshmi, Wiley, 2nd Edition 2016
Reference Books	
1.	Database System Concepts, by Abraham Silberschatz and Hank Korth, McGraw Hill Publication, 6th Edition, 2013
2.	Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, by Davy Cielen and Arno D.B. Meysman, Dreamtech Publication, 2016

INTRODUCTION TO BIOMETRICS	
Course Code: MIS -110 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 2

Introduction

Biometrics systems are preferred over traditional identification and verification methods to reduce the fraud and make system more secure This course introduces students to the basic principles and methods used for biometric identification. The objective is to provide students with the scientific foundations needed to design, implement, and evaluate large scale biometric identification systems.

Course Objectives

- To understand the scope and options for biometrics technologies such as fingerprint, face, iris, hand shape, gait and voice based biometrics.
- To evaluate various biometric systems
- To learn how biometric techniques should be used to ensure individual security and privacy.

Pre-requisites

- Basic mathematics - knowledge and ability to use calculus, probability, and statistics are essential.
- The student should have experience in a high level programming language such as Matlab or C/C++.

Course Outcome: Upon successful completion of this course, students will be able to:

- Practically design and implement the fingerprint recognition system
- Practically design and implement the face recognition,
- Practically design and implement the iris recognition,
- Practically design and implement the voice recognition, and
- Practically design and implement the multimodal biometric systems.

Pedagogy

Lectures will be supported with case studies and real time applications wherever applicable. Also, emphasis on developing applications (system software) by writing programs in Lab

Contents

UNIT-I	12 Hours
Introduction to Biometrics: Biometrics Overview, biometric systems, History of Biometrics, Biometric functionalities, Biometric system errors, Performance Evaluation , Design cycle of biometric systems, Biometric applications. Statistical evaluation of biometrics: Technology, scenario and operational evaluations. Errors of biometric systems, false non-match vs. false rejection, false match vs. false acceptance. Error curves, ROC, DET, CMC. Statistical error estimation, hypothesis testing. Principles of biometric database collection and usage. Pattern recognition and Biometrics as pattern recognition problem, Overview of Image Processing, Edge Detection in Digital Images, biometric image/signal processing.	
UNIT-II	10 Hours
Fingerprint recognition algorithms and systems: introduction, friction ridge pattern, fingerprint acquisition, Fingerprint image preprocessing, segmentation, binary and skeletal images, feature extraction, matching, figure print indexing, figure print synthesis, palmprint. Fingerprints in forensics and biometrics, similarities and differences. Face Recognition Algorithms and systems: introduction, facial features, image acquisition , face detection, feature extraction and matching, Face space, principal component analysis and its application, eigenfaces, linear discriminant analysis and its application, , Fisherfaces, advanced topics (issues in the current system , handling pose, illumination and expression variations, heterogeneous face recognition, face modelling)	
UNIT-III	10 Hours
Iris recognition algorithms and systems: Eye and iris morphogenesis, genetic penetrance. Design of an Iris Recognition System, Principles of iris image capture, iris sensors. Iris image preprocessing, Iris segmentation, formatting and filtering, Iris normalization, Iris encoding and matching, Performance evaluation, Other iris coding methods, wavelet analysis. Voice Recognition algorithms and systems: Introduction to Voice , Speech & speaker recognition algorithms. formants, speaker features in time, frequency and cepstrum domains, homomorphic deconvolution of voice signals Additional Biometric Traits: Introduction , Ear, hand geometry , Gait, Soft biometrics, Use of vein patterns of a hand, finger and retina. Thermal imaging and geometry of a hand. handwritten signatures	
UNIT-IV	10 Hours
Multi-modal Biometric Systems : Introduction, sources of multiple evidence, acquisition and processing architecture, Fusion level Security of biometric systems: introduction, adversary attacks, attacks at uer interface, attacks on biometric processing and attack on database. template protection. Merging biometrics and steganography, embedding steganographic signatures in biometric data. Biometrics & future trends	
Text Books	
1	Jain, Anil K., Arun A. Ross, and Karthik Nandakumar. Introduction to biometrics. 2011. Springer
Reference Books	
1	Maltoni, D., Maio, D., Jain, A.K., Prabhakar, S., Handbook of Fingerprint Recognition. Second edition 2009
2	Burge, M.J., Bowyer, K., Handbook of Iris Recognition. Edition 2013

COMPUTER VISION	
Course Code: MIS-112 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 2

Introduction:

Biometrics systems are preferred over traditional identification and verification methods to reduce the fraud and make system more secure among intelligence, security, e-commerce etc. This course introduces students to the basic principles and methods used for Computer Vision. The objective is to provide students with the scientific foundations needed to design, implement, and evaluate large scale computer vision systems.

