VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2020-2021)

B.Tech (CSE) - Specialization in Blockchain Technology

School of Computer Science and Engineering

B.Tech (CSE) - Specialization in Blockchain Technology

CURRICULUM AND SYLLABUS

(2020-21 Admitted Students)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.

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School of Computer Science and Engineering

B.Tech (CSE) - Specialization in Blockchain Technology

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would helpsolve industry's technological problems.
2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.
3. Graduates will function in their profession with social awareness and responsibility.
4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.
5. Graduates will be successful in pursuing higher studies in engineering or management.
6. Graduates will pursue career paths in teaching or research.

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B. Tech Computer Science and Engineering with Specialization in Blockchain Technology

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyze complex engineering problems.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_04: Having an ability to design and conduct experiments, as well as toanalyze and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognize the need for independent and lifelong learning

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School of Computer Science and Engineering

B.Tech (CSE) - Specialization in Blockchain Technology

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. The ability to formulate mathematical models and problem-solving skills through programming techniques for addressing real-time problems using appropriate data structures and algorithms.

2. The ability to provide design, build, and deploy a distributed application and provide solutions using blockchain applications to enhance business measures by sharing information safely and effectively.

3. The ability to create cryptocurrencies and give a strong technical understanding of Blockchain technologies with an in-depth understanding of applications, open research challenges, and future directions.

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B.Tech-CSE (Spl. in Blockchain Technology)

CREDIT STRUCTURE

Category-wise Credit distribution

CREDIT INFO		
S. No.	**Category**	**Credits**
1	Programme Core	**60**
2	Programme Elective	**23**
3	University Core	**53**
4	University Elective	**12**
5	Specialization Elective	**12**
6	Bridge Course	**0**
7	Non Credit Course	**5**
Total Credits		**165**

CREDIT INFO		
S.no	**Catagory**	**Credit**
1	Programme Core	60
2	Programme Elective	23
3	University Core	53
4	University Elective	12
5	Specialization Elective	12
6	Bridge Course	0
7	Non Credit Course	5
Total Credits		165

Programme Core									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credit**
1	BKT1001	Blockchain and Distributed Ledger Technology	Embedded Theory and Lab	1.0	3	0	2	0	4.0
2	BKT2001	Cryptography and Information Security	Embedded Theory and Lab	1.0	3	0	2	0	4.0
3	BKT3001	Design and Development of Blockchain Applications	Embedded Theory and Lab	1.0	3	0	2	0	4.0
4	CSE1003	Digital Logic and Design	Embedded Theory and Lab	1.1	3	0	2	0	4.0
5	CSE1004	Network and Communication	Embedded Theory and Lab	1.1	3	0	2	0	4.0
6	CSE1007	Java Programming	Embedded Theory and Lab	1.0	3	0	2	0	4.0
7	CSE2001	Computer Architecture and Organization	Theory Only	1.0	3	0	0	0	3.0
8	CSE2004	Database Management Systems	Embedded Theory and Lab	1.1	3	0	2	0	4.0
9	CSE2005	Operating Systems	Embedded Theory and Lab	1.1	3	0	2	0	4.0
10	CSE2010	Advanced C Programming	Embedded Theory and Lab	1.0	2	0	2	0	3.0
11	CSE2011	Data Structures and Algorithms	Embedded Theory and Lab	1.0	3	0	2	0	4.0
12	CSE2012	Design and Analysis of Algorithms	Embedded Theory and Lab	1.0	3	0	2	0	4.0
13	CSE2013	Theory of Computation	Theory Only	1.0	3	0	0	0	3.0
14	CSE3002	Internet and Web Programming	Embedded Theory and Lab	1.2	3	0	2	0	4.0
15	EEE1001	Basic Electrical and Electronics Engineering	Embedded Theory and Lab	1.0	2	0	2	0	3.0
16	MAT1014	Discrete Mathematics and Graph Theory	Theory Only	1.1	3	2	0	0	4.0

Programme Elective									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	BCI2001	Data Privacy	Embedded Theory and Project	1.0	3	0	0	4	4.0
2	BCI3001	Web Security	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
3	BCI3002	Disaster Recovery and Business Continuity Management	Embedded Theory and Project	1.0	3	0	0	4	4.0
4	BCI3003	Android Security	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
5	BCI3005	Digital Watermarking and Steganography	Embedded Theory and Project	1.0	3	0	0	4	4.0
6	BCI4001	Cyber Forensics and Investigation	Embedded Theory and Project	1.0	3	0	0	4	4.0
7	BCI4002	Vulnerability Analysis and Penetration Testing	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
8	BCI4003	Malware Analysis	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
9	CSE2006	Microprocessor and Interfacing	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
10	CSE3001	Software Engineering	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
11	CSE3009	Internet of Things	Embedded Theory and Project	1.0	3	0	0	4	4.0
12	CSE3011	Robotics and its Applications	Embedded Theory and Project	1.0	3	0	0	4	4.0
13	CSE3013	Artificial Intelligence	Embedded Theory and Project	1.0	3	0	0	4	4.0
14	CSE3022	Soft Computing	Embedded Theory and Project	1.0	3	0	0	4	4.0
15	CSE3035	Principles of Cloud Computing	Embedded Theory and Lab	1.0	3	0	2	0	4.0
16	CSE3501	Information Security Analysis and Audit	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0

Programme Elective									
17	CSE3502	Information Security Management	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
18	CSE4003	Cyber Security	Embedded Theory and Project	1.0	3	0	0	4	4.0
19	CSE4007	Mobile Computing	Embedded Theory and Project	1.0	3	0	0	4	4.0
20	CSE4019	Image Processing	Embedded Theory and Project	1.0	3	0	0	4	4.0
21	CSE4020	Machine Learning	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
22	CSE4022	Natural Language Processing	Embedded Theory and Project	1.0	3	0	0	4	4.0
23	CSE4024	Advanced Java Programming	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
24	MAT3004	Applied Linear Algebra	Theory Only	1.0	3	1	0	0	4.0

University Core									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	CHY1701	Engineering Chemistry	Embedded Theory and Lab	1.0	3	0	2	0	4.0
2	CSE1001	Problem Solving and Programming	Lab Only	1.0	0	0	6	0	3.0
3	CSE1002	Problem Solving and Object Oriented Programming	Lab Only	1.0	0	0	6	0	3.0
4	CSE1901	Technical Answers for Real World Problems (TARP)	Embedded Theory and Project	1.0	1	0	0	4	2.0
5	CSE1902	Industrial Internship	Project	1.0	0	0	0	0	1.0
6	CSE1903	Comprehensive Examination	Project	1.0	0	0	0	0	1.0
7	CSE1904	Capstone Project	Project	1.0	0	0	0	0	12.0
8	ENG1901	Technical English - I	Lab Only	1.0	0	0	4	0	2.0
9	ENG1902	Technical English - II	Lab Only	1.0	0	0	4	0	2.0
10	ENG1903	Advanced Technical English	Embedded Lab and Project	1.0	0	0	2	4	2.0
11	FLC4097	Foreign Language Course Basket	Basket	1.0	0	0	0	0	2.0
12	HUM1021	Ethics and Values	Theory Only	1.2	2	0	0	0	2.0
13	MAT1011	Calculus for Engineers	Embedded Theory and Lab	1.0	3	0	2	0	4.0
14	MAT2001	Statistics for Engineers	Embedded Theory and Lab	1.1	3	0	2	0	4.0

University Core									
15	MGT1022	Lean Start-up Management	Embedded Theory and Project	1.0	1	0	0	4	2.0
16	PHY1701	Engineering Physics	Embedded Theory and Lab	1.0	3	0	2	0	4.0
17	PHY1901	Introduction to Innovative Projects	Theory Only	1.0	1	0	0	0	1.0
18	STS4097	Soft Skills B.Tech. / B.Des.	Basket	1.0	0	0	0	0	6.0

Specialization Elective									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	BKT3002	Public Key Infrastructure and Trust Management	Embedded Theory and Lab	1.0	2	0	2	0	3.0
2	BKT4001	Blockchain Ecosystem	Theory Only	1.0	3	0	0	0	3.0
3	BKT4002	Bitcoin Mining	Embedded Theory and Lab	1.0	3	0	2	0	4.0
4	BKT4003	Smart Contract Essentials	Embedded Theory and Lab	1.0	3	0	2	0	4.0
5	BKT4004	Vulnerability Discovery and Exploit Development	Embedded Theory and Lab	1.0	2	0	2	0	3.0
6	BKT4005	Blockchain Architecture Design and Use Cases	Embedded Theory and Project	1.0	3	0	0	4	4.0
7	BKT4006	Cryptocurrency Technologies	Embedded Theory and Project	1.0	3	0	0	4	4.0

Bridge Course									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	ENG1000	Foundation English - I	Lab Only	1.0	0	0	4	0	2.0
2	ENG2000	Foundation English - II	Lab Only	1.0	0	0	4	0	2.0

Non Credit Course									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	CHY1002	Environmental Sciences	Theory Only	1.1	3	0	0	0	3.0
2	EXC4097	Co-Extra Curricular Basket	Basket	1.0	0	0	0	0	2.0

BKT1001	Blockchain and Distributed Ledger Technology	L	T	P	J	C
		3	0	2	0	4

Pre-requisite	Nil	Syllabus version
		1.0

Course Objectives

1. To understand conceptual elements for Blockchain and Distributed Ledger Technologies.
2. To summarize the major developments related to blockchain and cryptocurrencies.
3. To identify alternative techniques to proof of work for blockchain protocols, proof of stake/space.

Course Outcomes

Students who complete this course successfully are expected to:
1. Understand the cryptographic basis for cryptocurrency.
2. Choose a blockchain implementation based on real time scenario.
3. Categorize the various types of blockchains.
4. Examine the techniques for anonymity preservation.
5. Identify and understand the use cases of distributed ledger technology.
6. Evaluate alternative Blockchains and their applicability.

Module:1	Introduction to Blockchain, Cryptocurrencies and Distributed Ledgers	6 hours

Blockchain, Distributed Ledgers - Cryptographic basics for cryptocurrency - Hashing, signature schemes, encryption schemes and elliptic curve cryptography - CAP theorem and blockchain - Categories of Blockchains: Public, Private blockchains, Permissioned Ledger, Tokenized blockchains, Tokenless blockchains, Sidechains.

Module:2	Essentials of Cryptocurrencies	8 hours

Distributed identity: Public and private keys, Digital identification and wallets; Decentralized network - Distributed ledger: Permissioning framework, Blockchain data structure - Double spending; Network consensus -Sybil attacks, Block rewards and miners, Difficulty under competition, Forks and consensus chain, The 51% attack, Confirmations and finality - The limits of proof-of-work - Alternatives to Proof of Work.

Module:3	Blockchain Implementations	6 hours

Bitcoin: Bitcoin and Merkle Root - Eventual Consistency & Bitcoin - Byzantine Fault Tolerance - Bitcoin and Secure Hashing - Bitcoin block-size - Bitcoin Mining - Proof of Work (PoW) - Bitcoin Scripting.
Blockchain Collaborative Implementations: Hyperledger, Corda - ERC 20 and the token explosion.

Module:4	Decentralization using blockchain	6 hours

Blockchain and full ecosystem decentralization: Smart contract, Decentralized autonomous organization (DAO), Decentralized applications - Platforms for decentralization.

Module:5	Zero Knowledge proofs and protocols in Blockchain	7 hours

Pseudo-anonymity vs. anonymity - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves – Zcash - Zk-SNARKS for anonymity preservation.

Module:6	Future use cases of distributed ledger technology	4 hours

Financial Services: Accounting and audit, Global payments, Programmable money - Citizen Identification, Voting – Healthcare: Electronic health records system - Supply chain management - Trade finance - Tokenization of real assets.

Module:7	Distributed Ledger Technology in alternative Blockchains	6 hours

Alternative Blockchains: Kadena, Ripple, Stellar, Rootstock, Drivechain, Quorum - Transaction manager: Crypto Enclave, QuorumChain - Network manager: Tezos, Storj, Maidsafe, BigChainDB.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Treccani, A., Lipton, A. (2021). Blockchain And Distributed Ledgers: Mathematics, Technology, And Economics – First Edition, Singapore: World Scientific Publishing Company.	
2.	Wattenhofer, R. (2019). Blockchain Science: Distributed Ledger Technology - Third Edition, United States: Independently Published.	
Reference Books		
1.	Goldfeder, S., Bonneau, J., Miller, A., Felten, E., Narayanan, A. (2016). Bitcoin and Cryptocurrency Technologies - First Edition, Princeton University Press.	
2.	Bashir, I. (2020). Mastering Blockchain: A Deep Dive Into Distributed Ledgers, Consensus Protocols, Smart Contracts, DApps, Cryptocurrencies, Ethereum, and More - Third Edition, United Kingdom: Packt Publishing.	
Theory mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar / group discussion		
Indicative Experiments (Lab)		
1.	Deploying public key infrastructure (PKI)-Based Identity with Blockchain	5 Hours
2.	Two-Factor Authentication with Blockchain	5 Hours
3.	Posting IoT device data to a blockchain ledger	5 Hours
4.	Making IoT events to trigger smart contract blockchain transactions	5 Hours
5.	Deploying Blockchain-Based DDoS Protection.	5 Hours
6.	Set up and manage scalable blockchain private networks using cloud infrastructure.	5 Hours
	Total Laboratory Hours	**30 hours**
Lab mode of assessment: Continuous assessment / FAT / Oral examination and others		

Recommended by Board of Studies	28-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BKT2001	Cryptography and Information Security	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

Students will be able to

1. Understand fundamentals of cryptography and its applications
2. Acquainted basics of hash functions; authentication, digital signature.
3. Explore vulnerabilities in System, Network and Protocols used.

Course Outcomes

1. Understand fundamentals of Cryptography
2. Apply various cryptography techniques
3. Study practices behind key management.
4. Explore the authentication, Hashing and Digital Signature techniques
5. Understand and implement the various Security Applications
6. Apply security algorithms for images

Module:1	**Introduction**	**3 hours**
The OSI Security Architecture, Elements of Information Security, Security Attacks, Security Services and Security Mechanisms, Basic Network Security Terminology		
Module:2	**Number Theory**	**7 hours**
Introduction, Prime Numbers, Fermat's Theorem, Euler's Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, Primality Test, Fermat Primality Test, Miller–Rabin Primality Test, Chinese Remainder Theorem, Discrete Logarithms		
Module:3	**Cryptography**	**7 hours**
Data Encryption Techniques - Encryption Methods, Cryptanalysis, Data Encryption - Block Ciphers, Linear cryptanalysis - Weak Keys in DES Algorithms, Advanced Encryption Standard (AES), Blowfish Encryption Algorithm, RC5, IDEA.		
Module:4	**Public Key Cryptography**	**7 hours**
Cryptosystems - Public Key Cryptography, Authentication, Secrecy and Confidentiality, Key Length and Encryption Strength, Strength and Weakness of Public Key, RSA Algorithm		
Module:5	**Key Management**	**6 hours**
Key Distribution, Diffie–Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography, Elliptic Curve Diffie–Hellman, Zero-Knowledge Proof		
Module:6	**Authentication**	**6 hours**
Introduction, Authentication Methods, Extensible Authentication Protocol (EAP), Message Digest, Message Authentication and Hash Functions - Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function And MACs, Digital Signature - Authentication Protocol, Digital Signature Standard.		
Module:7	**Systems Security**	**5 hours**
Firewall – Architecture, Types of Firewalls, IDS, IPS, Electronic Mail Security –PGP, S/MIME, IP Security, Web Security - Securing Modern Web Applications, Secure Application Architecture, Reviewing Code for Security, Digital Watermarking and Steganography		
Module:8	**Contemporary Issues**	**4 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Pachghare, V. K. Cryptography and information security. 2019, PHI Learning Pvt. Ltd.
2.	Stallings, W. Cryptography and network security principles and practices, 2017 Pearson Education, Inc.

Reference Books

1.	Bao, F., Yung, M., Lin, D., & Jing, J. Information Security and Cryptology, 2010, Springer, Beijing, China.
2.	Hoffman, A. Web Application Security: Exploitation and Countermeasures for Modern Web Applications. 2020, O'Reilly Media.
3.	Chen, L., Takabi, H., & Le-Khac, N. A. Security, privacy, and digital forensics in the cloud. 2019, John Wiley & Sons.
4.	Kozierok, Charles M. The TCP/IP guide: a comprehensive, illustrated Internet protocols reference. No Starch Press, 2005.

Mode of Evaluation: CAT, Assignment, Quiz, FAT

LAB

Indicative Experiments

1.	Implement encryption algorithm
2.	Network Sniffing and Spoofing
3.	Reconnaissance and Exploitation
4.	Exploring weakness of Authentication mechanisms
5.	Pluggable Authentication Module
6.	Bypassing access control
7.	Implementing Digital Signature Algorithm
8.	Web Security – Content filtering, Same Origin Policy
9.	Simulation of Secure Payment System
10.	Implementation of Watermarking & Steganography algorithms

Total Laboratory Hours : 30 hours

Recommended by Board of Studies	28-10-2021		
Approved by Academic Council	No.64	Date	16-12-2021

BKT3001	Design and Development of Blockchain Applications	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

1. Understand the fundamentals of Blockchain technology
2. Comprehend the concept of application templates
3. Explore the architecture of smart contract
4. Analyze the contemporary blockchain decentralized applications
5. Apply blockchain technologies other than financial applications

Course Outcomes

After successfully completing the course the student should be able:

1. To understand the fundamentals of Blockchain technology
2. To gain knowledge about Blockchain application templates
3. To deal with solidity and smart contract
4. To familiar with Dapps
5. To foresee the uses of blockchain technology in various non-financial sector

Module:1	**Blockchain Concepts**	**5 hours**
Blockchain – Blockchain Application Example-Escrow, Blockchain Stack – FromWeb2.0to Decentralized Web – Doman-specific blockchain Applications-benefits and challenges		
Module:2	**Blockchain Application Templates**	**5 hours**
Blockchain Application Components-Design Methodology – Templates – Setting up ethereum Development Tools – Ethereum Clients – Ethereum Languages – TestRPC – Mist Ethereum Wallet – MetaMask – Web3 - Truffle		
Module:3	**Etherium Blockchain**	**7 hours**
Introduction – Ethereum network – Ethereum Ecosystem: Keys, Addresses, Transaction, Messages, Ether, Ethereum Virtual Machine - Ethereum Blockchain		
Module:4	**Solidity**	**8 hours**
Understanding Solidity – Decoding components of a smart contract – solidity compiler – working of solidity – syntax – variable types – naming rules – common solidity use cases		
Module:5	**Distributed Applications**	**8 hours**
Dapps – Implementing Dapps – Case studies: crowdfunding, Event Registration, Document Verification, Call option – Interest plate swap – Industrial IoT		
Module:6	**Mining**	**6 hours**
Consensus – mining – block validation – setting up a mining node – state storage in Ethereum – Whisper protocol – Routing approaches – API –Case study: smart switch Dapp		
Module:7	**Non-Financial Applications of Blockchain**	**4 hours**
Internet of Things: Physical, Device, Network, Management and Application layers – IoT Blockchain Experiment – Government: Border Control, Voting, Citizen Identification – Health – Finance: Insurance, Post-Trade, Financial Crime prevention - Media		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

	Text Book(s)
1.	Arshdeep Bahga, Vijay Madisetti. 2017. Blockchain Applications: A Hands-On Approach, 1st edition, United States: Arshdeep Bahga. 1-380 pages.
	Reference Books
1.	Imran bashir, Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, 2018, 2nd edition, Packt publishing, Birmingham-Mumbai

2.	Alessandro Parisi, Securing Blockchain Networks like Ethereum and Hyperledger Fabric: Learn advanced security configurations and design principles to safeguard Blockchain networks, 2020, 1st edition, Packt publishing, Birmingham-Mumbai.			
	Mode of Evaluation: CAT, Written assignment, Quiz and FAT			
LAB				
Indicative Experiments				
1.	Simple Dapps development using JavaScript and Web3			3 hours
2.	Develop a smart contract search engine			3 hours
3.	Application on smart contract hacks and vulnerabilities			3 hours
4.	IoT Application development using blockchain			3 hours
5.	E-Voting application development using blockchain			3 hours
6.	Insurance Application development using blockchain			3 hours
7.	Health sector application development using blockchain			3 hours
8.	Peer-reviewing application development using blocchain			3 hours
9.	Transcript verification application development using blockchain			3 hours
10.	Inventory management application development using blockchain			3 hours
			Total Laboratory Hours	**30 hours**
Mode of assessment: Continuous assessment / FAT				
Recommended by Board of Studies		28-10-2021		
Approved by Academic Council		No. 64	Date	16-12-2021

CSE1003	DIGITAL LOGIC AND DESIGN	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. Introduce the concept of digital and binary systems.
2. Analyze and Design combinational and sequential logic circuits.
3. Reinforce theory and techniques taught in the classroom through experiments in the laboratory.

Expected Course Outcome:

1. Comprehend the different types of number system.
2. Evaluate and simplify logic functions using Boolean Algebra and K-map.
3. Design minimal combinational logic circuits.
4. Analyze the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, demultiplexer.
5. Analyze and Design the Basic Sequential Logic Circuits
6. Outline the construction of Basic Arithmetic and Logic Circuits
7. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

Module:1	**INTRODUCTION**	**3 hours**
Number System - Base Conversion - Binary Codes - Complements(Binary and Decimal)		
Module:2	**BOOLEAN ALGEBRA**	**8 hours**
Boolean algebra - Properties of Boolean algebra - Boolean functions - Canonical and Standard forms - Logic gates - Universal gates – Karnaugh map - Don't care conditions - Tabulation Method		
Module:3	**COMBINATIONAL CIRCUIT - I**	**4 hours**
Adder - Subtractor - Code Converter - Analyzing a Combinational Circuit		
Module:4	**COMBINATIONAL CIRCUIT –II**	**6 hours**
Binary Parallel Adder- Look ahead carry - Magnitude Comparator - Decoders – Encoders - Multiplexers –Demultiplexers.		
Module:5	**SEQUENTIAL CIRCUITS – I**	**6 hours**
Flip Flops - Sequential Circuit: Design and Analysis - Finite State Machine: Moore and Mealy model - Sequence Detector.		
Module:6	**SEQUENTIAL CIRCUITS – II**	**7 hours**
Registers - Shift Registers - Counters - Ripple and Synchronous Counters - Modulo counters - Ring and Johnson counters		
Module:7	**ARITHMETIC LOGIC UNIT**	**9 hours**
Bus Organization - ALU - Design of ALU - Status Register - Design of Shifter - Processor Unit - Design of specific Arithmetic Circuits Accumulator - Design of Accumulator.		
Module:8	**Contemporary Issues: RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)		
1.	M. Morris Mano and Michael D.Ciletti– Digital Design: With an introduction to Verilog HDL, Pearson Education – 5th Edition- 2014. ISBN:9789332535763.	
Reference Books		
1.	Peterson, L.L. and Davie, B.S., 2007. Computer networks: a systems approach. Elsevier.	
2.	Thomas L Floyd. 2015. Digital Fundamentals. Pearson Education. ISBN: 9780132737968	
3.	Malvino, A.P. and Leach, D.P. and Goutam Saha. 2014. Digital Principles and Applications (SIE). Tata McGraw Hill. ISBN: 9789339203405.	
4.	Morris Mano, M. and Michael D.Ciletti. 2014. Digital Design: With an introduction to Verilog HDL. Pearson Education. ISBN:9789332535763	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Realization of Logic gates using discrete components, verication of truth table for logic gates, realization of basic gates using NAND and NOR gates	4.5 hours
	Implementation of Logic Circuits by verification of Boolean laws and verification of De Morgans law	3 hours
	Adder and Subtractor circuit realization by implementation of Half-Adder and Full-Adder, and by implementation of Half-Subtractor and Full-Subtractor	4.5 hours
	Combinational circuit design i. Design of Decoder and Encoder ii. Design of Multiplexer and De multiplexer iii. Design of Magnitude Comparator iv. Design of Code Converter	4.5 hours
	Sequential circuit design i. Design of Mealy and Moore circuit ii. Implementation of Shift registers iii. Design of 4-bit Counter iv. Design of Ring Counter	4.5 hours
	Implementation of different circuits to solve real world problems: A digitally controlled locker works based on a control switch and two keys which are entered by the user. Each key has a 2-bit binary representation. If the control switch is pressed, the locking system will pass the difference of two keys into the controller unit. Otherwise, the locking system will pass the sum of the two numbers to the controller unit. Design a circuit to determine the input to the controller unit.	4.5 hours
	Implementation of different circuits to solve real world problems: A bank queuing system has a capacity of 5 customers which serves on first come first served basis. A display unit is used to display the number of customers waiting in the queue. Whenever a customer leaves the queue, the count is reduced by one and the count is increased by one if a customer joins a queue. Two sensors (control signals) are used to sense customers leaving and joining the queue respectively. Design a circuit that displays the number of customers waiting in the queue in binary format using LEDs. Binary 1 is represented by LED glow and 0 otherwise.	4.5 hours
	Total Laboratory Hours	**30 hours**
Mode of assessment: Project/Activity		
Recommended by Board of Studies	28-02-2017	
Approved by Academic Council	No. 46	Date 24-08-2017

CSE1004	NETWORK AND COMMUNICATION	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.
2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.
3. To implement new ideas in Networking through assignments.

Expected Course Outcome:

1. Interpret the different building blocks of Communication network and its architecture.
2. Contrast different types of switching networks and analyze the performance of network
3. Identify and analyze error and flow control mechanisms in data link layer
4. Design subnetting and analyze the performance of network layer
5. Construct and examine various routing protocols
6. Compare various congestion control mechanisms and identify appropriate Transport layer protocol for real time applications
7. Identify the suitable Application layer protocols for specific applications and its respective security mechanisms

Module:1	Networking Principles and layered architecture	6 hours

Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements , Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network
Models (OSI, TCP/IP)

Module:2	Circuit and Packet switching	7 hours

Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters(Transmission Impairment, Data Rate and Performance)

Module:3	Data Link Layer	10 hours

Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring(IEEE 802.5) and Wireless Networks (IEEE 802.11, 802.15)

Module:4	Network Layer	6 hours

IPV4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format.

Module:5	Routing Protocols	4 hours

Routing-Link State and Distance Vector Routing Protocols- Implementation-Performance Analysis- Packet Tracer.

Module:6	**Transport Layer**	**7 hours**
TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters		
Module:7	**Application Layer**	**3 hours**
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP		
Module:8	**Recent Trends in Network Security**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Computer Networks: A Systems Approach, Larry Peterson and Bruce Davie, 5th Ed, The Morgan Kaufmann Series, Elsevier, 2011.
2.	Computer Networking: A Top-Down Approach Featuring the Internet, J.F. Kurose and K.W.Ross, 6th Ed., Pearson Education, 2012.
Reference Books	
1.	Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Ed., 2012.
2.	TCP/IP Protocol Suite, Behrouz A. Forouzan, McGraw-Hill Education, 4 Ed., 2009.
3.	Data and Computer Communications, William Stallings, Pearson Education, 10th Ed, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1	Demo session of all networking hardware and Functionalities	3 Hours
2	Network configuration commands using Linux	3 Hours
3	Error detection and correction mechanisms	3 Hours
4	Flow control mechanisms	3 Hours
5	IP addressing Classless addressing	3 Hours
6	Observing Packets across the network and Performance Analysis of Routing protocols	3 Hours
7	Socket programming(TCP and UDP) Multi client chatting	3 Hours
8	Simulation of unicast routing protocols	3 Hours
9	Simulation of Transport layer Protocols and analysis of congestion control techniques in network	3 Hours
10	Develop a DNS client server to resolve the given host name or IP address	3 Hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 46	Date	24-08-2017

CSE1007	JAVA PROGRAMMING	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To impart the core language features of Java and its Application Programming Interfaces (API).
2. To demonstrate the use of threads, exceptions, files and collection frameworks in Java.
3. To familiarize students with GUI based application development anddatabase connectivity.

Expected Course Outcome:

1. Comprehend Java Virtual Machine architecture and Java Programming Fundamentals.
2. Design applications involving Object Oriented Programming concepts such as inheritance, association, aggregation, composition, polymorphism, abstract classes and interfaces.
3. Design and build multi-threaded Java Applications.
4. Build software using concepts such as files, collection frameworks and containers.
5. Design and implement Java Applications for real world problems involving Database Connectivity.
6. Design Graphical User Interface using JavaFX.
7. Design, Develop and Deploy dynamic web applications using Servlets and JavaServer Pages.

Module:1	**Java Fundamentals**	**4 hours**

Java Basics: Java Design goal - Features of Java Language - JVM - Bytecode - Java source file structure basic programming constructs Arrays one dimensional and multi-dimensional enhanced for loop String package

Module:2	**Object Oriented Programming**	**5 hours**

Class Fundamentals - Object Object reference array of objects constructors methods over- loading this reference static block - nested class inner class garbage collection finalize() Wrapper classes Inheritance types - use of super - Polymorphism abstract class interfaces packages and sub packages.

Module:3	**Robustness and Concurrency**	**6 hours**

Exception Handling - Exceptions Errors - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling - user defined exceptions - Multithreading Thread creation sharing the workload among threads synchronization inter thread communication deadlock.

Module:4	**Files, Streams and Object serialization**	**7 hours**

Data structures: Java I/O streams Working with files Serialization and deserialization of objects Lambda expressions, Collection framework List, Map, Set Generics Annotations

Module:5	**GUI Programming and Database Connectivity**	**7 hours**

GUI programming using JavaFX, exploring events, controls and JavaFX menus Accessing databases using JDBC connectivity.

Module:6	**Servlet**	**7 hours**
Introduction to servlet - Servlet life cycle - Developing and Deploying Servlets - Exploring Deployment Descriptor (web.xml) - Handling Request and Response - Session Tracking Management.		
Module:7	**Java Server Pages**	**7 hours**
JSP Tags and Expressions - JSP Expression Language (EL) - Using Custom Tag - JSP with Java Bean.		
Module:8	**Latest Trends**	**2 hours**
Industry Expert talk		

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Herbert Schildt, The Complete Reference -Java, Tata McGraw-Hill Education, Tenth Edition, 2017.
2.	Paul J. Deitel, Harvey Deitel ,Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014
3.	Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015
Reference Books	
1.	Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011.
2.	Cay Horstmann BIG JAVA, 4th edition, John Wiley Sons,2009
3.	Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Write a program to demonstrate the use of multidimensional arrays and looping constructs.	2 hours
2.	Write a program to demonstrate the application of String handling functions.	2 hours
3.	Write a program to demonstrate the use of Inheritance.	2 hours
4.	Write a program to demonstrate the application of user-defined packages and sub-packages.	2 hours
5.	Write a program to demonstrate the use of Java Exception handling methods.	2 hours
6.	Write a program to demonstrate the use of threads in Java.	2 hours
7.	Demonstrate with a program the use of File handling methods in Java.	2 hours
8.	Demonstrate the use of Java collection frameworks in reducing application development time.	2 hours
9.	Build a GUI application using JavaFX	2 hours
10.	Write a program to register students data using JDBC with MySQL Database.	2 hours
11.	Write a program that uses Servlets to perform basic banking tasks.	2 hours
12.	Write a web application using JSP and demonstrate the use of http request and response methods.	2 hours
13.	Write a JSP program for an order management system.	2 hours
14.	Write a JSP program that using JDBC and MySQL database to store the user data.	2 hours
15.	JSP with Java Bean	2 hours
	Total Laboratory Hours	30 hours
Mode of assessment: Project/Activity		

Recommended by Board of Studies	10-08-2018		
Approved by Academic Council	No. 52	Date	14-09-2018

CSE2001	COMPUTER ARCHITECTURE AND ORGANIZATION	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**CSE1003 Digital Logic Design**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer.
2. To impart the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer.
3. To teach students how to describe machine capabilities and design an effective data path design for instruction execution. To introduce students to syntax and semantics of machine level programming.
4. To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer. And explore various alternate techniques for improving the performance of a processor.

Expected Course Outcome:

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machines with different capabilities.
2. Illustrate binary format for numerical and characters. Validate efficient algorithm for arithmetic operations.
3. Construct machine level program for given expression on n-address machine. Analyze and calculate memory traffic for a program execution. Design an efficient data path for an instruction format for a given architecture.
4. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction.
5. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.
6. Understand the structure and read write mechanisms for different storage systems. Illustrate and suggest appropriate use of RAID levels. Assess the performance of IO and external storage systems.
7. Classify parallel machine models. Illustrate typical 6-stage pipeline for overlapped execution. Analyze the hazards and solutions.

Module:1	Introduction and overview of computer architecture	3 hours

Introduction to computer systems - Overview of Organization and Architecture -Functional components of a computer -Registers and register files-Interconnection of components- Organization of the von Neumann machine and Harvard architecture-Performance of processor

Module:2	Data Representation And Computer Arithmetic	6 hours

Fixed point representation of numbers-algorithms for arithmetic operations: multiplication (Booths, Modified Booths) - division (restoring and non-restoring) - Floating point representation with IEEE standards and algorithms for common arithmetic operations- Representation of non-numeric data (character codes).

Module:3	**Fundamentals of Computer Architecture**	**11 hours**
Introduction to ISA (Instruction Set Architecture)-Instruction formats- Instruction types and addressing modes- Instruction execution (Phases of instruction cycle)- Assembly language programming-Subroutine call and return mechanisms-Single cycle Data path design-Introduction to multi cycle data path-Multi cycle Instruction execution.		
Module:4	**Memory System Organization and Architecture**	**9 hours**
Memory systems hierarchy-Main memory organization-Types of Main memory-memory interleaving and its characteristics and performance- Cache memories: address mapping-line size-replacement and policies- coherence- Virtual memory systems- TLB- Reliability of memory systems- error detecting and error correcting systems.		
Module:5	**Interfacing and Communication**	**7 hours**
I/O fundamentals: handshaking, buffering-I/O techniques: programmed I/O, interrupt-driven I/O, DMA- Interrupt structures: vectored and prioritized-interrupt overhead- Buses: Syn- chronous and asynchronous- Arbitration.		
Module:6	**Device Subsystems**	**4 hours**
External storage systems-organization and structure of disk drives: Electronic- magnetic and optical technologies- RAID Levels- I/O Performance		
Module:7	**Performance Enhancements**	**4 hours**
Classification of models - Flynns taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD)- Introduction to Pipelining- Pipelined data path-Introduction to hazards		
Module:8	**Contemporary issues: Recent Trends**	**1 hour**
Multiprocessor architecture: Overview of Shared Memory architecture, Distributed architecture.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.
Reference Books	
1.	W. Stallings, Computer organization and architecture, Prentice-Hall, 8th edition, 2013

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE2004	DATABASE MANAGEMENT SYSTEM	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To understand the concept of DBMS and ER Modeling.
2. To explain the normalization, Query optimization and relational algebra.
3. To apply the concurrency control, recovery, security and indexing for the real time data.

Expected Course Outcome:

1. Explain the basic concept and role of DBMS in an organization.
2. Illustrate the design principles for database design, ER model and normalization.
3. Demonstrate the basics of query evaluation and heuristic query optimization techniques.
4. Apply Concurrency control and recovery mechanisms for the desirable database problem.
5. Compare the basic database storage structure and access techniques including B Tree, B+ Tress and hashing.
6. Review the fundamental view on unstructured data and its management.
7. Design and implement the database system with the fundamental concepts of DBMS.

Module:1	**DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE**	**5 hours**

History and motivation for database systems -characteristics of database approach - Actors on the scene - Workers behind the scene - Advantages of using DBMS approach– Data Models, Schemas, and Instances– Three-Schema Architecture and Data Independence– The Database System Environment– Centralized and Client/Server Architectures for DBMSs– Classification of database management systems.

Module:2	**DATA MODELING**	**4 hours**

Entity Relationship Model : Types of Attributes, Relationship, Structural Constraints - Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity constraints

Module:3	**SCHEMA REFINEMENT**	**6 hours**

Guidelines for Relational Schema – Functional dependency; Normalization, Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form; Join dependency and Fifth Normal form.

Module:4	**QUERY PROCESSING AND TRANSACTION PROCESSING**	**5 hours**

Translating SQL Queries into Relational Algebra - heuristic query optimization - Introduction to Transaction Processing - Transaction and System concepts – Desirable properties of Transactions - Characterizing schedules based on recoverability - Characterizing schedules based on serializability

Module:5	**CONCURRENCY CONTROL AND RECOVERY TECHNIQUES**	**4 hours**

Two-Phase Locking Techniques for Concurrency Control – Concurrency Control based on timestamp – Recovery Concepts – Recovery based on deferred update – Recovery techniques based on immediate update - Shadow Paging.

Module:6	**PHYSICAL DATABASE DESIGN**	**3 hours**

Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing		
Module:7	**RECENT TRENDS - NOSQL DATABASE MANAGEMENT**	**3 hours**
Introduction, Need of NoSQL, CAP Theorem, different NoSQL data models: Key-value stores, Column families, Document databases, Graph databases		
	Total Lecture hours:	**30 hours**
Text Book(s)		
1.	R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2015	
2.	Raghu Ramakrishnan,Database Management Systems,Mcgraw-Hill,4th edition,2015.	
Reference Books		
1.	A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 6th Edition 2010.	
2.	Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.	
3.	Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2012.	
4.	Shashank Tiwari ,Professional NoSql,Wiley ,2011	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	DDL and DML	3 hours
2.	Single row and aggregate functions	3 hours
3.	Joins and Sub queries	3 hours
4.	Anonymous blocks and control structures	3 hours
5.	Iterations	3 hours
6.	Cursors	3 hours
7.	Functions and Procedures	3 hours
8.	Exception Handling and triggers	3 hours
9.	DBA Concepts	3 hours
10.	XML, DTD, XQuery Representations	3 hours
	Total Laboratory Hours	**30 hours**
Mode of assessment: Project/Activity		
Recommended by Board of Studies	04-04-2014	
Approved by Academic Council	No. 37 Date 16-06-2015	

Course code	Course Title	L	T	P	J	C
CSE2005	OPERATING SYSTEMS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v.x.x				

Course Objectives:

1. To introduce the operating system concepts, designs and provide skills required to implement the services.
2. To describe the trade-offs between conflicting objectives in large scale system design.
3. To develop the knowledge for application of the various design issues and services.

Expected Course Outcome:

1. Interpret the evolution of OS functionality, structures and layers.
2. Apply various types of system calls and to find the stages of various process states.
3. Design a model scheduling algorithm to compute various scheduling criteria.
4. Apply and analyze communication between inter process and synchronization techniques.
5. Implement page replacement algorithms, memory management problems and segmentation.
6. Differentiate the file systems for applying different allocation and access techniques.
7. Representing virtualization and demonstrating the various Operating system tasks and the principle algorithms for enumerating those tasks.

Module:1	Introduction	3 hours	CO:1

Introduction to OS: Functionality of OS - OS design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, resources - Influence of security, networking, and multimedia.

Module:2	OS Principles	4 hours	CO:2

System calls, System/Application Call Interface – Protection: User/Kernel modes - Interrupts - Processes - Structures (Process Control Block, Ready List etc.), Process creation, management in Unix – Threads: User level, kernel level threads and thread models.

Module:3	Scheduling	9 hours	CO:3

Processes Scheduling - CPU Scheduling: Pre-emptive, non-pre-emptive - Multiprocessor scheduling – Deadlocks - Resource allocation and management - Deadlock handling mechanisms: prevention, avoidance, detection, recovery.

Module:4	Concurrency	8 hours	CO:4

Inter-process communication, Synchronization - Implementing synchronization primitives (Peterson's solution, Bakery algorithm, synchronization hardware) - Semaphores – Classical

synchronization problems, Monitors: Solution to Dining Philosophers problem – IPC in Unix, Multiprocessors and Locking - Scalable Locks - Lock-free coordination.			
Module:5	**Memory Management**	**7 hours**	**CO:5**
Main memory management, Memory allocation strategies, Virtual memory: Hardware support for virtual memory (caching, TLB) – Paging - Segmentation - Demand Paging - Page Faults - Page Replacement -Thrashing - Working Set.			
Module:6	**Virtualization and File System Management**	**6 hours**	**CO:7**
Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates - Log-structured file system - Distributed file system.			
Module:7	**Storage Management, Protection and Security**	**6 hours**	**CO:6**
Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication - System protection: Access matrix – Capability based systems - OS: performance, scaling, future directions in mobile OS.			
Module:8	**Recent Trends**	**2 hours**	**CO:7**
	Total Lecture hours:	**45 hours**	

Text Book(s)		
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley (2018).	
Reference Books		
1.	Ramez Elmasri, A.Gil Carrick, David Levine, Operating Systems, A Spiral Approach - McGrawHill Higher Education (2010).	
2.	Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces, Arpaci-Dusseau Books, Inc (2015).	
3.	Andrew S. Tanenbaum, Modern Operating Systems, Pearson, 4th Edition (2016).	
4.	William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9th Edition (2018).	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Design a boot loader - to load a particular OS say TinyOS/ KolibriOS image - code to access from BIOS to loading the OS - involves little assembly code may use QEMU/virtual machines for emulation of hardware.	3 hours

2.	Allocate/free memory to processes in whole pages, find max allocatable pages, incorporate address translation into the program.	3 hours
3.	Create an interrupt to handle a system call and continue the previously running process after servicing the interrupt.	3 hours
4.	Write a Disk driver for the SATA interface. Take care to check readiness of the controller, locked buffer cache, accept interrupts from OS during the period, interrupting the OS again once done and clearing buffers.	3 hours
5.	Demonstrate the use of locks in conjunction with the IDE driver.	3 hours
6.	Run an experiment to determine the context switch time from one process to another and one kernel thread to another. Compare the findings	3 hours
7.	Determine the latency of individual integer access times in main memory, L1 Cache and L2 Cache. Plot the results in log of memory accessed vs average latency.	3 hours
8.	Compare the overhead of a system call with a procedure call. What is the cost of a minimal system call?	3 hours
9.	Compare the task creation times. Execute a process and kernel thread, determine the time taken to create and run the threads.	3 hours
10.	Determine the file read time for sequential and random access based of varying sizes of the files. Take care not to read from cached data - used the raw device interface. Draw a graph log/log plot of size of file vs average per-block time.	3 hours
	Total Laboratory Hours	30 hours
Mode of evaluation: Project/Activity		
Recommended by Board of Studies	09-09-2020	
Approved by Academic Council	No. 59	Date 24-09-2020

Course code	Advanced C Programming	L	T	P	J	C
CSE2010		2	0	2	0	3
Pre-requisite	CSE1001	Syllabus version				
Anti-requisite	CSE1008	v. xx.xx				

Course Objectives:

1. In depth understanding of storage classes, memory allocation and pointer manipulation.
2. High level and low level organization of files.
3. Explore the power of macros and preprocessor directives.

Expected Course Outcome:

At the end of this course students will be able to:

1. Learn various control structures and derived data types for solving real world problems using user defined functions.
2. Explore dynamic memory allocations strategies and user defined data types.
3. Realize the features of various Input and Output methods including files.
4. Idealize the power of preprocessor directives and recognize programming methods
5. Able to modularize the programming using various input, output, mathematical and utility functions in C and unix system interfaces.
6. Able to design the software in c using features of graphics, embedded programming concepts.
7. Apply the learned concepts and design algorithmic solutions for the real world problems.

Module:1	Control Structures, Functions and Pointer	3 hours	CO: 1

Review of C fundamentals : Data types, Operators and Expressions, Control structures, Arrays, Functions, String, Pointers and Structures.

Module:2	Memory Allocation	5 hours	CO: 2

The memory layout in c programming, dynamic memory allocation: malloc(), calloc(), realloc(), free(), core dump, memory leak, dangling pointer. Pointers and array: Pointer and one dimensional arrays, Array of pointers, Pointers and two dimensional arrays, Subscripting pointer to an array, Dynamic 1D and 2D array.

Module:3	User defined data types	5 hours	CO: 2

Structures, array of structures, passing structure to functions, function pointers : Passing and returning values using pointers, Array as function argument, Using Pointers as Arguments, Functions returning address, Function returning pointers, Pointer to a function, Calling a function through function pointer, Functions with varying number of arguments. arrays and structures within structures, Unions, Bit fields, enumerations, typedef.

Module:4	Input/Output Manipulation and Files	5 hours	CO: 3

I/O Manipulation: Standard I/O, Formatted Output - printf, Formated Input - scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions. Files manipulations: File Descriptors, File pointer, Working with text files, working with binary files, Character I/O, EOF, Sequential and random access.

Module:5	**Preprocessor Directives and programming method**	**4 hours**	**CO: 4**
Preprocessor Directives: #include statements, #define statements, #error, Conditional compilation, #undef, The # and ## preprocessor operators, Predefined macro names, Nested macros, Multiline macros, Macros pitfalls, Macros Vs enums, Inline functions, Macros vs inline functions, Inline recursive functions, Command line arguments, Environment Variables in C Programs, Type qualifiers. Programming Method: Debugging, User Defined Header, User Defined Library Function, makefile utility.			
Module:6	**Standard Library functions and Unix system Interface**	**3 hours**	**CO: 5**
Standard Library functions: I/O functions, string and character functions, mathematical functions, time, date and localization functions, utility functions, wide-character functions. Unix system Interface: File Descriptor, Low level I/O - read and write, Open, create, close and unlink, Random access - Iseek, Discussions on Listing Directory, Storage allocator.			
Module:7	**Graphics, embedded C and Software development using C**	**3 hours**	**CO: 6**
Graphics: writing a text graphics program, writing a pixel graphics program, two dimensional graphics. Embedded C programming : Basics, Data types, keywords, programming structure, basic embedded c programming. Software development using c: Building a windows 2000 skeleton, software engineering using c, efficiency, porting programming.			
Module:8	**Contemporary issues**	**2hours**	**CO: 7**
	Total Lecture hours:	**30 hours**	

Text Book(s)

1.	**Byron Gottfried and Jitender Chhabra , "Programming with C (Schaum's Outlines Series)", Third Edition. McGraw Hill Education. ISBN: 978-0070145900, July 2017.**
2.	**Herbert Schildt., "C: The Complete Reference", Fourth Edition. McGraw Hill Education. 978-0070411838. July 2017.**
3.	Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", Pearson Education India; 2nd Edition. ISBN: 978-9332549449. 2015.
4.	Peter Prinz and Tony Crawford, "C in a Nutshell: The Definitive Reference". O'Reilly Media. Inc., Second Edition. ISBN: 978-1491904756. December 2015.
5.	K R. Venugopal, Sudeep. R Prasad, "Mastering C", McGraw Hill Publishers, Second Edition. ISBN: 9789332901278. May 2015.

Reference Books

1.	**Jeff Szuhay, "Learn C Programming: A beginner's guide to learning C programming the easy and disciplined way", Packt Publishing Limited, First Edition, ISBN: 978-1789349917. June 2020.**

2.	**Zed A Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)", First Edition. Addison Wesley. ISBN: 978-0-321-88492-3. September 2015.**			
3.	Richard M. Reeses, "Understanding and Using C Pointers", First Edition. O'Reilly Publishers, ISBN: 9781449344184. January 2013.			
4.	A.R. Bradley, "Programming for Engineers", Springer, Berlin, Heidelberg. First Edition. ISBN: 978-3-642-23303-6, 2011.			
5.	A. Forouzan and Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", CENGAGE LEARNING (RS), Third Edition.ISBN: 978-8131503638, 2007.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)			**CO: 7**	
1.	Programs to demonstrate the use of various data types and storage classes.			2 hours
2.	Programs to understand various control structures.			2 hours
3.	Programs for Manipulating Arrays (One dimensional and Two dimensional)			4 hours
4.	Programs to understand memory allocations using pointers (simple and arrays)			2 hours
5.	Programs using pointers to arrays including strings (One dimensional and two dimensional)			6 hours
6.	Programs to explore different kinds of macros.			2 hours
7.	Programs to manipulate different records (employee, students, HR) using structures (with and without pointers)			6 hours
8.	Programs to manipulate different files (sequential and random)			6 hours
			Total Laboratory Hours	30 hours
Mode of evaluation:				
Recommended by Board of Studies	09-09-2020			
Approved by Academic Council	No. 59	Date	24-09-2020	

Course code	Data Structures and Algorithms	L	T	P	J	C
CSE2011		3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. XX.XX				

Course Objectives:

1. To understand the basic concepts of data structures and algorithms.
2. To differentiate linear and non-linear data structures and the operations upon them.
3. Ability to perform sorting and searchingin a given set ofdata items.
4. To comprehend the necessity of time complexity in algorithms.

Expected Course Outcome:

1. Understanding the fundamental analysis and time complexity for a given problem.
2. Articulate linear data structures and legal operations permitted on them.
3. Articulate non-linear data structures and legal operations permitted on them.
4. Applyinga suitable algorithm for searching and sorting.
5. Understanding graph algorithms, operations, and applications.
6. Understanding the importance of hashing.
7. Applying the basic data structures to understand advanced data structure operations and applications.
8. Application ofappropriate data structures to find solutions to practical problems.

Module:1	Introduction to Algorithms and Analysis	6 hours	CO:1

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation – Recursive Tree Method.

Module:2	Linear Data Structures	8 hours	CO: 2,8

Array- 1D and 2D array , Stack - Applications of stack: Expression Evaluation - Conversion of Infix to postfix and prefix expression, Tower of Hanoi.

Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists, Applications -Polynomial Manipulation - Josephus problem(permutation)

Module:3	Sorting and Search Techniques	8 hours	CO:4,8

Searching - Linear Search and binary search, Applications - Finding square root of ‘n’-Longest Common Prefix

Sorting – Insertion sort - Selection sort – Bubble sort – (Counting Sort) - Quick sort- Merge sort , Analysis, Applications - Finding the ‘n’ closest pair’s

Module:4	**Non-linear Data Structures - Trees**	**6 hours**	**CO:5,8**
Tree - Terminology, Binary Tree – Terminology and Properties, Tree Traversals, Expression Trees – Binary Search Trees – operations in BST – insertion, deletion, finding min and max, Finding the kth minimum element in a BST, Applications – Dictionary			
Module:5	**Non-linear Data Structures - Graphs**	**6 hours**	**CO:3,8**
Graph – basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra's Algorithm.			
Module:6	**Hashing**	**4 hours**	**CO:6,8**
Hash functions, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications – Dictionary-Telephone directory			
Module:7	**Heaps and Balanced Binary Search Trees**	**5 hours**	**CO:7,8**
Heaps - Heap sort, Applications -Priority Queue using Heaps AVL trees – Terminology - basic operations(rotation, insertion and deletion			
Module:8	**Recent Trends**	**2 hours**	**CO:8**
Recent trends in algorithms and data structures			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009.
2	Mark A. Weiss,Data Structures & Algorithm Analysis in C++, 3rd edition, 2008, PEARSON.
Reference Books	
1.	Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008.
2.	Horowitz, Sahni, and S. Anderson-Freed , Fundamentals of Data Structures in C UNIVERSITIES PRESS,Second Edition,2008.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Experiments (Indicative)	**CO:3,4,5**	
1.	Implementation of Stack and its applications	4 hours
2.	Implementation of queue and its applications	4 hours

3.	Linked List			4 hours
4.	Searching algorithm			2 hours
5.	Sorting algorithm – insertion, bubble, selection etc.			2 hours
6.	Randomized Quick sort and merge sort			2 hours
7.	Binary Tree traversals			2 hours
8.	Binary search tree			2 hours
9.	DFS, BFS			3 hours
10.	Minimum Spanning Tree – Prim's and Kruskal's			3hours
11.	Single source shortest path algorithm – Connected Components and finding a cycle in a graph			2 hours
			Total Laboratory Hours	30 hours
Mode of evaluation:				
Recommended by Board of Studies	09-09-2020			
Approved by Academic Council	No. 59	Date	24-09-2020	

Course code	Design and Analysis of Algorithms	L	T	P	J	C
CSE2012		3	0	2	0	4
Pre-requisite	CSE2011 – Data Structures and Algorithms	Syllabus version				
		v. XX.XX				

Course Objectives:

1. To provide a mathematical foundation for analyzing and proving the efficiency of an algorithm.
2. To focus on the design of algorithms in various domains of computer engineering.
3. To provide familiarity with main thrusts of work in algorithms sufficient to give some context for formulating and seeking known solutions to an algorithmic problem.

Expected Course Outcome:

On completion of this course, student should be able to

1. Ability to use mathematical tools to analyze and derive the running time of algorithms and prove the correctness.
2. Explain and apply the major algorithm design paradigms.
3. Explain the major graph algorithms and their analyses.
4. Explain the major String Matching algorithms and their analysis.
5. Explain the major Computational Geometry algorithms and their analysis.
6. Provide algorithmic solutions to real-world problem from various domains.
7. Explain the hardness of real world problems with respect to algorithmic efficiency and learning to cope with it.

Module:1	Algorithm Development	4 hours	CO: 1

Stages of algorithm development for solving a problem: Describing the problem, Identifying a suitable technique, Design of an algorithm, Proof of Correctness of the algorithm.

Module:2	Algorithm Design Techniques	10 hours	CO: 2

Brute force techniques – Travelling Salesman Problem, Divide and Conquer - Finding a maximum and minimum in a given array -Matrix multiplication: Strassen's algorithm, Greedy techniques Huffman Codes and Data Compression -Fractional Knapsack problem, Dynamic programming - O/1 Knapsack problem-Matrix chain multiplication, LCS, Travelling Salesman Problem, Backtracking-N-Queens Problem, Knights Tour on Chess Board.

Module:3	String Matching Algorithms	5 hours	CO:1,4

Naïve String matching Algorithms, KMP algorithm, Rabin-Karp Algorithm

Module:4	Computational Geometry Algorithms	5 hours	CO:1,5

Line Segments – properties, intersection; Convex Hull finding algorithms- Graham's Scan, Jarvis's March Algorithm.

Module:5	Graph Algorithms	6 hours	CO:1,3

All pair shortest path – Floyd-Warshall Algorithm. Network Flows - Flow Networks, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.

Module:6	**Complexity Classes**	**7 hours**	**CO:1,6**
The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover, Independent Set, Maximum Clique.			
Module:7	**Approximation and Randomized Algorithms**	**6 hours**	**CO:7**
Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum Cut			
Module:8	**Recent Trends**	**2 hours**	**CO:7**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009.

Reference Books

1. Jon Kleinberg, ÉvaTardos ,Algorithm Design, Pearson education, 2014
2. Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, "Network Flows: Theory, Algorithms, and Applications", Pearson Education, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Assignment: Exploring Finite Automata and String Matching

List of Experiments (Indicative)	**Total Hours: 30**
1. Design and implement an algorithm that multiplies two 'n' digit numbers faster than O(n3). 2. Design and implement an algorithm that will find the top and the least scores of students from an online Quiz. Note: The scores are stored in an array. 3. Design a solution for an Airline Customer on what to leave behind and what to carry based on cabin baggage weight limits. The Customer has to pack as many items as the limit allows while maximizing the total worth. The data can be shared in a CSV File.	

4. Assume you have an unparenthesized arithmetic expression with only + and - operators. You can change the value ofexpression by parenthesizing at different positions. To keep it simple, assume that parenthesis occur only before or immediately after operands and not operators. Design an algorithm that can take a maximum possible value theexpression can take in after adding the parenthesis. 5. About 14 historic sites in Tamilnadu is shown in https://www.google.com/maps/search/historic+sites+in+tamilnadu/@10.7929896,78.2883573,7z/data=!3m1!4b1 Design a solution that identifies the shortest possible routes for a traveler to visit these sites. 6. Design a solution to see if a content C = PGGA is plagiarizedin Text T = SAQSPAPGPGGAS. 7. You can find the schematics of Delhi Art Gallery (GroundFloor) in: https://www.archdaily.com/156154/delhi-art-gallery-re-design- vertex-design/50151feb28ba0d02f0000302-delhi-art-gallery-re- design-vertex-design-first-floor-plan Design a model to install fewest possible Closed CircuitCameras covering all hallways and turns. 8. A maze has to be created and path has to be displayed whichwill be taken by the rat by using backtracking concept. 9. Consider x=aabab and y=babb. Each insertion and deletionhas a unit 1) cost where as a change costs 2 units. Find a minimum cost edit sequence that transforms x into y by usingsuitable algorithm design technique. 10. Implement N-Queens problem and analyse its timecomplexity using backtracking. 11. Write a program to find all the Hamiltonian cycles in aconnected undirected graph G(V,E) using backtracking 12. Design and implement a solution to find a subset of a givenset S = {Sl, S2,. ,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5,6, 8} and d= 9,there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.	

