M. TECH in CYBER FORENSIC AND INFORMATION SECURITY

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M. TECH – CYBER FORENSIC AND INFORMATION SECURITY

National Institute of Electronics and Information Technology

Technological advancements have witnessed remarkable growth, particularly in the realm of Cyber Forensic and Information Security. The inception of electronic components in this domain has evolved to address the increasing challenges posed by cyber threats and information breaches. The introduction of cybersecurity measures started with the implementation of firewalls, antivirus programs, and encryption protocols, laying the foundation for further developments.

The impetus for technological advancements in Cyber Forensic and Information Security arises from a dual source—Customer demand for robust protection against cyber threats and the imperative Legislative Push to enhance cybersecurity measures. As the digital landscape becomes more intricate, the demand for cybersecurity solutions has surged. This trend has propelled the Global Cyber Forensic and Information Security market, according to industry reports. The proliferation of digital devices and the increasing volume of sensitive data make cybersecurity a critical aspect of contemporary technological ecosystems.

With a surge in the number of cyber incidents and the sophistication of hacking techniques, the overall expenditure on cybersecurity is anticipated to grow steadily. By 2030, it is projected that cybersecurity expenditures will constitute a significant portion of the overall IT budget, reflecting the paramount importance of securing digital assets. The Asia Pacific region is expected to play a pivotal role in driving the global growth of Cyber Forensic and Information Security, given the region's rapid digitization and increasing reliance on digital platforms.

The introduction of advanced technologies such as blockchain, artificial intelligence, and machine learning has become instrumental in bolstering cybersecurity measures. Legislative mandates and heightened awareness among customers are propelling the adoption of new technologies across various sectors, including government agencies, financial institutions, and businesses. Emerging technologies like threat intelligence, behavioral analytics, and security automation are becoming integral components of cybersecurity strategies.

As the digital landscape evolves, the complexity of cybersecurity challenges also increases, necessitating a workforce with specialized skills in Cyber Forensic and Information Security. There is a current shortage of qualified professionals equipped with comprehensive skills in digital forensics, ethical hacking, and cybersecurity management. The need for skilled human resources in this field is anticipated to grow in tandem with the evolving threat landscape. Consequently, there is a compelling need for a unique training program in Cyber Forensic and Information Security with a focus on securing digital systems. The M.Tech program in Cyber Forensic and Information Security is meticulously designed to meet these industry demands and equip professionals with the necessary expertise to safeguard digital assets and combat cyber threats effectively.

M. Tech in CYBER FORENSIC AND INFORMATION SECURITY

Program Education Objectives (PEO)

PEO1:
Attain advanced education, equipped with a deep understanding enriched by both academic and industrial skill sets.

PEO2: Achieve excellence in one's professional journey by mastering the ability to offer effective solutions to Information Technology challenges.

PEO3: Demonstrate leadership qualities and contribute actively within teams, serving as catalysts for change and innovation in organizations focused on product design and manufacturing.

PEO4: Showcase flexible and nimble skills in the specialized field of Information Science & Engineering to effectively tackle both technical and managerial challenges.

Program Outcomes (PO)

PO1 An ability to independently carry out research /investigation and development work to solve practical problems.

PO2 An ability to write and present a substantial technical report/doan cument.

PO3 An ability to demonstrate a degree of mastery over the area as per the specialization of the program

PO4 An ability to use modern tools for engineering design problems, analyze the performance and optimize the systems-level approaches.

PO5 An ability to engage in independent and life-long learning in the context of technological change and industrial demands. Rephrase above outcomes

Course Category Wise Credit Distribution:

Category	Credits
Program Core	12
Core Labs	4
Electives	15
Electives Labs	4
Audit Course	2
Open Electives	3
Project / Dissertation	28

M. Tech in CYBER FORENSIC AND INFORMATION SECURITY

Semester-I						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CIL601	Program Core-I Mathematics For Information Security and Cyber Forensics	3	0	0	3
2.	CIL602	Program Core-II Advanced Data Structures and Algorithms	3	0	0	3
3.	CIL***	Program Elective I	3	0	0	3
4.	CIL***	Program Elective II	3	0	0	3
5.	ACL601	Research Methodology and IPR	2	0	0	0
6.	ACL***	Audit course	2	0	0	1
7.	CIP601	Laboratory-I (Advanced Data Structures and Algorithms Lab)	0	0	4	2
8.	CIP***	Laboratory-II (Based on Electives)	0	0	4	2
Total credits: 17						
Semester-II						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CIL603	Program Core-III Digital Forensics and Cyber Crime Investigation	3	0	0	3
2.	CIL604	Program Core-IV Cloud Computing Security	3	0	0	3
3.	CIL***	Program Elective III	3	0	0	3
4.	CIL***	Program Elective IV	3	0	0	3
5.	CIL***	Audit Course	2	0	0	1
6.	CIL***	Laboratory-III (Digital Forensics and Cyber Crime Investigation Lab)	2	0	0	2
7.	CIP604	Laboratory-IV	0	0	4	2

		(Based on Electives)				
Total Credits: 17						
Semester-III						
1.	CIL***	Program Elective-V	3	0	0	3
2.	OEL***	Open Elective	3	0	0	3
3.	CID701	Dissertation-I/ Industrial project	0	0	20	10
Total credit: 16						
Semester-IV						
S. No	**Course Code**		**L**	**T**	**P**	**C**
1.	AID702	Dissertation-II	0	0	32	18
Total credit: 18						

Elective Courses						
Sl. No.	**Course code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CIL701	Basics of Forensics Psychology	3	0	0	3
2.	CIL702	Operating System Security	3	0	0	3
3.	CIL703	IOT and its Applications	3	0	0	3
4.	CIL704	Ethical Hacking	3	0	0	3
5.	CIL705	Cyber Law	3	0	0	3
6.	CIL706	Biometrics	3	0	0	3
7.	CIL707	Web and Database Security	3	0	0	3
8.	CIL708	Edge Computing	3	0	0	3
9.	CIL709	Information Security Audit	3	0	0	3
10.	CIL710	Data Privacy	3	0	0	3
11.	CIL711	Applied Cryptography	3	0	0	3
12.	CIL712	Malware Analysis	3	0	0	3

13.	CIL713	Image Forensics and Security	3	0	0	3
14.	CIL714	Data Analytics for Fraud Detection	3	0	0	3
15.	CIL715	Block Chain Technology	3	0	0	3

Audit Course						
Sl. No.	**Course code**	**Course Name**	**L**	**T**	**P**	**C**
1.	ACL701	English for Research Paper Writing	3	0	0	2
2.	ACL702	Disaster Management	3	0	0	2
3.	ACL703	Sanskrit for Technical Knowledge	3	0	0	2
4.	ACL704	Value Education	3	0	0	2
5.	ACL705	Constitution of India	3	0	0	2
6.	ACL706	Pedagogy Studies	3	0	0	2
7.	ACL707	Stress Management by Yoga	3	0	0	2
8.	ACL708	Personality Development through Life Enlightenment Skills.	3	0	0	2

Open Electives						
Sl. No.	**Course code**	**Course Name**	**L**	**T**	**P**	**C**
9.	OEL701	Business Analytics	3	0	0	3
10.	OEL702	Industrial Safety	3	0	0	3

11.	OEL703	Operations Research	3	0	0	3
12.	OEL704	Cost Management of Engineering Projects	3	0	0	3
13.	OEL705	Composite Materials	3	0	0	3
14.	OEL706	Waste to Energy	3	0	0	3

Core Subjects:

Program Core-I

Course Code	CIL601
Course Name	Mathematics For Information Security and Cyber Forensics
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• To define algebra for constructing and writing mathematical proofs.
• To Illustrate the limitations of predicate logic.
• To recognize the patterns that arise in graph problems and use this knowledge for constructing the trees and spanning trees.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 INTRODUCTION TO ABSTRACT ALGEBRA Groups (Definition and Examples) – Subgroups– Permutation groups – Homomorphism – Kernel – Cosets– Lagrange's theorem – Rings – Fields (Definition and Examples).	
Unit 2 COMBINATORICS Mathematical Induction – Pigeon Hole Principle – Principle of Inclusion and Exclusion – Recurrence Relations – Generating Functions.	
Unit 3 MATHEMATICAL LOGIC Statements – Truth Table – Connectives – Normal Forms – Predicate Calculus – Inference Theory.	
Unit 4 DISCRETE STRUCTURES I Basic concepts of Graphs – Subgraphs– Paths and Circuits – Matrix representation of Graphs – Graph Isomorphism – Connected graphs and Components – Euler and Hamiltonian paths – Travelling salesman problem.	
Unit 5 DISCRETE STRUCTURES II Basic concepts of Trees– Properties – Pendant vertices – Rooted and Binary trees – Spanning trees – Fundamental circuits – Finding all spanning trees of a graph – Spanning trees in a weighted graph.	

COURSE OUTCOMES
• To understand the concepts of Algebraic Structures (L2)
• To understand the concepts of Combinatorics (L2)
• To understand the concepts associated with Mathematical Logic and Predicate calculus. (L2)
• To determine if a given graph is simple or a multi graph, directed or undirected, Eulerian and Hamiltonian Graphs, Shortest path algorithm and determine the connectivity of a graph (L4)
• To construct a minimal spanning tree by using Kruskal's and Prim's algorithm in order to obtain a solution for a real time problem. (L4)

REFERENCES BOOKS

1) Tremblay J.P., Manohar R., *Discrete Mathematical structures with applications to Computer science*, Tata McGraw Hill Publishing Co., (2004).

2) Kenneth Rosen, *Discrete Mathematics and its applications (SIE)*, Tata McGraw Hill Publishing Co.,(2007).

3) John C. Martin, *Introduction to languages and the theory of computation (3rd ed.)*, Mcgraw Hill, (2003).

4) Hopcroft J.E., Ullman J.D.,*Introduction to Automata theory, Languages and Computation*, Narosa Publishing house, (2002).

5) NarsinghDeo, *Graph theory with applications to Engineering and Computer Science*,Prentice Hall of India, (2004).

6) Robin J. Wilson, *Introduction to Graph theory (4th ed.)*, Pearson, (2002).

Program Core-II

Course Code	CIL602
Course Name	Advanced Data Structures and Algorithms
Credits	3
Pre-Requisites	NIL

Total Number of Lectures:48

COURSE OBJECTIVE
• To learn the mathematical basics and various notations to analyze the complexities of Algorithms.
• To understand the various sorting techniques and tree data structure.
• To understand and analyze the various Text Processing operations and their performances.
• To analyze and understand graph data structures and their applications.
• To understand the performance of polynomial time and NP-Completeness

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 ALGORITHM NOTATIONS AND REPRESENTATION Mathematical Induction - Asymptotic Notations – Algorithm Analysis - NP-Hard and Completeness – Recurrence Equations – Solving Recurrence Equations – Memory Representation of Multi-dimensional Arrays – Time-Space Tradeoffs.	
Unit 2 SORTING AND TREES Heapsort – Quicksort – Topological sort - Sorting in Linear Time – Elementary Data Structures – Hash Tables – Hash Functions- Binary Search Trees – AVL Trees – Red Black trees – Multi-way Search Trees –B-Trees- Fibonacci Heaps – van Emde Boas Trees – Data Structures for Disjoint Sets.	
Unit 3 TEXT PROCESSING OPERATIONS Text Processing: String Operations - Brute-Force Pattern Matching - The Boyer-Moore Algorithm - The Knuth-Morris-Pratt Algorithm - Standard Tries - Compressed Tries - Suffix Tries - The Huffman Coding Algorithm - The Longest Common Subsequence Problem (LCS) - Applying Dynamic Programming to the LCS Problem.	
Unit 4 GRAPH ALGORITHMS Elementary graph Algorithms – Minimum Spanning Trees – Single Source Shortest Paths- All PairsShortest Paths – Maximum Flow - Multithreaded Algorithms – Matrix Operations.	
Unit 5 LINEAR PROGRAMMING Linear programming – Polynomials and Fast Fourier Transform – Number Theoretic Algorithms –Computational Geometry –NP-Completeness – Approximation Algorithms.	

COURSE OUTCOMES
• Demonstrate various algorithm notations and algorithm correctness. (L1)
• Construct various applications based on sorting and tree data structure.(L2)
• Experiment with the performance of various Text Processing operations.(L2)
• Apply graph data structures to the real time applications.(L3)
• Illustrate the performance of the polynomial time algorithm(L4)

REFERENCES BOOKS

1. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, “Data Structures and Algorithms”, Addison Wesley, Fifth Edition, 2017.
2. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss,Addison-Wesley Publishing Company, Sixth Edition, 2016.

3. Narasimha karumanchi, Data Structures and algorithms made easy, Fifth Edition, 2017.
4. E. Horowitz, S.Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", University Press,Fourth Edition, 2007.
5. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, Second Edition, 2002.

Program Core-III

Course Code	CIL603
Course Name	Digital Forensics and Cyber Crime Investigation
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• Understand the languages of digital forensics ,and the investigation of digital crime scene
• Learn the basics of computer investigators
• Become knowledgeable in the digital forensics networks and OSI layers

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 **Introduction:** Computer Forensics Needs, Computer forensics fundamentals, Introduction to Steps of Digital Forensics, Computer Crimes, Types of Digital forensics evidences, Legal Aspects of Digital Forensics.	
Unit 2 **Hardware and Software:** Understanding Computer components- input and output devices, CPU, Digital Media, System software - Operating System Architecture, Application Software, File Systems, Memory organization concept, Data Storage concepts. Network: Topology, Devices, Protocols and Port, Communication media. IP Address: Types and classes.	
Unit 3 **Foundations:** Basic Principles and methodologies for digital forensics, Design systems with forensic needs in mind. Phases of Digital Forensics. Introduction to Digital Forensics Tools, Life of a Digital Forensic Investigator. **Data Acquisition:** Principles of Digital Forensic Acquisition, Evidence Handling and Processing Digital Forensic Data.	

Unit 4 **Evidence Collection:** Rules of Evidence, Jurisdictions, Techniques and standards for Preservation of Data. **Evidence Analysis:** OS / File System Forensics, Application Forensics, Web Forensics, Network Forensics, Mobile Device Forensics.	
Unit 5 **Investigation:** Computer, Network, System attacks, Attack detection and investigation, Anti forensics. Case studies on File System, Network storage, Web and Mobile.	

COURSE OUTCOMES
• Understanding the Computer forensics (L2)
• Can conduct the investigate and recover the data in Computer forensics.(L2)
• Applying the knowledge in offending and secure the evidence (L3)
• Analyze the knowledge to investigate through the digital evidence (L4)
• To Apply network investigation. (L3)

REFERENCES BOOKS

1. Thomas J Holt , Adam M Bossler, Kathryn C Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge, 2016
2. Eoghan Casey, Handbook of Digital Forensics and Investigation, Academic Press, 2017
3. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and

   the Internet, III Edition, 2016
4. Angus McKenzie Marshall, Digital Forensics: Digital Evidence in Criminal Investigations, Wiley- Blackwell, 2018

Program Core-IV

Course Code	CIL604
Course Name	Cloud Computing Security
Credits	3
Pre-Requisites	Database

Total Number of Lectures:48

COURSE OBJECTIVE
The student should be made to: • Identify the technical foundations of cloud systems architectures.
• Analyze the problems and solutions to cloud application problems.

• Apply principles of best practice in cloud application design and management.
• Identify and define technical challenges for cloud applications and assess their importance.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 **Introduction** Cloud Computing Essentials, Overview of Cloud Computing, Cloud Security Baselines, Cloud Security, Privacy, and Trust Baselines, Infrastructure as a Service (IaaS).	
Unit 2 **Risk Analysis and Division of Responsibility** Risk and Trust Assessment: Schemes for Cloud Services, Managing Risk in the Cloud, Cloud Security Risk Management, Secure Cloud Risk Management: Risk Mitigation Methods, Specification and Enforcement of Access Policies in Emerging Scenarios, Cryptographic Key Management for Data Protection, Cloud Security Access Control: Distributed Access Control, Cloud Security Key Management: Cloud User Controls, Cloud Computing Security Essentials and Architecture, Cloud Computing Architecture and Security Concepts, Secure Cloud Architecture.	
Unit 3 **Operating System and Network Security** Locking Down Cloud Servers, Third-Party Providers Integrity Assurance for Data Outsourcing, Negotiating Cloud Security Requirements with Vendors, Managing Legal Compliance Risk in the Cloud and Negotiating Personal Data Protection Requirements with Vendors, Integrity Assurance for Data Outsourcing, Secure Computation outsourcing	
Unit 4 **Meeting Compliance Requirements** Computation Over Encrypted Data, Trusted Computing Technology, Computing Technology for Trusted Cloud Security, Trusted Computing Technology and Proposals for Resolving Cloud Computing Security Problems, Assuring Compliance with Government Certification and Accreditation Regulations, Government Certification, Accreditation, Regulations, and Compliance Risks, Simplifying Secure Cloud Computing Environments with Cloud Data Center, Availability, Recovery, and Auditing across Data Centers	
Unit 5 **Advanced Cloud Computing Security**	

Advanced Security Architectures for Cloud Computing, Side-Channel Attacks and Defenses on Cloud Traffic, Clouds Are Evil, Future Directions in Cloud Computing Security: Risks and Challenges	

COURSE OUTCOMES
• Understand the fundamental principles of cloud computing. (L2)
• Remember the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.(L1)
• Analyze the performance of Cloud Computing. (L4)
• Apply the Concept of Cloud Infrastructure Model.(L3)
• Analyze the concept of Cloud Security.(L4)

REFERENCES BOOKS

1. Krutz, Ronald L., and Russell Dean Vines. *Cloud security: A comprehensive guide to secure cloud computing*. Wiley Publishing, 2010.
2. Carlin, Sean, and Kevin Curran. "Cloud computing security." Pervasive and Ubiquitous Technology Innovations for Ambient Intelligence Environments. IGI Global, 2013. 12-17.

Elective Courses

Course Code	CIL701
Course Name	Basics of Forensics Psychology
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• To learn the basic psychology
• Analyze the behavior of biology and its structure
• Evaluate the learning process
• Identify the concepts of Psychologists and investigation
• To Discuss the Risks
• To Identify the Interrogation and confessions

LECTURE WITH BREAKUP	**NO. OF LECTURES**

Unit 1 **The Science of psychology:** The history of psychology, issues of psychology, modern perspectives, the scientific methodology, issues in psychology, ethics of psychological research. The biological perspective: Neurons and nerves, an overview of the nervous system, distant connection, looking inside living brain, from the bottom up. Sensation and perception: The ABCs of sensation, the science of seeing, the hearing sense, chemical sense somesthetics sense, The ABCs perception. Conciousness : sleep, dreams effects o f hypnosis, influence of psychoactive drugs.	
Unit 2 **Learning:** Classical conditioning, operant conditioning, cognitive leaning theory, observational learning. Memory: three memory system, retrieval of long term memories, reconstructive nature of long term memory retrival, neuroscience of memory, health and memory.	
Unit 3 Forensic psychology, forensic psychologists, psychology and law enforcement, techniques of criminal investigation.	
Unit 4 Insanity and competency, From dangerousness to risk assessment, Syndrome evidence, child sexual abuse, child custody and related decisions, improving eyewitness identification procedures.	
Unit 5 Performance Metrics- General issues- Partitioning the patterns for training, testing, and validation-Cross validation - Fitness and fitness functions - Parametric and nonparametric statistics, Evolutionary algorithm effectiveness metrics, Receiver operating characteristic curves, Computational intelligence tools for explanation facilities, Case Studies for implementation of practical applications in computational intelligence.	

COURSE OUTCOMES
Students completing this course were able to • Understanding the psychology of historical roots (L2)
• To know about the structure of biology and its behaviours (L2)
• Assess the investigation. (L5)
• To assess the Risks. (L3)
• Understanding the various Interrogations (L2)

REFERENCES

1. Psychology, by Saundra K. Ciccarelli Gulf Coast State College J. Noland White Georgia College 4th edition. (unit 1 &2)

2. Forensic Psychology, by Solomon M.Fulero & Lawrence S. Wrightsman 3rd edition. (unit 3,4,5)

Course Code	CIL702
Course Name	Operating System Security
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• Understanding the concepts of Operating System Security
• Have depth knowledge about Security kernels
• To Analyze the different types of commercial OS
• To understand Secure Virtual Machine Systems

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 **Introduction**-Secure Operarting Systems-Security Goals-Trust Model- Threat Model. Access Control Fundamentals-Protection System-Reference Monitor-Secure Operating Definition .Multics- Multics System-Multics Security- Multics Vulnerability Analysis	
Unit 2 Security in OS & Goals System Histories-UNIX Security- Windows Security-Information Flow- Information Flow Secrecy Models, Information flow integrity models- Covert Channels.	
Unit 3 Security Kernels & Securing Commercial OS Secure Communications Processor-Architecture, Hardware, Trusted Operating Program, Kernel Interface Package, Applications, Gemini Secure Operating System-Retrofitting Security into a Commercial OS- History of Retrofitting Commercial OS-Commercial Era-Microkernel Era- Unix Era	
Unit 4 Secure Virtual Machine Systems Separation Kernels-VAX VMM Security Kernel-VAX VMM Design - VAX VMM Evaluation - VAX VMM Result- Security in other virtual Machine Systems- System Assurance.	
Unit 5 **CASE STUDY :** Solaris Trusted Extensions-Trusted Extensions Access Control-	

Solaris Compatibility-Trusted Extensions Mediation-Process Rights Management-Role Based Access Control – Trusted Extensions Networking-Multilevel Services-Administration-Linux Security Modules-Security Enhanced Linux.	

COURSE OUTCOMES
Students completing the course were able to • Understand and analyze operating systems Security (L2)
• Analyze Security Kernels (L4)
• Apply the concept of commercial OS (L3)
• Analyze secure Virtual Machine Systems(L4)
• Apply the functionalities in Solaris (L3)

REFERENCES

1. Mukesh Singhal, Niranjan G Shivratri , "Advanced Concepts in Operating Systems", McGraw Hill International, 1994.
2. Pradeep Kumar Sinha, "Distributed Operating Systems: Concepts and Design", PHI, 2002.

Course Code	CIL703
Course Name	IOT and its Applications
Credits	3
Pre-Requisites	Networks

Total Number of Lectures:48

COURSE OBJECTIVE
• To study fundamental concepts of IoT.
• To understand roles of sensors in IoT
• To learn different protocols used for IoT design
• To be familiar with IoT and M2M
• To understand the role of IoT in various domains of Industry.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 Introduction of IoT Introduction- Characteristics of IoT- Physical & Logical Design of IoT-Enabling Technologies in IoT-IoT Levels and Deployment Templates.	

Unit 2 Sensors Networks Definition-Types of Sensors-Types of Actuators, Examples and Working-IoT Development Boards: Arduino IDE and Board Types-RaspberryPi Development Kit-RFID Principles and components- Wireless Sensor Networks.	
Unit 3 Wireless Technologies for IoT WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus-IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT-Edge connectivity and protocols.	
Unit 4 IoT and M2M Introduction- M2M-Difference between IoT and M2M-SDN and NFV for IoT.	
Unit 5 Applications Home Automation-Smart Cities- Energy- Retail Management- Logistics-Agriculture-Health and Lifestyle- Environment- Energy.	

COURSE OUTCOMES
• Understand the various concepts, terminologies and architecture of IoT systems.(L2)
• Use sensors and actuators for design of IoT. (L3)
• Apply various protocols for design of IoT systems (L3)
• Differentiate between IoT and M2M. (L3)
• Apply various design methodologies for IoT applications s. ,(L4)

REFERENCES

1. Daniel Minoli, ― "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Course Code	CIL704
Course Name	Ethical Hacking
Credits	3
Pre-Requisites	Network Security

Total Number of Lectures:48

COURSE OBJECTIVE
The student should be made to: • Understand issues relating to ethical hacking
• Employ network defense measures

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 INTRODUCTION TO ETHICAL HACKING Essential Terminologies –Importance of security- Threat- Attack- Vulnerabilities Penetration Test – Vulnerability Assessments versus Penetration Test – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests	
Unit 2 FOOTPRINTING & PORT SCANNING Foot printing - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS	
Unit 3 SYSTEM HACKING Aspect of remote password guessing- Role of eavesdropping -Various methods of password cracking- Keystroke Loggers- Understanding Sniffers - Comprehending Active and Passive Sniffing- ARP Spoofing and Redirection DNS and IP Sniffing- HTTPS Sniffing.	
Unit 4 HACKING WEB SERVICES & SESSION HIJACKING Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools	
Unit 5 HACKING WIRELESS NETWORKS Introduction to 802.11-Role of WEP- Cracking WEP Keys- Sniffing Traffic Wireless DOS attacks- WLAN Scanners-WLAN Sniffers-Hacking Tools-Securing Wireless Networks	

COURSE OUTCOMES
• Collect information using network scanning (L1)
• Execute a penetration test using standard hacking tools in an ethical manner(L3)
• Identify legal and ethical issues related to vulnerability and penetration testing.(L1)
• Plan a vulnerability assessment and penetration test for a network. (L2)
• Identify methods to gain access to systems (L1)

REFERENCES

1. Kevin Beaver, "Ethical Hacking for Dummies", Sixth Edition, Wiley, 2018.
2. Jon Erickson, "Hacking: The Art of Exploitation", Second Edition, Rogunix, 2007

Course Code	CIL705
Course Name	Cyber Law
Credits	3
Pre-Requisites	NIL

Total Number of Lectures:48

COURSE OBJECTIVE
The student should be made to: • To enable learner to understand, explore, and acquire a critical understanding cyber law.
• Develop competencies for dealing with frauds and deceptions (confidence tricks, scams) and other cyber crimes for example, child pornography etc.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 Emergence of Cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.	
Unit 2 Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.	
Unit 3 Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act,	
Unit 4 Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute	

Resolution , Online Dispute Resolution (ODR).Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C, E security.	
Unit 5 Application area: Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends. Case Study On Cyber Crimes: Harassment Via E-Mails, Email Spoofing (Online A Method Of Sending E-Mail Using A False Name Or E-Mail Address To Make It Appear That The E-Mail Comes From Somebody Other Than The True Sender, Cyber Pornography (Exm.MMS),Cyber- Stalking	

COURSE OUTCOMES
• Collect information using network scanning (L1)
• Execute a penetration test using standard hacking tools in an ethical manner(L3)
• Identify legal and ethical issues related to vulnerability and penetration testing.(L1)
• Plan a vulnerability assessment and penetration test for a network. (L2)
• Identify methods to gain access to systems (L1)

REFERENCES

1. K.Kumar," Cyber Laws: Intellectual property & E Commerce, Security",1st Edition, Dominant Publisher,2011.
2. Rodney D. Ryder, " Guide To Cyber Laws", Second Edition, Wadhwa And Company, New Delhi, 2007.
3. Information Security policy &implementation Issues, NIIT, PHI.
4. Vakul Sharma, "Handbook Of Cyber Laws" Macmillan India Ltd, 2nd Edition,PHI,2003.
5. Justice Yatindra Singh, " Cyber Laws", Universal Law Publishing, 1st Edition,New Delhi, 2003.
6. Sharma, S.R., "Dimensions Of Cyber Crime", Annual Publications Pvt. Ltd., 1st Edition, 2004.
7. Augastine, Paul T.," Cyber Crimes And Legal Issues", Crecent Publishing Corporation, 2007.

Course Code	CIL706
Course Name	Biometrics
Credits	3
Pre-Requisites	NIL

Total Number of Lectures:48

COURSE OBJECTIVE
• To understand the biometric equipment and standards applied to security.
• To interpretation the context of Biometric Applications
• To study the various authentication with passwords
• To study the various biometrics systems

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Biometrics Introduction, Benefits of Biometrics over traditional authentication systems and identification systems, Selecting a Biometric for a system, Biometric Applications, Key Biometric terms and processes, Matching process of Biometrics, Limitations and Accuracy measures in Biometric systems.	
Unit 2 Physiological Biometric Technologies Fingerprints - Technical description –characteristics - Competing technologies - strengths – weaknesses – deployment - Facial scan - Technical description, Characteristics, Strengths, Weaknesses, Deployment, Iris Scan- Technical description, Characteristics, Strengths, Weaknesses, Deployment, R - Retina vascular pattern Technology - characteristics - strengths – weaknesses –deployment - Hand scan - characteristics - strengths – weaknesses deployment – DNA biometrics.	
Unit 3 Behavioral Biometric Technologies Behavioral Biometric Technologies: Handprint Biometrics - DNA Biometrics - signature and handwriting technology - Technical description – classification - keyboard / keystroke dynamics - Voice – data acquisition - Feature Selection and Extraction, Characteristics, Strengths, Weaknesses, Deployment.	
Unit 4 Multi Biometrics Multi biometrics: Multi biometrics and multi factor biometrics - two-factor authentication with passwords - tickets and tokens – executive decision - implementation Plan.	
Unit 5 Case Studies Case studies on Physiological, Behavioral and multifactor biometrics in identification systems.	

COURSE OUTCOMES
Students completing this course were able to

• Express knowledge of the basic physical and biological science and engineering principles underlying biometric systems (L3)
• Understand and analyze biometric systems at the component level and be able to analyze and design basic biometric system applications. (L2)
• Develop team work effectively and express their work and ideas orally and in writing.(L4)
• Discover the sociological and acceptance issues associated with the design and implementation of biometric systems.(L4)
• Understand various Biometric security issues.(L2)

REFERENCES

1. *Samir Nanavathi, Michel Thieme, and Raj Nanavathi, "Biometrics -Identity verification in a network", Wiley Eastern*
2. *John Chirillo and Scott Blaul," Implementing Biometric Security", Wiley Eastern Publications*
3. *John Berger," Biometrics for Network Security", Prentice Hall*

Course Code	CIL707
Course Name	Web and Database Security
Credits	3
Pre-Requisites	DBMS

Total Number of Lectures:48

COURSE OBJECTIVE
• To give an Overview of information security
• To Give an overview of Access control of relational databases To reveal the underlying in web application
• To identify future trends in database publishing.
• To understand the security re-engineering for databases
• To give an Overview of information security

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 The Web Security, The Web Security Problem ,Risk Analysis and Best Practices Cryptography and the Web : Cryptography and Web Security, Working Cryptographic Systems and Protocols , Legal Restrictions on Cryptography ,Digital Identification	

Unit 2 The Web's War on Your Privacy, Privacy-Protecting Techniques , Backups and Antitheft, Web Server Security, Physical Security for Servers, Host Security for Servers, Securing Web Applications	
Unit 3 Database Security : Recent Advances in Access Control, Access Control Models for XML, Database Issues in Trust Management and Trust Negotiation, Security in Data Warehouses and OLAP Systems	
Unit 4 Security Re-engineering for Databases: Concepts and Techniques , Database Watermarking for Copyright Protection , Trustworthy Records Retention , Damage Quarantine and Recovery in Data Processing Systems , Hippocratic Databases: Current Capabilities	
Unit 5 Future Trends Privacy in Database Publishing: A Bayesian Perspective, Privacy-enhanced Location-based Access Control , Efficiently Enforcing the Security and Privacy Policies in a Mobile Environment	

COURSE OUTCOMES
• Identify common application vulnerabilities (L1)
• Analyze the concepts of quantum cryptography (L3)
• Analyze the Web architecture and applications (L3)
• Examine, how common mistakes can be bypassed and exploit the application (L5)
• Apply client side and service side programming (L4)

REFERENCES

1. Web Security ,Privacy and Commerce Simson GArfinkel, Gene Spafford,O'Reilly .
2. Handbook on Database security applications and trends Michael Gertz, Sushil Jajodia

Course Code	CIL708
Course Name	Edge Computing
Credits	3
Pre-Requisites	Distributed Systems and Algorithms

Total Number of Lectures:48

COURSE OBJECTIVE
Introduction to Edge Computing is for beginners to gain a quick understanding of the edge computing technology. The course covers various topics such as the evolution of computing industry, cloud computing basics and edge computing.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M	
Unit 2 A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment,	
Unit 3 Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.	
Unit 4 Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols, MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example	
Unit 5 Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.	

COURSE OUTCOMES
• This course will explore research, frameworks, and applications in Edge Computing, (L2)
• The class will begin with a review of current IoT Applications(L2)
• Explore frameworks for computing using RaspberryPi(L4)
• Apply the Interfacing edge to cloud applications (L3)
• Analyze edge computing with others (L3)

REFERENCES

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
2. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE

Course Code	CIL709

M. Tech in CYBER FORENSIC AND INFORMATION SECURITY

Course Name	Information Security Audit
Credits	3
Pre-Requisites	Network Security

Total Number of Lectures:48

COURSE OBJECTIVE
• To introduce the fundamental concepts and techniques in computer and network security, giving students an overview of information security and auditing.
• To expose students to the latest trend of computer attack and defense. Other advanced topics on information security such as mobile computing security, security and privacy of cloud computing, as well as secure information system development will also be discussed.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 A model for Internetwork security, Conventional Encryption Principles & Algorithms (DES, AES, RC4, Blowfish), Block Cipher Modes of Operation, Location of Encryption Devices, Key Distribution. Public key cryptography principles, public key cryptography algorithms (RSA, Diffie- Hellman, ECC), public Key Distribution.	
Unit 2 Approaches of Message Authentication - Secure Hash Functions (SHA-512, MD5) and HMAC, Digital Signatures, Kerberos, X.509 Directory Authentication Service, Email Security: Pretty Good Privacy (PGP) IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.	
Unit 3 Web Security: Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Firewalls: Firewall Design principles, Trusted Systems, Intrusion Detection Systems	
Unit 4 Auditing For Security: Introduction, Basic Terms Related to Audits, Security audits, The Need for Security Audits in Organization, Organizational Roles and Responsibilities for Security Audit, Auditors Responsibility In Security Audits, Types Of Security Audits.	
Unit 5 Information Security Assessments: Vulnerability Assessment, Classification,Types of Vulnerability Assessment, Vulnerability Assessment Phases, Vulnerability Analysis Stages, Characteristics of a Good Vulnerability Assessment Solutions &Considerations, Vulnerability Assessment Reports – Tools and choosing a right Tool, Information Security Risk Assessment, Risk Treatment, Residual Risk, Risk Acceptance, Risk Management Feedback Loops etc.	

COURSE OUTCOMES
• Discussed various algorithms and Distributions.(L3)
• Understanding the approaches of message authentication (L2)
• Analyze the security principles and its requirements(L4)
• Apply the roles and procedures for audit(L3)
• Analyze the approaches to audits during the system development(L4)

REFERENCES

1. Information Security by Mark Stamp, Wiley – INDIA, 2006.
2. Fundamentals of Computer Security, Springer.
3. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
4. Computer Security Basics by Rick Lehtinen, Deborah Russell & G. T. Gangemi Sr., SPD O'REILLY 2006.
5. Modern Cryptography by Wenbo Mao, Pearson Education 2007.
6. Principles of Information Security, Whitman, Thomson.

Course Code	CIL710
Course Name	Data Privacy
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• To introduce the fundamentals of statistics ,data privacy & polices.
• To Study the mathematical model and computing practices
• To learn the protection models and surveys
• To study the computation system
• Aware of policies and practices of technology

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 **Data Privacy and its Importance** - Need for Sharing Data, Methods of Protecting Data, Importance of Balancing Data Privacy and Utility, Disclosure, Tabular Data, Micro data, Approaches to Statistical disclosure control, Ethics, principles, guidelines and regulations.	
Unit 2	

Microdata- Disclosure, Disclosure risk, Estimating re-identification risk, Non-perturbative microdata masking, Perturbative microdata masking, Information loss in microdata.	
Unit 3 **Static Data Anonymization on Multidimensional Data -** Privacy Preserving Methods, Classification of Data in a Multidimensional Data Set, Group- Based Anonymization, k- Anonymity, l-Diversity, t- closeness.	
Unit 4 **Static Data Anonymization on Complex Data Structures -** Privacy Preserving Graph Data, Privacy Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Trans- action Data.	
Unit 5 **Data Anonymization Threats**-Threats to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques, Randomization, k-Anonymization, l-Diversity, t-Closeness. Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Dynamic Data Protection, Benefits of Tokenization Compared to Other Methods, Components for Tokenization.	

COURSE OUTCOMES
• Learning and applying the concepts of statistics and policies (L3)
• Describe the mathematical models and computations. (L3)
• Capable to protect the models through techniques (L3)
• To protect the system through computation. (L4)
• Implement the policies and practices in the system (L4)

REFERENCES

1. George T. Duncan. Mark Elliot, Juan-Jose Salazar-GonZalez, Statistical Confidentiality: Principle and Practice. Springer, 2011. (ISBN No.: 978-1-44-197801-1).
2. Aggarwal, Charu C., Yu, Philip S., Privacy-Preserving Data Mining : Models and Algorithms, Springer, 2010. (ISBN No.: 978-0-38-770991-8). Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Course Code	CIL711
Course Name	Applied Cryptography
Credits	3
Pre-Requisites	Network Security

Total Number of Lectures:48

COURSE OBJECTIVE

• Acquire fundamental knowledge on the concepts of finite fields and number theory
• Identify the various cryptographic protocols
• Identify the intermediate protocols
• Describe the principles of public key cryptosystems, hash functions and digital signature.
• Understand various block cipher and stream cipher models

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 MATHEMATICAL FOUNDATION Number theory: Fermat's and Euler's theorem-Chinese remainder theorem-Euclidean algorithm- Test for primality-Discrete logarithms, Information theory: entropy, Uncertainity-Complexity theory: pseudo random number generation and generators.	
Unit 2 CRYPTOGRAPHIC PROTOCOLS Protocol Building Blocks-Basic Protocols: key Exchange-Authentication-Authentication and Key exchange: Wide-mouth frog, Yahalom, Kerberos-Formal Analysis of Authentication and Key Exchange Protocols-Multiple Key Public Key Cryptography-Secret Splitting-Secret Sharing: Secret Sharing with Cheaters-Cryptographic protection of Databases.	
Unit 3 INTERMEDIATE PROTOCOLS Time stamping services, Linking protocol, Distributed Protocol-Undeniable digital signatures- Proxy Signatures-Group Signatures-Fail-stop signatures-computing with encrypting data-bit commitment- Fair coin flips-one-way accumulators.	
Unit 4 ADVANCED PROTOCOLS Zero knowledge proof, Parallel Zero Knowledge Proof, Zero Knowledge proof of identity: Chess Grandmaster Problem-Blind Signatures-Simultaneous Contract Signing-Digital certified Mail- Simultaneous Exchange of Secrets-Esoteric protocols: Secure Elections-Secure Multiparty Computation.- Digital cash	
Unit 5 CRYPTOGRAPHIC TECHNIQUES AND ALGORITHMS Key Length: Symmetric key Length, Public Key length-Algorithm types and Modes: Electronic Code Book Mode, Block Replay, Cipher Block Chaining Mode-Using Algorithms: Choosing an Algorithm, Public Key Cryptography vs Symmetric Cryptography, Encrypting Communication Channels- Public Key Algorithms: RSA, Pohlig-Hellman, Rabin, Elliptic Curve Cryptosystems - Public Key Digital Signature Algorithms: Ghost Digital Signature Algorithm, Discrete Logarithm Signature schemes. Real World approach: IBM secret key management protocol- MITRENET,ISDN, SESAME.	

COURSE OUTCOMES
• Understand the fundamentals of number theory and algorithms (L2)
• Analyze , design, and implement different cryptography protocols (L4)

• Apply the intermediate protocols for linking and distributing (L3)
• Understand various Security practices and System security standards (L2)
• Apply the various Authentication schemes to simulate different applications (L3)

REFERENCES

1. Applied Cryptography: Protocols, Algorithms and source code in C, Wiley, Second Edition- Bruce Schneier (OCT 18, 1996)
2. Cryptography and Network Security Principles and practices-William Stallings (Jan 24, 2010)
3. **Foundations of Cryptography: Volume 1, Basic Tools by OdedGoldreich (Jan 18, 2007)**
4. Encryption: High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity... by Kevin Roebuck, Emereopty Limited, 2011.
5. **Foundations of Cryptography: Volume 2, Basic Applications by OdedGoldreich (Sep 17, 2009)**

Course Code	CIL712
Course Name	Malware Analysis
Credits	3
Pre-Requisites	Network Security

Total Number of Lectures:48

COURSE OBJECTIVE
• Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization
• Practice with an expertise in academics to design and implement security solutions
• Understand key terms and concepts in Cryptography, Governance and Compliance.
• Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 MATHEMATICAL FOUNDATION Malware Analysis and Reverse Engineering, Types of Malware Analysis, Purpose of Malware Analysis Limitations of Malware Analysis, The Malware Analysis Process , Malware Classes Infectors, Network Worms, Trojan Horse Backdoors, Remote-Access Trojan, Information Stealers .	
Unit 2 CRYPTOGRAPHIC PROTOCOLS Malware Infection Vectors, Speed, Stealth, Coverage, Shelf Life, Types of Malware Infection Vectors, Physical Media, E-mails. Instant Messaging and	

Chat, Social Networking, URL Links, File Shares, Software Vulnerabilities- **Protective Mechanisms-** The Two States of Malware, Static Malware, Dynamic Malware, Protective Mechanisms,Static Malware Protective Mechanisms, Dynamic Malware Protective Mechanisms	
Unit 3 INTERMEDIATE PROTOCOLS Dependency Types, Environment Dependencies, Program Dependencies, Timing Dependencies, Event Dependencies, **Malware Collection-** Your Own Backyard, Scan for Malicious Files, Look for Active Rootkits, Inspect Startup Programs, Inspect Running Processes, Extract Suspicious Files, **The Portable Executable File-**The Windows Portable Executable File, The PE File Format, Relative Virtual Address, PE Import Functions.	
Unit 4 ADVANCED PROTOCOLS **The Proper Way to Handle Files-** File's Analysis Life Cycle, Transfer, Analysis, Storage, **Inspecting Static Malware-** Static Analysis Techniques, File Type Identification, Antivirus Detection, Protective Mechanisms Identification, PE Structure Verification	
Unit 5 CRYPTOGRAPHIC TECHNIQUES AND ALGORITHMS **Inspecting Static Malware-**Static Analysis Techniques, ID Assignment-File Type Identification, Antivirus Detection, Protective Mechanisms Identification, PE Structure Verification, Dynamic Analysis-Analyzing Host Behavior, Analyzing Network Behavior	

COURSE OUTCOMES
• Understand the purpose of malware analysis L2
• Analyze various malwares and understand the behavior of malwares in real world applications L4
• Implement different malware analysis techniques L3
• Identify the various tools for malware analysis. L1
• Analyze the malware behavior in windows and android L4

REFERENCES

1. Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware ForensicsField Guide for Windows Systems, Syngress, Elsevier, 2014
2. Ken Dunham, Saeed Abu-Nimeh, Michael Becher and Seth Fogie, Mobile Malware Attacks andDefense, Syngress, Elsevier, 2009
3. Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides byCameron H.Malin, Eoghan Casey, James M. Aquiline 1 st Edition.
4. The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and MacMemory by Michael Hale Ligh, Kindle Edition

Course Code	CIL713
Course Name	Image Forensics and Security

M. Tech in CYBER FORENSIC AND INFORMATION SECURITY

Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• To understand the concepts of Image Forensics and Security
• Emphasize the fundamentals and importance of image security techniques
• Presents the Digital Image Processing, Digital Image Formation, Image Forensics, Pixel Based, Statistical-Based, Camera-Based, Video Forensics, Image Hiding, Image Coding, Image security techniques: visual cryptography, stenography, water marking

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 INTRODUCTION Introduction to Image Processing, Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing- Image Acquisition, Storage, Processing, Communication, Display.	
Unit 2 DIGITAL IMAGE FORMATION Image formation, image compression, point processing, neighbourhood operations, image analysis. Morphological Image Processing : Dilation and Erosion, Opening and Closing, Extensions to gray level images, hit or miss transformation, basic morphologic algorithms	
Unit 3 IMAGE FORENSICS Format-Based Forensics- Fourier Transform-Smoothing and Sharpening, frequency domain filters- Ideal, Butterworth and Gaussian Filters, Homomorphic filtering, JPEG, Camera-Based Forensics. Pixel-Based Forensics: Resampling, Cloning, Thumbnails.	
Unit 4 STATISTICAL-BASED FORENSICS Principal Component Analysis, Linear Discriminant Analysis, Quadratic Discriminant Analysis and Logistic Regression, Computer Generated or Photographic: Perception.	
Unit 5 VIDEO FORENSICS & IMAGE SECURITY TECHNIQUES Motion, Re-Projected, Projectile, Enhancement Physics-Based Forensics: 2-D Lighting, Lee Harvey Oswald (case study). Image Hiding, Image Coding. Image file Forensics, Video Surveillance, RFID and Vehicular tracking (GPS) devices, Image security techniques: visual cryptography, Stenography, water marking.	

COURSE OUTCOMES
Students completing this course were able to • Upon successful completion of this course, the students will get an in-depth knowledge in image and video forensics and its security techniques L2

• Helps students to learn various types of image formation Techniques L3
• Students will learn the Fourier Transform and Forensic image analysis L2
• Students will gain the knowledge of statistical based forensics L2
• Students learn to conduct a Video Forensics & Image Security Techniques in an organized and systematic way L2

REFERENCES

1. N.Efford, Digital Image Processing, Addison Wesley 2000, ISBN 0-201-59623-7
2. 3. M Sonka, V Hlavac and R Boyle, Image Processing, Analysis and Machine Vision, PWS 1999, ISBN 0- 534-95393
3. Pratt.W.K., Digital Image Processing, John Wiley and Sons, New York, 1978

Course Code	CIL714
Course Name	Data Analytics for Fraud Detection
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
• Discuss the overall process of how data analytics is applied
• Discuss how data analytics can be used to better address and identify risks
• Help mitigate risks from fraud and waste for our clients and organizations

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 Introduction: Defining Fraud, Anomalies versus ,Fraud, Types of Fraud, Assess the Risk of Fraud, Fraud Detection : Recognizing Fraud, Data Mining versus Data Analysis and Analytics, Data Analytical Software, Anomalies versus Fraud within Data, Fraudulent Data Inclusions and Deletions	
Unit 2 The Data Analysis Cycle : Evaluation and Analysis, Obtaining Data Files, Performing the Audit, File Format Types, Preparation for Data Analysis, Arranging and Organizing Data, Statistics and Sampling: Descriptive Statistics, Inferential Statistics , Measure of Centre, Dispersion, Variability, Sampling.	
Unit 3 Data Analytical Tests : Benford's Law, Number Duplication Test , Z-Score, Relative Size Factor Test, Same-Same-Same Test , Same-Same-Different Test	

Unit 4 Advanced Data Analytical Tests: Correlation, Trend Analysis, , GEL-1 and GEL-2 , Skimming and Cash Larceny, Billing schemes : and Data Familiarization, Benford's Law Tests, Relative Size Factor Test , Match Employee Address to Supplier data,Gap Detection of Check Number Sequences	
Unit 5 Payroll Fraud: Data and Data Familiarization, Analysis , The Payroll Register, Expense Reimbursement Schemes , Register disbursement schemes , Nocash Misappropriations	

COURSE OUTCOMES
Students completing this course were able to • Formulate reasons for using data analysis to detect fraud. (L6)
• Clarify characteristics and components of the data and assess its completeness (L3)
• Identify known fraud symptoms and use digital analysis to identify unknown fraud symptoms. (L1)
• Automate the detection process (L5)
• Prove results and understand how to prosecute fraud (L5)

REFERENCES

Course Code	CIL715
Course Name	Block Chain Technology
Credits	3
Pre-Requisites	Cryptography

Total Number of Lectures:48

COURSE OBJECTIVE
• Know the concepts of block chain technologies
• understand primary objective of this course is to cover the technical aspects of crypto currencies, block chain technologies, and distributed consensus.
• familiarize potential applications for Bit coin-like crypto currencies

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 INTRODUCTION Basic of Blockchain Architecture – Challenges – Applications – Block chain Design Principles -The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal	

treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).	
Unit 2 CRYPTOGRAPHIC FUNDAMENTALS Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm – SHA 256,signature schemes, encryption schemes and elliptic curve cryptography- Introduction to Hyperledger- Hyperledger framework - Public and Private Ledgers.	
Unit 3 BIT COIN Bit coin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity – forks-double spending - mathematical analysis of properties of Bitcoin.Bitcoinblockchain,thechallenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their uses.	
Unit 4 ETHEREUM Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts. Ethereum and Smart Contracts- The Turing Completeness of Smart Contract Languages and verification challenges- comparing Bitcoin scripting vs. Ethereum Smart Contracts	
Unit 5 HYPERLEDGER Understanding Hyperledger Fabric, Overview of Open source Hyperledger project, Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric. Case studies/ Enabling Technologies and applications- Application of blockchain in privacy and security, IoT and smart cities, Business and Industry, Data management, e-Governance	

COURSE OUTCOMES
• Understand emerging abstract models for Block chain Technology L2
• Analyse the concept of bit coin and mathematical background behind it L4
• Apply the tools for understanding the background of crypto currencies L3
• Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain L1
• Understanding of latest advances and its applications in Block Chain Technology L1

REFERENCES

1. Ritesh Modi, “Solidity Programming Essentials: A Beginner‟s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing

Audit Courses:

ACL701: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4

5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first-time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

ACL702: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4

4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

ACL703: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects
4. enhancing the memory power
5. The engineering scholars equipped with Sanskrit will be able to explore the
6. huge knowledge from ancient literature

Syllabus

Unit	***Content***	***Hours***
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8

3	• Technical concepts of Engineering-Electrical, Mechanical, • Architecture, Mathematics	8

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

ACL704: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Units	CONTENTS	Hours
1	• Values and self-development – Social values and individual attitudes. • Work ethics, Indian vision of humanism. • Moral and non-moral valuation. Standards and principles. • Value judgments.	4
2	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism. Love for nature, Discipline.	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labor. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth.	6

	• Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	
4	• Character and Competence – Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence, Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6

Suggested reading

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

ACL705: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

Units	Content	Hours
1	**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	**Philosophy of the Indian Constitution:** Preamble Salient Features	4

3	• **Contours of Constitutional Rights & Duties:** • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies □ Directive Principles of State Policy • Fundamental Duties.	4
4	• **Organs of Governance:** • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions	4
5	• **Local Administration:** • District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation. • Pachayati raj: Introduction, PRI: ZilaPachayat. • Elected officials and their roles, CEO ZilaPachayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy	4
6	• **Election Commission:** • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

ACL706: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Syllabus

Units	Content	Hours
1	• **Introduction and Methodology:** • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions**.** • Overview of methodology and Searching.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education.	2
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	• Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes	4

5	• **Research gaps and future directions** • Research design • Contexts	2
	• Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact.	

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

ACL707: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	***Content***	***Hours***
	Definitions of Eight parts of yog. (Ashtanga)	2

2	Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	3
3	Asan and Pranayam i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam	8

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata **Course Outcomes:**

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

ACL708: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	8
2	• Approach to day to day work and duties. • Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	8

3	• Statements of basic knowledge. • Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	8

Suggested reading

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication
2. Department), Kolkata
3. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
4. Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Open Elective Subjects:

Business Analytics

Teaching scheme

Lecture: - 3 h/week

Course Code	
Course Name	**Business Analytics**
Credits **Prerequisites**	

Total Number of Lectures: 48

Course objective

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8
Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive	9
analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	10
Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

COURSE OUTCOMES

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Industrial Safety

Teaching scheme

Lecture: - 3 h/week

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance **Reference:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES
Operations Research

Teaching Scheme

Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex

Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming **Unit 3**:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic

Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Cost Management of Engineering Projects

Teaching scheme

Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Composite Materials

Teaching scheme

Lecture: - 3 h/week

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Waste to Energy

Teaching scheme

Lecture: - 3 h/week

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India. **References:**

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.