Course Objectives:

- Understand the scope and options of Machine Learning in computer vision: Face detection using Adaboost, Object detection using parts.
- Students will learn how the technologies should be used to use in the human recognition

Pre-requisites:

- Basic mathematics - knowledge and ability to use calculus, probability, and statistics are essential.
- The student should have experience in a high level programming language such as Matlab or C/C++.

Course Outcome

After completing the course students will be able to:

- identify basic concepts, terminology, theories, models and methods in the field of computer vision,
- describe known principles of human visual system,
- describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition,
- suggest a design of a computer vision system for a specific problem

Pedagogy

Lectures will be supported with case studies and real time applications wherever applicable.
Also, emphasis will be given on developing applications (system software) by writing programs.

Contents

UNIT-I	10 Hours
Introduction to Computer Vision, Image Formation: Geometric primitives and transformations, Photometric image formation , The digital camera Image processing: Point operators, Linear filtering, More neighbourhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization Feature detection and matching, Points and patches, Edges, Lines	
UNIT-II	12 Hours
Image Segmentation: Active contours , Split and merge , Mean shift and mode finding , Normalized cuts, Graph cuts and energy-based methods Feature-based alignment: 2D and 3D feature-based alignment , Pose estimation, Geometric intrinsic calibration Structure from motion: Triangulation , Two-frame structure from motion , Factorization, Bundle adjustment, Constrained structure and motion Dense motion estimation: Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion Image stitching: Motion models, Global alignment, Compositing	
UNIT-III	10 Hours
Computational photography: Photometric calibration, High dynamic range imaging, Super-resolution and blur removal, Image matting and compositing, Texture analysis and synthesis. Stereo correspondence: Epipolar geometry, Sparse correspondence, Dense correspondence, Local methods, Global optimization, Multi-view stereo. 3D reconstruction: Shape from X, Active rangefinding, Surface representations, Point-based representations, Volumetric representations, Model-based reconstruction, Recovering texture maps and albedos	
UNIT-IV	10 Hours
Image-based rendering: View interpolation , Layered depth images , Light fields and Lumigraphs , Environment mattes , Video-based rendering Recognition: Object detection , Face recognition , Instance recognition , Category recognition , Context and scene understanding , Recognition databases and test sets Future applications of computer vision	

Text Books

1	Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2015.

Reference Books

1	Digital Image Processing and Analysis: Application with MATLAB and CVIPtools, 3rd Edition, SE Umbaugh, Taylor&Francis/CRC Press, 2018

BLOCKCHAIN FUNDAMENTALS	
Course Code: MIS-114 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 2

Introduction: Blockchain can be described as a data structure that holds transactional records and while ensuring security, transparency, and decentralization. You can also think of it as a chain or records stored in the forms of blocks which are controlled by no single authority. A blockchain is a distributed ledger that is completely open to any and everyone on the network. Once an information is stored on a blockchain, it is extremely difficult to change or alter it. Blockchain and Cryptocurrency is vastly discussed now days in all research domains to bring the decentralization. This course is to understand Blockchain and its main application cryptocurrency.

Course Objectives:

- To build expertise in Blockchain and Distributed Ledger Technology
- To understanding basics of Cryptocurrency - Bitcoin
- To understanding Smart Contracts

Pre-requisite: Basics of Elliptic Curve Cryptography, Decentralized or Distributed Computing, Peer- to-peer Computing, Basic knowledge of programming.

Course Outcome: The students will be able to

- Get expertise in Blockchain and Distributed Ledger Technology
- Get Hands-on PoC experience across major Blockchain Platforms
- Exposure to Blockchain Use Cases across Domains

Pedagogy: Lecture delivery via discussions, whiteboard, slideshows, case studies' implementation

Contents:

UNIT I	12 hrs
Basics: Distributed Database, Two General Problem, Byzantine General problem And Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	
UNIT II	10 hrs
Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain	
UNIT III	10 hrs
Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin	
UNIT IV	10 hrs
Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy. Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain	
Text books	
1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.	
2. Wattenhofer, The Science of the Blockchain, 2016	
3. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing platform, 2017	
4. Chad Steel, "Windows Forensics", Wiley India, 2006	
5. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, Thomson Course Technology, ISBN: 0-619-21706-5.	
Reference books	
1. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System	
2. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts	

RESEARCH ETHICS	
Course Code: ROC-102 Contact Hours: L-3 T-0 P-0 Course Category: ROC	Credits: 3 Semester: 2

Introduction: The course introduces students to the key concepts, principles, debates and legal regulations of research ethics and professional conduct.