Mode of evaluation:			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Theory of Computation	L	T	P	J	C
CSE2013		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. xx.xx				

Course Objectives:

The objectives of this course are to learn
1. Types of grammars and models of automata.
2. Limitation of computation: What can be and what cannot be computed.
3. Establishing connections among grammars, automata and formal languages.

Expected Course Outcome:

After successfully completing the course the student should be able to
1.Compare and analyze different computational models
2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
3. Identify limitations of some computational models and possible methods of proving them.

Module:1	Introduction to Languages and Grammars	4 hours	CO: 1

Recall on Proof techniques in Mathematics -Overview of a Computational Models - Languages and Grammars - Alphabets - Strings - Operations on Languages, Overview on Automata

Module:2	Finite State Automata	8 hours	CO: 2

Finite Automata (FA) - Deterministic Finite Automata (DFA) - Non-deterministic Finite Automata (NFA) - NFA with epsilon transitions – NFA without epsilon transition, conversion of NFA to DFA, Equivalence of NFA and DFA – minimization of DFA

Module:3	Regular Expressions and Languages	7 hours	CO: 2

Regular Expression - FA and Regular Expressions: FA to regular expression and regular expression to FA- - Pattern matching and regular expressions - Regular grammar and FA- Pumping lemma for regular languages - Closure properties of regular languages.

Module:4	Context Free Grammars	7 hours	CO: 3

Context-Free Grammar (CFG) – Derivations- Parse Trees - Ambiguity in CFG - CYK algorithm – Simplification of CFG – Elimination of Useless symbols, Unit productions, Null productions - Normal forms for CFG: CNF and GNF - Pumping Lemma for CFL - Closure Properties of CFL

Module:5	Pushdown Automata	5 hours	CO: 2

Definition of the Pushdown automata - Languages of a Pushdown automata – Power of Non-Deterministic Pushdown Automata and Deterministic pushdown automata

Module:6	**Turing Machine**	**6 hours**	**CO: 3**
Turing Machines as acceptor and transducer - Multi head and Multi tape Turing Machines – Universal Turing Machine - The Halting problem - Turing-Church thesis			
Module:7	**Recursive and Recursively Enumerable Languages**	**6 hours**	**CO: 3**
Recursive and Recursively Enumerable Languages, Language that is not Recursively Enumerable (RE) – computable functions – Chomsky Hierarchy – Undecidable problems - Post's Correspondence Problem			
Module:8	**Recent Trends**	**2 hours**	**CO: 3**
	Total Lecture hours:	**45 hours**	

Text Book(s)

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson Education, India 2008. ISBN: 978-8131720479
2. Peter Linz, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett, 2016. ISBN: 978-9384323219

Reference Books

1. K. Krithivasan and R. Rama, "Introduction to Formal Languages, Automata and Computation", Pearson Education, 2009. ISBN: 978-8131723562
2. Michael Sipser, Introduction of the Theory and Computation, Cengage; 3rd edition, 2014, ISBN: 978-8131525296
3. Dexter C. Kozen, "Automata and Computability", Springer; Softcover reprint of the original 1st ed. 1997 edition. 2012
4. John C Martin, "Introduction to Languages and the Theory of Computation", McGraw Hill Publishing Company, Fourth Edition, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Mode of assessment:

Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

CSE3002	INTERNET AND WEB PROGRAMMING	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**CSE2004-Database Management System**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To comprehend and analyze the basic concepts of web programming and internet protocols.
2. To describe how the client-server model of Internet programming works.
3. To demonstrates the uses of scripting languages and their limitations.

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Differentiate web protocols and web architecture.
2. Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites.
3. Implement client side scripting using JavaScript.
4. Develop applications using Java.
5. Implement server side script using PHP, JSP and Servlets.
6. Develop XML based web applications.
7. Develop application using recent environment like Node JS, Angular JS, JSON and AJAX.

Module:1	**INTRODUCTION TO INTERNET**	**2 hours**

Internet Overview- Networks - Web Protocols — Web Organization and Addressing - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL - Domain Name – Client-side and server-side scripting.

Module:2	**WEB DESIGNING**	**4 hours**

HTML5 – Form elements, Input types and Media elements, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

Module:3	**CLIENT-SIDE PROCESSING AND SCRIPTING**	**7 hours**

JavaScript Introduction –Functions – Arrays – DOM, Built-in Objects, Regular Expression, Exceptions, Event handling, Validation- AJAX - JQuery.

Module:4	**SERVER SIDE PROCESSING AND SCRIPTING - PHP**	**5 hours**

Introduction to PHP – Operators – Conditionals – Looping – Functions – Arrays- Date and Time Functions – String functions - File Handling - File Uploading – Email Basics - Email with attachments.

Module:5	**PHP SESSION MANAGEMENT and DATABASE CONNECTIVITY**	**3 hours**

Sessions-Cookies-MySQL Basics – Querying single and multiple MySQL Databases with PHP – PHP Data Objects.

Module:6	**XML**	**4 hours**

XML Basics – XSL, XSLT, XML Schema-JSON.

Module:7	**APPLICATION DEVELOPMENT USING NODE JS**	**4 hours**
Introduction to Node.js- Installing Node.js - Using Events, Listeners, Timers, and Callbacks in Node.js – Introduction to Mongo DB- Accessing MongoDB from Node.js.		
Module:8	**Industry Expert Talk**	**1 hour**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5th edition, Pearson Education, 2012.
2.	Kogent Learning Solutions Inc, Web Technologies Black Book, Dream Tech press, 2013.
3.	Brad Dayley, Brendan Dayley, and Caleb Dayley , Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications, 2nd Edition, Pearson Education, 2018
Reference Books	
1.	Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O'Reilly Media, 2015
2.	Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3rd Edition, Mc-Graw Hill, 2017
3.	Steven Holzener , PHP – The Complete Reference, 1st Edition, Mc-Graw Hill, 2017
4.	Sandeep Kumar Patel, Developing Responsive Web Applications with AJAX and JQuery, Packt Publications, 2014
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	HTML basic tags, HTML forms, table, list, HTML frames and CSS internal, external and inline	4 hours
2.	JavaScript validation, DOM and Ajax	6 hours
3.	Java, Servlet and JSP	8 hours
4.	PHP : Forms and File handling, Session Management and Cookies, Databases	8 hours
5.	XML	4 hours
	Total Laboratory Hours	30 hours
Mode of assessment: Project/Activity		

Recommended by Board of Studies	19-11-2018		
Approved by Academic Council	No. 53	Date	13-12-2018

EEE1001	Basic Electrical and Electronics Engineering	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**NIL**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To understand the various laws and theorems applied to solve electric circuits and networks
2. To provide the students with an overview of the most important concepts in Electrical and Electronics Engineering which is the basic need for every engineer

Expected Course Outcome:

1. Solve basic electrical circuit problems using various laws and theorems
2. Analyze AC power circuits and networks, its measurement and safety concerns
3. Classify and compare various types of electrical machines
4. Design and implement various digital circuits
5. Analyze the characteristics of semiconductor devices and comprehend the various modulation techniques in communication engineering
6. Design and conduct experiments to analyze and interpret data

Module:1	**DC circuits**	**5 hours**

Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem

Module:2	**AC circuits**	**6 hours**

Alternating voltages and currents, AC values, Single Phase RL, RC, RLC Series circuits, Power in AC circuits-Power Factor- Three Phase Systems – Star and Delta Connection- Three Phase Power Measurement – Electrical Safety –Fuses and Earthing, Residential wiring

Module:3	**Electrical Machines**	**7 hours**

Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Special Machines-Stepper motor, Servo Motor and BLDC motor

Module:4	**Digital Systems**	**5 hours**

Basic logic circuit concepts, Representation of Numerical Data in Binary Form- Combinational logic circuits, Synthesis of logic circuits

Module:5	**Semiconductor devices and Circuits**	**7 hours**

Conduction in Semiconductor materials, PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers, Feedback Amplifiers using transistors. Communication Engineering: Modulation and Demodulation - Amplitude and Frequency Modulation

	Total Lecture hours:	**30 hours**	

Text Book(s)

1.	1. John Bird, 'Electrical circuit theory and technology ', Newnes publications, 4 t h Edition, 2010.

Reference Books

1.	Allan R. Hambley, 'Electrical Engineering -Principles & Applications' Pearson Education, First Impression, 6/e, 2013

2.	Simon Haykin, 'Communication Systems', John Wiley & Sons, 5 t h Edition, 2009.			
3.	Charles K Alexander, Mathew N O Sadiku, 'Fundamentals of Electric Circuits', Tata McGraw Hill, 2012.			
4.	Batarseh, 'Power Electronics Circuits', Wiley, 2003			
5.	H. Hayt, J.E. Kemmerly and S. M. Durbin, 'Engineering Circuit Analysis', 6/e, Tata McGraw Hill, New Delhi, 2011.			
7.	Fitzgerald, Higgabogan, Grabel, 'Basic Electrical Engineering', 5t h edn, McGraw Hill, 2009.			
8.	S.L.Uppal, 'Electrical Wiring Estimating and Costing ', Khanna publishers, NewDelhi, 2008.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	Thevenin's and Maximum Power Transfer Theorems – Impedance matching of source and load			3 hours
2.	Sinusoidal steady state Response of RLC circuits			3 hours
3.	Three phase power measurement for ac loads			3 hours
4.	Staircase wiring circuit layout for multi storey building			3 hours
5.	Fabricate and test a PCB layout for a rectifier circuit			3 hours
6.	Half and full adder circuits.			3 hours
7.	Full wave Rectifier circuits used in DC power supplies. Study the characteristics of the semiconductor device used			3 hours
8.	Regulated power supply using zener diode. Study the characteristics of the Zener diode used			3 hours
9.	Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars. Study the characteristics of the transistor used			3 hours
10.	Characteristics of MOSFET			3 hours
			Total Laboratory Hours	**30 hours**
Mode of assessment: CAT / Assignment / Quiz / FAT / Project / Seminar				
Recommended by Board of Studies	**29/05/2015**			
Approved by Academic Council	**37th AC**	Date	**16/06/2015**	

MAT1014	Discrete Mathematics and Graph Theory	L	T	P	J	C
		3	2	0	0	4
Pre-requisite	Nil	Syllabus Version				
		1.0				

Course Objectives:

1. To address the challenge of the relevance of lattice theory, coding theory and algebraic structures to computer science and engineering problems.
2. To use number theory, in particular congruence theory to cryptography and computer science problems.
3. To understand the concepts of graph theory and related algorithm concepts.

Expected Course Outcome:

At the end of this course, students are expected to

1. form truth tables, proving results by truth tables, finding normal forms,
2. learn proof techniques and concepts of inference theory
3. understand the concepts of groups and application of group codes, use Boolean algebra for minimizing Boolean expressions.
4. learn basic concepts of graph theory, shortest path algorithms, concepts of trees and minimum spanning tree and graph colouring, chromatic number of a graph.
5. Solve Science and Engineering problems using Graph theory.

Module:1	Mathematical Logic and Statement Calculus	6 hours

Introduction-Statements and Notation-Connectives–Tautologies–Two State Devices and Statement logic -Equivalence - Implications–Normal forms - The Theory of Inference for the Statement Calculus.

Module:2	Predicate Calculus	4 hours

The Predicate Calculus - Inference Theory of the Predicate Calculus.

Module:3	Algebraic Structures	5 hours

Semigroups and Monoids - Groups – Subgroups – Lagrange's Theorem Homomorphism – Properties-Group Codes.

Module:4	Lattices	5 hours

Partially Ordered Relations -Lattices as Posets – Hasse Digram – Properties of Lattices.

Module:5	Boolean algebra	5 hours

Boolean algebra - Boolean Functions-Representation and Minimization of Boolean Functions – Karnaugh map – McCluskey algorithm.

Module:6	Fundamentals of Graphs	6 hours

Basic Concepts of Graph Theory – Planar and Complete graph - Matrix representation of Graphs – Graph Isomorphism – Connectivity–Cut sets-Euler and Hamilton Paths–Shortest Path algorithms.

Module:7	Trees, Fundamental circuits , Cut sets,	12 hours

	Graph colouring, covering, Partitioning	
Trees – properties of trees – distance and centres in tree –Spanning trees – Spanning tree algorithms- Tree traversals- Fundamental circuits and cut-sets. Bipartite graphs - Chromatic number – Chromatic partitioning – Chromatic polynomial - matching – Covering– Four Colour problem.		
Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial class. • Another 5 problems per Tutorial Class to be given as home work.	**15 hours**
Mode of Evaluation		
Individual Exercises, Team Exercises, Online Quizzes, Online, Discussion Forums		
Text Book(s)		
1. Discrete Mathematical Structures with Applications to Computer Science, J .P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint, 2017. 2. Graph theory with application to Engineering and Computer Science, Narasing Deo, Prentice Hall India 2016.		
Reference Books		
1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill, 2019. 2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018. 3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017. 4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017. 5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017. 6. Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.		
Mode of Evaluation		
Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test		
Recommended by Board of Studies	03-06-2019	
Approved by Academic Council	No.55	Date 13-06-2019

PROGRAMME ELECTIVE

BCI2001	DATA PRIVACY	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To recognize the need of data privacy.
2. To categorize the statistical and computational techniques needed to share data, with a primary focus on the social, behavioural and health sciences.
3. To formulate architectural, algorithmic and technological foundations for the maintenance of the privacy of individuals, the confidentiality of organizations, and the protection of sensitive information, despite the requirement that information be released publicly or semi-publicly

Expected Course Outcome:

1.Characterize basic rules and principles for protecting privacy and personal information.
2.Design enhanced privacy protection methods by envisioning the basic attacks to happen.
3.Formulate data that supports useful statistical inference while minimizing the disclosure of sensitive information

Module:1	**Data Privacy and its Importance**	**4 hours**

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

Module:2	**Microdata**	**7 hours**

Disclosure, Disclosure risk, Estimating re-identification risk, Non-perturbative microdata masking, Perturbative microdata masking, Information loss in microdata

Module:3	**Static Data Anonymization on Multidimensional Data**	**8 hours**

Privacy Preserving Methods, Classification of Data in a Multidimensional Data Set, Group- Based Anonymization, k- Anonymity, l-Diversity, t-closeness

Module:4	**Static Data Anonymization on Complex Data Structures**	**8 hours**

Privacy Preserving Graph Data, Privacy Preserving Time Series Data, Time Series Data Pro- tection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Trans- action Data.

Module:5	**Data Anonymization Threats**	**8 hours**

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.

Module:6	**Privacy Preserving Data Mining**	**4 hours**

Key Functional Areas of Multidimensional Data for privacy preservation , Association Rule Mining, Clustering algorithms for privacy preservation

Module:7	**Privacy Preserving Test Data Generation**	**7 hours**
Test Data Fundamentals, Utility of Test Data: Test Coverage, Privacy Preservation of Test Data, Quality of Test Data, Anonymization Design for PPTDG, Insufficiencies of Anonymized Test Data.		
Module:8	**Contemporary Issues: RECENT TRENDS**	**2 hours**
Very large Scale Integrated circuits (VLSI), Field Programmable Gate Arrays(FPGA).		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	1. Nataraj Venkataramanan, AshwinShriram, Data Privacy: Principles and Practice, Taylor Fran- cis, 2016. (ISBN No.: 978-1-49-872104-2).
2.	Anco Hundepool, Josep Domingo-Ferrer, Luisa Franconi, Sarah Giessing, Eric Schulte Nordholt, Keith Spicer, Peter-Paul de Wolf, Statistical Disclosure Control, Wiley, 2012. (ISBN No.: 978- 1-11-997815-2)
Reference Books	
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	
Mode of assessment: Project/Activity	

Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

BCI3001	WEB SECURITY	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To study and practice fundamental techniques in developing secure web based applications
2. To identify and find the vulnerabilities of web based applications and to protect those applications from attacks

Expected Course Outcome:

1.To understand security-related issues in Web-based systems and applications.
2.To understand the fundamental mechanisms of securing a Web-based system.
3.To be able to implement security mechanisms to secure a Web-based application.
4.To be able to evaluate a Web-based system with respect to its security requirements

Module:1	**Introduction**	**3 hours**

Introduction - Evolution of Web Applications - Web Application Security - Core Defence Mechanisms - Handling User Access - Handling User Input- Handling Attackers - Managing the Application - The OWASP Top Ten List

Module:2	**WEB APPLICATION TECHNOLOGIES**	**4 hours**

Web Functionality Encoding Schemes Mapping the Application - Enumerating the Content and Functionality Analysing the Application Bypassing Client Side Controls : Transmitting Data Via the Client Capturing User Data Handling Client Side Data Securely - Input Validation, Blacklist Validation - Whitelist Validation - The Defence-in-Depth Approach - Attack Surface Reduction Rules of Thumb

Module:3	**WEB APPLICATION AUTHENTICATION**	**4 hours**

Authentication Fundamentals- Two Factor and Three Factor Authentication - Password Based, Built-in HTTP, Single Sign-on Custom Authentication- Secured Password Based Authentication: Attacks against Password, Importance of Password Complexity - Design Flaws in Authentication Mechanisms - Implementation Flaws in Authentication Mechanisms - Securing Authentication

Module:4	**SESSION MANAGEMENT**	**3 hours**

Need for Session Management Weaknesses in Session Token Generation Weaknesses in Session Token Handling Securing Session Management; Access Control : Access Control Overview, Common Vulnerabilities Attacking Access Controls Securing Access Control.

Module:5	**WEB SECURITY PRINCIPLES**	**3 hours**

Origin Policy, Exceptions Cross Site Scripting, Cross Site Forgery Scripting; File Security Principles: Source Code Security, Forceful Browsing, Directory Traversals- Classifying and Prioritizing Threats Origin Policy.

Module:6	**WEB APPLICATION VULNERABILITY**	**6 hours**

Understanding Vulnerabilities in Traditional Client Server Application and Web Applications, Client State Manipulation, Cookie based Attacks, SQL Injection, Cross Domain Attack (XSS/ XSRF/ XSSI), HTTP Header Injection, SSL Vulnerabilities And Testing - Proper Encryption use in Web Application - Session Vulnerabilities and Testing - Cross-Site Request Forgery		
Module:7	**EXPLOITING SYSTEMS**	**5 hours**
Path Traversal - Finding and Exploiting Path Traversal Vulnerability Preventing Path Traversal Vulnerability Information Disclosure - Exploiting Error Messages Securing Compiled Applica- tions Buffer Overflow Vulnerability Integer Vulnerability Format String Vulnerability.		
Module:8	**Contemporary Issues: RECENT TRENDS**	**2 hours**
Very large Scale Integrated circuits (VLSI), Field Programmable Gate Arrays(FPGA).		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	B. Sullivan, V. Liu, and M. Howard, Web Application Security, A B Guide. New York: McGraw-Hill Education, 2011. (ISBN No.: 978-0-07-177616-5).
2.	D. Stuttard and M. Pinto, , 2nd ed. Indianapolis, IN: Wiley, John Sons, 2011. (ISBN No. : 978-1-118-02647-2)
Reference Books	
1.	Hanqing and L. Zhao, Web Security: A Whitehat Perspective. United Kingdom: Auerbach Publishers, 2015.(ISBN No.: 978-1-46-659261-2).
2.	M. Shema and J. B. Alcover, Hacking Web Apps: Detecting and Preventing Web Application Security Problems. Washington, DC, United States: Syngress Publishing, 2014.(ISBN No. 978-1-59-749951-4)

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1	Reconnaissance on any popular websites	3 hours
2	Crawling a website	3 hours
3	Vulnerability scanning	3 hours
4	Cookie Stealing with cross site scripting	3 hours
5	Commit identity theft	3 hours
6	Website Security implementation Apache hardening, MySQL hardening, PHP hardening	3 hours
7	XSS and SQL injections	3 hours
8	Password security	3 hours
9	Browser security	3 hours
10	Web application security assessment	3 hours
	Total Laboratory Hours	**30 hours**
Mode of assessment: Project/Activity		

Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

BCI3002	DISASTER RECOVERY AND BUSINESS CONTINUITY MANAGEMENT	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To develop an understanding of concepts of risk management
2. To examine aspects of incident response and contingency planning consisting of incident response plans, disaster recovery plans, and business continuity plans.
3. To develop and execute plans to deal with contingency, incident response, disaster recovery and business continuity

Expected Course Outcome:

1. Describe concepts of risk management
2. Define and differentiate contingency planning components
3. Define and be able to discuss incident response options
4. Design an incident response plan for sustained organizational operations
5. Discuss and recommend contingency strategies including data backup and recovery and alternate site selection for business resumption planning
6. Describe the escalation process from incident to disaster
7. Design a disaster recovery plan, business continuity plan for sustained organizational operations

Module:1	DISASTER RECOVERY AND BUSINESS CONTINUITY INTRODUCTION	5 hours

Disaster Different source of disaster and types of disasters. Disaster Recovery Operational cycle of disaster recovery, disaster recovery cost, incidents that requires disaster recovery plans, evaluating disaster recovery - methods, team, phases, objectives, checklist. Best practises for disaster recovery - Business continuity - Business continuity vs. disaster recovery

Module:2	DISASTER RECOVERY PLANNING AND IMPLEMENTATION	6 hours

Introduction - Aspects of security - Application security - Database security - Distributed system security - Firmware security - Industrial security. Profiles Operational profile, Appli- cation profiles, Inventory profile, Disaster recovery plan - Business impact analysis - Disaster recovery roles and responsibilities - Disaster recovery planning steps - Disaster preparedness - Notification and activation procedures

Module:3	BUSINESS CONTINUITY MANAGEMENT	6 hours

Introduction - Elements of business continuity management. Business continuity plan - Business continuity planning and strategies - BCP standards and guidelines - BCP Project Organization - Crisis communication plan - Emergency response plan - Contingency planning

Module:4	MANAGING, ASSESSING AND EVALUATING RISKS	6 hours

Introduction - Importance of risk management - Risk management methodology - Attack methods and Countermeasures - Cost benefits analysis of risk management - Risk assessment responsibilities - Responsibilities of security professional - Information system auditing and monitoring - Verification

tools and techniques.		
Module:5	**RISK CONTROL POLICIES AND COUNTER MEASURES**	**7 hours**
Introduction - Counter measures - Risk control policy development factors Development of information assurance principles and practices - Laws and procedures in information assurance policy implementation, Security test and evaluation, Automated security tools, Cost benefit analysis, Developing a risk assessment methodology, Security requirements, Information categorization, Risk management methodologies to develop life cycle management policies and procedures, Education, training and awareness. Policy development Information security pol- icy, change control policies, system acquisition policies and procedures, Risk analysis policies and General risk control policies.		
Module:6	**STORAGE DISASTER RECOVERY SERVICES TOOLS**	**7 hours**
Introduction - Importance of data backup - Preventing data loss - Developing an effective data backup strategy - Backup techniques Disk mirroring, Snapshot, Continuous data protection, and Parity protection. Backup schedules - Removable backup media - Potential risks - Challenges in backup and recovery - Backup and recovery checklist - Data backup and recovery tools - Offsite data backup methods and strategies - Enterprise backup tools		
Module:7	**BUSINESS RECOVERY**	**6 hours**
Business recovery planning process mobilizing business recovery team, Assessing extent of damage and business impact, Preparing specific recovery plans, Assess damaged property and documents, Backup recovery site, Monitoring progress, Keeping stockholders informed, Handling business operation back to regular management. Planning recovery activities Communication systems, Human resources, Corporate proprietary information and documentation, IT systems Software architecture recovery.		
Module:8	**Contemporary Issues: RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	John W. Rittinghouse and James F. Ransome, Business Continuity and Disaster Recovery for Info Sec Managers. Elsevier: Elsevier Digital Press, 2005. (ISBN: 978-0-52-119019-0)
2.	EC Council Press. Disaster Recovery, 1st Ed. Course Technology, 2011. (ISBN: 978-1-55558-339-2)
Reference Books	
1.	ISO 27001:2013 A specification for an information security management system
2.	David Alexander, Amanda Finch, David Sutton, Andy Taylor. Information Security Management Principles, 2nd Ed. BCS Shop, 2013. (ISBN: 9781780171753)
3	ISO Guide 73:2009 Definitions of generic terms related to Risk Management
4	ISO Guide 27005:2011 Guidelines for information security risk management
5	ISO 31010:2010 Risk Management Risk Assessment Techniques
6	Mark Talabis, Jason Martin. Information Security Risk Assessment Toolkit Practical Assessments through Data Collection and Data Analysis. Syngress Imprint, 2013. (ISBN: 978-1-59-749735-0).

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

BCI3003	ANDROID SECURITY	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**					**Syllabus version**
						v1.0

Course Objectives:

1.To learn basic of the Android operating system and security aspects.
2.To practice the android malware analysis techniques.
3.To appraise the malwares analysis of real world applications.

Expected Course Outcome:

1.Identify various malwares and understand the behavior of malwares in real world applications.
2.Implement different malware analysis techniques.
3.Understand the malware behavior in android.
4.Understand the purpose of malware analysis.
5.Identify the various tools for malware analysis.

Module:1	**INTRODUCTION TO ANDROID OPERATING SYSTEMS**	**3 hours**

Introduction to Android, Android API, DVM, APK File Structure Basic Analysis of an APK, Dex structure, Dex Structure Parsing, APK install process, Android Root.

Module:2	**APPLICATION SECURITY**	**5 hours**

Inspecting the AndroidManifest.xml file - Introduction to Android Debugging Tools and Their Usage, Interacting with the Activity Manager via ADB - Extracting Application Resources via ADB, Inspecting Application Certificates and Signatures - Verifying Application Signatures - Signing Android Applications. Mobile Security - IOS vs Android vs Windows

Module:3	**PERMISSIONS**	**4 hours**

Nature of Permissions, Permission Management, Permission Assignment, Permission Enforcement

Module:4	**ANDROID MALWARE VULNERABILITY**	**4 hours**

Master Key Vulnerability - File Name Length Vulnerability Introduction to Obfuscation - DEX Code Obfuscation

Module:5	**ENTERPRISE LEVEL SECURITY FOR MOBILE DEVICES**	**4 hours**

Security enhancement for Android, Device administration, Customizable secure boot, Knox security, Knox container, TIMA Trust Zone-based Integrity Measurement Architecture.

Module:6	**REVERSE ENGINEERING APPLICATIONS**	**4 hours**

Introduction Decompiling DEX Files to Java Interpreting the Dalvik Bytecode Decompiling the

applications native libraries, Debugging Android process, CFF explorer, dex2Jar, Hex Editor, JD-GUI		
Module:7	**DEVICE ADMINISTRATION POLICIES**	**4 hours**
Introduction - Using Cryptography Libraries - Screen Security - Secure USB Debugging		
Module:8	**Contemporary Issues: RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**30 hours**

Text /Reference Book(s)		
1.	Nikolay Elenkov, Android Security Internals - An InDepth Guide to Android Security Architecture , No Starch Press, 2015. (ISBN : 978-1-59-327581-5)	
2.	Keith Makan, Scott Alexander-Bown, Android Security Cookbook, Packt Publishers, 2013. (ISBN: 978 -1-78- 216716-7)	
3.	Erik Hellman, Android Programming Pushing the Limits, Wiley Publishers, 2014.(ISBN : 978-1-118-71737-0)	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1	Inspect details of AndroidManifest.xml	3 Hours
2	Installation of APK and identify the application	3 Hours
3	Analysis of various Malware types and behavior	4 Hours
4	Android malware analysis	4 Hours
5	Data encoding and malware countermeasures	4 Hours
6	Comparative study of various malware analysis tools	4 Hours
7	Tools available in Antivirus Application	4 Hours
8	Packet sniffing with Wire shark	4 Hours
	Total Laboratory Hours	30 Hours

Recommended by Board of Studies		28-02-2017		
Approved by Academic Council		No. 44	Date	16-03-2017

BCI3005	DIGITAL WATERMARKING AND STEGANOGRAPHY	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**					**Syllabus version**
						v1.0

Course Objectives:

1. To develop an understanding of digital watermarking and steganography basics, various approaches, characteristics and application domains.
2. To apply digital watermarking as an authentication tool for distribution of content over the Internet and steganography techniques for covert communication.
3. To understand the basics of the counter measures like steganalysis for assessing the data hiding methods.
4. To enable to evaluate and choose appropriate data hiding technique based on a multitude of security factors.

Expected Course Outcome:

1 Describe watermarking and steganography fundamental concepts and principles.
2. Identify and assess different types of data hiding techniques in various image formats like GIF, BMP etc., and various data hiding methods like LSB, EzStego, OutGuess, and F5.
3. Describe the block codes and its usage for covert communication.
4. Demonstrate the use of watermarking for copyright protection and steganography for secret communication in various digital media.
5. Design and implement efficient data hiding methods.
6. Assess the strength of any data hiding algorithm against steganalysis techniques.

Module:1	DATA HIDING	5 hours

Relationship between Watermarking and Steganography. Digital Watermarking Basics: Mod- els of Watermarking, Basic Message Coding, Error Coding. Digital Watermarking Theoretic Aspects: Mutual Information and Channel Capacity, Designing a Good Digital Mark, Theoretical Analysis of Digital Watermarking Types of Watermarking Fragile, Semi-Fragile.

Module:2	SPREAD SPECTRUM WATERMARKING	5 hours

Transform Domain Watermarking, Quantization Watermarking. Protocols: Buyer Seller Watermarking Protocols, Efficient and Anonymous Buyer-Seller Watermarking Protocol

Module:3	STEGANOGRAPHY	8 hours

Introduction - Text Steganography Image Steganography: Data Hiding in Raw (BMP) Images - LSB (Least Significant Bit) Embedding - Data Hiding by Mimicking Device Noise (Stochastic Modulation). Data Hiding in Palette (GIF) Images - Palette Formats (GIF) - Hiding by Decreasing Colour Depth, Gifshuffle, - Optimal Palette Parity Assignment. Data Hiding in JPEG Images - JPEG Format - J-Steg Data Hiding Algorithm Hiding in Spatial Domain Hiding in Transform Domain Image Quality Metrics

Module:4	AUDIO STEGANOGRAPHY	6 hours

Temporal Domain Techniques - Low-Bit Encoding - Echo Hiding - Hiding in Silence Intervals. Transform Domain Hiding Techniques - Magnitude Spectrum - Tone Insertion - Phase Coding

- Amplitude Coding - Cepstral Domain Codecs Domain: Codebook Modification Bit stream Hiding Audio Quality Metrics		
Module:5	**VIDEO STEGANOGRAPHY**	**6 hours**
Introduction Video Streams - Substitution- Based Techniques - Transform Domain Techniques - Adaptive Techniques - Format-Based Techniques - Cover Generation Techniques Video Quality Metrics - Perceptual Transparency Analysis - Robustness against Compression - Robustness against Manipulation.		
Module:6	**WET PAPER CODES**	**6 hours**
Random Linear Codes - LT Codes - Perturbed Quantization, Matrix Embedding - Matrix Embedding Theorem - Binary Hamming Codes, Q-Ary Case Random Linear Codes for Large Payloads		
Module:7	**STEGANALYSIS**	**7 hours**
Principles, Approaches, ROC Analysis - Sample Pairs Analysis - Attacks using Histogram Characteristic Function - Spatial Domain Steganalysis using Higher Order Statistics - Steganalysis using Resampling Calibration - Feature Selection - Calibration by Recompression		
Module:8	**Contemporary Issues: RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	I. J. Cox, M. L. Miller, J. A. Bloom, T. Kalker, and J. Fridrich, Digital Watermarking and Steganography, 2nd Ed. Amsterdam: Morgan Kaufmann Publishers In, 2007. (ISBN No. : 978-0-12-372585-1)
2.	J. Fridrich, Steganography in Digital Media: Principles, Algorithms, and Applications. Cambridge: Cambridge University Press, 2009. (ISBN No.: 978-0-52-119019-0)
Reference Book(s)	
1.	R. C. Gonzalez, R. E. Woods, D. J. Czitrom, and S. Armitage, Digital Image Processing, 3rd Ed. United States: Prentice Hall, 2007. (ISBN No.: 978-0-13-168728-8)
2.	P. Wayner, Disappearing Cryptography: Information hiding: Steganography and Watermarking , 3rd ed. Amsterdam: Morgan Kaufmann Publishers In, 2008 . (ISBN No. : 978-0-08-092270-6)
3	M. Arnold, M. Schmucker, and S. D. Wolthusen, Techniques and applications of digital Watermarking and content protection, 2nd Ed. Boston, MA: Artech House Publishers, 2003. (ISBN No.: 978-1-58-053664-6)

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

BCI4001	CYBER FORENSICS AND INVESTIGATION	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To present the students with a comprehensive understanding of digital forensic principles and the collection, preservation, and analysis of digital evidence
2. To enlighten the importance of forensic principles and procedures, legal considerations, digital evidence controls, and the documentation of forensic analysis
3. To develop an understanding of the different applications and methods for conducting network and digital forensic acquisition and analysis

Expected Course Outcome:

1. Explain the responsibilities and liabilities of a computer forensic investigator
2. Plan and prepare for an incident requiring computer forensic skills
3. Seize a computer from a crime scene without damaging it or risking it becoming inadmissible in a court of law
4. Identify potential sources of electronic evidence.
5. Understand the importance of maintaining the integrity of digital evidence.
6. Demonstrate the ability to perform basic forensic data acquisition and analysis using computer and network based applications and utilities.
7. Demonstrate the ability to accurately document forensic procedures and results

Module:1	UNDERSTANDING CYBER FORENSICS AND LEGAL ASPECTS	7 hours

Forensics Fundamentals ; Computer Forensics and Law Enforcement- Indian Cyber Forensic - Forensics Services, Professional Forensics Methodology- Types of Forensics Technology Forensics system and Services : Forensics on - Internet Usage – Intrusion - Firewall and Storage Area Network; Occurrence of Cyber-crimes- Cyber Detectives- Fighting Cyber Crimes- Forensic Process

Module:2	COMPUTER FORENSICS	6 hours

Data Backup and Recovery - Test Disk Suite, Data-Recovery Solution, Hiding and Recovering Hidden data, Evidence Collection and Data Seizure.

Module:3	DIGITAL FORENSICS AND PRESERVATION	6 hours

Digital Repositories - Evidence Collection – Data Preservation Approaches – Meta Data and Historic records – Legal aspects

Module:4	FORENSIC DATA ANALYSIS	6 hours

Basic Steps of Forensic Analysis in Windows and Linux – Forensic Scenario – Email Analysis – File Signature Analysis – Hash Analysis – Forensic Examination of log files

Module:5	MOBILE DEVICE SECURITY AND FORENSICS	6 hours
Introduction to Mobile Forensic – Android Device – Analysis- Android Malware – iOS Forensic Analysis – SIM Forensic Analysis – Case study		
Module:6	**CLOUD FORENSICS**	**5 hours**
Working with the cloud vendor, obtaining evidence, reviewing logs and APIs		
Module:7	**CURRENT COMPUTER FORENSIC TOOLS**	**7 hours**
Overview of different software packages – Encase-Autopsy-Magnet – Wireshark - Mobile Forensic Tools – SQLite Case study Report Preparation A real Forensic case study – Processing a complete Forensic case – Preparing Forensic Report		
Module:8	**Recent Trends**	**2 hours**
Industry Expert talk		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	J. R. Vacca, Computer forensics: Computer Crime Scene investigation, 2nd Ed. Hanover, NH, United States: Charles River Media, 2002.(ISBN No.: 978-1-58-450389-7).
2	C. Altheide, H. Carvey, and R. Davidson, Digital Forensics with Open Source Tools: Using Open Source Platform Tools for Performing Computer Forensics on Target Systems: Windows, Mac, Linux, Unix, etc, 1st Ed. United States: Syngress Media,U.S., 2011.(ISBN No. : 978-1-59-749586-8).
3	S. Bommisetty, R. Tamma, and H. Mahalik, Practical Mobile Forensics: Dive into Mobile Forensics on IOS, Android, windows, and blackBerry devices with this action-packed, practical guide. United Kingdom: Packt Publishing, 2014. (ISBN No. : 978-1783288311).
4	G. Gogolin, Digital Forensics Explained, 1st Ed. Boca Raton, FL: CRC Taylor Francis, 2013. (ISBN No. : 978-1-43-987495-0)
5	M. Dawson and M. Omar, Eds., New Threats and Countermeasures in Digital Crime and Cyber Terrorism. Boca Raton, FL, United States: Idea Group,U.S., 2015. (ISBN No.: 978-1-46-668345-7)
Reference Books	
1.	A. Hoog and J. McCash, Android forensics: Investigation, Analysis, and Mobile Security for Google Android. Waltham, MA: Syngress Media,U.S., 2011. (ISBN No.: 1597496510).
2.	B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, Guide to Computer Forensics and Investigations, Second edition, 2nd Ed. Boston: Thomson Course Technology, 2009. (ISBN No. : 0-619-21706-5)

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment: Project/Activity			
Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

BCI4002	VULNERABILITY ANALYSIS A ND PENETRATION TESTING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To learn the tools that can be used to perform information gathering
2. To identify various attacks in various domains of cyber space.
3. To learn about exploits in various operating systems and Wireless environment
4. To learn how vulnerability assessment can be carried out by means of automatic tools or manual investigation
5. To learn the vulnerabilities associated with various network applications and database system.

Expected Course Outcome:

1 Ability to determine the security threats and vulnerabilities in computer networks using penetration testing techniques
2. Set up of a hacking lab environment to study and document vulnerabilities within the network
3. Realize and respect ethical boundaries to demonstrate and understand what is necessary and appropriate when conducting penetration tests

Module:1	**Information Gathering and Detecting Vulnerabilities**	**5 hours**
Open Source Intelligence Gathering - Port Scanning - Nessus Policies - Web Application Scanning Manual Analysis- Traffic Capturing		

Module:2	**Attacks**	**4 hours**
Password Attacks Client side Exploitation Social Engineering- Bypassing Antivirus Applications.		

Module:3	**Exploits**	**4 hours**
Metasploit Payloads Open phpMyAdmin -Buffer overflow: Windows and Linux,Web scanning exploits, port scanning exploits, SQL exploits		

Module:4	**Wireless Security**	**5 hours**
Wired vs. wireless Privacy Protocols - Wireless Frame Generation Encryption Cracking Tools- Wireless DoS Attacks		

Module:5	**Common Vulnerability Analysis of Application Protocols**	**4 hours**
Simple Mail Transfer Protocol- File Transfer Protocol- Trivial File Transfer Protocol-Hyper Text Transmission Protocol-ICMP SMURF- UDP-DNS-PING-SYN		

Module:6	**Network Vulnerability Analysis**	**4 hours**
Domain Name Server and Dynamic Host Configuration Protocol -Light Weight Directory Access Protocol-Simple Network Management Protocol-Remote Procedural Call		

Module:7	**Penetration Tools and Database Security**	**3 hours**

Traceroutes, Neotrace, Whatweb. Database Security : Access control in database systems - Inference control - Multilevel database security		
Module:8	**Recent Trends**	**1 hour**
Industry Expert talk		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Georgia Weidman, "Penetration Testing: A Hands On Introduction to Hacking", No Startch Press, First Edition 2014. ISBN-13: 978-1593275648 ISBN-10: 1593275641.
2	B.Singh, H.Joseph and Abhishek Singh,"Vulnerability Analysis and Defense for the Internet, Springer, 2008 Edition. ISBN-10: 0387743898 ISBN-13: 978-0387743899.
Reference Books	
1.	Rafay Baloch, "Ethical Hacking and Penetration Testing Guide",CRC Press, 2015,ISBN :78-1-4822-3161-8.
2.	Dr.Patrick Engebretson, "The Basics of Hacking and Penetration Testing",Syngress Publications Elseveir, 2013, ISBN : 978-0-12-411644-3
3.	Prakhar Prasad, Mastering Modern Web Penetration Testing (Kindle Edition),2016 , Packt Publishing, ISBN:978-1-78528-458-8.
4	Gilberto Najera Gutierrez, Kali Linux Web Penetration Testing Cookbook ,2016, ISBN13 9781784392918
5	Robert Svensson, From Hacking to Report Writing: An Introduction to Security and Penetration Testing 2016, ISBN 978-1-4842-2282-9

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Set up of Kali Linux in a Virtual machine and setup with DNS info and collection of local network.	2 hours
2.	Scan the network for Windows XP and Windows 7 Target machines in local network and virtual network.	2 hours
3.	Identify the open ports and firewall rules setup.	2 hours
4.	Use password guessing tools to guess a password. Use password strengthening tools to strengthen the password. Try guessing the password and tabulate the enhanced difficulty due to length of password and addition of special characters	2 hours
5.	Extract password hashes from Windows XP/ NT machine. Use a password extraction tool, using word list, single crack or external mode to recover the password. Increase the complexity of the password and determine the point at which the cracking tool fails	2 hours
6.	Experiments on SQL injections.	2 hours
7.	Analysis of WEP flaws.	2 hours
8.	Experiments on Wireless DoS Attacks.	2 hours
9.	Buffer Overflow Prevention	2 hours
10.	Prevention against Cross Site Scripting Attacks.	2 hours
11.	Experiments on Metasploit Framework.	2 hours
12.	Cross Site Scripting.	2 hours
13.	Cross Site Request Forgery.	2 hours
14	File upload vulnerability on Social engineering.	2 hours
15	Cracking Linux passwords	2 hours
	Total Laboratory Hours	**30 hours**
Mode of assessment: Project/Activity		

Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

BCI4003	MALWARE ANALYSIS	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To introduce the fundamentals of malware, types and its effects
2. To enable to identify and analyse various malware types by static, dynamic analysis and reverse engineering
3. To deal with detection, analysis, understanding, controlling, and eradication of malware

Expected Course Outcome:

1 Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
2. Have an intimate understanding of executable formats, Windows internals and API s, and malware analysis techniques.
3. Extract investigative leads from host and network-based indicators associated with a malicious program.
4. Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti-analysis techniques in future malware samples.
5. Achieve proficiency with industry standard tools including ProcMon, CFF Explorer, ProcExplore, BinText, FileAlyzer, OllyDbg etc

Module:1	**INTRODUCTION TO MALWARE ANALYSIS**	**4 hours**

Malware taxonomy - Malware threats - Malware analysis methodologies - Legal considerations - Identifying and protecting against malware - Malware hiding places - Collecting malware from live system - Identifying malware in dead system Malware Analysis Environment : Virtual machine - Real systems - Malware analysis tools ProcMon, CFF Explorer, ProcExplore, BinText, FileAlyzer, OllyDbg

Module:2	**STATIC ANALYSIS**	**4 hours**

Detailed file analysis -Database of file hashes. Identifying file compile date Identifying packing/ obfuscation methods - Strings analysis - File signature analysis - Local and online malware scanning -Identifying file dependencies.

Module:3	**Dynamic Analysis**	**4 hours**

System baselining - Host integrity - Monitor - Installation monitor - Process monitor - File monitor - Registry analysis/ monitoring - Network traffic monitoring/ ana lysis - Port monitor - DNS monitoring/ resolution -Simulating internet services

Module:4	**CODE ANALYSIS**	**4 hours**

Reverse engineering malicious code - Identifying malware passwords - Bypassing authentication - Assembly level computing Standard x86 instructions, Introduction to IDA, Olly Dbg, Advanced malware analysis Virus, Trojan. Parsing Basic analysis of an APK

Module:5	MALICIOUS DOCUMENT ANALYSIS	4 hours
PDF and Microsoft Office document structures - PDF and office document vulnerabilities - Malware extraction and analysis tools - Analysis of malicious documents		
Module:6	**MALWARE CHALLENGES**	**3 hours**
Virtual environment - Live internet connection - Real, fake, and virtual services -Anti-debug and anti-forensic malware		
Module:7	**MOBILE MALWARE ANALYSIS**	**5 hours**
Need for mobile application penetration testing testing methodology Android and iOS Vulnerabilities - Exploit Prevention - Handheld Exploitation- Android Root Spreading and Distribution Android Debugging		
Module:8	**Recent Trends**	**2 hours**
Industry Expert talk		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	M. Sikorski and A. Honig, Practical Malware Analysis: The Hands-on Guide to Dissecting Malicious Software. San Francisco: No Starch Press San Francisco, CA, 2012. (ISBN No.: 978-1-59-327290-6)
2	M. H. Ligh, S. Adair, and B. Hartstein, Cookbook and DVD: Tools and Techniques for Fighting Malicious Code. Indianapolis, IN: Wiley, John Sons, 2010. (ISBN No. : 978-0-470-61303-0).
3	K. Dunham and S. Abu-Nimeh, Mobile Malware Attacks and Defense. Washington, DC, United States: Syngress Media,U.S., 2008. (ISBN No. : 978-1-59-749298-0).
Reference Books	
1.	C. H. Malin, J. M. Aquilina, and E. Casey, Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides, R. Maxwell, Ed. Waltham, MA: Syngress Media,U.S., 2012. (ISBN No.: 978-1-59-749472-4).
2.	B. Dang, A. Gazet, E. Bachaalany, and S. Josse, Practical Reverse Engineering: X86, X64, arm, Windows Kernel, Reversing Tools, and Obfuscation. United States: Wiley, 2014. (ISBN No. : 978-1-118-78731-1)
3.	C. Eagle, The IDAPro Book: The Unofficial Guide to the worlds most popular Disassembler , 2nd Ed. San Francisco: No Starch Press San Francisco, CA, 2011. (ISBN No. : 978-1-59327-289-0).
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1	Sandboxing malware and gathering information from runtime analysis	2 hours
2	Basic malware analysis finding file compilation date, imports/ exports, suspicious strings , run-time effect, procmon filter, hist -based signatures revealing files, registry keys, processes, services, network based signatures revealing URLs, packet contents, intention, checksum, and evidence	2 hours
3	Advanced static malware analysis finding address of main, code constructs, suspicious strings, imported functions, their tasks, intention of the malware, impact of the malware via hexcode	2 hours
4	Basic analysis of Windows programs for imports, msdn based purposes, changes, suspicious strings, persistence mechanism, COM interface, COM functions, host-based signature, checksum, VirusTotal Report for that malware.	2 hours
5	Advacned analysis of Windows programs for processes, interactive remote shell, uploaded file, address of the subroutine, return value, Windows APIs, functionalities of the malware	2 hours
6	Malware behaviour analysis finding the source of malware, how it reached	2 hours

	the system, persistence mechanism, multiple instances replication mechanism, hiding strategies, API calls for key logging, constants involved, post-infection actions of the malware, mutex, SendMessage API structure, what is done with the collected data	
7	Anti-disassembly and anti-debugging technique used in the binary by patching the PE, set a breakpoint in the malicious subroutine and let the program execute until the breakpoint	3 hours
8	Packing and unpacking malware finding the packers name, indicator, unpacking script, removing the nagging screen, resolving any PE header corruption, fixing the import table	3 hours
9	Disassembling Portable Executable (PE32) File Format following all imports, exports, functions, main address, malicious string locations, x86 assembly language	3 hours
10	Reversing basics: branches, loops, switches, differences between code and data, cross-references, imports & exports, searching, defining arrays, structures , and ,functions, standard library functions and FLIRT, IDA scripts and plugins	3 hours
11	Malware self- defense, compression, and obfuscation techniques packing, unpacking, identifying malicious code section, recognizing and defeating data encryption and encoding techniques etc	3 hours
12	Analyzing malicious Microsoft Office and Adobe PDF documents to locate potentially malicious embedded code such as shellcode, VBA macros or JavaScript, extract suspicious code from the file, disassemble and/ or debug shellcode, understand all the steps in the infection chain	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity			
Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 44	Date	16-03-2017

CSE2006	MICROPROCESSOR AND INTERFACING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**CSE1003-Digital Logic Design, CSE2001-Computer Architecture and Organization**	**Syllabus version**				
		v1.0				

Course Objectives:

1. Students will gain knowledge on architecture, accessing data and instruction from memory for processing.
2. Ability to do programs with instruction set and control the external devices through I/O interface
3. Generate a system model for real world problems with data acquisition, processing and decision making with aid of micro controllers and advanced processors.

Expected Course Outcome:

1. Recall the basics of processor, its ways of addressing data for operation by instruction set.
2. Execute basic and advanced assembly language programs.
3. Learn the ways to interface I/O devices with processor for task sharing.
4. Recall the basics of co-processor and its ways to handle float values by its instruction set.
5. Recognize the functionality of micro controller, latest version processors and its applications.
6. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

Module:1	**INTRODUCTION TO 8086 MICROPROCESSOR**	**6 hours**

Introduction to 8086, Pin diagram, Architecture, addressing mode and Instruction set

Module:2	**INTRODUCTION TO ALP**	**5 hours**

Tools- Assembler Directives, Editor, assembler, debugger, simulator and emulator. E.g., ALP Programs-Arithmetic Operations and Number System Conversions, Programs using Loops, If then else, for loop structures

Module:3	**Advanced ALP**	**2 hours**

Interrupt programming using DOS BIOS function calls, File Management

Module:4	**Introduction to Peripheral Interfacing-I**	**5 hours**

PPI 8255, Timer 8253,Interrupt controller-8259

Module:5	**Introduction to Peripheral Interfacing-II**	**4 hours**

IC 8251 UART, Data converters (A/D and D/A Converter), seven segment display and key- board interfacing

Module:6	**Co-Processor**	**4 hours**

Introduction to 8087, Architecture, Instruction set and ALP Programming

Module:7	**Introduction to Arduino Boards**	**2 hours**

Introduction to Microcontroller- Quark SOC processor, programming, Arduino Boards using GPIO (LED, LCD, Keypad, Motor control and sensor), System design application and case study.

Module:8	Contemporary issues	2 hours
Architecture of one of the advanced processors such as Multicore, Snapdragon, ARM processor in iPad		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	A.K. Ray and K.M. Bhurchandi Advanced Microprocessors and Peripherals, third Edition, Tata McGraw Hill, 2012.
2.	Barry B Bray , The Intel Microprocessor 8086/8088, 80186,80286, 80386 and 80486 Arcitecture, programming and interfacing, PHI, 8th Edition, 2009.

Reference Books	
1.	Douglas V. Hall, SSSP Rao Microprocessors and Interfacing Programming and Hardware. Tata McGraw Hill, Third edition, 2012.
2.	Mohamed Rafiquazzaman, Microprocessor and Microcomputer based system design, Universal Book stall, New Delhi, Second edition, 1995
3.	K Uday Kumar, B S Umashankar, Advanced Micro processors IBM-PC Assembly Language Programming, Tata McGraw Hill, 2002.
4.	Massimo Banzi,Getting Started with Arduino , First Edition, pub. O'Reilly, 2008.
5.	John Uffenbeck and 8088 Family. 1997. The 80x86 Family: Design, Programming, and Interfacing (2nd ed.). Prentice Hall PTR, Upper Saddle River, NJ, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Arithmetic operations 8/16 bit using different addressing modes.	2.5 hours
2.	Finding the factorial of an 8 /16 bit number.	2.5 hours
3.	(a) Solving nCr and nPr (b) Compute nCr and nPr using recursive procedure. Assume that n and r are non-negative integers	2.5 hours
4.	Assembly language program to display Fibonacci series	2.5 hours
5.	Sorting in ascending and descending order	2.5 hours
6.	(a) Search a given number or a word in an array of given numbers. (b) Search a key element in a list of n 16-bit numbers using the Binary search algorithm.	2.5 hours
7.	To find the smallest and biggest numbers in a given array.	2.5 hours
8.	ALP for number system conversions.	2.5 hours
9.	(a) String operations(String length, reverse, comparison, concatenation, palindrome)	2.5 hours
10.	ALP for Password checking	2.5 hours
11.	Convert a 16-bit binary value (assumed to be an unsigned integer) to BCD and display it from left to right and right to left for specified number of times	2.5 hours
12.	ALP to interface Stepper motor using 8086/ Intel Galileo Board	2.5 hours
	Total Laboratory Hours	30 hours

Mode of assessment: Project/Activity

Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE3001	SOFTWARE ENGINEERING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To introduce the essential software engineering concepts involved
2. To impart skills in the design and implementation of efficient software systems across disciplines
3. To familiarize engineering practices and standards used in developing software products and components

Expected Course Outcome:

1. Apply the principles of the engineering processes in software development.
2. Demonstrate software project management activities such as planning,scheduling and Estimation.
3. Model the requirements for the software projects.
4. Design and Test the requirements of the software projects.
5. Implement the software development processes activities from requirements to validation and verification.
6. Apply and evaluate the standards in process and in product.

Module:1	**OVERVIEW OF SOFTWARE ENGINEERING**	**5 hours**

Nature of Software, Software Engineering, Software process, project, product, Process Models Classical Evolutionary models, Overview of System Engineering

Module:2	**INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT**	**3 hours**

Planning scope, milestones deliverables, Risk Management, Metrics Measurement

Module:3	**MODELLING REQUIREMENTS**	**6 hours**

Requirements Engineering process Requirement Elicitation, System Modelling - Requirements Specification and Requirement Validation

Module:4	**SOFTWARE DESIGN**	**4 hours**

Design concepts and principles - Abstraction - Refinement - Modularity Cohesion coupling, Architectural design, Detailed Design Transaction Transformation, Refactoring of designs, Object-oriented Design User-Interface Design

Module:5	**VALIDATION and VERIFICATION**	**4 hours**

Strategic Approach to Software Testing, Testing Fundamentals Test Plan, Test Design, Test Execution, Reviews, Inspection Auditing

Module:6	**SOFTWARE EVOLUTION**	**4 hours**

Software Maintenance, Types of Maintenance, Software Configuration Management, Overview of RE-engineering Reverse Engineering

Module:7	**QUALITY ASSURANCE**	**2 hours**

Product Process Metrics, Quality Standards Models ISO, TQM, Six-Sigma

Module:8	**RECENT TRENDS**	**2 hours**

Recent Trends in Software Design/Specialized Software Testing, Related Tools and Standards

	Total Lecture hours:	**30 hours**	

Text Book(s)				
1.	Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw-Hill, 2010.			
Reference Books				
1.	Ian Sommerville, Software Engineering, 9th Edition, Addision-Wesley, 2016			
2.	Pankaj Jalote, A Concise Introduction to Software Engineering, Springer, 2008			
3.	William E. Lewis , Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2008			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based)			3 hours
2.	Estimations Cost and Schedule			3 hours
3.	Entity Relationship Diagram, Context flow diagram, DFD (Structural Modeling and Functional Modeling)			4 hours
4.	State Transition Diagrams (Behavioral Modeling)			4 hours
5.	System Requirements Specification			4 hours
6.	UML diagrams for OO Design			4 hours
7.	Tools for Version Control			3 hours
8.	Black-box, White-box testing			3 hours
9.	Non-functional testing			2 hours
			Total Laboratory Hours	30 hours
Mode of assessment: Project/Activity				
Recommended by Board of Studies	04-04-2014			
Approved by Academic Council	No. 37	Date	16-06-2015	

CSE3009	INTERNET OF THINGS	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To apprise students with basic knowledge of IoT that paves a platform to understand physical, logical design and business models
2. To teach a student how to analyze requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
3. To explain the students how to code for an IoT application and deploy for real-time scenario.

Expected Course Outcome:

1. Describe various layers of IoT protocol stack and describe protocol functionalities.
2. Evaluate efficiency trade-offs among alternative communication models for an efficient IoT application design.
3. Comprehend advanced IoT applications and technologies from the basics of IoT.
4. Understand working principles of various sensor for different IoT platforms.
5. Estimate the cost of hardware and software for low cost design IoT applications.
6. Compare various application business models of different domains.
7. Solve real-time problems and demonstrate IoT applications in various domains using prototype models.

Module:1	**Introduction To Internet of Things**	**5 hours**

Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.

Module:2	**Components In Internet of Things**	**7 hours**

Control Units Communication modules Bluetooth Zigbee Wifi GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc), MQTT, Wired Communication, Power Sources.

Module:3	**Technologies Behind IoT**	**7 hours**

Four pillars of IOT paradigm, - RFID, Wireless Sensor Networks, SCADA (Supervisory Con- trol and Data Acquisition), M2M - IOT Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems.

Module:4	**Programming The Microcontroller For IoT**	**8 hours**

Working principles of sensors IOT deployment for Raspberry Pi /Arduino /Equivalent plat- formReading from Sensors, Communication: Connecting microcontroller with mobile devices, communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator.

Module:5	**Resource Management in IoT**	**4 hours**

Clustering, Clustering for Scalability, Clustering Protocols for IOT.

Module:6	**From The Internet Of Things To The Web Of Things**	**6 hours**

The Future Web of Things Set up cloud environment Cloud access from sensors Data Analytics for IOT- Case studies- Open Source e-Health sensor platform Be Close Elderly monitoring Other recent

projects.		
Module:7	**IoT Applications**	**6 hours**
Business models for the internet of things, Smart city, smart mobility and transport, smart buildings and infrastructure, smart health, environment monitoring and surveillance.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011
2.	Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015
Reference Books	
1.	Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April 2002
2.	Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE3011	ROBOTICS AND ITS APPLICATIONS	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v.2.0				

Course Objectives:

1. To introduce the parts of robots, basic working concepts and types of robots
2. To make the students familiar with the various drive systems of robots, sensors and their applications in robots
3. To discuss the applications and implementation of robots

Expected Course Outcome:

1. Explain the basic working concepts of robots
2. Analyze the function of sensor in robot and design the robotic arm with various tools
3. Program the robot for typical application and path planning of robot using robotic vision
4. Understand the various robot programming languages
5. Conduct and design the experiments for various robot operations
6. Use the advanced techniques for robot processing

Module:1	**Introduction**	**3 hours**

Introduction, brief history, components of robotics, classification, workspace, work-envelop, motion of robotic arm, end-effectors and its types, service robot and its application, Artificial Intelligence in Robotics.

Module:2	**Actuators and sensors**	**7 hours**

Types of actuators, stepper-DC-servo-and brushless motors- model of a DC servo motor-types o transmissions-purpose of sensor-internal and external sensor-common sensors-encoders tachometers-strain gauge based force torque sensor-proximity and distance measuring sensors

Module:3	**Kinematics of robots**	**6 hours**

Representation of joints and frames, frames transformation, homogeneous matrix, D-H matrix, Forward and inverse kinematics: two link planar (RR) and spherical robot (RRP). Mobile robot Kinematics: Differential wheel mobile robot.

Module:4	**Localization**	**6 hours**

Self-localizations and mapping - Challenges in localizations – IR based localizations – vision based localizations – Ultrasonic based localizations - GPS localization systems.

Module:5	**Path Planning**	**6 hours**

Introduction, path planning-overview-road map path planning-cell decomposition path planning-potential field path planning-obstacle avoidance-case studies

Module:6	**Vision system**	**6 hours**

Robotic vision systems-image representation-object recognition-and categorization-depth measurement- image data compression-visual inspection-software considerations

Module:7	**Application**	**9 hours**

Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- andmilitary applications-nuclear applications-space applications-Industrial robots-artificial intelligence in robots-application of robots in material handling-continuous arc welding-spot welding-spray painting-assembly operation-cleaning-etc.

Module:8	**Contemporary issues**		**2 hours**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Richared D.Klafter. Thomas Achmielewski and Mickael Negin, Robotic Engineering and Integrated Approach, Prentice Hall India-Newdelhi-2001
2.	Saeed B.Nikku, Introduction to robotics, analysis, control and applications, Wiley-India, 2nd edition 2011
Reference Books	
1.	Industrial robotic technology-programming and application by M.P.Groover et.al, McGrawhill-2008
2.	Robotics technology and flexible automation by S.R.Deb, THH-2009
3.	ABB reference Manual
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)	
Study of robotics part and microcontroller family and programming environments	2 hours
1. Sensor interface application program development (Like IR, Ultrasonic, etc.)	4 hours
2. Motor interface application development	4 hours
3. Sensor and motor interface control aspects	4 hours
4. Robotic ARM design and simulation	4 hours
5. Vision system simulation	4 hours
6. Interactive –Chat Bots	4 hours
7. Application of robot1- Firefighting robot simulation	2 hours
8. Application of robot2- Drones simulation	2 hours
9. Application of robot3- Service robot simulation	2 hours
Total Laboratory Hours	32 hours

Mode of assessment:			
Recommended by Board of Studies	DD-MM-YYYY		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

CSE3013	ARTIFICIAL INTELLIGENCE	L	T	P	J	C
		3	0	0	4	4

Pre-requisite	NIL	Syllabus version
		v1.0

Course Objectives:

1. To impart artificial intelligence principles, techniques and its history
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems
3. To develop intelligent systems by assembling solutions to concrete computational problems

Expected Course Outcome:

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
4. Analyze and illustrate how search algorithms play vital role in problem solving
5. Illustrate the construction of learning and expert system
6. Discuss current scope and limitations of AI and societal implications.

Module:1	Artificial Intelligence and its Issues	9 hours

Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.

Module:2	Overview to Problem Solving	5 hours

Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement.

Module:3	Heuristic Search	4 hours

Types, Game playing mini-max algorithm, Alpha-Beta Pruning

Module:4	Knowledge Representation and Reasoning	7 hours

Logical systems Knowledge Based systems, Propositional Logic Constraints, Predicate Logic First Order Logic, Inference in First Order Logic, Ontological Representations and applications

Module:5	Uncertainty and knowledge Reasoning	7 hours

Overview Definition of uncertainty, Bayes Rule Inference, Belief Network, Utility Based System, Decision Network

Module:6	Learning Systems	4 hours

Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning Decision Trees

Module:7	Expert Systems	7 hours

Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems

- Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems			
Module:8	**Recent Trends**		**2 hours**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2.	Poole, D. and Mackworth, A. 2010. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press.
Reference Books	
1.	Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.
2.	Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.
3.	Brachman, R. and Levesque, H. 2004. Knowledge Representation and Reasoning, Morgan Kaufmann.
4.	Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT Press.
5.	Sutton R.S. and Barto, A.G. 1998. Reinforcement Learning: An Introduction, MIT Press.
6.	Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE3022	SOFT COMPUTING	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**					

Objective of the course

The objective of this course is to introduce methods for handling imprecise and uncertain data using Rough sets, Neuro Fuzzy Systemsand foster their abilities in designing and implementing optimal solutions for real-world and engineering problems using derivative freeoptimization techniques.

Expected Outcome

After successfully completing the course the student should be able to Expected

- Have a general understanding of soft computing methodologies,to deal with imprecise and uncertain data
- Develop computational neural network models for some simplebiological systems
- Develop fuzzy models for engineering systems, particularly forcontrol systems;
- Apply derivative free optimization methods to solve real worldproblems
- Demonstrate some applications of computational intelligence

Module 1	Introduction to Soft Computing	**2 Hrs**
Soft Computing Overview – Uncertainty in data, Hard vs Soft Computing		
Module 2	Neural Networks	7
Introduction, RBF Networks, Self-Organizing Map, BoltzmannMachines, Convolutional Neural Networks		
Module 3	Fuzzy Systems	7
Fuzzy Sets, Fuzzy Relations, and Membership functions,Properties of Membership functions, Fuzzification and Defuzzification		
Module 4	Fuzzy logic	7
Fuzzy Rule based systems, Fuzzy Decision making, FuzzyClassification, Fuzzy C-Means Clustering		
Module 5	Rough Sets	7
Rough Sets – Definition, Upper and Lower Approximations, Boundary Region, Decision Tables and Decision Algorithms. Properties of Rough Sets. Rough K-means clustering, Rough Support Vector Clustering		
Module 6	Optimization Techniques	8
Introduction, Genetic Algorithm, Memetic Algorithms, Particle Swarm Optimization, Ant Colony Optimization, Frog-Leaping. Hybrid Systems		
Module 7	GA Based Back Propagation Networks, Fuzzy Back Propagation Networks, Evolutionary Ensembles	5
Module 8	Recent trends	2
	Total hours	45

Reference Books

1. S.N. Sivanandham and S.N.Deepa, “Principles of Soft Computing”, 2nd Edition, Wiley Publications.
2. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", John Wiley &Sons,2007
3. Laurene V. Fausett “Fundamentals of Neural Networks: Architectures, Algorithms And Applications”, Pearson, 1993
4. Simon Haykin "Neural Networks and Learning Machines" Prentice Hall, 2008.
5. Timothy Ross, “Fuzzy Logic with Engineering Applications”, Third Edition, Wiley, 2010
6. S. N. Sivanandam,S. Sumathi and S. N. Deepa, “Introduction to Fuzzy Logic usingMatlab”– Springer, 2007.
7. Samir Roy, Udit Chakraborty, “Introduction to Soft Computing Neuro Fuzzy Geneticalgorithms”, Pearson Education, 2013.
8. Witold Pedrycz, Andrzej Skowron, Vladik Kreinovich “Handbook of GranularComputing”, Wiley, 2008

Approved by Academic Council	No. 41	Date	19-06-2016

Project J Component:

Generally a team project consists of four to six members60
Down to earth application and innovative idea should have been attemptedNon# Report in Digital format with all drawings using software package to be Contactsubmitted.Hours
Assessment on a continuous basis with a min of 3 reviews.

The following is the sample project that can be given to students to beimplemented in any programming languages.

- Develop Fuzzy Decision-Making for Job Assignment Problem
- Implement TSP using Optimization Techniques
- Develop a suitable method for Health Care Application using Neuro-Fuzzy systems
- Develop a suitable method for Face Recognition System
- Layout Optimization using Genetic Algorithms
- Fault Diagnosis using rough set theory
- Software safety analysis using rough sets

A Neuro-fuzzy Approach to Bad Debt Recovery in Healthcare

Course code	Course Title	L	T	P	J	C
CSE3035	Principles of Cloud Computing	3	0	2	0	4
Pre-requisite		Syllabus version				
		V 1.0				

Course Objectives:

1. To introduce the cloud computing concepts and map reduce programming model.
2. To provide skills and knowledge about operations and management in cloud technologies so as to implement large scale systems.
3. To provide skills to design suitable cloud infrastructure that meets the business services and customer needs.

Expected Course Outcome:

1. Understand the evolution, principles, and benefits of Cloud Computing in order to assess existing cloud infrastructures to choose an appropriate architecture that meets business needs.
2. Decide a suitable model to capture the business needs by interpreting different service delivery and deployment models.
3. Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.
4. Infer architectural style, work flow of real world applications and to implement the cloud applications using map reduce programming models.
5. Design a cloud framework with appropriate resource management policies and mechanism.
6. Compare operation and economic models of various trending cloud platforms prevailing in IT industry.

Module:1	Foundations of cloud	6 hours

Inception and need for cloud computing: Motivations from distributed computing predecessors - Evolution - Characteristics - Business Benefits – Challenges in cloud computing - Exploring the Cloud Computing Stack - Fundamental Cloud Architectures – Advanced Cloud Architectures - Specialized Cloud Architectures

Module:2	Service Delivery and Deployment Models	5 hours

Service Models (XaaS): Infrastructure as a Service (IaaS) - Platform as a Service (PaaS) - Software as a Service(SaaS) - Deployment Models: Types of cloud - Public cloud - Private cloud - Hybrid cloud – Service level agreements - Types of SLA – Lifecycle of SLA- SLA Management

Module:3	Cloud Resource Virtualization	5 hours

Virtualization as Foundation of Cloud – Understanding Hypervisors – Understanding Machine Image and Instances - Managing Instances – Virtual Machine Provisioning and Service Migrations

Module:4	Cloud Computing: Applications and Paradigms	8 hours

Existing Cloud Applications and Opportunities for New Applications - Architectural Styles for Cloud Applications - Workflows: Coordination of Multiple Activities - Coordination Based on a State Machine Model: The ZooKeeper - The MapReduce Programming Model - A Case Study: The GrepTheWeb Application

Module:5	Resource Management and Scheduling in Cloud	6 hours
Policies and Mechanisms for Resource Management – Stability of a Two-Level Resource Allocation Architecture- Feedback Control Based on Dynamic Thresholds - Coordination of Specialized Autonomic Performance Managers - A Utility-Based Model for Cloud-Based Web Services - Resource Bundling: Combinatorial Auctions for Cloud Resources – Scheduling Algorithms for Computing Clouds - Resource Management and Dynamic Application Scaling		
Module:6	**Cloud Platforms and Application Development**	**9 hours**
Comparing Amazon web services, Google AppEngine, Microsoft Azure from the perspective of architecture (Compute, Storage Communication) services and cost models. Cloud application development using third party APIs, Working with EC2 API – Google App Engine API - Facebook API, Twitter API.		
Module:7	**Advances is Cloud**	**4 hours**
Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Clouds		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Rajkumar Buyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 1st Edition, 2013.
2.	Sosinsk, Barrie, Cloud Computing Bible, John Wiley & Sons, 1st Edition, 2011.
Reference Books	
1.	Marinescu, Dan C. Cloud Computing: Theory and Practice. Morgan Kaufmann, 2017.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Mc Graw Hill Education, 1st Edition, 2017.
3.	Buyya, Rajkumar, Christian Vecchiola, and S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Applications Programming, Tata Mcgraw Hill, 1st Edition, 2017.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Experiments		
1.	Configure a VM instance in your local machine and in cloud (by creating a cloud account). Allocate CPU, memory and storage space as per a specified requirement. Install Guest OS image in that instance, launch the same and confirm the successful installation of the OS by performing few OS commands.	3 hours
2.	Configure a Nested Virtual Machine (VM under another VM) in cloud and local machine. Install OS images and work with few OS commands.	2 hours
3	Create a ssh tunnel between your server in local machine and remote clients in EC2 instances and test the connections with programs using X11 traffic	3 hours
4.	Install the Hadoop framework and create an application using Map Reduce Programming Model	2 hours
5.	Perform live QEMU-KVM VM migrations using NFS	3 hours

6.	Experiment cloud scheduling algorithms using Cloud Sim/ OPNET / CloudAnalyst tool.	3 hours
7.	Experiment cloud load balancing algorithms using Cloud Sim/ OPNET/ CloudAnalyst tool.	2 hours
8.	Monitor, visualize and analyze performance of resource utilization in cloud platforms using Grafana tool.	2 hours
9.	Configure a VLAN using cisco packet tracer and analyze traffic issues	2 hours
10.	Build container images, launch the container instance in the cloud and run an application inside the container instance in cloud	2 hours
11.	EC2 AWS – Instance Creation, Migration	2 hours
12.	DaaS – Deployment of a basic web app and add additional Functionality (Javascripts based)	2 hours
13.	SaaS – Deployment of any SaaS application for a online Collaborative tool	2 hours
	Total Laboratory Hours	30 hours

Mode of evaluation: Project/Activity			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

CSE3501	Information Security Analysis and Audit	L	T	P	J	C
	Job Role: SSC/Q0901	2	0	2	4	4
Pre-requisite	Computer Networks	Syllabus version				
		v.1.0				

Objective of the course

1. Explore system security related incidents and gain insight on potential defenses and counter measures against common threat/vulnerabilities.
2. Install, configure and troubleshoot information security devices
3. Gain experience using tools and common processes in information security audits and analysis of compromised systems.

Expected Outcome

After successfully completing the course the student should be able to

- Contribute to managing information security
- Co-ordinate responses to information security incidents
- Install and configure information security devices
- Contribute to information security audits
- Support teams to prepare for and undergo information security audits
- Manage their work to meet requirements
- Work effectively with colleagues
- Maintain a healthy, safe and secure working environment
- Provide data/information in standard formats
- Develop their knowledge, skills and competence

1	**Information Security Fundamentals**	7 hours
Definitions & challenges of security, Attacks & services, Security policies, Security Controls, Access control structures, Cryptography, Deception, Ethical Hacking, Firewalls, Identify and Access Management (IdAM).		
2	**System Security**	6 hours
System Vulnerabilities, Network Security Systems, System Security, System Security Tools, Web Security, Application Security, Intrusion Detection Systems.		
3	**Information Security Management**	3 hours
Monitor systems and apply controls, security assessment using automated tools, backups of security devices, Performance Analysis, Root cause analysis and Resolution, Information Security Policies, Procedures, Standards and Guidelines		
4	**Incident Management**	5 hours
Security requirements, Risk Management, Risk Assessment, Security incident management, third party security management, Incident Components, Roles.		
5	**Incident Response**	4 hours
Incident Response Lifecycle, Record, classify and prioritize information security incidents using standard templates and tools, Responses to information security incidents, Vulnerability Assessment, Incident Analysis.		
6	**Conducting Security Audits**	3 hours

Common issues in audit tasks and how to deal with these, Different systems and structures that may need information security audits and how they operate, including: servers and storage devices, infrastructure and networks , application hosting and content management, communication routes such as messaging, Features, configuration and specifications of information security systems and devices and associated processes and architecture, Common audit techniques, Record and report audit tasks, Methods and techniques for testing compliance.		
7	**Information Security Audit Preparation**	2 hours
Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits.		
8	**Self and Work Management**	2 hours
Establish and agree work requirements with appropriate people, Keep the immediate work area clean and tidy, utilize time effectively, Use resources correctly and efficiently, Treat confidential information correctly, Work in line with organization's policies and procedures, Work within the limits of their job role.		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 3rd edition, 2014.
2.	Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Wiley, 2017
3.	Nina Godbole, Sunit Belapure, Cyber Security- Understanding cyber-crimes, computer forensics and legal perspectives, Wiley Publications, 2016
4.	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly, 2010

Reference Books

1.	Charles P. Pfleeger, Security in Computing, 4th Edition, Pearson, 2009.
2.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004
3.	Peter Zor, The Art of Computer Virus Research and Defense, Pearson Education Ltd, 2005
4.	Lee Allen, Kevin Cardwell, Advanced Penetration Testing for Highly-Secured Environments - Second Edition, PACKT Publishers, 2016
5.	Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014
6.	David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014

7	Practical Malware Analysis by Michael Sikorski and Andrew Honig, No Starch Press, 2015
8.	Ref Links:
9.	https://www.iso.org/isoiec-27001-information-security.html https://csrc.nist.gov/publications/detail/sp/800-55/rev-1/final https://www.sans.org/reading-room/whitepapers/threats/paper/34180 https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

List of Experiments (Indicative)	
• Install and configure information security devices • Security assessment of information security systems using automated tools. • Vulnerability Identification and Prioritization • Working with Exploits • Password Cracking • Web Application Security Configuration • Patch Management • Bypassing Antivirus Software • Static Malware Analysis • Dynamic Malware Analysis • Penetration Testing • MySQL SQL Injection • Risk Assessment • Information security incident Management • Exhibit Security Analyst Role	
Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	05-FEB-2020		
Approved by Academic Council	58	Date	26-FEB-2020

CSE3502	Information Security Management	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	Computer Networks	Syllabus version				
		v.1.0				

Objective of the course

1. Explore system security related incidents and gain insight on potential defenses and counter measures against common threat/vulnerabilities.
2. Install, configure and troubleshoot information security devices
3. Gain experience using tools and common processes in information security audits and analysis of compromised systems.

Expected Outcome

After successfully completing the course the student should be able to

- Contribute to managing information security
- Co-ordinate responses to information security incidents
- Install and configure information security devices
- Contribute to information security audits
- Support teams to prepare for and undergo information security audits
- Manage their work to meet requirements
- Work effectively with colleagues
- Maintain a healthy, safe and secure working environment
- Provide data/information in standard formats
- Develop their knowledge, skills and competence

1	**Information Security Devices**	5 hours

Identify And Access Management (IdAM), Networks (Wired And Wireless) Devices, Endpoints/Edge Devices, Storage Devices, Servers, Infrastructure Devices (e.g. Routers, Firewall Services) , Computer Assets, Servers And Storage Networks, Content management, IDS/IPS

2	**Security Device Management**	6 hours

Different types of information security devices and their functions, Technical and configuration specifications, architecture concepts and design patterns and how these contribute to the security of design and devices.

3	**Device Configuration**	5 hours

Common issues in installing or configuring information security devices, Methods to resolve these issues, Methods of testing installed/configured information security devices.

4	**Information Security Audit Preparation**	5 hours

Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits. **Security Audit Review -**

Organize data/information required for information security audits using standard templates and tools, Audit tasks, Reviews, Comply with the organization's policies, standards, procedures, guidelines and

checklists, Disaster Recovery Plan		
5	**Team Work and Communication**	2 hours
Communicate with colleagues clearly, concisely and accurately , Work with colleagues to integrate their work effectively, Pass on essential information to colleagues in line with organizational requirements, Identify any problems they have working with colleagues and take the initiative to solve these problems, Follow the organization's policies and procedures for working with colleagues		
6	**Managing Health and Safety**	2 hours
Comply with organization's current health, safety and security policies and procedures, Report any identified breaches in health, safety, and Security policies and procedures, Identify, report and correct any hazards, Organization's emergency procedures, Identify and recommend opportunities for improving health, safety, and security.		
7	**Data and Information Management**	3 hours
Fetching the data/information from reliable sources, Checking that the data/information is accurate, complete and up-to-date, Rule-based analysis of the data/information, Insert the data/information into the agreed formats, Reporting unresolved anomalies in the data/information.		
8	**Learning and Self Development**	2 hours
Identify accurately the knowledge and skills needed, Current level of knowledge, skills and competence and any learning and development needs, Plan of learning and development activities to address learning needs, Feedback from appropriate people, Review of knowledge, skills and competence regularly and appropriate action taken		

	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Nina Godbole, Wiley, 2017
2.	Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, . Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.
3.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004

Reference Books

1.	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly 2010
2.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004 Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014

3.	David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014
4.	Ref Links:
5.	https://www.iso.org/isoiec-27001-information-security.html https://www.sans.org/reading-room/whitepapers/threats/paper/34180 https://csrc.nist.gov/publications/detail/sp/800-40/version-20/archive/2005-11-16 https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

List of Experiments (Indicative)		
1.	• Install and configure information security devices • Penetration Testing • MySQL SQL Injection • Information security incident Management • Intrusion Detection/Prevention • Port Redirection and Tunneling • Exploring the Metasploit Framework • Working with Commercial Tools like HP Web Inspect and IBM AppScan etc., • Explore Open Source tools like sqlmap, Nessus, Nmap etc • Documentation with Security Templates from ITIL • Carry out backups of security devices and applications in line with information security policies, procedures and guidelines • Information security audit Tasks - Procedures/guidelines/checklists for the audit tasks	
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	05-FEB-2020		
Approved by Academic Council	58	Date	26-FEB-2020

CSE4003	CYBER SECURITY	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1 To learn the concepts of number theory, cryptographic techniques.
2.To understand integrity and authentication process.
3.To familiarize various cyber threats, attacks, vulnerabilities, defensive mechanisms, security policies and practices.

Expected Course Outcome:

1 Know the fundamental mathematical concepts related to security.
2.Implement the cryptographic techniques to real time applications.
3.Comprehend the authenticated process and integrity, and its implementation
4.Know fundamentals of cybercrimes and the cyber offenses.
5.Realize the cyber threats, attacks, vulnerabilities and its defensive mechanism.
6.Design suitable security policies for the given requirements.
7.Exploring the industry practices and tools to be on par with the recent trends

Module:1	**Introduction to Number Theory**	**6 hours**

Finite Fields and Number Theory: Modular arithmetic, Euclidian Algorithm, Primality Testing: Fermats and Eulers theorem, Chinese Reminder theorem, Discrete Logarithms

Module:2	**Cryptographic Techniques**	**9 hours**

Symmetric key cryptographic techniques: Introduction to Stream cipher, Block cipher: DES, AES,IDEA Asymmetric key cryptographic techniques: principles,RSA,ElGamal,Elliptic Curve cryptography, Key distribution and Key exchange protocols.

Module:3	**Integrity and Authentication**	**5 hours**

Hash functions,Secure Hash Algorithm (SHA)Message Authentication, Message Authentica- tion Code (MAC), Digital Signature Algorithm : RSA ElGamal based

Module:4	**Cybercrimes and cyber offenses**	**7 hours**

Classification of cybercrimes, planning of attacks, social engineering:Human based, Computer based: Cyberstalking, Cybercafe and Cybercrimes

Module:5	**Cyber Threats, Attacks and Prevention**	**9 hours**

Phishing, Password cracking, Keyloggers and Spywares, DoS and DDoS attacks, SQL Injection Identity Theft (ID) : Types of identity theft, Techniques of ID theft

Module:6	**Cybersecurity Policies and Practices**	**7 hours**

What security policies are: determining the policy needs, writing security policies, Internet and email security policies, Compliance and Enforcement of policies, Review

Module:7	**Recent Trends**	**2 hours**

Industry Expert talk

	Total Lecture hours:	**45 hours**

Text Book(s)				
1.	Cryptography and Network security, William Stallings, Pearson Education, 7th Edition, 2016			
2	Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives, Nina Godbole,Sunit Belapure, Wiley Publications, Reprint 2016			
3	Writing Information Security Policies, Scott Barman, New Riders Publications, 2002			
Reference Books				
1.	Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011			
2.	Cryptography and Network security, Behrouz A. Forouzan , Debdeep Mukhopadhyay, Mcgraw Hill Education, 2 nd Edition, 2011			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
Recommended by Board of Studies		04-04-2014		
Approved by Academic Council		No. 37	Date	16-06-2015

CSE4007	Mobile Computing	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	Nil	Syllabus Version				
		1.0				

Course Objectives:

1. Understand the basic concepts of mobile computing.
2. Learn the basics of mobile telecommunication system.
3. To be familiar with the mobile network layer protocols and Ad-Hoc networks.
4. Know the basis of mobile transport and application layer protocols.
5. Gain knowledge about different mobile platforms and application development.
6. Knowledge about different mobile security and future mobile networks

Course Outcome:

1.Understand the concepts of Mobile Communication
2.Analyze the next generation Mobile telecommunication system
3.Understand network and transport layers of Mobile telecommunication system
4.Enable the students to apply the knowledge gained to design and develop a mobile application
5. Design and build an efficient and secure mobile computing environment.
6.Understand the concepts of future mobile networks

Student Learning Outcomes (SLO):	2, 9, 17

Module:1	Wireless Communication Fundamentals	5 hours

Introduction to Mobile Computing - Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA- Novel applications of mobile computing - Limitations of mobile computing.

Module:2	Mobile Telecommunication System	7 hours

Introduction to Cellular Systems - GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management –GPRS Architecture – 3G , 4G networks

Module:3	Mobile Network Layer	6 hours

Mobile IP – DHCP – AdHoc Networks– Proactive Routing protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET.

Module:4	Mobile Transport and Application Layer	6 hours

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

Module:5	Mobile Platforms and Applications	7 hours

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues

Module:6	Mobile Security	6 hours

Security, Analysis of existing wireless network -Information Security- Attacks, Components of Information Security - Security Techniques and Algorithms- Stream Ciphering and Block Ciphering, Symmetric Key Cryptography, Public Key Cryptography - Security Frame Works for Mobile Environment- 3GPP Security, Mobile VPN, Multifactor Security, Smart Card Security, Mobile virus, Mobile Worm.

Module:7	Future Mobile Networks	6 hours

Drone networking - Multi-UAV networks, architectures and civilian applications - Communication challenges and protocols for micro UAVs - Connected and autonomous cars - Wireless technologies for Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications - Automotive surrounding sensing with GHz and THz signals.

Module:8	**Recent Trends**	**2 hours**
	Total Lecture Hours:	**45hours**

Text Book(s)	
1.	Prasant Kumar Pattnaik, Rajib Mall, Fundamentals of Mobile Computing, PHI Learning Pvt.Ltd, New Delhi – 2012.
2.	Raj Kamal, Mobile Computing, Oxford University Press; 3rd edition, 2019
Reference Books	
1.	Asoke K Talukder and Roopa R. Yavagal, Mobile Computing – Technology, Applications and Service Creation; Tata McGraw Hill, 2010.
2.	Andre Perez ,Mobile Networks Architecture, Wiley, 2013
3.	Rishabh Anand, Mobile Computing, Khanna Publishing House, 1st Edition 2012
4.	David Thiel, Chris Clark, Himanshu Dwivedi, Mobile Application Security, McGraw-Hill, 2010

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Project Component:
Students should identify a problem to build novel commercial mobile applications. The goal is to select appropriate models and model specifications and apply the respective methods to develop the mobile security, mobile commerce, mobile payment system and future mobile network. Students will identify the potential use of mobile applications to formulate the problem, identify the right sources of data, analyze data, and prescribe actions to improve the outcome of decisions. Students can use any app development tool and software development kit like iOS, Android, BlackBerry, and Windows Phone.

Mode of evaluation: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

CSE4019	IMAGE PROCESSING	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1 To provide the basic knowledge on image processing concepts.
2.To develop the ability to apprehend and implement various image processing algorithms.
3.To facilitate the students to comprehend the contextual need pertaining to various image processing applications.

Expected Course Outcome:

1. Ascertain and describe the basics of image processing concepts through mathematical interpretation.
2. Acquire the knowledge of various image transforms and image enhancement techniques involved.
3.Demonstrate image restoration process and its respective filters required.
4. Experiment the various image segmentation and morphological operations for a meaningful partition of objects.
5. Design the various basic feature extraction and selection procedures and illustrate the various image compression techniques and their applications.
6. Analyze and implement image processing algorithms for various real-time applications.

Module:1	**Introduction- Digital Image,its Representation**	**6 hours**

Image Representation and Image Processing Paradigm - Elements of digital image processing-Image model. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels - Color image (overview, various color models)-Various image formats bmp, jpeg, tiff, png, gif, etc.

Module:2	**Digital Image Properties- Operations on Digital Images**	**6 hours**

Topological Properties of Digital Images-Histograms, Entropy, Eigen Values-Image Quality Metrics-Noise in Images Sources, types. Arithmetic operations - Addition, Subtraction, Multi- plication, Division-Logical operations NOT, OR, AND, XOR-Set operators-Spatial operations Single pixel, neighbourhood, geometric-Contrast Stretching-Intensity slicing-Bit plane slicing Power Law transforms

Module:3	**Image Enhancement**	**6 hours**

Spatial and Frequency domain-Histogram processing-Spatial filtering-Smoothening spatial filters-Sharpening spatial filters- Discrete Fourier Transform-Discrete Cosine Transform-Haar Trans- form -Hough Transform-Frequency filtering-Smoothening frequency filters-Sharpening frequency filters-Selective filtering.

Module:4	**Digital Image Restoration- Digital Image Registration**	**7 hours**

Noise models - Degradation models-Methods to estimate the degradation-Image de-blurring-Restoration in the presence of noise only spatial filtering-Periodic noise reduction by frequency domain filtering-Inverse filtering-Wiener Filtering. Geometrical transformation-Point based methods- Surface based methods-Intensity based methods

Module:5	**Feature Extraction**	**6 hours**

Region of interest (ROI) selection - Feature extraction: Histogram based features - Intensity features-Color, Shape features-Contour extraction and representation-Homogenous region extraction and representation-Texture descriptors - Feature Selection: Principal Component Analysis (PCA).		
Module:6	**Image Segmentation- Morphological Image Processing**	**6 hours**
Discontinuity detection-Edge linking and boundary detection.Thresholding-Region oriented segmentation- Histogram based segmentation.Object recognition based on shape descriptors.Dilation and Erosion-Opening and Closing-Medial axis transforms-Objects skeletons-Thinning boundaries.		
Module:7	**Image Coding and Compression**	**6 hours**
Lossless compression versus lossy compression-Measures of the compression efficiency- Huf- mann coding-Bitplane coding-Shift codes-Block Truncation coding-Arithmetic coding-Predictive coding techniques-Lossy compression algorithm using the 2-D. DCT transform-The JPEG 2000 standard Baseline lossy JPEG, based on DWT.		
Module:8	**Recent Trends**	**2 hours**
Industry Expert talk		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice-Hall, 2008.
Reference Books	
1.	William K. Pratt, Digital Image Processing, John Wiley, 4th Edition, 2007
2.	Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
3.	Sonka, Fitzpatrick, Medical Image Processing and Analysis, 1st Edition, SPIE,2000.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE4020	MACHINE LEARNING	L	T	P	J	C
		2	0	2	4	4

Pre-requisite	Nil	Syllabus version
		v1.0

Course Objectives:

1. Ability to comprehend the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Expected Course Outcome:

1. Recognize the characteristics of machine learning that makes it useful to solve real-world problems.
2. Provide solution for classification and regression approaches in real-world applications.
3. Gain knowledge to combine machine learning models to achieve better results.
4. Choose an appropriate clustering technique to solve real world problems.
5. Realize methods to reduce the dimension of the dataset used in machine learning algorithms.
6. Choose a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems.
7. Understand cutting edge technologies related to machine learning applications.

Module:1	Introduction to Machine Learning	3 hours

What is Machine Learning, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning

Module:2	Supervised Learning - I	4 hours

Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.

Module:3	Supervised Learning - II	5 hours

Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors

Module:4	Ensemble Learning	3 hours

Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking

Module:5	Unsupervised Learning - I	7 hours

Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional : K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models

Module:6	Unsupervised Learning - II	3 hours

Principal components analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis

Module:7	**Machine Learning in Practice**	**3 hours**
Machine Learning in Practice Design, Analysis and Evaluation of Machine Learning Experiments,		
Feature selection Mechanisms, Other Issues: Imbalanced data, Missing Values, Outliers		
Module:8	**Recent Trends**	**2 hours**
Industry Expert talk		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Ethem Alpaydin, Introduction to Machine Learning , MIT Press, Prentice Hall of India, Third Edition 2014
Reference Books	
1.	Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 4th edition, 2008, ISBN:9781597492720.
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar ”Foundations of Machine Learning, MIT Press, 2012
3.	Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition,1997.
4	Charu C. Aggarwal, Data Classification Algorithms and Applications , CRC Press, 2014
5	Charu C. Aggarwal, DATA CLUSTERING Algorithms and Applications, CRC Press, 2014
6	Kevin P. Murphy ”Machine Learning: A Probabilistic Perspective”, The MIT Press, 2012
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Implement Decision Tree learning.	2 hours
2.	Implement Logistic Regression.	2 hours
3.	Implement classification using Multilayer perceptron.	2 hours
4.	Implement classification using SVM	2 hours
5.	Implement Adaboost	2 hours
6.	Implement Bagging using Random Forests	2 hours
7.	Implement K-means Clustering to Find Natural Patterns in Data.	2 hours
8.	Implement Hierarchical clustering.	2 hours
9.	Implement K-mode clustering	2 hours
10.	Implement Principle Component Analysis for Dimensionality Reduction.	2 hours
11.	Implement Multiple Correspondence Analysis for Dimensionality Reduction.	2 hours
12.	Implement Gaussian Mixture Model Using the Expectation Maximization.	2 hours
13.	Evaluating ML algorithm with balanced and unbalanced datasets.	2 hours
14.	Comparison of Machine Learning algorithms.	2 hours
15.	Implement k-nearest neighbors algorithm	2 hours
	Total Laboratory Hours	30 hours

Mode of assessment: Project/Activity			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE4022	NATURAL LANGUAGE PROCESSING	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To introduce the fundamental concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.
3. To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications.

Expected Course Outcome:

1. Understand the principles and Process the Human Languages Such as English and other Indian Languages using computers.
2. Creating CORPUS linguistics based on digestive approach (Text Corpus method)
3. Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.
4. Perform POS tagging for a given natural language.
5. Select a suitable language modelling technique based on the structure of the language.
6. Check the syntactic and semantic correctness of sentences using grammars and labelling.
7. Develop Computational Methods for Real World Applications and explore deeplearning based NLP

Module:1	**INTRODUCTION TO NLP**	**3 hours**

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, question answering, and machine translation.

Module:2	**TEXT PROCESSING**	**6 hours**

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

Module:3	**MORPHOLOGY**	**6 hours**

Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers.

Module:4	**LEXICAL SYNTAX**	**6 hours**

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions.

Module:5	**LANGUAGE MODELING**	**6 hours**

The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

Module:6	**SYNTAX & SEMANTICS**	**10 hours**

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs.

Module:7	**APPLICATIONS OF NLP**		**6 hours**
NL Interfaces, Text Summarization, Sentiment Analysis, Machine Translation, Question answering.			
Module:8	**RECENT TRENDS**		**2 hours**
Recent Trends in NLP			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.
Reference Books	
1.	Chris Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing", 2nd edition, MITPress Cambridge, MA, 2003.
2.	NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
3.	James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

MAT3004	APPLIED LINEAR ALGEBRA	L	T	P	J	C
		3	2	0	0	4

Pre-requisite	MAT2002 Applications of Differential and Difference Equations	Syllabus Version
		v1.0

Course Objectives

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
2. apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. solve problems in cryptography, computer graphics and wavelet transforms

Expected Course Outcomes

At the end of this course the students are expected to learn
1. the abstract concepts of matrices and system of linear equations using decomposition methods
2. the basic notion of vector spaces and subspaces
3. apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
4. applications of inner product spaces in cryptography
5. Use of wavelet in image processing.

Module:1	System of Linear Equations:	6 hours

Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - - LU factorizations.

Module:2	Vector Spaces	6 hours

The Euclidean space R^n and vector space- subspace –linear combination-span-linearly dependent-independent- bases - dimensions-finite dimensional vector space.

Module:3	Subspace Properties:	6 hours

Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

Module:4	Linear Transformations and applications	7 hours

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity

Module:5	Inner Product Spaces:	6 hours

Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalisation

Module:6	Applications of Inner Product Spaces:	6 hours

QR factorization- Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes

Module:7	**Applications of Linear equations** :	**6 hours**
An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets (only approx. of Wavelet from Raw data)		
Module:8	**Contemporary Issues:**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial Class • Another 5 problems per Tutorial Class to be given as home work.	**15 hours**

Text Book(s)

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5)
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

Reference Books

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)
2. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Mode of Evaluation

Digital Assignments, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	25-02-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

UNIVERSITY CORE

CHY1701	ENGINEERING CHEMISTRY	L	T	P	J	C
		3	0	2	0	4
Pre-requisite		**Syllabus version**				
		1.1				

Course Objectives:

1. To impart technological aspects of applied chemistry
2. To lay foundation for practical application of chemistry in engineering aspects

Expected Course Outcomes (CO): Students will be able to

1. **Recall** and **analyze** the issues related to impurities in water and their removal methods and **apply** recent methodologies in water treatment for domestic and industrial usage
2. **Evaluate** the causes of metallic corrosion and **apply** the methods for corrosion protection of metals
3. **Evaluate** the electrochemical energy storage systems such as lithium batteries, fuel cells and solar cells, and **design** for usage in electrical and electronic applications
4. **Assess** the quality of different fossil fuels and create an awareness to **develop** the alternative fuels
5. **Analyze** the properties of different polymers and distinguish the polymers which can be degraded and **demonstrate** their usefulness
6. **Apply** the theoretical aspects: (a) in **assessing** the water quality; (b) **understanding** the construction and working of electrochemical cells; (c) **analyzing** metals, alloys and soil using instrumental methods; (d) **evaluating** the viscosity and water absorbing properties of polymeric materials

Module:1	**Water Technology**	**5 hours**

Characteristics of hard water - hardness, DO, TDS in water and their determination – numerical problems in hardness determination by EDTA; Modern techniques of water analysis for industrial use - Disadvantages of hard water in industries.

Module:2	**Water Treatment**	**8 hours**

Water softening methods: - Lime-soda, Zeolite and ion exchange processes and their applications. Specifications of water for domestic use (ICMR and WHO); Unit processes involved in water treatment for municipal supply - Sedimentation with coagulant- Sand Filtration - chlorination; Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultrafiltration, UV treatment, Ozonolysis, Reverse Osmosis; Electro dialysis.

Module:3	**Corrosion**	**6 hours**

Dry and wet corrosion - detrimental effects to buildings, machines, devices & decorative art forms, emphasizing Differential aeration, Pitting, Galvanic and Stress corrosion cracking; Factors that enhance corrosion and choice of parameters to mitigate corrosion.

Module:4	**Corrosion Control**	**4 hours**

Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods; Advanced protective coatings: electroplating and electroless plating, PVD and CVD.

Alloying for corrosion protection – Basic concepts of Eutectic composition and Eutectic mixtures - Selected examples – Ferrous and non-ferrous alloys.

Module:5	**Electrochemical Energy Systems**	**6 hours**

Brief introduction to conventional primary and secondary batteries; High energy electrochemical energy systems: Lithium batteries – Primary and secondary, its Chemistry, advantages and applications.

Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells- working principles, advantages, applications.

Solar cells – Types – Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells, dye sensitized solar cells - working principles, characteristics and applications.

Module:6	**Fuels and Combustion**	**8 hours**

Calorific value - Definition of LCV, HCV. Measurement of calorific value using bomb calorimeter and Boy's calorimeter including numerical problems.

Controlled combustion of fuels - Air fuel ratio – minimum quantity of air by volume and by weight- Numerical problems-three way catalytic converter- selective catalytic reduction of NO_X; Knocking in IC engines-Octane and Cetane number - Antiknocking agents.

Module:7	**Polymers**	**6 hours**

Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - ABS, PVC, PTFE and Bakelite; Compounding of plastics: moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays, (Compression moulding), Fibre reinforced polymers, Composites (Transfer moulding), PET bottles (blow moulding);

Conducting polymers- Polyacetylene- Mechanism of conduction – applications (polymers in sensors, self-cleaning windows)

Module:8	**Contemporary issues:**	**2 hours**

Lecture by Industry Experts

	Total Lecture hours:	**45 hours**

Text Book(s)

1. 1. Sashi Chawla, A Text book of Engineering Chemistry, Dhanpat Rai Publishing Co., Pvt. Ltd., Educational and Technical Publishers, New Delhi, 3rd Edition, 2015.
   2. O.G. Palanna, McGraw Hill Education (India) Private Limited, 9th Reprint, 2015.
   3. B. Sivasankar, Engineering Chemistry 1st Edition, Mc Graw Hill Education (India), 2008
   4. "Photovoltaic solar energy : From fundamentals to Applications", AngÃ¨le Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Wiley publishers, 2017.

Reference Books

2. 1. O.V. Roussak and H.D. Gesser, ***Applied Chemistry-A Text Book for Engineers and Technologists***, Springer Science Business Media, New York, 2nd Edition, 2013.
   2. S. S. Dara, ***A Text book of Engineering Chemistry,*** S. Chand & Co Ltd., New Delhi, 20th Edition, 2013.

Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

List of Experiments

	Experiment title	Hours
1.	Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin	1 h 30 min
2.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by	3 h

3.	Winkler's method Estimation of sulphate/chloride in drinking water by conductivity method	
4/5.	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods	3h
6.	Analysis of Iron in carbon steel by potentiometry	1 h 30 min
7.	Construction and working of an Zn-Cu electrochemical cell	1 h 30 min
8.	Determination of viscosity-average molecular weight of different natural/synthetic polymers	1 h 30 min
9.	Arduino microcontroller based sensor for monitoring pH/temperature/conductivity in samples.	1 h 30 min
	Total Laboratory Hours	17 hours

Mode of Evaluation: Viva-voce and Lab performance & FAT			
Recommended by Board of Studies	**31-05-2019**		
Approved by Academic Council	**54th ACM**	**Date**	**13-06-2019**

Course code	PROBLEM SOLVING AND PROGRAMMING	L	T	P	J	C
CSE1001		0	0	6	0	3
Pre-requisite	NIL	Syllabus version				
		v1.0				

Course Objectives:

1. To develop broad understanding of computers, programming languages and their generations
2. Introduce the essential skills for a logical thinking for problem solving
3. To gain expertise in essential skills in programming for problem solving using computer

Expected Course Outcome:

1. Understand the working principle of a computer and identify the purpose of a computer programming language.
2. Learn various problem solving approaches and ability to identify an appropriate approach to solve the problem
3. Differentiate the programming Language constructs appropriately to solve any problem
4. Solve various engineering problems using different data structures
5. Able to modulate the given problem using structural approach of programming
6. Efficiently handle data using flat files to process and store data for the given problem

List of Challenging Experiments (Indicative)

1	Steps in Problem Solving Drawing flowchart using yEd tool/Raptor Tool	4 Hours
2	Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements	4 Hours
3	Simple Program to display Hello world in Python	4 Hours
4	Operators and Expressions in Python	4 Hours
5	Algorithmic Approach 1: Sequential	4 Hours
6	Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else)	4 Hours
7	Algorithmic Approach 3: Iteration (while and for)	6 Hours
8	Strings and its Operations	6 Hours
9	Regular Expressions	6 Hours
10	List and its operations	6 Hours
11	Dictionaries: operations	6 Hours
12	Tuples and its operations	6 Hours
13	Set and its operations	6 Hours
14	Functions, Recursions	6 Hours
15	Sorting Techniques (Bubble/Selection/Insertion)	6 Hours
16	Searching Techniques : Sequential Search and Binary Search	6 Hours
17	Files and its Operations	6 Hours
	Total hours:	**90 hours**

Text Book(s)

1. John V. Guttag., 2016. Introduction to computation and programming using python: with applications to understanding data. PHI Publisher.

Reference Books

1. Charles Severance.2016.Python for everybody: exploring data in Python 3, Charles Severance.
2. Charles Dierbach.2013.Introduction to computer science using python: a computational problem-solving focus. Wiley Publishers.

Mode of Evaluation: **PAT / CAT / FAT**

Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 38	Date	23-10-2015

CSE1002	PROBLEM SOLVING AND OBJECT ORIENTED PROGRAMMING	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	**Nil**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts.
2. To enable students to solve the real time applications using object oriented programming features
3. To improve the skills of a logical thinking and to solve the problems using any processing elements

Expected Course Outcome:

1. Demonstrate the basics of procedural programming and to represent the real world entities as programming constructs.
2. Enumerate object oriented concepts and translate real-world applications into graphical representations.
3. Demonstrate the usage of classes and objects of the real world entities in applications.
4. Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems.
5. Illustrate possible error-handling constructs for unanticipated states/inputs and to use generic programming constructs to accommodate different datatypes.
6. Validate the program against file inputs towards solving the problem..

List of Challenging Experiments (Indicative)

1.	**Postman Problem** A postman needs to walk down every street in his area in order to deliver themail. Assume that the distances between the streets along the roads are given. The postman starts at the post office and returns back to the post office after delivering all the mails. Implement an algorithm to help the postman to walk minimum distance for the purpose.	10 hours
2.	**Budget Allocation for Marketing Campaign** A mobile manufacturing company has got several marketing options such as Radio advertisement campaign, TV non peak hours campaign, City top paper network, Viral marketing campaign, Web advertising. From their previous experience, they have got a statistics about paybacks for each marketing option. Given the marketing budget (rupees in crores) for the current year and details of paybacks for each option, implement an algorithm to determine the amount that shall spent on each marketing option so that the company attains the maximum profit.	15 hours
3.	**Missionaries and Cannibals** Three missionaries and three cannibals are on one side of a river, along witha boat that can hold one or two people. Implement an algorithm to find a way to get everyone to the other side of the river, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.	10 hours
4.	**Register Allocation Problem** A register is a component of a computer processor that can hold any type of	15 hours

	data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG)is constructed. In a RIG, a node represents a temporary variable and an edgeis added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, twotemporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution	
5.	**Selective Job Scheduling Problem** A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and softwareresources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time Schedule Server and memory Schedule Server respectively. Design a OOP model and implementthe time Schedule Server and memory Schedule Server. The Time ScheduleServer arranges jobs based on time required for execution in ascending orderwhereas memory Schedule Server arranges jobs based on memory required for execution in ascending order	15 hours
6.	**Fragment Assembly in DNA Sequencing** DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), andthymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence (superstring). Each read is a small string. In such a fragment assembly, givena set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, 000, 001, 010, 011, 100, 101, 110, 111 the shortest superstring is 0001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.	15 hours
7.	**House Wiring** An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points andthe distances between them, implement an algorithm to find the minimumcable required.	10 hours
	Total Laboratory Hours	**90 hours**
Text Book(s)		
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, C++ primer, Fifth edition, Addison-Wesley, 2012.	
2	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999.	
3	Brian W. Kernighan, Dennis M. Ritchie , The C programming Language, 2nd edition, Prentice Hall Inc., 1988.	

Reference Books				
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013			
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010			
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014.			
Mode of assessment: **PAT / CAT / FAT**				
Recommended by Board of Studies		29-10-2015		
Approved by Academic Council		No. 39	Date	17-12-2015

CSE1901	Technical Answers for Real World Problems (TARP)	L	T	P	J	C
		1	0	0	4	2

Pre-requisite	Nil	Syllabus version
		1.0

Course Objectives:

- To help students to identify the need for developing newer technologies for industrial / societal needs
- To train students to propose and implement relevant technology for the development ofthe prototypes / products
- To make the students learn to the use the methodologies available for analysing the developed prototypes / products

Expected Course Outcome:

At the end of the course, the student will be able to

1. Identify real life problems related to society
2. Apply appropriate technology(ies) to address the identified problems usingengineering principles and arrive at innovative solutions

Module:1 **15 hours**

1. Identification of real life problems
2. Field visits can be arranged by the faculty concerned
3. 6 – 10 students can form a team (within the same / different discipline)
4. Minimum of eight hours on self-managed team activity
5. Appropriate scientific methodologies to be utilized to solve the identified issue
6. Solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology(ies)
7. Consolidated report to be submitted for assessment
8. Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component
9. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility
10. Contribution of each group member to be assessed
11. The project component to have three reviews with the weightage of 20:30:50

Mode of Evaluation: (No FAT) Continuous Assessment the project done – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews

Recommended by Board of Studies	28-02-2016		
Approved by Academic Council	No.37	Date	16-06-2015

CSE1902	Industrial Internship	L	T	P	J	C
		0	0	0	0	1
Pre-requisite	Completion of minimum of Two semesters					

Course Objectives:

The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

Contents	**4**	**Weeks**

Four weeks of work at industry site.
Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Recommended by Board of Studies	28-02-2016		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE1903	Comprehensive Examination	L	T	P	J	C
		0	0	0	0	1
Pre-requisite		**Syllabus version**				
		1.00				

Digital Logic and Microprocessor

Simplification of Boolean functions using K-Map – Combinational logic: Adder, subtractor, encoder, decoder, multiplexer, de-multiplexer – Sequential Logic: Flip flops- 8086 Microprocessor: instructions – peripherals: 8255, 8254, 8257.

Computer Architecture and Organization

Instructions - Instruction types- Instruction Formats - Addressing Modes- Pipelining- Data Representation - Memory Hierarchy- Cache memory-Virtual Memory- I/O Fundamentals- I/O Techniques - Direct Memory Access - Interrupts-RAID architecture

Programming, Data Structures and Algorithms

Programming in C; Algorithm Analysis – Iterative and Recursive Algorithms; ADT - Stack and its Applications - Queue and its Applications; Data Structures – Arrays and Linked Lists; Algorithms - Sorting – Searching; Trees – BST, AVL; Graphs – BFS , DFS , Dijkstra"s Shortest Path Algorithm.

Theory of Computation

Deterministic Finite Automata, Non deterministic Finite Automata, Regular Expressions, Context Free Grammar, Push down Automata and Context Free Languages, Turing Machines.

Web Technologies

Web Architecture- JavaScript – objects String, date, Array, Regular Expressions, DHTML- HTML DOM Events; Web Server – HTTP- Request/Response model-RESTful methods- State Management – Cookies , Sessions – AJAX.

Operating Systems

Processes, Threads, Inter-process communication, CPU scheduling, Concurrency and synchronization, Deadlocks, Memory management and Virtual memory & File systems.

Database Management System

DBMS, Schema, catalog, metadata, data independence, pre-compiler; Users-naïve, sophisticated, casual ;ER Model- Entity, attributes, structural constraints; Relational Model-Constraints, Relational Algebra operations; SQL- DDL, DML, TCL, DCL commands, basic queries and Top N queries; Normalization-properties, 1NF, 2NF, 3NF, BCNF; Indexing-different types, Hash Vs B-tree Index; Transaction-problems, Concurrency Control-techniques, Recovery-methods.

Data Communication and Computer Networks

Circuit Switching, Packet Switching, Frame Relay, Cell Switching, ATM , OSI Reference model, TCP\IP, Network topologies, LAN Technologies, Error detection and correction techniques, Internet protocols , IPv4/IPv6, Routing algorithms, TCP and UDP, Sockets, Congestion control, Application Layer Protocols, Network Security: Basics of public and private key cryptosystems- Digital Signatures and Hash codes, Transport layer security, VPN, Firewalls.

Recommended by Board of Studies	05-03-2016		
Approved by Academic Council	No. 40	Date	18-03-2016

CSE1904	Capstone Project	L	T	P	J	C
		0	0	0	0	12
Pre-requisite	**As per the academic regulations**	**Syllabus version**				
		v. 1.0				

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Expected Course Outcome:

At the end of the course the student will be able to

1. Formulate specificproblemstatementsfor ill-defined real life problemswithreasonable assumptions and constraints.
2. Perform literature search and /or patent search in the area of interest.
3. Conductexperiments / Design and Analysis / solution iterations and documentthe results.
4. Perform error analysis / benchmarking / costing
5. Synthesise the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Contents

1. Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.

3. Can be individual work or a group project, with a maximum of 3 students.

4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.

5. Carried out inside or outside the university, in any relevant industry or research institution.

6. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Recommended by Board of Studies	10.06.2015		
Approved by Academic Council	37th AC	Date	16.06.2015

Course Code	Course Title	L	T	P	J	C
ENG1901	Technical English - I	0	0	4	0	2
Pre-requisite	Foundation English-II	Syllabus Version				
		1				

Course Objectives:

1. To enhance students' knowledge of grammar and vocabulary to read and write error-free language in real life situations.
2. To make the students' practice the most common areas of written and spoken communications skills.
3. To improve students' communicative competency through listening and speaking activities in the classroom.

Expected Course Outcome:

1. Develop a better understanding of advanced grammar rules and write grammatically correct sentences.
2. Acquire wide vocabulary and learn strategies for error-free communication.
3. Comprehend language and improve speaking skills in academic and social contexts.
4. Improve listening skills so as to understand complex business communication in a variety of global English accents through proper pronunciation.
5. Interpret texts, diagrams and improve both reading and writing skills which would help them in their academic as well as professional career.

Module:1	Advanced Grammar (CO: 1,2)	4 hours

Articles, Tenses, Voice and Prepositions

Activity: Worksheets on Impersonal Passive Voice, Exercises from the prescribed text

Module:2	Vocabulary Building I (CO:2&5)	4 hours

Idioms and Phrases, Homonyms, Homophones and Homographs

Activity: Jigsaw Puzzles; Vocabulary Activities through Web tools

Module:3	Listening for Specific Purposes (CO:4&5)	4 hours

Gist, monologues, short conversations, announcements, briefings and discussions

Activity: Gap filling; Interpretations

Module:4	Speaking for Expression (CO:3&4)	6 hours

Introducing oneself and others, Making Requests & responses, Inviting and Accepting/Declining Invitations

Activity: Brief introductions; Role-Play; Skit.

Module:5	Reading for Information (CO: 5&4)	4 hours

Reading Short Passages, News Articles, Technical Papers and Short Stories

Activity: Reading specific news paper articles; blogs

Module:6	**Writing Strategies (CO:5&3)**	**4 hours**
Joining the sentences, word order, sequencing the ideas, introduction and conclusion Activity: Short Paragraphs; Describing familiar events; story writing		
Module:7	**Vocabulary Building II (CO:2,3&5)**	**4 hours**
Enrich the domain specific vocabulary by describing Objects, Charts, Food, Sports and Employment. Activity: Describing Objects, Charts, Food, Sports and Employment		
Module:8	**Listening for Daily Life (CO: 4 &5)**	**4 hours**
Listening for statistical information, Short extracts, Radio broadcasts and TV interviews Activity: Taking notes and Summarizing		
Module:9	**Expressing Ideas and Opinions (3,4 &5)**	**6 hours**
Telephonic conversations, Interpretation of Visuals and describing products and processes. Activity: Role-Play (Telephonic); Describing Products and Processes		
Module: 10	**Comprehensive Reading (1,2&5)**	**4 hours**
Reading Comprehension, Making inferences, Reading Graphics, Note-making, and Critical Reading. Activity: Sentence Completion; Cloze Tests		
Module: 11	**Narration (5,2 &4)**	**4 hours**
Writing narrative short story, Personal milestones, official letters and E-mails. Activity: Writing an E-mail; Improving vocabulary and writing skills.		
Module:12	**Pronunciation (2,3 &4)**	**4 hours**
Speech Sounds, Word Stress, Intonation, Various accents Activity: Practicing Pronunciation through web tools; Listening to various accents of English		
Module:13	**Editing (1,4&5)**	**4 hours**
Simple, Complex & Compound Sentences, Direct & Indirect Speech, Correction of Errors, Punctuations. Activity: Practicing Grammar		
Module:14	**Short Story Analysis (5,2&3)**	**4 hours**
"The Boundary" by Jhumpa Lahiri Activity: Reading and analyzing the theme of the short story.		
	Total Lecture hours	**60 hours**
Text Book / Workbook		
1.	Wren, P.C.; Martin, H.; Prasada Rao, N.D.V. (1973–2010). *High School English Grammar & Composition*. New Delhi: Sultan Chand Publishers.	
2	Kumar, Sanjay,; Pushp Latha. (2018) English Language and Communication Skills for Engineers, India: Oxford University Press.	

Reference Books	
1.	Guptha S C, (2012) *Practical English Grammar & Composition*, 1st Edition, India: Arihant Publishers
2.	Steven Brown, (2011) Dorolyn Smith, *Active Listening* **3**, 3rd Edition, UK: Cambridge University Press.
3.	Liz Hamp-Lyons, Ben Heasley, (2010) *Study Writing*, 2nd Edition, UK: Cambridge University Pres.
4.	Kenneth Anderson, Joan Maclean, (2013) Tony Lynch, *Study Speaking*, 2nd Edition, UK: Cambridge, University Press.
5.	Eric H. Glendinning, Beverly Holmstrom, (2012) *Study Reading*, 2nd Edition, UK: Cambridge University Press.
6.	Michael Swan, (2017) *Practical English Usage* (Practical English Usage), 4th edition, UK: Oxford University Press.
7.	Michael McCarthy, Felicity O'Dell, (2015) *English Vocabulary in Use Advanced* (South Asian Edition), UK: Cambridge University Press.
8.	Michael Swan, Catherine Walter, (2012) *Oxford English Grammar Course Advanced*, Feb, 4th Edition, UK: Oxford University Press.
9.	Watkins, Peter. (2018) *Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers*, UK: Cambridge University Press.
10.	(*The Boundary by Jhumpa Lahiri)* URL: https://www.newyorker.com/magazine/2018/01/29/the-boundary?intcid=inline_amp
Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT	

List of Challenging Experiments (Indicative)		
1.	Self-Introduction	**12 hours**
2.	Sequencing Ideas and Writing a Paragraph	**12 hours**
3.	Reading and Analyzing Technical Articles	**8 hours**
4.	Listening for Specificity in Interviews (Content Specific)	**12 hours**
5.	Identifying Errors in a Sentence or Paragraph	**8 hours**
6.	Writing an E-mail by narrating life events	**8 hours**
	Total Laboratory Hours	**60 hours**
Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT		

Recommended by Board of Studies	08.06.2019	
Approved by Academic Council	55	Date: 13-06-2019

Course Code	Course Title	L	T	P	J	C
ENG 1902	Technical English - II	0	0	4	0	2

Pre-requisite	71% to 90% EPT score	Syllabus Version
		1

Course Objectives:

1. To acquire proficiency levels in LSRW skills on par with the requirements for placement interviews of high-end companies / competitive exams.
2. To evaluate complex arguments and to articulate their own positions on a range of technical and general topics.
3. To speak in grammatical and acceptable English with minimal MTI, as well as develop a vast and active vocabulary.

Expected Course Outcome:

1. Communicate proficiently in high-end interviews and exam situations and all social situations
2. Comprehend academic articles and draw inferences
3. Evaluate different perspectives on a topic
4. Write clearly and convincingly in academic as well as general contexts
5. Synthesize complex concepts and present them in speech and writing

Module:1	Listening for Clear Pronunciation	4 hours

Ice-breaking, Introduction to vowels, consonants, diphthongs.
Listening to formal conversations in British and American accents (BBC and CNN) as well as other 'native' accents
Activity: Factual and interpretive exercises; note-making in a variety of global English accents

Module:2	Introducing Oneself	4 hours

Speaking: Individual Presentations
Activity: Self-Introductions, Extempore speech

Module:3	Effective Writing	6 hours

Writing: Business letters and Emails, Minutes and Memos
Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order; Formats of Minutes and Memos
Activity: Students write a business letter and Minutes/ Memo

Module:4	Comprehensive Reading	4 hours

Reading: Reading Comprehension Passages, Sentence Completion (Technical and General Interest), Vocabulary and Word Analogy
Activities: Cloze tests, Logical reasoning, Advanced grammar exercises

Module:5	Listening to Narratives	4 hours

Listening: Listening to audio files of short stories, News, TV Clips/ Documentaries, Motivational Speeches in UK/ US/ global English accents.
Activity: Note-making and Interpretive exercises

Module:6	**Academic Writing and Editing**	**6 hours**
Writing: Editing/ Proofreading symbols Citation Formats Structure of an Abstract and Research Paper Activity: Writing Abstracts and research paper; Work with Editing/ Proofreading exercise		
Module:7	**Team Communication**	**4 hours**
Speaking: Group Discussions and Debates on complex/ contemporary topics Discussion evaluation parameters, using logic in debates Activity: Group Discussions on general topics		
Module:8	**Career-oriented Writing**	**4 hours**
Writing: Resumes and Job Application Letters, SOP Activity: Writing resumes and SOPs		
Module:9	**Reading for Pleasure**	**4 hours**
Reading: Reading short stories Activity: Classroom discussion and note-making, critical appreciation of the short story		
Module: 10	**Creative Writing**	**4 hours**
Writing: Imaginative, narrative and descriptive prose Activity: Writing about personal experiences, unforgettable incidents, travelogues		
Module: 11	**Academic Listening**	**4 hours**
Listening: Listening in academic contexts Activity: Listening to lectures, Academic Discussions, Debates, Review Presentations, Research Talks, Project Review Meetings		
Module:12	**Reading Nature-based Narratives**	**4 hours**
Narratives on Climate Change, Nature and Environment Activity: Classroom discussions, student presentations		
Module:13	**Technical Proposals**	**4 hours**
Writing: Technical Proposals Activities: Writing a technical proposal		
Module:14	**Presentation Skills**	**4 hours**
Persuasive and Content-Specific Presentations Activity: Technical Presentations		
	Total Lecture hours:	**60 hours**

Text Book / Workbook

1.	Oxenden, Clive and Christina Latham-Koenig. *New English File: Advanced Students Book*. Paperback. Oxford University Press, UK, 2017.
2	Rizvi, Ashraf. *Effective Technical Communication*. McGraw-Hill India, 2017.

Reference Books

1.	Oxenden, Clive and Christina Latham-Koenig, *New English File: Advanced: Teacher's Book with Test and Assessment*. CD-ROM: Six-level General English Course for Adults. Paperback. Oxford University Press, UK, 2013.
2.	Balasubramanian, T. *English Phonetics for the Indian Students: A Workbook*. Laxmi Publications, 2016.

3.	Philip Seargeant and Bill Greenwell, *From Language to Creative Writing*. Bloomsbury Academic, 2013.
4.	Krishnaswamy, N. *Eco-English*. Bloomsbury India, 2015.
5.	Manto, Saadat Hasan. *Selected Short Stories*. Trans. Aatish Taseer. Random House India, 2012.
6.	Ghosh, Amitav. *The Hungry Tide*. Harper Collins, 2016.
7.	Ghosh, Amitav. *The Great Derangement: Climate Change and the Unthinkable*. Penguin Books, 2016.
8.	*The MLA Handbook for Writers of Research Papers,* 8th ed. 2016.
	Online Sources: https://americanliterature.com/short-short-stories. (75 *short* short stories) http://www.eco-ction.org/dt/thinking.html (Leopold, Aldo."Thinking like a Mountain") /www.esl-lab.com/; www.bbc.co.uk/learningenglish/; /www.bbc.com/news; /learningenglish.voanews.com/a/using-voa-learning-english-to-improve-listening-skills/3815547.html

Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT

	List of Challenging Experiments (Indicative)	
1.	Self-Introduction using SWOT	**12 hours**
2.	Writing minutes of meetings	**10 hours**
3.	Writing an abstract	**10 hours**
4.	Listening to motivational speeches and interpretation	**10 hours**
5.	Cloze Test	**6 hours**
6.	Writing a proposal	**12 hours**
	Total Laboratory Hours	**60 hours**

Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT

Recommended by Board of Studies	08.06.2019	
Approved by Academic Council	55	Date: 13-06-2019

Course Code	Course title	L	T	P	J	C
ENG1903	Advanced Technical English	0	0	2	4	2
Pre-requisite	Greater than 90 % EPT score	Syllabus Version				
		1				

Course Objectives:

1. To review literature in any form or any technical article
2. To infer content in social media and respond accordingly
3. To communicate with people across the globe overcoming trans-cultural barriers and negotiate successfully

Expected Course Outcome:

1. Analyze critically and write good reviews
2. Articulate research papers, project proposals and reports
3. Communicate effectively in a trans-cultural environment
4. Negotiate and lead teams towards success
5. Present ideas in an effective manner using web tools

Module:1	Negotiation and Decision Making Skills through Literary Analysis	5 hours

Concepts of Negotiation and Decision Making Skills

Activity: Analysis of excerpts from Shakespeare's "The Merchant of Venice" (court scene) and discussion on negotiation skills.

Critical evaluation of excerpts from Shakespeare's "Hamlet"(Monologue by Hamlet) and discussion on decision making skills

Module:2	Writing reviews and abstracts through movie interpretations	5 hours

Review writing and abstract writing with competency

Activity: Watching Charles Dickens "Great Expectations" and writing a movie review

Watching William F. Nolan's "Logan's Run" and analyzing it in tune with the present scenario of depletion of resources and writing an abstract

Module:3	Technical Writing	4 hours

Stimulate effective linguistics for writing: content and style

Activity: Proofreading

Statement of Purpose

Module:4	Trans-Cultural Communication	4 hours

Nuances of Trans-cultural communication

Activity:

Group discussion and case studies on trans-cultural communication.

Debate on trans-cultural communication.

Module:5	**Report Writing and Content Writing**	**4 hours**
Enhancing reportage on relevant audio-visuals Activity: Watch a documentary on social issues and draft a report Identify a video on any social issue and interpret		
Module:6	**Drafting project proposals and article writing**	**4 hours**
Dynamics of drafting project proposals and research articles Activity: Writing a project proposal. Writing a research article.		
Module:7	**Technical Presentations**	**4 hours**
Build smart presentation skills and strategies Activity: Technical presentations using PPT and Web tools		
	Total Lecture hours	**30 hours**

Text Book / Workbook	
1.	Raman, Meenakshi & Sangeeta Sharma. *Technical Communication: Principles and Practice*, 3rd edition, Oxford University Press, 2015.
Reference Books	
1	Basu B.N. *Technical Writing*, 2011 Kindle edition
2	Arathoon, Anita. *Shakespeare's The Merchant of Venice* (Text with Paraphrase), Evergreen Publishers, 2015.
3	Kumar, Sanjay and Pushp Lata. *English Language and Communication Skills for Engineers,* Oxford University Press, India, 2018.
4	Frantisek, Burda. *On Transcultural Communication*, 2015, LAP Lambert Academic Publishing, UK.
5	Geever, C. Jane. *The Foundation Center's Guide to Proposal Writing*, 5th Edition, 2007, Reprint 2012 The Foundation Center, USA.
6	Young, Milena. *Hacking Your Statement of Purpose: A Concise Guide to Writing Your SOP*, 2014 Kindle Edition.
7	Ray, Ratri, *William Shakespeare's Hamlet*, The Atlantic Publishers, 2011.
8	C Muralikrishna & Sunitha Mishra, *Communication Skills for Engineers,* 2nd edition, NY: Pearson, 2011.

Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments

List of Challenging Experiments (Indicative)		
1.	Enacting a court scene - Speaking	**6 hours**
2.	Watching a movie and writing a review	**4 hours**
3.	Trans-cultural – case studies	**2 hours**
4.	Drafting a report on any social issue	**6 hours**
5.	Technical Presentation using web tools	**6 hours**
6.	Writing a research paper	**6 hours**
J- Component Sample Projects		
1.	Short Films	
2.	Field Visits and Reporting	

3.	Case studies	
4.	Writing blogs	
5.	Vlogging	
	Total Hours (J-Component)	**60 hours**
Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT		
Recommended by Board of Studies	08.06.2019	
Approved by Academic Council	55	Date: 13-06-2019

HUM1021	ETHICS AND VALUES	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	Nil	**Syllabus version**				
		1.1				

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:

Students will be able to:

1. Follow sound morals and ethical values scrupulously to prove as good citizens
2. Understand various social problems and learn to act ethically
3. Understand the concept of addiction and how it will affect the physical and mental health
4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
5. Identify the main typologies, characteristics, activities, actors and forms of cybercrime

Module:1	**Being Good and Responsible**	**5 hours**

Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society

Module:2	**Social Issues 1**	**4 hours**

Harassment – Types - Prevention of harassment, Violence and Terrorism

Module:3	**Social Issues 2**	**4 hours**

Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices;
White collar crimes - Tax evasions – Unfair trade practices

Module:4	**Addiction and Health**	**5 hours**

Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides;
Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

Module:5	**Drug Abuse**	**3 hours**

Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention

Module:6	**Personal and Professional Ethics**	**4 hours**

Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

Module:7	**Abuse of Technologies**	**3 hours**

Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social

networking websites			
Module:8	**Contemporary issues:**		**2 hours**
Guest lectures by Experts			
	Total Lecture hours:	**30 hours**	

Reference Books

1. Dhaliwal, K.K , "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts,2016, Writers Choice, New Delhi, India.
2. Vittal, N, "Ending Corruption? - How to Clean up India?", 2012, Penguin Publishers, UK.
3. Pagliaro, L.A. and Pagliaro, A.M, "Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological , Developmental and Clinical Considerations", 2012Wiley
4. Publishers, U.S.A.
   Pandey, P. K (2012), "Sexual Harassment and Law in India", 2012, Lambert Publishers, Germany.

Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	26-07-2017		
Approved by Academic Council	No. 46	Date	24-08-2017

MAT1011	CALCULUS FOR ENGINEERS	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	10+2 Mathematics or MAT1001	Syllabus Version				
		1.0				

Course Objectives :

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

Expected Course Outcome:

At the end of this course the students should be able to

1. Apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. Understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution
3. Evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
4. Evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. Understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gauss theorems
6. Demonstrate MATLAB code for challenging problems in engineering

Module: 1	Application of Single Variable Calculus	9 hours

Differentiation-Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem-Increasing and Decreasing functions and First derivative test-Second derivative test-Maxima and Minima-Concavity. Integration-Averagefunction value - Area between curves - Volumes of solids of revolution - Beta and Gamma functions–interrelation

Module: 2	Laplace transforms	7 hours

Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.

Module: 3	Multivariable Calculus	4 hours

Functions of two variables-limits and continuity-partial derivatives –total differential-Jacobian and its properties.

Module: 4	Application of Multivariable Calculus	5 hours

Taylor's expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange's multiplier method.

Module: 5	Multiple integrals	8 hours

Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - Evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates- evaluation of multiple integrals using gamma and beta functions.

Module: 6	Vector Differentiation	5 hours

Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials–Statement of vector identities-Simple problems

Module: 7	Vector Integration	5 hours

line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems -verification and evaluation of vector integrals using them.

Module: 8	**Contemporary Issues:**	**2 hours**
Industry Expert Lecture		
Total Lecture hours		**45 hours**
Text Book(s)		
1. Thomas' Calculus, George B.Thomas, D.Weir and J. Hass, 13th edition, Pearson, 2014. 2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.		
Reference Books		
1. Higher Engineering Mathematics, B.S. Grewal, 43rd Edition,Khanna Publishers, 2015 2. Higher Engineering Mathematics, John Bird, 6thEdition,Elsevier Limited, 2017. 3. Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017. 4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7thEdition, Palgrave Macmillan (2013)		
Mode of Evaluation: Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test		
List of Challenging Experiments (Indicative)		
1.	Introduction to MATLAB through matrices, and general Syntax	2 hours
2.	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB	2 hours
3.	Evaluating Extremum of a single variable function	2 hours
4.	Understanding integration as Area under the curve	2 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	2 hours
6.	Evaluating maxima and minima of functions of several variables	2 hours
7.	Applying Lagrange multiplier optimization method	2 hours
8.	Evaluating Volume under surfaces	2 hours
9.	Evaluating triple integrals	2 hours
10.	Evaluating gradient, curl and divergence	2 hours
11.	Evaluating line integrals in vectors	2 hours
12.	Applying Green's theorem to real world problems	2 hours
Total Laboratory Hours		**24 hours**
Mode of Assessment: Weekly Assessment, Final Assessment Test		
Recommended by Board of Studies	12.06.2015	
Approved by Academic Council	37th ACM **Date**	16.06.2015

MAT2001	STATISTICS FOR ENGINEERS	L	T	P	J	C
		3	0	2	0	4
Prerequisites	MAT1011 – Calculus for Engineers	Syllabus Version: 1.0				

Course Objectives :

1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Expected Course Outcome:

At the end of the course the student should be able to:

1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. Demonstrate R programming for statistical data

Module: 1	Introduction to Statistics	6 hours
Introduction to statistics and data analysis-Measures of central tendency–Measuresof variability-[Moments-Skewness-Kurtosis (Concepts only)].		
Module: 2	**Random variables**	**8 hours**
Introduction–random variables–Probability mass Function, distribution and density functions–joint Probability distribution and joint density functions–Marginal, conditional distribution and density functions–Mathematical expectation, and its properties Covariance, moment generating function–characteristic function.		
Module: 3	**Correlation and regression**	**4 hours**
Correlation and Regression – Rank Correlation– Partial and Multiple correlation– Multiple regression.		
Module: 4	**Probability Distributions**	**7 hours**
Binomial and Poisson distributions – Normal distribution – Gamma distribution – Exponential distribution – Weibull distribution.		
Module: 5	**Hypothesis Testing I**	**4 hours**
Testing of hypothesis – Introduction–Types of errors, critical region, procedure of testing hypothesis-Large sample tests– Z test for Single Proportion, Difference of Proportion, mean and difference of means.		
Module: 6	**Hypothesis Testing II**	**9 hours**
Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes-Design of Experiments - Analysis of variance – one and two way classifications - CRD-RBD-LSD.		
Module: 7	**Reliability**	**5 hours**
Basicconcepts-Hazard function-Reliabilities of series and parallel systems-System Reliability-Maintainability-Preventive and repair maintenance-Availability.		
Module: 8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
Total Lecture hours		**45 hours**

Text book(s)

1. Probability and Statistics for engineers and scientists, R.E.Walpole, R.H.Myers,S.L.Mayers and K.Ye, 9th Edition, Pearson Education (2012).
2. Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th Edition, John Wiley & Sons (2016).

Reference books

1. Reliability Engineering, E.Balagurusamy, Tata McGraw Hill, Tenth reprint 2017.
2. Probability and Statistics, J.L.Devore, 8th Edition, Brooks/Cole, Cengage Learning (2012).
3. Probability and Statistics for Engineers, R.A.Johnson, Miller Freund's, 8th edition, Prentice Hall India (2011).
4. Probability, Statistics and Reliability for Engineers and Scientists, Bilal M. Ayyub and Richard H. McCuen, 3rdedition, CRC press (2011).

Mode of Evaluation: Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.

List of Experiments (Indicative)

1.	Introduction: Understanding Data types; importing / exporting data.	2 hours
2.	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations.	2 hours
3.	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.	2 hours
4.	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.	2 hours
5.	Fitting the following probability distributions: Binomial distribution	2 hours
6.	Normal distribution, Poisson distribution	2 hours
7.	Testing of hypothesis for One sample mean and proportion from real-time problems.	2 hours
8.	Testing of hypothesis for Two sample means and proportion from real-time problems	2 hours
9.	Applying the t test for independent and dependent samples	2 hours
10.	Applying Chi-square test for goodness of fit test and Contingency test to real dataset	2 hours
11.	Performing ANOVA for real dataset for Completely randomized design, Randomized Block design, Latin square Design	2 hours
Total laboratory hours		**22 hours**

Mode of Evaluation: Weekly Assessment, Final Assessment Test

Recommended by Board of Studies	25.02.2017		
Approved by Academic Council	47th ACM	**Date**	05.10.2017

MGT1022	LEAN START-UP MANAGEMENT	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

To develop the ability to

4. Learn methods of company formation and management.
5. Gain practical skills in and experience of stating of business using pre-set collection of business ideas.
6. Learn basics of entrepreneurial skills.

Expected Course Outcome:

On completion of this course the students will be able to:

1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of enterprise
3. Analyze market size, cost structure, revenue streams, and value chain
4. Understand build-measure-learn principles
5. Foreseeing and quantifying business and financial risks

Module: 1	2hours
Creativity and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)	
Module: 2	**3 hours**
Minimum Viable Product (Value Proposition, Customer Segments, Build-measure-learn process)	
Module: 3	**3hours**
Business Model Development (Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Business model canvas–the lean model-templates)	
Module: 4	**3 hours**
Business Plan and Access to Funding (visioning your venture, taking the product / service to market, Market plan including Digital & Viral Marketing, start-up finance – Costs / Profits & Losses / cash flow, Angel / VC / Bank Loans and Key elements of raising money)	
Module: 5	**2hours**
Legal, Regulatory, CSR, Standards,Taxes	
Module: 6	**2 hours**
Lectures by Entrepreneurs	
Total Lecture hours	**15 hours**

Text Book (s)

1.	Steve Blank, K & S Ranch (2012)The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, 1st edition
2.	Steve Blank (2013) The Four Steps to the Epiphany, K&S Ranch; 2nd edition
3.	Eric Ries (2011) The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business

Reference Books	
1.	Holding a Cat by the Tail, Steve Blank, K & S Ranch Publishing LLC (August 14, 2014)
2.	Product Design and Development, Karal TUlrich, SDEppinger, McGrawHill
3.	Zero to One: Notes on Startups, or How to Build the Future, Peter Thiel, Crown Business (2014)
4.	Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series), Alistair Croll & Benjamin Yoskovitz, O' Reilly Media; 1st Edition (March 21, 2013)
5.	Inspired: How to create Products Customers Love, Marty Cagan,S VPG Press; 1st edition (June18, 2008)
6.	**Website References:** 1. http://theleanstartup.com/ 2. https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by-eric-ries 3. http://businessmodelgeneration.com/ 4. https://www.leanstartupmachine.com/ 5. https://www.youtube.com/watch?v=fEvKo90qBns 6. http://thenextweb.com/entrepreneur/2015/07/05/whats-wrong-with-the-lean-startup-methodology/#gref 7. http://www.businessinsider.in/Whats-Lean-about-Lean-Startup/articleshow/53615661.cms 8. https://steveblank.com/tools-and-blogs-for-entrepreneurs/ 9. https://hbr.org/2013/05/why-the-lean-start-up-changes-everything 10. chventures.blogspot.in/platformsandnetworks.blogspot.in/p/saas-model.html
Teaching Modes: Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks	

Project				
1.	Project	60 hours		
Total Project		**60 hours**		
Recommended by Board of Studies		08.06.2015		
Approved by Academic Council		37th ACM	**Date**	16.06.2015

PHY1701	ENGINEERING PHYSICS	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Physics of 12th standard or equivalent**	**Syllabus version**				
		2.1				

Course Objectives:

To enable the students to understand the basics of the latest advancements in Physics viz., Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.

Expected Course Outcome:

On completion of this course the students will be able to:

1. To understand the dual nature of radiation and matter.
2. To apply Schrodinger's equations to solve finite and infinite potential problems.
3. To apply quantum ideas at the nanoscale.
4. To apply quantum ideas for understanding the operation and working principle of optoelectronic devices.
5. To analyze the Maxwell's equations in differential and integral form.
6. To classify the optical fiber for different Engineering applications.
7. To apply concept of Lorentz Transformation for engineering applications.
8. To demonstrate the quantum mechanical ideas – Lab

Module: 1	**Introduction to Modern Physics**	**6 hours**

Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent).

Module: 2	**Applications of Quantum Physics**	**5 hours**

Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling Effect (Qualitative) (AB 205), Scanning Tunneling Microscope (STM).

Module: 3	**Nanophysics**	**5 hours**

Introduction to Nano-materials, Moore's law, Properties of Nano-materials, Quantum confinement, Quantum well, wire & dot, Carbon Nano-tubes (CNT), Applications of nanotechnology in industry.

Module: 4	**Laser Principles and Engineering Application**	**6 hours**

Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Population inversion, Two, three & four level systems, Pumping schemes, Threshold gain coefficient, Components of laser, Nd-YAG, He-Ne, CO2 and Dye laser and their engineering applications.

Module: 5	**Electromagnetic Theory and its application**	**6 hours**

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral, Maxwell Equations (Qualitative), Wave Equation (Derivation), EM Waves, Phase velocity, Group velocity, Group index , Wave guide (Qualitative)

Module: 6	**Propagation of EM waves in Optical fibers and Optoelectronic Devices**	**6 hours**

Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers - step index, graded index, single mode & multimode, Attenuation, Dispersion-intermodal and intramodal. Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication- Endoscopy.

Module: 7	Special Theory of Relativity	**9 hours**

Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.

Module: 8	**Contemporary issues**	**2 hours**
Lecture by Industry Experts		
Total Lecture hours		**45 hours**

Text Book (s)	
1.	Arthur Beiser et al., Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw Hill. William Silfvast,
2.	Laser Fundamentals, 2008, Cambridge University Press
3.	D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson
4.	Djafar K. Mynbaev and Lowell L.Scheiner, Fiber Optic Communication Technology, 2011, Pearson
Reference Books	
1.	Raymond A. Serway, Clement J. Mosses, Curt A. Moyer Modern Physics, 2010, 3rd Indian Edition Cengage learning.
2.	John R. Taylor, Chris D. Zafiratos and Michael A. Dubson, Modern Physics for Scientists and Engineers, 2011, PHI Learning Private Ltd.
3.	Kenneth Krane Modern Physics, 2010, Wiley Indian Edition.
4.	Nityanand Choudhary and RichaVerma, Laser Systems and Applications, 2011, PHI Learning Private Ltd.
5.	S. Nagabhushana and B. Sathyanarayana, Lasers and Optical Instrumentation, 2010, I.K. International Publishing House Pvt. Ltd.
6.	R. Shevgaonkar, Electromagnetic Waves, 2005, 1st Edition, Tata McGraw Hill
7.	Principles of Electromagnetics, Matthew N.O. Sadiku, 2010, Fourth Edition, Oxford
8.	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press
Mode of Evaluation: Quizzes , Digital Assignments, CAT-I and II and FAT		

List of Challenging Experiments (Indicative)		
1.	Determination of Planck's constant using electrolumine scence process	2 hrs
2.	Electron diffraction	2 hrs
3.	Determination of wave length of laser source (He-Ne laser and diodelasers of Different wave lengths) using diffraction technique	2 hrs
4.	Determination of size offine particle using laser diffraction	2 hrs
5.	Determination of the track width (periodicity) in a written CD	2 hrs
6.	Optical Fiber communication (source+optical fiber+detector)	2 hrs
7.	Analysis of crystallite size and strain in a nano-crystalline film using X-ray diffraction	2 hrs
8.	Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (can be given as an assignment)	2 hrs
9.	Laser coherence length measurement	2 hrs
10.	Proof for transverse nature of E.M. waves	2 hrs
11.	Quantum confinement and Heisenberg's uncertainty principle	2 hrs
12.	Determination of angle of prism and refractive index for various colour – Spectrometer	2 hrs
13.	Determination of divergence of a laser beam	2 hrs
14.	Determination of crystalline size for nanomaterial (Computer simulation)	2 hrs
15.	Demonstration of phase velocity and group velocity (Computer simulation)	2 hrs
Total Laboratory Hours		**30 hours**
Mode of assessment: CAT / FAT		

Recommended by Board of Studies	04.06.2019		
Approved by Academic Council	55th ACM	**Date**	13.06.2019

Course code	Course title	L	T	P	J	C
PHY1901	Introduction to Innovative Projects	1	0	0	0	1
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

This course is offered to the students in the 1st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.

1. To make students confident enough to handle the day to day issues.
2. To develop the "Thinking Skill" of the students, especially Creative Thinking Skills
3. To train the students to be innovative in all their activities
4. To prepare a project report on a socially relevant theme as a solution to the existing issues

Expected Course Outcome: Students will be able to

1. Understand the various types of thinking skills.
2. Enhance the innovative and creative ideas.
3. Find out a suitable solution for socially relevant issues- J component

Module:1 A	Self Confidence	1 hour

Understanding self – Johari Window –SWOT Analysis – Self Esteem – Being a contributor – Case Study

Project : Exploring self, understanding surrounding, thinking about how s(he) can be a contributor for the society, Creating a big picture of being an innovator – writing a 1000 words imaginary autobiography of self – Topic "Mr X – the great innovator of 2015" and upload. **(4 non- contact hours)**

Module:1 B	Thinking Skill	1 hour

Thinking and Behaviour – Types of thinking– Concrete – Abstract, Convergent, Divergent, Creative, Analytical, Sequential and Holistic thinking – Chunking Triangle – Context Grid – Examples – Case Study.

Project : Meeting at least 50 people belonging to various strata of life and talk to them / make field visits to identify a min of100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. **(4 non-contact hours)**

Module:1 C	Lateral Thinking Skill	1 hour

Blooms Taxonomy – HOTS – Outof the box thinking – deBono lateral thinking model – Examples **Project :** Last weeks - incomplete portion to be done and uploaded		
Module:2 A	**Creativity**	**1 hour**
Creativity Models – Walla – Barrons – Koberg & Begnall – Examples **Project :** Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools & upload . **(4 non- contact hours)**		
Module:2 B	**Brainstorming**	**1 hour**
25 brainstorming techniques and examples **Project :** Brainstorm and come out with as many solutions as possible for the top 5 issues identified & upload . **(4 non- contact hours)**		
Module:3	**Mind Mapping**	**1 hour**
Mind Mapping techniques and guidelines. Drawing a mind map **Project :** Using Mind Maps get another set of solutions forthe next 5 issues (issue 6 – 10) . **(4 non- contact hours)**		
Module:4 A	**Systems thinking**	**1 hour**
Systems Thinking essentials – examples – Counter Intuitive condemns **Project :** Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out]. Go back to the customer and assess the acceptability and upload. . **(4 non- contact hours)**		
Module:4 B	**Design Thinking**	**1 hour**
Design thinking process – Human element of design thinking – case study **Project :** Apply design thinking to the selected solution, apply the engineering & scientific tinge to it. Participate in "design week" celebrations upload the weeks learning out come.		
Module:5 A	**Innovation**	**1 hour**
Difference between Creativity and Innovation – Examples of innovation –Being innovative. **Project:** A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload. . **(4 non- contact hours)**		
Module:5 B	**Blocks for Innovation**	**1 hour**
Identify Blocks for creativity and innovation – overcoming obstacles – Case Study **Project :** Project presentation on problem identification, solution, innovations-expected results – Interim review with PPT presentation. . **(4 non- contact hours)**		
Module:5 C	**Innovation Process**	**1 hour**
Steps for Innovation – right climate for innovation **Project:** Refining the project, based on the review report and uploading the text. . **(4 non-contact hours)**		
Module:6 A	**Innovation in India**	**1 hour**
Stories of 10 Indian innovations **Project:** Making the project better with add ons. . **(4 non- contact hours)**		
Module:6 B	**JUGAAD Innovation**	**1 hour**
Frugal and flexible approach to innovation - doing more with less Indian Examples **Project:** Fine tuning the innovation project with JUGAAD principles and uploading (Credit for JUGAAD implementation) . **(4 non- contact hours)**		
Module:7 A	**Innovation Project Proposal Presentation**	**1 hour**
Project proposal contents, economic input, ROI – Template **Project:** Presentation of the innovative project proposal and upload . **(4 non- contact hours)**		
Module:8 A	Contemporary issue in Innovation	**1 hour**

Contemporary issue in Innovation **Project:** Final project Presentation , Viva voce Exam (**4 non- contact hours)**			
	Total Lecture hours:	**15 hours**	

Text Book(s)	
1.	How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007
2.	The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008
Reference Books	
1.	Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000
2.	Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008
3.	Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015
4.	JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Three reviews with weightage of 25 : 25 : 50 along with reports

Recommended by Board of Studies	15-12-2015		
Approved by Academic Council	No. 39	Date	17-12-2015

SPECIALIZATION ELECTIVE

BKT3002	Public Key Infrastructure And Trust Management	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives:

To provide the knowledge on Public Key infrastructure and trust management techniques and their applications.

Course Outcome:

Upon successful completion of the course, the student should be able to:

1. Analyze and design Public Key cryptographic algorithms.
2. Analyze the components of PKI and design & integrate PKI services.
3. Design the Digital Certificates with PKI considerations.
4. Identify the access control mechanism and sole the security challenges.
5. Apply suitable trust models for the application with operational considerations.

Module:1	**Public Key Cryptography Basics**	**3 hours**

Public Key Cryptography: Symmetric v/s Asymmetric ciphers, Secret key, Public key, public/private key pair, Services of public key cryptography. Diffie Hellman key exchange algorithm, RSA algorithm. RABIN Cryptosystem ElGamal Cryptosystem, message Integrity & Authentication; Random Oracle model, message authentication, Cryptographic hash functions; MD hash families, Whirlpool, SHA-512.

Module:2	**Public Key Infrastructure**	**6 hours**

Public key infrastructure: components and architecture of fully functional PKI: Certification authority, Certificate repository, Certificate revocation, Key backup and recovery, Automatic key update, Key history management, Cross-certification, Support for non-repudiation, Time stamping, Client software, Core PKI Services, PKI-Enabled Services, PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. PKI architectures: Single CA, Hierarchial PKI, Mesh PKI, Trust Lists, Bridge CAs, Different PKIs: PGP (Pretty Good Privacy): Web of trust, applications; X.509: X.500, Certification Authority (CA), Registration Authority (RA), Root-CA, X.509 Protocols, Simple PKI (SPKI), PKI application : Smart card integration with PKI's.

Module:3	**Digital Certificates**	**5 hours**

Digital Certificates: Introduction to Digital Certificate, Certificate Structure and Semantics, Alternative Certificate Formats, Certificate Policies, Object Identifiers, Policy Authorities, Certification Authority. Key/Certificate Life-Cycle Management. Certificate Revocation, Representing certificates in terms of S-Expressions- Certificate Chain.

Module:4	**Access Control Mechanisms and Security Challenges**	**3 hours**

Access Control Mechanisms: Discretionary Access Control (DAC) – Mandatory Access Control (MAC) – Role Based Access Control (RBAC).Issues : Revocation- Anonymity-Privacy issues, Entity Authentication; Passwords and Challenge Response, zero-knowledge and bio-metrics, Key management; security key distribution, Kerberos, Symmetric Key agreement, Public Key Distribution and Hi-jacking, Issues of revocation, Anonymity and Privacy.

Module:5	**Trust Models**	**5 hours**

Strict Hierarchy of Certification Authorities, Loose Hierarchy of Certification Authorities, Policy-Based Hierarchies, Distributed Trust Architecture, Mesh Configuration, Hub-and-Spoke Configuration, Four-Corner Trust Model, Web Model, User-Centric Trust, Cross-Certification, Entity Naming, Certificate Path Processing, Path Construction, Path Validation, Trust Anchor Considerations, Multiple Key Pairs, Key Pair Uses, Relationship between Key Pairs and Certificates, Real-World Difficulties, Independent Certificate

Management, Support for Non-repudiation.		
Module:6	**Trust Management Systems**	**3 hours**
Social network based Trust Management System- Reputation based Trust Management System (DMRep, EigenRep, P2Prep), Framework for Trust Establishment, Risks Impact on E-Commerce and E- Business: Information Risk – Technology Business Risk.		
Module:7	**Operational Considerations**	**3 hours**
Client-Side Software, Off-line Operations, Physical Security, Hardware Components, User Key Compromise, Disaster Preparation and Recovery, Relying Party Notification, Preparation. Recovery, Electronic Signature Legislation and Considerations.		
Module:8	**Contemporary Issues:**	**2 hours**
Total Lecture hours:		**30 hours**

Reference Books

1. Carlisle Adams, Steve Lloyd, "Understanding PKI: Concepts, Standards, and Deployment Considerations", 2nd Edition, Addison-Wesley
2. Ashutosh Saxena, "Public Key Infrastructure", Tata McGraw Hill.
3. John R. Vacca. "Public Key Infrastructure: Building Trusted Applications and Web Services", Auerbach Publications.
4. Messaoud Benantar, "Introduction to the Public Key Infrastructure for the Internet", Pearson Education
5. Desmedt, Yvo G. (Ed.), "Secure Public Key Infrastructure Standards, PGP and Beyond", Springer, 2012.
6. J. Camenisch and C. Lambrinoudakis, "Public Key Infrastructures, Services and Applications", EuroPKI 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Implementation of RSA algorithms	3 hours
2.	Implementation of Cryptographic hash functions	3 hours
3.	Implementation of PGP (Pretty Good Privacy)	4 hours
4.	Implementation of Simple PKI (SPKI)	5 hours
5.	Design an application to generate digital certificate	5 hours
6.	Smart card integration with PKI's	5 hours
7.	Implementation of Four-Corner Trust Model	5 hours
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	28-10-2021		
Approved by Academic Council	No.64	Date	16-12-2021

BKT4001	Blockchain Ecosystem	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

Students will be able to:

1. Understand blockchain building blocks.
2. Familiar with Ethereum and Hyperledger.
3. Exploit applications of Blockchain in real world scenarios.

Course Outcomes

1. Understand blockchain building blocks:
2. Explore the components DLT and Smart Contract.
3. Design and develop end-to-end decentralized applications.
4. Acquaint blockchain ecosystem.
5. Blockchain Ecosystem Services in real world sceneries.
6. Comprehend of emerging models.

Module:1	**Foundations of Blockchain**	**7 hours**

Basic of Blockchain Architecture – Challenges – Applications – Block chain Design Principles -The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - peer-to-peer network – Abstract Models - GARAY model - RLA Model - Proof of Work (PoW) - Proof of Stake (PoS) based Chains - Hybrid models.

Module:2	**Distributed Ledger Technology**	**6 hours**

Origin of Ledgers, Features of DLT, Types of Distributed Ledger Technologies, Role of Consensus Mechanism, DLT Ecosystem, Distributed Ledger Implementations - Blockchain, Ethereum.

Public and Private Ledgers - Registries, Ledgers, Practitioner Perspective: Keyless Technologies, Transparency as a Strategic Risk, Transparency as a Strategic Asset, Usage of Multiple IDs, Zero Knowledge Proofs, Implementation of Public and Private Blockchain.

Module:3	**Smart Contract**	**5 hours**

Anatomy of a Smart Contract, Life Cycle, Usage Patterns, DLT-based smart contracts, Use Cases: Healthcare Industry, Property Transfer.

Module:4	**Decentralized Organizations**	**5 hours**

Decentralization versus Distribution, Centralized-distributed (Ce-Di) organizations, Decentralized-distributed (De-Di) organizations, Decentralized Autonomous Organizations, Aragon, DAOstack, DAOhaus and Colony.

Module:5	**Types of Blockchain Ecosystem**	**7 hours**

One-Leader Ecosystem, Joint Venture or Consortia Ecosystems, Regulatory Blockchain Ecosystems, Components in Blockchain Ecosystem - Leaders, Core Group, Active Participants, Users, Third-Party Service Providers, Governance for Blockchain Ecosystems.

Module:6	**Blockchain Protocol**	**8 hours**

Ethereum tokens - Augur, Golem, ERC20 token, Understanding Ethereum tokens - App Coins and Protocol Tokens, Blockchain Token Securities Law Framework, Token Economy, Token sale structure, Ethereum Subreddit.

Module:7	**High Performance Computing**	**5 hours**

Integrity of High Performance Systems, Data Provenance, Cluster Construction and Deployment, Mock Workload, Blockchain Software Evaluation, Blockchain storage of Integrity Data

Module:8	**Contemporary Issues:**	**2 hours**

	Total Lecture hours:			**45 hours**
Text Book(s)				
1	Dhillon, V., Metcalf, D., & Hooper, M. Blockchain enabled applications, 2017, CA: Apress, Berkeley.			
2	Diedrich, H. Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations, 2016, Wildfire publishing, Sydney.			
3	Wattenhofer, R. P. Distributed Ledger Technology: The Science of the Blockchain. 2017, Inverted Forest Publishing.			
	Reference Books			
1	Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. Bitcoin and cryptocurrency technologies, Book Bitcoin and cryptocurrency technologies., 2016.			
2	Baset, S. A., Desrosiers, L., Gaur, N., Novotny, P., O'Dowd, A., & Ramakrishna, V. Hands-on blockchain with Hyperledger: building decentralized applications with Hyperledger Fabric and composer, 2018, Packt Publishing Ltd.			
Mode of Evaluation: CAT, written assignment, Quiz, FAT				
Recommended by Board of Studies		28-10-2021		
Approved by Academic Council		No.	Date	16-12-2021

BKT4002	Bitcoin Mining	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

1. To understand the mechanism of Cryptocurrency.
2. To understand the functionality of Bitcoin
3. An exposure towards recent research on Bitcoin

Course Outcomes

1. To Understand and apply the fundamentals of Cryptography in Cryptocurrency
2. To gain knowledge about various operations associated with Cryptocurrency
3. To deal with the methods for verification and validation of Bitcoin transactions
4. To educate the principles, practices and policies associated Bitcoin business

Module:1	**Introduction to Crypto and Crypto-currency:**	**4 hours**
Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Crypto-currency		
Module:2	**Mechanics of Bitcoin:**	**5 hours**
Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network,Limitations & Improvements		
Module:3	**How to Store and Use Bitcoins**	**7 hours**
How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets		
Module:4	**Bitcoin Mining:**	**10 hours**
The Task of Bitcoin Miners, Mining Hardware, Energy Consumption & Ecology, Mining Pools, Mining Incentives and Strategies		
Module:5	**Bitcoin and Anonymity:**	**5 hours**
Anonymity Basics, How to de-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash, Tor and the Silk Road		
Module:6	**Alternative Mining Strategies :**	**5 hours**
Puzzle Requirements, ASIC Resistant Puzzles, Proof-of-useful-work, Nonoutsourceable Puzzles Proof-of-Stake "Virtual Mining" Bitcoin and Altcoins: Merge mining.		
Module:7	**Bitcoin as a Platform:**	**7 hours**
Bitcoin as an Append-Only Log, Bitcoin As Smart Property, Secure Multi-Party Lotteries in Bitcoin, Bitcoin As Randomness Source, Prediction Markets & Real-World Data Feeds.		
Module:8	**Contemporary Issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S. (2016). Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press. 1st editions.

Reference Books

1. Antonopoulos, A. M. (2017). Mastering Bitcoin: unlocking digital cryptocurrencies. OReilly Media, Inc.". 2nd editions.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

LAB

Indicative Experiments		
1.	Hashes, Signatures, Hashcash, and Bitcoind.	4 hours
2.	Merkle Trees, Mining, and the Genesis Block.	4 hours

3.	ASIC Mining, Bitcoin Consensus, and Hard Forks.	4 hours
4.	Parsing Bitcoin Data Structures.	4 hours
5.	Script, Opcodes, and Blockchain Data.	4 hours
6	Create a Bitcoin-payable server to sell digital goods.	5 hours
7	Create a digital supply chain.	5 hours
	Total Laboratory Hours	**30 hours**
Mode of assessment: Continuous assessment / FAT / Oral examination and others		
Recommended by Board of Studies	28-10-2021	
Approved by Academic Council	No. 64	Date 16-12-2021

BKT4003	Smart Contract Essentials	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

1. To introduce Smart Contracts under Blockchain framework.
2. To be aware of the tools and programming skills required to generate Smart Contracts.
3. To assess the effectiveness of the Smart Contracts from security standpoint.

Course Outcomes

1. Understand the basics and objectives of Smart Contracts in a Blockchain.
2. Apply Ethereum in generating a Smart Contract
3. Evaluate the various functionalities and features in an Ethereum Smart Contract.
4. Introduce the Solidity language in creation of a Smart Contract.
5. Incorporate Smart Contracts in decentralized applications.
6. Assess the security issues and effectiveness of a Smart Contract in real world scenarios.

Module:1	**Introduction to Smart Contracts**	**3 hours**

Basic definitions of Blockchain, Cryptocurrency and Smart Contracts; Understanding the Virtual Machine of a Blockchain; Terminology, concepts and practices in Smart Contracts; Hash Functions

Module:2	**Ethereum Smart Contracts**	**7 hours**

Definition of Ethereum; Prevalence of the Ethereum blockchain in Smart Contract development;
Ethereum Virtual Machine (EVM); Ether and Gas as costs of running a Smart Contract; Sample examples of working Ethereum Smart Contracts.

Module:3	**Issues in Application of Smart Contracts**	**7 hours**

Market impact & scientific innovation; Trust; Future-resistance features; Security; Merkle Trees; Notable smart-contract-related hacks and scandals; Workflow of developing a Smart Contract; Execution environments in writing a Smart Contract

Module:4	**Solidity Language Basics**	**7 hours**

Layout of a Solidity Source File; Structure of a contract; Control structures; Functions; Scoping and declarations; Error handling

Module:5	**Solidity with Contracts**	**7 hours**

Creating contracts; Object-oriented high level language features; Visibility and Getters; Events; Abstract Contracts; Libraries

Module:6	**Decentralized Applications**	**6 hours**

Decentralized Application Architecture; Connecting to the Blockchain and Smart Contract; Web3js; Deployment; Sample Web Pages (HTML/CSS/Javascript)

Module:7	**Security and Practicality issues**	**6 hours**

Developer responsibility when writing a Smart Contract; Shifting from Trust-in-People to Trust-in-Code; Data permanence; Selective-Obscurity; Quantum readiness; security counter measures.

Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**45 hours**

Text Book(s)

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (2016).

Reference Books

1. Dannen, C., 2017. Introducing Ethereum and solidity (Vol. 318). Berkeley: Springer.
2. Modi, Ritesh. Solidity Programming Essentials: A beginner's guide to build smart

	contracts for Ethereum and blockchain. Packt Publishing Ltd, 2018.
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar / group discussion / field work (include only those that are relevant to the course. Use ',' to separate the evaluations. Eg. CAT, Quiz and FAT	
List of Experiments (Indicative)	
1. Setting up Ethereum network by using Geth command line interface.	**2**
2. Identifying and setting up a testnet , like Ropsten or Kovan, so that free ethers can be used as transaction.	**2**
3. Transfer ethers from one account to another on an Ethereum testnet.	**3**
4. Constructing Solidity code for a decentralized application where the owner can create a contract (with a tenant) which can be replicated to all nodes.	**4**
5. In a rented house setup with the owner and the tenants, the tenant can submit a deposit and the contract's state changes on all the decentralized nodes.	**3**
6. The owner should be able to check the balance of the contract from any one of the nodes.	**3**
7. Using Remix on the Solidity code to develop, compile and deploy the contract.	**3**
8. Using setter and getter functions to interact with the contract	**2**
9. Withdrawing funds from a contract to a restricted account, preferably the owner's, with different levels of security restrictions.	**4**
10. Deploying a contract on an external blockchain by using Ganache and/or MyEtherwalllet, Metamask.	**4**
Total Hours:	**30 Hours**

Recommended by Board of Studies	28-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BKT4004	Vulnerability Discovery and Exploit Development	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives:

To provide the knowledge on vulnerability discovery and exploit development techniques.

Course Outcome:

Upon successful completion of the course, the student should be able to:

1. Identify and select suitable Vulnerability Discovery Methodologies for real time applications
2. Apply various fuzzing methodologies for automation
3. Analyze how to exploit a program and different types of software exploitation techniques
4. Identify and control the exploitation in Linux and windows system
5. Debug the Windows Kernel and android exploitation

Module:1	**Introduction**	**3 hours**

Introduction: Security threats - Sources of security threats- Motives - Target Assets and Vulnerabilities. Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers,Insider threats, Cyber crimes, Stack Overflow, Heap Overflow, Race Conditions, Triaging,

Module:2	**Targets and Automation**	**6 hours**

Automation and Data Generation, Environment Variable and Argument Fuzzing, Environment Variable and Argument Fuzzing: Automation, Web Application and Server Fuzzing, Web Application and Server Fuzzing: Automation, File Format Fuzzing, File Format Fuzzing: Automation on UNIX, File Format Fuzzing: Automation on Windows, Network Protocol Fuzzing, Network Protocol Fuzzing: Automation on UNIX, Network Protocol Fuzzing: Automation on Windows, Web Browser Fuzzing, Web Browser Fuzzing: Automation, In-Memory Fuzzing, In-Memory Fuzzing: Automation

Module:3	**SQL Injection**	**3 hours**

SQL injection, cross-site scripting, and command injection, SQL Injection Countermeasures, Web-based State Using Hidden Fields and Cookies, Session Hijacking, Cross-site Request Forgery – CSRF, Cross-site Scripting

Module:4	**Advanced Linux Exploitation**	**5 hours**

Linux heap management, constructs, and environment, Navigating the heap, Abusing macros such as unlink() and frontlink(), Function pointer overwrites, Format string exploitation, Abusing custom doubly-linked lists, Defeating Linux exploit mitigation controls, Using IDA for Linux application exploitation, Patch Diffing, one day Exploits and Return Oriented Shellcode, The Microsoft patch management process and Patch Tuesday, Obtaining patches and patch extraction, Binary diffing with BinDiff, patchdiff2, turbodiff, and darungrim, Visualizing code changes and identifying fixes, Reversing 32-bit and 64-bit applications and modules, Triggering patched vulnerabilities, Writing one-day exploits, Handling modern exploit mitigation controls

Module:5	**Windows Kernel Debugging and Exploitation**	**4 hours**

Understanding the Windows Kernel, Navigating the Windows Kernel, Modern Kernel protections, Debugging the Windows Kernel, WinDbg, Analysing Kernel vulnerabilities and Kernel vulnerability types, Kernel exploitation techniques.

Module:6	**Windows Heap Overflows and Client-Side Exploitation**	**4 hours**

Windows heap management, constructs, and environment, Browser-based and client-side exploitation, Remedial heap spraying, Understanding C++, vftable/vtable behavior, Modern heap spraying to determine address predictability, Use-After-Free attacks and dangling pointers, Determining exploitability, Defeating ASLR, DEP, and other common exploit mitigation controls

Module:7	**Android and iOS Exploitation**	**3 hours**
Android Basics, Android Security Model, Introduction to ARM, Android Development Tools, Engage with Application Security, Android Security Assessment Tools, Exploiting Applications, Protecting Applications, Secure Networking, Native Exploitation and Analysis. iOS exploitation-Introduction to iOS hacking, iOS User Space Exploitation, iOS Kernel Debugging and Exploitation		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Reference Books

1. Hack I.T. - Security Through Penetration Testing, T. J. Klevinsky, Scott Laliberte and Ajay Gupta, Addison-Wesley, ISBN: 0-201-71956-8.
2. Metasploit: The Penetration Tester's Guide, David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni.
3. Professional Penetration Testing: Creating and Operating a Formal Hacking Lab, Thomas Wilhelm.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Create an M3U fuzzer	3 hours
2.	Fuzzing the ActFax RAW server	3 hours
3.	Crafting an exploit for the ActFax RAW server	3 hours
4.	Hacking the JavaScript Engine to create custom objects	3 hours
5.	Bypassing ASLR and DEP	3 hours
6.	Discover vulnerabilities using Microsoft patch analysis	3 hours
7.	Escaping the Java sandbox	3 hours
8	Return Oriented Programming (ROP) security mitigation - Memory Protection Checks	3 hours
9	Constructing a ROP Chain and Disabling DEP	3 hours
10	Data Execution Prevention (DEP) security mitigation	3 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: CAT / FAT

Recommended by Board of Studies	28-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BKT4005	Blockchain Architecture Design and Use Cases	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

1. To understand the technology behind blockchain.
2. To comprehend the fundamental design and architectural primitives of Blockchain and the security aspects.
3. To study the various use cases from different application domains.

Course Outcomes

1. Understand the requirements of the basic concepts of blockchain.
2. Understand and apply the concept of Bitcoin.
3. Recognize the underlying technology of transactions, blocks, proof-of-work, and consensus building.
4. Deal with the various design methods for Blockchain Architecture and implementing usecase.
5. Design and explore the applications of Blockchain.
6. Develop own blockchain application using different ways.

Module:1	**Introduction**	**6 hours**

Introduction to Blockchain, Bitcoin and their related usecases - How Bitcoin Works: Blocks, Mining, and the Blockchain - Bitcoin Transactions - Constructing a Transaction - Bitcoin Mining - Basic Crypto Primitives.

Module:2	**Blockchain for Enterprise**	**6 hours**

Overview - Blockchain Components and Concepts - Block Header and Identifiers - Linking Blocks in the Blockchain - Merkle Trees - Mining and Consensus: Aggregating Transactions into Blocks -Mining the Block - Validating and Assembling and Selecting Chains of Blocks.

Module:3	**Transactions and Bitcoin Network**	**6 hours**

Transactions: Lifecycle – Structure - Outputs and Inputs - Standard Transactions - Bitcoin Network.

Module:4	**Bitcoin Client**	**8 hours**

Consensus in Bitcoin - The Basics, PoW and Beyond, The Miners - Bitcoin Core - reference implementation - JSON-RPC API from the command line - Alternative clients, libraries and toolkits - Bitcoin Addresses - Implementing Keys and Addresses in Python – Wallets.

Module:5	**Bitcoin's Blockchain Security**	**6 hours**

Security Architecture principles - User Security Best Practices - Technical and inherent risks of the blockchain technology - Attacks on Privacy: Blockchain and non-blockchain based Attacks - Risks and Limitations of Blockchain.

Module:6	**Blockchain Architecture and applications**	**6 hours**

Design methodology for blockchain applications, blockchain application templates, blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems.

Module:7	**Blockchain Use Cases**	**5 hours**

Blockchain in Financial Software and Systems - Supply chain and logistics monitoring - Music royalties tracking - Advertising insights - Blockchain Implementation for Land Records - Digital content publishing and selling - Digital Supply chain.

Module:8	**Contemporary Issues**	**2 hours**

Total Lecture hours:	**45 hours**

Text Book(s)			
1.	Mastering Bitcoin: Programming the open blockchain. O'Reilly Media, Inc. Andreas M. Antonopoulos, 2017.		
2.	Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.		
Reference Books			
1.	Blockchain: Blueprint for a new economy, Swan, Melanie. O'Reilly Media, Inc, 2015.		
2.	Blockchain enabled applications. Berkeley, CA: Apress. Dhillon, V., Metcalf, D. and Hooper, M., 2017.		
3.	Blockchain applications: a hands-on approach, Bahga A., Madisetti V., VPT, 2017.		
4.	Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J.Bambara and Paul R. Allen, McGraw Hill, 2018.		
5.	Mastering Bitcoin: unlocking digital cryptocurrencies. O'Reilly Media, Inc. Andreas M. Antonopoulos, 2014.		
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	28-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BKT4006	Cryptocurrency Technologies	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives

1. To introduce the cryptocurrency concepts and techniques used in business transactions.
2. To provide skills and knowledge about operations and management in cryptocurrency technologies applied in large scale business.
3. To provide skills to design own cryptocurrencies that meets the business services and customer needs.

Course Outcomes

1. Understand the evolution, principles and benefits of cryptocurrencies.
2. Assess existing technologies to choose an appropriate one that meets business needs.
3. Understand scripting foundations to cater the needs of generating own cryptocurrencies.
4. Decide a suitable model to capture the business needs by interpreting different crypto primitives and technologies.
5. Infer the various bitcoin related security and privacy issues.
6. Design a cryptocurrency with appropriate policies and mechanisms.

Module:1	**Introduction**	**6 hours**

Cryptocurrency Definitions and Attributes, Origin and Importance, Legal Status, Usage of Cryptocurrency, Blockchain, Structure of a Blockchain, Link between Blockchain and Cryptocurrencies, Technological Overview, Importance, uses and hardware and software requirements of Block chain.

Module:2	**Emerging Cryptocurrencies**	**5 hours**

Bitcoin and other Cryptocurrencies, Decentralized System, distributed consensus and atomic broadcast, Byzantine fault-tolerant consensus methods, cryptocurrency as application of blockchain technology, Blockchain based cryptocurrency, Technologies borrowed in Blockchain, Hash pointers, Consensus, Byzantine fault-tolerant distributed computing, digital cash,

Module:3	**Bitcoin scripting**	**8 hours**

Bitcoin scripting language and their use, Alternatives to Bitcoin consensus, Alternative coins, Ethereum and Smart contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, Comparing Bitcoin scripting vs. