CENTRE FOR ADVANCED STUDIES

Dr. APJ Abdul Kalam Technical University, Lucknow

Syllabus for

M.Tech - Computer Science and Engineering (CSE)

With Specialization in - Cyber Security (CyS)
&
Information and Communication Technologies (ICT)

INDEX

MARKS DISTRIBUTION

Following is Marks Distribution for courses depending upon the credit of the courses:

(1 credit = 50 marks)

Credit	Type of Course	Max. Marks	Major (End Semester examination)	Performance Evaluation		Lab Evaluation
				Minor I & II	Internal Assessments (Attendance, Quiz, Seminar & Assignments)	
3	Theory course	150	75	40 (20 each)	35	-
4	Theory course (with lab)	200	75	40 (20 each)	35	50
4	Thesis / dissertation -I	200	100	100		-
14	Thesis / dissertation -I	700	300	400		-

Note: Maximum Marks is fixed for all the courses. Only internal assessments and lab evaluation marks distribution may vary as per the instructions communicated by the assigned Faculty. Refer to M.Tech Ordinance & Regulation for Assessment Procedures and Performance Evaluation.

SEMESTER-I

1. **Course Code: MCSC-101,**
   Course Name : ADVANCE DESGIN AND ANALYSIS OF ALGORITHMS ,
   Credit: 4

   Syllabus : Network flows (max flow and min-cost flow/circulation) , Data structures (Fibonacci heaps, splay trees, dynamic trees) , Linear programming (structural results, algorithms) and SDP based , Dealing with intractability: approximation algorithms (techniques for design and analysis), Dealing with large data sets (compression, streaming algorithms, compressed sensing), Computational geometry, Hardness of approximation - Approximation Algorithms based on Algorithmic Game Theory, Randomized Algorithms, complexity theory, Parallel Algorithms.

   Lab : Programming on searching , sorting and linked list , Binary Tree, Binary Search Tree, Traversal: BFS, DFS; Minimum Spanning Tree, Implementing String Matching Algo's, Greedy & Dynamic Approach, Backtrack/ Branch & Bound, Approximation Algorithms.

2. **Course Code: MCSC-102,**
   Course Name: MOBILE AND WIRELESS SENSOR NETWORKS,
   Credit: 4

   Syllabus: Introduction to Wireless Sensor Networks and applications – Tracking chemical plumes- Smart transportation, Network Architecture - Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Hardware Platforms, ns-3 core , Medium Access Control Protocol design, Introduction to Markov Chain, MAC Protocol Analysis, Routing protocols-Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast, MANETS, Routing protocols for WSN, Opportunistic Routing Analysis, Clustering, QoS management ,Sensor mode selection, Localization, Time Synchronization, Security-SPINS, Static and dynamic key distribution, Energy Harvesting WSNs, Programming in WSNs, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming, Open Research Issues.

   Lab: Programming routing protocol an sensor network using ns-3 , practicing theories in simulator.

3. **Course Code: MCSC-103,**
   Course Name : ADVANCED COMPUTER NETWORKS AND COMMUNICATION,
   Credit: 4

   Syllabus : Includes : 1) telecommunications history; 2) telecommunications media (conducted and radiated); 3) transmission characteristics (including an introduction to coding and modulation techniques); 4) error characteristics, detection, and correction; 5) local and wide

area networking applications, hardware, and software; 6) the OSI model; 7) industry standards; 8) topologies; 9) protocols; 10) internetworking devices; 11) communications management; 12) security and recovery; 13) information system applications; and 14) the selection of telecommunications and networking systems communication security, Digital signatures, authentication protocols. WLAN, Mobile IP.

SNMP(V1 and V2)-Organizational model-System Overview, The information model,communication model-Functional model, SNMP proxy server. Broadband networks and services, ATM Technology, Configuration management, Fault management, performance management. Network Management Tools, Network Statistics Measurement Systems – Web Based Management, XML Based Network Management

Lab: Programming protocol USING C/C++ and MATLAB and practicing theory.

4. **Course Code: MCSC-104,**
   Course Name : CLOUD COMPUTING,
   Credit: 3

   Syllabus : Introduction , Cloud Computing Architecture - Cloud Reference Model, Types of Clouds, Cloud Interoperability & Standards, Scalability and Fault Tolerance, **Cloud Solutions:** Cloud Ecosystem, Cloud Business Process Management, Cloud Service Management. **Cloud Offerings**: Cloud Analytics, Testing Under Control, Virtual Desktop Infrastructure.

   Cloud Management & Virtualization Technology: Resiliency, Provisioning, Asset management, Concepts of Map reduce, Cloud Governance, High Availability and Disaster Recovery. Virtualization: Fundamental concepts of compute ,storage, networking, desktop and application virtualization .Virtualization benefits, server virtualization, Block and file level storage virtualization Hypervisor management software, Infrastructure Requirements , Virtual LAN(VLAN) and Virtual SAN(VSAN) and their benefits.

   Cloud Security: Cloud Information security fundamentals, Cloud security services, Design principles, Secure Cloud Software Requirements, Policy Implementation, Cloud Computing Security Challenges, Virtualization security Management, Cloud Computing Security Architecture. Market Based Management of Clouds , Federated Clouds/Inter Cloud: Characterization & Definition , Cloud Federation Stack , Third Party Cloud Services . Case study : Google App Engine, Microsoft Azure , Hadoop , Amazon , Aneka. Performance, scalability and consistency on Clouds.

5. **A. (For CyS)**
   Course Code: MCySC-101,
   Course Name : FUNDAMENTAL OF INFORMATION SECURITY & PRACTICES,
   Credit: 3

   Syllabus : Introduction to information security, need, scope, basic principles- CIAA , policies, procedures, Guidelines, Standards Administrative Measures and Technical Measures info sec culture, interpretation of info sec culture, dynamic organizational model, modeling the

information sharing of organization. Standards available for infosec: Cobit, ISO 27001 Overview, Vulnerability, Threat and Risk, Risk Assessment and Mitigation + Quick fixes, Introduction to HIPPA/PCI DSS/ BCP / DRP / ITIL. Segregation and Separation of Duties & Roles and responsibilities. Introduction to IT ACT 2000. Current trends in security, OWASP, OSSTMM SANS 2014 Trends That Will Reshape Organizational Security , issues of info security in Choose your own IT (CYOIT) , Increased virtualization and use of cloud and software-as a-service (SaaS) , Supply chain integrity worries ,The Internet of Things/Everything , Bitcoin currencies, Security Services, Security Mechanism , Security Attacks and explanation. Use of different information security models in emerging IT Technologies. Types of assessments for Information Security - VAPT of Networks; Assessment of Security Devices (Web Filtering, Firewalls, IDS / IPS, Routers; Data Center Assessment; Security of Application Software; SAP Security; Desktop Security; RDBMS Security. Use of information security for Nations defence. Computer Software and Intellectual Property-Objective, Copyright Protection, Reproducing, Defences, Patent Protection, Database and Data Protection-Objective, domain name and Intellectual Property, disputes under Intellectual Property Rights, Jurisdictional Issues, International Perspective.

5. B. (For ICT)

Course Code: MICTC-101,

Course Name : MATHEMATICAL FOUNDATIOS FOR COMPUTING IN ICT,

Credit: 3

Syllabus : Fundamental Concepts of Mathematics: Statements – Connectives – Truth Tables – Normal forms – Predicate calculus – Inference – Theory for Statement Calculus and Predicate Calculus – automata theorem proving. Review of Permutation and Combination – Proofs - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion - generating function - Recurrence relations. Semi goup - Monoid – Groups- Cyclic group - Permutation group - Substructures - Homomorphism of semi group, monoid and groups - Cosets and Lagrange Theorem – Normal Subgroups - Rings and Fields. Recursive functions - Primitive recursive functions - computable and non - computable functions. Partial order relation, poset – Lattices. Discrete Structures: Modular Arithmetic, Graphs, Trees, State machines, Counting Analysis techniques based on counting methods and recurrence equations; Discrete Probability Theory; Application of these in Computer Science and algorithms.

SEMESTER-II

1. Course Code: MCSC-201,
Course Name : RESEARCH METHODOLOGY ,
Credit: 3

Syllabus : 1. Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process 2. Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance 3. Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. 4. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. 5. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. 6. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size. 7. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. 8. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. 9. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. 10. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

2. Course Code: MCSC-202,
Course Name : PROBABILITY AND STATISTICS ,
Credit: 3

Syllabus : Introduction. Events and outcomes. Probability rules. Conditional probability. Independence. Bayes' Rule. Combinatorics. Random variables and their distributions. Discrete random variables. Discrete distributions: Bernoulli, Binomial, Geometric, Negative Binomial,

Poisson. Continuous distributions and probability densities. Continuous distributions: Exponential, Gamma, Weibull, Hyperexponential, Normal Expectation and moments. Central Limit Theorem. Simulation of discrete and continuous random variables. Monte Carlo methods. Stochastic processes. Main concepts and classification. Bernoulli process. Poisson process. Markov chains and simple queuing systems. Simulation, performance evaluation, bootstrapping. Statistics and sampling distribution of the sample mean; Statistics and sampling distribution of the sample proportion .Statistical inference; Parameter Estimation (Method of Moments, Maximum Likelihood Method); Confidence Intervals (Pivotal Quantity Method). Hypothesis Testing; type I and type II errors; anomalous events and how to identify them. Parameters and statistics. Parameter estimation and hypothesis testing. Graphics and exploratory data analysis, Simple/multiple regression and least squares, Logistic regression, Analysis of variance, Robust and nonparametric statistics.

3. **(For CyS)**

Course Code: MCySC- 201,
Course Name : CRYPTOGRAPHY ,
Credit: 4

Syllabus: History and overview of cryptography, identification protocols. Password protocols, salts, PBKDF2; one time passwords (S/Key and SecurID); challenge response authentication, One time pad and stream ciphersperfect secrecy and the one time pad, semantic security and stream ciphers, Block ciphers. Case studies: Feistel networks, DES, 3DES, and DES basic modes of operation: CBC and counter mode. Block cipher abstractions: PRPs and PRFs . Pseudo Random Permutations (PRP); Pseudo Random Functions (PRF);security against chosen plaintext attacks (CPA); nonce-based CBC encryption and nonce-based counter mode. Attacks on block ciphers exhaustive search, time-space tradeoffs, differential & linear cryptanalysis, meet in the middle, side channels. Message integrity: definition and applications CBC-MAC and PMAC. Collision resistant hashing ,Merkle-Damgard and Davies-Meyer. MACs from collision resistance. Elliptic key cryptography. Case studies: SHA and HMAC. Authenticated encryption: security against active attacks , intro to session setup using a key distribution center (KDC). Cryptography using arithmetic modulo primes, vanilla key exchange (Diffie-Hellman); the CDH and discrete-log assumptions . Public key encryption semantically secure El Gamal encryption; CCA security. Arithmetic modulo composites. RSA and Rabin functions ,how to encrypt with trapdoor permutations. Digital signatures: definitions and applications. How to sign using RSA. More signature schemes Lamport and Merkle schemes. Overview of signatures based on discrete-logcertificates and trust management. Identification protocols :Password protocols, salts; one time passwords (S/Key and SecurID); challenge response authentication. Authenticated key exchange and SSL/TLS session setup, Zero knowledge protocols

Lab : Programming and implementation of cipher , cryptographic algo and digital signatures in C/java and practicing theory.

4. **(For CyS)**

Course Code: MCySC -202,

Course Name: SECURE SOFTWARE DESIGN AND OPERATING SYSTEM SECURITY,

Credit: 4

Syllabus : Security principles and secure coding practices using Java Security Platform, Class loading, Byte code verifier, Security Manager, security policies, and Security Framework Secure SDLC, threat modeling, software security frameworks, and secure software architectures • Best practices and standards and guidelines for secure file input/output and serialization • input validation techniques, validation errors, and best practices • exceptions, erroneous behaviors, and the best practices to handle or avoid them • Secure authentication and authorization processes, Core security coding practices of Java Cryptography that includes Encryption, Key Generator and implementation of Cipher Class, • Digital signatures, secret keys, and key management • Various Java application vulnerabilities.

Theoretical foundation for designing trusted OS , Version of OS , Patches and Service Packs , Checking for hot fixes and service packs , Software Inventory , Alternative OS Support , Drives and file systems ; NTFS, FAT, Linux . User right agreement: Security Options, Account Lockout Policy, Password Policy, BIOS Password, Password protected screen saver , Number of Windows platforms on a machine. Introduction to Access Control and authentication methods, Shares and Share Security , File/Folder permissions and Encryption, active directory security, Virtualization and its effect on secure OS, IIS Sec : ODBC connections security , IIS installation location , IIS components , Services required for IIS , FPSE (Front Page Server Extensions) Security , ACLs on virtual directories, Sample files and websites, Script mappings, Reverse Code Engineering, Registry Security, Event Log configuration , Backup procedures, Virus Protection, Case studies of secure OS , System administration.

Lab: Practical implementation of theory classes as assigned by Faculty on java input validation techniques, validation errors , exceptions, erroneous behaviours, Encryption, Key Generator.

3. **(For ICT)**

Course Code: MICTC- 201,

Course Name: DIGITAL SIGNAL PROCESSING & SIGNAL THEORY,

Credit: 4

Syllabus: Discrete-time signals and systems, Constant coefficient difference equation. Review of Z Transform: properties, R.O.C, stability and Causality criterion. Structures for digital filters. DTFT and DFT: properties, linear and circular convolution.FFT: Decimation in time & Decimation in frequency. Design of IIR Filters: Bilinear transformation, Impulse invariant transformation. Butterworth, Chebychev, Inverse Chebychev and Elliptical filters etc. Design of F.I.R filters by windowing: rectangular, Bartlett, Hann, Hamming, Kaiser window

filters, Design method, Relationship of Kaiser to other windows. Application of MATLAB for design of digital filters. Advanced signal processing techniques: Multirate Signal processing – Down sampling/up sampling.

Representation of deterministic signals: Orthogonal representation of signals. Dimensionality of signal spaces. Construction of orthogonal basis functions. Time-bandwidth relationship: RMS duration and bandwidth, uncertainty relations. Random variables: Distribution and density functions, Some special random variables, Conditional distributions and total probability. Functions of one random variable: Mean, variance, Moments, Characteristic functions. Functions of two random variables: Moments and joint distributions, Conditional distributions, Conditional expected values, Mean square estimation. Random Processes: Definition and classification, stochastic integrals, Fourier transforms of random processes, stationary and non-stationary processes, correlation functions. Ergodicity, power spectral density, transformations of random processes by linear systems. Representation of random processes (via sampling, K-L expansion and narrow band representations).

Lab: **(Using MATLAB)** Generation of Sinusoidal waveform / signal based on recursive difference equations . To find DFT / IDFT of given DT signal . To find frequency response of a given system given in (Transfer Function/ Differential equation form). Implementation of FFT of given sequence. Determination of Power Spectrum of a given signal(s). Implementation of LP FIR filter for a given sequence . Implementation of HP FIR filter for a given sequence . Implementation of LP IIR filter for a given sequence . Implementation of HP IIR filter for a given sequence . Generation of Sinusoidal signal through filtering . Generation of DTMF signals . Implementation of Decimation Process . Implementation of Interpolation Process . Implementation of I/D sampling rate converters . Impulse response of first order and second order systems .

4. (For ICT)

Course Code: MICTC- 202,

Course Name: SPEECH COMMUNICATION AND BIOMEDICAL SIGNAL PROCESSING,

Credit: 4

Syllabus : The **Speech** Production mechanism. Physiological and Mathematical Model. Relating the physiological and mathematical model. Categorization of Speech Sounds based on the source-system and the articulatory model. Basic Speech Signal Processing Concepts. Discrete time speech signals, relevant properties of the fast Fourier transform and Z-transform for speech recognition, convolution, linear and non linear filter banks. Spectral estimation of speech using the Discrete Fourier transform. Pole-zero modelling of speech and linear prediction (LP) analysis of speech. Homomorphic speech signal de convolution, real and complex cepstrum. The Speech Recognition Front End. Feature extraction for speech recognition, Static and dynamic features for speech recognition, robustness issues, discrimination in the feature space, feature selection. Mel frequency cepstral co-efficients (MFCC), Linear prediction cepstral coefficients (LPCC), Perceptual LPCC. Distance measures for comparing speech patterns. Log spectral distance, cepstral distances, weighted cepstral distances, distances for linear and warped scales Vector quantization models and applications

in speaker recognition. Gaussian mixture modelling for speaker and speech recognition. Discrete and Continuous Hidden Markov modelling for isolated word and continuous speech recognition. Using the HTK toolkit for building a simple speech recognition system.

Biomedical Signals and Images ECG: Cardiac electrophysiology, relation of electrocardiogram (ECG) components to cardiac events, clinical applications. Guest lecture. Speech Signals: The source-filter model of speech production, spectrographic analysis of speech. Speech Coding: Analysis-synthesis systems, channel vocoders, linear prediction of speech, linear prediction vocoders. Imaging Modalities: Survey of major modalities for medical imaging: ultrasound, X-ray, CT, MRI, PET, and SPECT.MRI: Physics and signal processing for magnetic resonance imaging. Fundamentals of Deterministic Signal and Image Processing .Data Acquisition: Sampling in time, aliasing, interpolation, and quantization. Digital Filtering: Difference equations, FIR and IIR filters, basic properties of discrete-time systems, convolution. DTFT: The discrete-time Fourier transform and its properties. FIR filter design using windows.DFT: The discrete Fourier transform and its properties, the fast Fourier transform (FFT), the overlap-save algorithm, digital filtering of continuous-time signals. Sampling Revisited: Sampling and aliasing in time and frequency, spectral analysis. Image processing I: Extension of filtering and Fourier methods to 2-D signals and systems. Image processing II: Interpolation, noise reduction methods, edge detection, homomorphic filtering. Probability and Random Signals PDFs: Introduction to random variables and probability density functions (PDFs).Classification: Bayes' rule, detection, statistical classification. Random signals I: Time averages, ensemble averages, autocorrelation functions, crosscorrelation functions. Random signals II: Random signals and linear systems, power spectra, cross spectra, Wiener filters. Blind source separation: Use of principal component analysis (PCA) and independent component analysis (ICA) for filtering.

Lab : Programming and practicing theory .

5. A. Course Code: MCSC- 203,

Course Name: INTRODUCTION TO FORMAL METHODS AND VERIFICATION OF LARGE SYSTEMS,

Credit: 3

Syllabus : Process algebras and concurrent systems: Reactive systems, Formal methods for reactive systems, Labelled transition systems, Operational semantics for concurrent processes, Operators for process modelling, Pi-calculus. Behavioural equivalences and proof techniques: Bisimulation, Induction and co-induction proofs, Induction as a fixed point technique, Weak bisimulation, Weak bisimulations “upto”, Bisimulation in concurrency, Other equivalences such as failure equivalence, testing, testing equivalence. Type systems: Revisit to Pi-calculus, Simply typed Pi-calculus, Input output types, Linear types, Session types. Model checking: Finite state model checking, Symbolic model checking, Probabilistic model checking, Real time model checking, Optimal scheduling using model checking. Stochastic modelling: Foundation, Quantitative modelling, Markovian methods, PEPA as case study. Tools:

Experimental practice on mobility workbench (MBW), concurrency workbench (CWB- NC), CTMC.

5. B. (For CyS)

Course Code: MCySE-201 ,
Course Name: SECURITY STANDARDS & PROJECT MANAGEMENT ,
Credit: 3

Syllabus : Introduction, design goals, role and security architecture relationship to information security, incident management and IT auditing processes; security risk management; legal and ethical issues of security and privacy .Trusted computing base, protection measures of trusted computing base, system security assurance concepts, confidentiality and integrity models, security risk management process, data classification, regulatory requirements, web services. What is information security management (ISM) , Why ISM is important to an organization , What are the benefits of ISM, What is the background of ISM ,What are the key concepts and principles in ISO/IEC 27001:2013 , The terms and definitions used,The main requirements of ISO/IEC 27001:2013, COBIT , ITIL, PCI DSS, HIPPA.

5. C. (For CyS)

Course Code: MCySE-202,
Course Name: SYSTEM SECURITY,
Credit: 3

Syllabus : Introduction to Database Security Issues, Types of Security, Database Security and DBA, Access Protection, User Accounts, and Database Audits. Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control(DAC), NonDiscretionary Access Control , Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations, Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing Discretionary Access Control and Mandatory Access Control, Role-Based Access Control , Access Control Policies for E-Commerce and the Web, Introduction to Statistical Database Security, Introduction to Flow Control, Covert Channels. Concept of Trusted system and multilevel security model as : Bell lapadula model ,Biba"s intrigity model, Clark-Wilson model, Domain type enforcement model, , mapping the enterprise view to the system view, RBAC for UNIX and JAVA environments Case study: Multiline Insurance Company.

Database vulnerability and attack: SQL Injection, and security mechanisms : Advanced Encryption Standards, Public Key Encryption , Digital Signatures , Dabase auditing : Data Control Language (DCL) activities, Data Definition Language (DDL) activities, and Data

Manipulation Language (DML). Smart card operating system-fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR,PPS Security techniques- user identification , smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

5.D. (For CyS)

Course Code: MCySE- 203,
Course Name: IDENTITY AND ACCESS MANAGEMENT & TRUSTED COMPUTING,
Credit: 3

Syllabus : Identity and access management (IAM) overview , Attributes of information security, Symmetric and asymmetric cryptography ,Hashing and digital signature,Key management, Public Key Infrastructure (PKI) Architecture: certification and registration authority, Life cycle management, Types of certificates and usage patterns – Encryption, Digital signature, Client certificate,SSL server certificate, Attribute based certificate, Case studies (e.g. email protection, mobile banking, and document signing), Identification verification and authentication overview, Mechanisms of identification and authentication -One time password,Biometric,Digital signature,Smartcard,Soft/hard tokens, Mobile device, Risk based authentication, Step-up authentication, Single-sign on and federated single-sign-on,OATH, OpenID, BorwserID, and SAML, Architecture framework and industrial tools,Trusted computing role in identity assurance, Security risks associated with the discussed mechanisms Access control , Principles of authorization , Access control schemes , OAuth protocol ,Enterprise rights management and digital rights management, Privileged account management , Governance and compliance . IAM framework and use cases ,IAM architecture framework, IAM echo system, IAM and cloud computing, Illustrative use cases - Border control, E-passport, National ID ,E-banking ,E-health system and EMV scheme

5.B. (For ICT)

Course Code :MICTE-201,
Course Name: SOFTWARE DESIGN AND ENGINEERING,
Credit: 3

Syllabus : Concepts and techniques relevant to production of large software systems: Structured programming, Requirements specification and analysis. Top-down design and development, Information hiding, abstraction, modularity, object-oriented techniques. Separate compilation, configuration management, program libraries Design patterns, UML Documentation, validation, Quality assurance, safety, Testing and test case generation, Software metrics, Cost analysis and estimation, manpower and time management. Organization and management of large software design projects. Introduction to software engineering, Software requirement study and Analysis, Software Requirement Specifications ,Software Estimation, Objectives of activity planning, Software Design Concept ,Risk Management, Software Testing and Software Maintenance.

5.C. (For ICT)

Course Code: MICTE- 202,
Course Name: INFORMATION THEORY AND CODING ,
Credit: 3

Syllabus : Entropy, mutual information, channel capacity, information rate, Shannon's noiseless coding theorem and Shannon's fundamental coding theorem; modelling of information sources—zero memory and Markov models; modelling of information channels--BSC and BEC channels, additivity of information and cascaded channels; construction of compact source codes--Kraft inequality, compact codes, Huffman and Shannon Fano compression codes; and analysis and design of error-control channel codes--Hamming distance, binary linear codes and the parity-check matrix, Hamming codes, checksum codes, cyclic codes and the generator polynomial and CRC codes, convolutional codes, Viterbi and other decoding algorithms.

5.D. (For ICT)

Course Code: MICTC-301,
Course Name: INTELLIGENT SYSTEM & GREEN ICT,
Credit: 3

Syllabus : Artificial Intelligence and expert systems. **Advanced Intelligent Systems-** Neural Computing and Machine Learning , Neural Network Fundamentals, Neural Network Application Development , Data Collection and Preparation, Neural Network Architecture Neural Network Preparation, Learning Algorithms, Back propagation, Testing, Implementation. **Application of Advanced Intelligent Systems:** Credit Approval with Neural Networks , Stock Market Prediction System with Modular Neural Networks , Integrated ANNs and Expert Systems , Optimization Algorithms. Intelligent Agents: An Overview , Characteristics of Agents, Single Task , Why Intelligent Agents? , Classification and Types of Agents ,Internet-Based Software Agents , Electronic Commerce Agents.

Understand the overall need for an organisation to adopt a Green IT strategy, Provide an understanding of the historic development and context of the Kyoto Protocol. The key elements of Green IT , Commonly accepted definitions , IT as an energy consumer , IT as a green 'enabler', The concept and dangers of 'Green Wash', Identify and understand an organisation's external drivers and opportunities for greening its IT, identify and understand the internal drivers, opportunities and benefits of adopting a Green IT strategy for both an organisation and its IT service provider(s) -Cost , Operations , Marketing/PR ,Culture. The role of a Green IT policy , The importance of a Green IT policy, Definition of carbon footprints: direct and indirect emissions - Examples of an organisation's footprints: direct and indirect emissions , An understanding of carbon emissions across a product/service lifecycle including: 1. Concept & design 2. Material extraction 3. Transport 4. Manufacture 5. Usage 6. Disposal , Carbon Footprint Calculators , Carbon Offsetting and Carbon Neutrality , Carbon trading. Establishing a continuous improvement framework for Green ICT including use of the ITIL Continual Service

Improvement Model. Understand the importance and risks, issues and opportunities around improving efficiency. Understand how best to re-use, recycle and dispose of IT assets.

SEMESTER-III

1. **Course Code: MCSC- 301,**
   Course Name: PATTERN RECOGNITION AND DATA MINING
   Credit: 4

Syllabus : Introduction, Algorithmic models of learning, Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs from experience. Bayesian, maximum a posteriori, and minimum description length frameworks. Parameter estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers. Computational learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting. Dimensionality reduction, feature selection and visualization. Clustering, mixture models, k-means clustering, hierarchical clustering, distributional clustering. Reinforcement learning; Learning from heterogeneous, distributed, data and knowledge. Selected applications in data mining, automated knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human-computer interaction, semantic web, and bioinformatics and computational biology.

Data Science : Statistical Thinking ,Examples ,Numerical Data, Summary Statistics ,From Population to Sampled Data, Different Types of Biases , Probability, Statistical Inference . Association and Dependence , Association and Causation ,Conditional Probability and Bayes Rule, Simpsons Paradox, Confounding ,Introduction to Linear Regression, Special Regression Models ,Exploratory Data Analysis and Visualization-Goals ,Graphs of Data, Graphs of Fitted Models, Graphs to Check Fitted Models, Principles of graphics. Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for predictive modeling. Bayesian Modeling- Bayesian inference: combining models and data in a forecasting problem, Bayesian hierarchical modeling for studying public opinion, Bayesian modeling for Big Data.

Big Data Analytics, Introduction to R and R Studio, Basic analysis in R, Intermediate R, Intermediate analysis in R, Visualization and Data Exploration, K-means Clustering., Independent Sample Tests, Basic Association Analysis, Association Rule Speedup.

Hadoop : History of Hadoop- The Hadoop Distributed File System – Components of Hadoop- Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS- Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features.

Lab : Programming and implementation using R and HADOOP.

2. **Course Code: MCSC-302,**
   Course Name: THESIS /DISSERTATION - I,
   Credit: 4

   Syllabus: Students are expected to formulate a problem relevant to their area of specialisation, study the relevant literature and come out with an algorithm/software/implementation plan related to the problem formulated. Research Progress Seminar will be held twice a month for continuous evaluation.

3. **(For CyS)**
   Course Code: MCySC- 301,
   Course Name : ETHICAL HACKING AND DIGITAL FORENSICS,
   Credit: 3

   Syllabus : Computer network and defense fundamentals • Network security threats, vulnerabilities, and attacks .**Overview of the Top 20 OWASP Security vulnerabilities. CVSS Scoring system including VAPT techniques** • Network security controls, protocols, and devices • Network security policy design and implementation • Physical security • Host security • Secure firewall configuration and management • Secure IDS configuration and management • Secure VPN configuration and management • Wireless network defense • Network traffic monitoring and analysis • Network risk and vulnerability management • Data backup and recovery • Network incident response and management , ethical hacking • Foot printing and reconnaissance • Scanning networks • Enumeration • Sniffing • System hacking • Malware threats • Social engineering • Denial of service • Session hijacking • Hacking web applications • SQL injection • Hacking wireless networks • Hacking web servers • Hacking mobile platforms • Evading IDS, Firewalls, and Honeypot.
   Computer forensics in today's world • Computer forensics investigation process , Data Acquisition and Duplication • Understanding hard disks and file systems • Defeating anti-forensics techniques • Operating system forensics • Network forensics • Investigating web attacks • Database forensics • Cloud forensics • Malware forensics • Investigating email crimes • Mobile forensics process , Mobile OS architecture, boot process, and file systems , Mobile threats and security • Forensics report writing and presentation , encryption and stenography analysis. Investigation process : legal process of investigation, jurisdiction and agencies, internet investigation, ip address and domain names, investigation method , evidence collection . Legal Issues: Constitutional law, search and seizure guidelines, ECPA , challenges in process, international computer crime law.

   Lab: **Practical implementation of theory classes on** Introduction to Application Security : Injection Attacks , Broken Authentication and Session Management ,Cross Site Scripting (XSS) , Insecure Direct Object References, Security Misconfiguration ,Sensitive Data Exposure , Missing Function Level Access Control ,Cross Site Request Forgery , Using

Components with Known Vulnerabilities ,Unvalidated Redirects and Forwards, LDAP attack, XML , HTTP aattack using DVWA, METASPLOIT, WIRESHARK and other security tools.
Data Acquisition and Duplication in forensics --Understanding hard disks and file systems • Defeating anti-forensics techniques • Operating system forensics • Network forensics • Investigating web attacks • Database forensics using FDK, ENCASE, PASSWORD RECOVERY TOOLS.

3. **(For ICT)**

Course Code: MICTC- 301,
Course Name: EMBEDDED SYSTEMS AND VLSI ALGORITHM DESIGN,
Credit: 3

Syllabus: Overview of Embedded System- Categories, Requirements , Challenges and Issues in Embedded Software Development, Applications. Hardware Architecture, Micro-Controller Architecture, Communication Interface Standards, Embedded System Development Process, Embedded Operating systems, Types of Embedded Operating systems. 8Bit microcontrollers Architecture on chip peripherals instruction set/ programming of Intel M CS51 family (8 bit) microcontroller, Inter facing of 8051 with LCD, ADC, sensors, stepper motor, key board, DAC, memory. Real Time & Database Applications: Real-Time Embedded Software Development, Sending a Message over a Serial Link, Simulation of a Process Control System, Controlling an Appliance from the RT Linux System, Embedded Database Applications using examples like Salary Survey, Energy Meter Readings. Microchip PIC16 family PIC16F873 processor features architecture memory organization register file map I/ O ports. Implementing Embedded Systems. Impact of VLSI technology on digital systems and architectures. A variety of applications of these architectures explored with emphasis on digital signal processing and other arithmeticintensive computations. Introduction to hierarchical structural design: IC design for parallel architecture: Use of pipelining and parallelism, self-synchronized designs, VLSI computing structures. Introduction to systolic arrays, mapping algorithms on systolic arrays, design of systolic arrays, system examples and design exercises. Circuits and DSP. architecture design: Fast filtering algorithms, retiming and pipelining, block processing, folding, distributed arithmetic architectures, VLSI performance measures (area, power, and speed), structural modelling in VHDL. DSP module synthesis: Arithmetic unit architectures (adders, multipliers, dividers), bit-parallel, bit-serial, digit-serial, carry-save architectures, redundant number system, modelling for synthesis in VHDL, synthesis via SYNOPSYS, place-androute via CADENCE.

Lab : 1. Design Entry and simulation of combinational logic circuits (8 bit adders, 4 bit multipliers, address decoders, multiplexers), Test bench creation, functional verification, and concepts of concurrent and sequential execution to be highlighted. 2. Design Entry and simulation of sequential logic circuits (counters, PRBS generators, accumulators). Test bench creation, functional verification, and concepts of concurrent and sequential execution to be highlighted. 3. Synthesis, P&R and Post P&R simulation for all the blocks. Concepts of FPGA

floor plan, critical path, design gate count, I/O configuration and pin assignment 4. Generation of configuration/fuse files for all the blocks/codes developed as part of Expt.1. and Expt. 2. FPGA devices must be configured and hardware tested for the blocks/codes. The correctness of the inputs and outputs for each of the blocks must be demonstrated atleast on oscilloscopes (logic analyzer preferred). 5. Schematic Entry and SPICE simulation of MOS differential amplifier. Determination of gain, bandwidth, output impedance and CMRR. 6. Layout of a simple CMOS inverter, parasitic extraction and simulation. 7. Design of a 10 bit number controlled oscillator using standard cell approach, simulation followed by study of synthesis reports. 8. Automatic layout generation followed by post layout extraction and simulation of the circuit.

SEMESTER-IV

1. **Course Code: MCSC-401,**
   Course Name: THESIS /DISSERTATION - II,
   Credit: 14

   Syllabus: The students will continue to work on the problem identified in "Minor Project" (in Semester III) as per the work plan. The work is continued until all stated objectives and deliverables are met. Student will prepare a comprehensive report containing introduction to the problem, literature review, methodology, results and discussion and conclusion. Research Progress Seminar will be held twice a month for continuous evaluation. The result will be declared only after acceptance or publication of full length paper at least in peer reviewed Journal, International Conference or National Conference . The thesis grading shall be done as –

S.No.	Grade	Condition
1.	A+	Publication from thesis in SCI indexed journal.
2.	A	Publication from thesis in Scopus indexed journal.
3.	B+	Publication from thesis in proceeding of International conference which is SCI indexed .
4.	B	Publication from thesis in proceeding of International Conference.
5.	C+	Publication from thesis in proceeding of National Conference.