Course Objectives:

- The purpose is to enable students to correctly identify ethical risks in research and to apply ethical constructs to individual research projects, as well as to professional conduct.
- In addition, the students will gain empowering tools and skills that will increase their ability to contribute to the ongoing debate and development of research ethics and professional conduct.

Pre-requisites: None

Course Outcomes: Having successfully completed this course

- The students will have general knowledge and systematic understanding of research ethics and responsible conduct in theory and practice.
- They will also have familiarity with key concepts, topics, and developments in research ethics and responsible conduct familiarity with the legal regulation of research ethics in India and internationally.
- They will also acquire skills and capabilities to correctly apply ethical constructs to individual research projects, as well as critically reflect on their application ,intellectual independence and scientific integrity, as well as insight into the, responsibility for his/her research and for its publication and dissemination.

Pedagogy: Classroom teaching which focuses upon relating the textbook concepts with real world phenomena, along with regular tutorial classes to enhance the problem-solving ability.

Contents

UNIT-I	10 Hours
Moral Theory Natural Law theory, Utilitarianism, Kant's Moral Theory, Ethical Egoism, Pluralism, Categorical Imperative, Rosses's intuitionism, Stewardship theory, Research Involving Human Subjects, Animals. Responsibility to society, science and self.	
UNIT-II	10 Hours
Copyrights Data Sharing Plans, Indian Copyright Act, 1957 and its amendments. International copyright acts. Indian Patent Act 1970 and its amendments. USPTO. Creative Common License, plagiarism.	
UNIT-III	10 Hours
Conflict of Interests Conflict of Interest, Candor Theory, Sarbanes-Oxley Act of 2002, Scientific Misconduct, Institutional Responsibility, Informed Consent, Confidentiality, Non-Disclosure Agreement. Regulatory compliance.	
UNIT-IV	12 Hours
Case Studies Immortal Life of Henrietta Lacks, Stanford Prison Experiment, Tuskegee Syphilis Experiment. SCIGen-An automatic CS paper generator, Chernobyl Disaster and more can be added by the instructor.	

Text Books

1.	On Being a Scientist: A Guide to Responsible Conduct in Research: 3rd Edition,3rd Revised Edition, Committee on Science Engineering and Public Policy, National Academies Press, 2009.
2.	Penslar, Robin L., Research Ethics: Cases and Materials, ,Ed.,Indiana University Press, 1995.
3.	D Elliot, and J E Stern, Research Ethics: A Reader, 1st Edition, University Press of New England, 1997.
4.	The student's guide to research ethics, Paul Oliver, 2 Edition, Open University Press, 2010.

PROBABILITY and RANDOM PROCESSES	
Course Code: MCS-106 Contact Hours: L-3 T-0 P- 2 Course Category: DEC	Credits: 4 Semester: 2

Introduction: This course provides necessary basic concepts in probability and random processes for applications such as Artificial intelligence. The aim of the course to understand the basic concept of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon. This course helps to understand the basic concepts of random processes which are widely used in IT fields.

Course Objective: To provide a detailed treatment of techniques used in mathematics regarding probability and random processes and to introduce the students to the techniques of dealing with uncertainties.

Pre-requisite: Students should have studied basic course on Mathematics and should be aware about the procedure about problem solving through AI.

Course outcomes: After studying this course, students would be able to :

- Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.
- Characterize probability models and function of random variables based on single & multiples random variables.
- Evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits.
- Understand the concept of random processes and determine covariance and spectral density of stationary random processes.
- Demonstrate the specific applications to Poisson and Gaussian processes.

Pedagogy: Classroom teaching which focuses on developing understanding of students to understand the concepts of subject larger number of examples and presentations and lab exercises.

Contents

UNIT I Hrs. 10
Introduction to Probability: Sets and set operations, probability space, conditional probability and Bayes theorem, combinatorial probability and sampling models.
UNIT II Hrs. 10
Random Variables: Discrete random variables, probability mass function, probability distribution function, example random variables and distributions continuous random variables, probability density function, probability distribution function, example distributions Joint distributions, functions of one and two random variables, moments of random variables conditional distribution, densities and moments, characteristic functions, Markov, Cheby-shev and Chernoff bounds.
UNIT III Hrs.10
Sequence of Random Variables and Convergence: Random sequences, Almost sure (a.s.) convergence and strong law of large numbers convergence in mean square sense with examples from parameter estimation convergence in probability with examples convergence in distribution central limit theorem.
UNIT IV Hrs.10
Random Processes: Random processes, stationary processes, mean and covariance functions, ergodicity, linear filtering of random processes, power spectral density, examples of random processes: white noise process and white noise sequence, Gaussian process, Poisson process, Markov process.
Text Book
1.Geoffrey Grimmett, Probability and Random Processes, , Oxford University Press , 3rd edition 2001.
2. Henry Stark and John W. Woods, Probability and Random Processes with Applications to Signal Processing, Prentice Hall, 3rd Edition 2001.
3.An Introduction to Probability Theory and Its Applications, Volume 2, PHI publication 2nd Edition. 2012
References Book
1.Papoulis, A. Probability, Random Variables and Stochastic Processes, Mc Graw Hill , First edition , 2010
2.G.P. Beaumont, Probability and Random Variables, John Wiley and Sons. 2010.
3.A. Papoulis, and S. UnnikrishnaPillai: Probability, Random Variables and Stochastic Processes,., Tata McGraw Hill, 4th Edition 2002.

SEMANTIC WEB	
Course Code: MIS-118 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 2

Introduction:
The knowledge contained in the World Wide Web is available in interlinked documents written in natural language. To make use of this knowledge, technologies such as natural language processing, information retrieval, data and knowledge mining must be applied. Semantic Web technologies follow an alternative approach by complementing web documents with explicit semantics based on formal knowledge representations, such as ontologies. This course provides an introduction and practical tutorial on the RDF-based semantic annotation of Web resources and services for the Semantic Web, Linked Data and Ontology Engineering; and also reviews some modern applications of these methods and techniques for Web-based intelligent applications and services.

Course Objectives:
- To offer an introduction to knowledge and logic-based information technologies, using logic programming as the primary example of knowledge-based reasoning, and the Semantic Web as the primary example of a knowledge-based application area.
- To introduce the W3C standard Web Ontology Language, OWL, and its underlying Description Logics
- To provide experience using a set of established patterns for developing OWL ontologies
- To understand linked data technologies and applications

Pre-requisites:
Knowledge of basic logic; Java/object-oriented programming, data structures and algorithms, Web technologies, such as URL, http, HTML, and XML-based technologies, Database technology such as, relational databases and SQL query language

Course Outcomes:
On successful completion of this course, the students should be able to:
- Apply RDF, OWL, and SWRL syntax for semantic annotations and rule specification for web resources.
- Build and visualize rich ontologies using editors such as Protégé.
- Describe Linked Data principles and architecture, as in dbpedia, Wiki, FOAF etc.
- Perform Linked data analysis and visualization using SPARQL with R/Python.
- Develop a deep insight to the various state-of-the-art technologies of semantic search engine, semantic web browser and semantic recommender systems.

Pedagogy:
Lecture delivery via discussions, whiteboard, slideshows with case studies' implementation.

Contents

UNIT-I	10 Hours
Knowledge Engineering and the Web of Data, Semantic Web standards: Uniform Resource Identifier (URI) RDF (Resource Description Framework); Ontology Engineering; OWL (Web Ontology Language), SPARQL, Semantic Web mission; concepts of semantic interoperability, integration and automation; concept of metadata and ontology; description logics	
UNIT-II	11 Hours
Methods for developing and evaluating ontologies. Application development using the OWL API, Tableaux Algorithm, DL Reasoning Problems, Canonical forms, Resolution (PL/FOL), OWL and RDF(S) Semantics Basics, Open and Closed world assumptions, Rules for inferring knowledge, First order Logic, RDF-S semantics, Web Ontology Language(OWL), Semantic Web Rule Language(SWRL), Friend-of-a-Friend(FOAF)	
UNIT-III	11 Hours
Query languages SPARQL, SWRL (Semantic Web Rules Language); Semantic Technology; Rules, Protége, Ontology Alignment, Ontology Evaluation, More Ontology Design Methodologies, Metadata, Fundamentals of Ontology and its types, monolithic vs. modular ontology, ontology design methodology, ontology learning, ontology learning from text, automated ontology learning process	
UNIT-IV	10 Hours
Linked Data Engineering, Semantic (Web) infrastructure, applications and Services; Relation to Big Data and Industry 4.0, Linked Data Programming, Semantic Annotation, Named Entity Resolution, Semantic Search, Exploratory Search, Linked Data Analytics, Semantic Recommendations	

Text Books	
1	Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra, A Semantic Web Primer, MIT Press, 3rd Edition (September, 2012).
3	David Wood, Marsha Zaidman, Luke Ruth, and Michael Hausenblas, Linked Data: Structured Data on the Web, Manning Publications; 1st Edition (January 24, 2014).
4	Bob DuCharme, Learning SPARQL: Querying and Updating with SPARQL 1.1, O'Reilly Media; 2nd Edition (July 18, 2013)
Reference Books	
1	Liyang Yu, A Developer's Guide to the Semantic Web, Springer Science & Business Media, 2011
2	SteffanStaab and Rudi Studer , Handbook on Ontologies", Springer Science & Business Media, 2010

SECURITY TESTING AND RISK MANAGEMENT			
Course Code	: MIS-120	Credits	: 4
Contact Hours	: L-3 T-0 P-2	Semester	: 2
Course Category	: DEC		

Introduction: This course is designed to enable students to recognize the need for Security Testing of software applications and assessing the risk associated. Design software with a security mindset and implementing security by writing secure code does not necessarily mean that the software is secure. It is imperative to validate and verify the functionality and security of software and this can be accomplished by quality assurance testing which should include testing for security functionality and security testing. Security testing is an integral process in the secure software development life cycle. Software that has undergone and passed validation of its security through testing is said to be of relative higher quality than software that hasn't. The course is effective in enabling students to learn Software Security testing techniques so as to develop software that is reliable and resilient to software attacks.

Course Objectives:

- To learn different types of functional and security testing and criteria that can be used to determine the type of security tests.
- To learn implementation of security patterns in removing the software and network vulnerabilities.
- To learn assessment and management of Risk through various risk assessment and management framework.

Pre-requisite:

- Basic Knowledge of Software applications, programming, Database, Network Concepts,

Course Outcome: Upon successful completion of this course, students will be able to:

- Learn what to test, which modules to test and how to test for software security issues.
- Perform Security testing of software and web applications.
- Detect Security vulnerabilities in software and network.
- Implement Security patterns and security controls to secure Software applications and network.
- Assess, evaluate and analyse risk of a software applications using standard Rsik assessment and Management Framework.

Pedagogy

Lectures will be imparted along with hands on lab sessions and security testing and risk management for software applications for case study (ies) .

Contents

UNIT-I	10 Hours
Introduction: Testing Objectives, Software Testing Process, Software Testing Principles, Tester Role in Software Development Organization, Test Case Implementation and Execution. Testing Concepts: Levels of Testing, Test Cases Design and Strategy, Test Suit, Test Plan, Testing as a Process, Security Testing Versus Traditional Software Testing, the Paradigm Shift of Security Testing, High-Level Security Testing Strategies, the Fault Injection Model of Testing	
UNIT-II	10 Hours
Software Vulnerabilities fundamentals: causes of software vulnerabilities, Software Vulnerabilities, Principle and Classification of software vulnerabilities, authentication and authorization, classification of SQL Injection attacks, buffer overflow, distributed denial of service attacks, , session attacks, Cross site scripting, Cross site request forgery (CSRF), Format string problems, Integer overflows	
UNIT-III	12 Hours
Security Testing into the Software Development Lifecycle, Need for Security Testing, Testing Techniques, Attack Surface Validation, Cryptographic Validation Testing , Penetration Testing, Testing for Input Validation , Testing for Scripting Attacks Controls , Network fault injection, port discovery, port scanning, proxies , Testing for Error and Exception Handling Controls, Vulnerability Detection and Assessment Approaches Software design Patterns and Security Patterns, their role, impact and usability. Tools for Security Testing	
UNIT-IV	10 Hours
Risk Management, Categories of Risk, Approaches to Risk Identification, Analyzing Risk, Qualitative Analysis and quantitative analysis, Performing Ongoing Risk Analysis, conducting Routine security review, Working with management, Responding to Security Incidents, ranking the risk associated with a vulnerability, Vulnerability scoring system CVSS, VRSS, Risk Prioritization, Planning the risk response, Updating Security Policy, Taxonomy of information security risk assessment Case Study : Risk Assessment and Management Framework (NIST, OCTAVE-Allegro, OCTAVE-S)	
Text Books	
1	Chris Wysopal, Luke Nelson and Elfriede Dustin, " The Art of Software Security Testing, "Pearson Education, 2006
2	Alfred Basta, Nadine Basta, Mary Brown, "Computer Security and Penetration Testing", Cengage India Private Limited, Second Edition, 2017
Reference Books	
1	Evan Wheeler, "Security Risk Management: Building and information Security Risk Management Programme from the Ground UP", Syngress , 2011
2	Mano Paul, Official (ISC) 2 Guide to the CSSLP, CRC Press, First Edition, 2016

NATURAL LANGUAGE PROCESSING AND INFORMATION RETRIEVAL	
Course Code: MIS-122 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 2

Introduction:
Natural language processing (NLP) is an area of computer science and artificial intelligence that is concerned with the interaction between computers and humans in natural language. The ultimate goal of NLP is to enable computers to understand language as well as we do. This course covers a wide range of tasks in Natural Language Processing from basic to advanced: sentiment analysis, summarization, dialogue state tracking, to name a few. Upon completing, students will be able to recognize NLP tasks in your day-to-day work, propose approaches, and judge what techniques are likely to work well.

Course Objectives:
- To equip students with a fundamental understanding of automated methods for processing linguistic data in textual form (natural language processing) from different sources (newswire, web, social media, academic publications) and associated challenges.
- To provide students with the skills to analyse textual data and familiarise them with state-of-the-art tools and applications.

Pre-requisites:
Machine learning, Theory of Formal Languages and Parsing Fundamentals, Statistics, Data Structures, Programming Language such as Python

Course Outcomes: The students will be able to
- Apply various phases of NLP that will be required for the specific applications such as document classification, named entity recognition, machine translation
- Use various libraries (e.g., SCIKIT, NLTK) required for implementation of document classification algorithms
- Design, implement and analyze the applications of Natural Language Processing (NLP) using various machine learning algorithms

Pedagogy:
- Lectures to be reinforced with case studies (based on research papers) pertinent to natural language processing applications and issues
- Emphasis on writing programs to analyse various natural language processing tasks

Contents:

UNIT-I	10 Hours
Introduction to Natural Language Processing (NLP): regular expressions and automata, NLP Challenges, layers of computational linguistics, The problem of ambiguity. Mathematical foundations: Probability Theory, Vector Spaces, Matrix algebra, Probability, Data representation, Tokenization, Lemmatization, Minimum edit distance and examples of use in spelling correction	
UNIT-II	11 Hours
N-gram model, smoothing, entropy, Parts-of-speech tagging: Various Models: Hidden Markov Model,SVM, CRF, RNN, LSTM, parsing: Linguistic Essentials, Markov Models, Applications of tagging, Probabilistic parsing - CFG, CSG, PCFG	
UNIT-III	11 Hours
Word sense disambiguation and lexical acquisition from large text corpora. NLP applications: Document summarization, Machine Translation, Spell Correction, News Article Title Generation, Question Answering, Sentiment Analysis; Text Entailment, topic modelling: Latent Dirichlet Allocation (LDA) and its Variants	
UNIT-IV	10 Hours
Conversion of Data to information, Information Retrieval, Information Retrieval Models, Classical & Non Classical Models of Informational Retrieval Relation. Matching, Knowledge-based Approaches, Conceptual Graphs, Applications, Information Extraction, Automatic Text Summarization Systems, Question Answering Systems.	
Text Books	
1	Foundations of Statistical NLP by Hinrich Schtze, Christopher D. Manning
2	D. Jurafsky and J. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Prentice Hall, 2nd Edition, 2008
3.	D.A Grossman, O.Frieder, Information Retrieval, 2nd Edition, 2004, Springer Publication
Reference Books	
1	Statistical Machine Translation by Philipp Koehn, Cambridge University Press
2	Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, OReilly, 2nd Edition, 2014.
3	Joseph Olive, Caitlin Christianson, John McCary, Handbook of Natural Language Processing & Machine Translation, Springer, 2011.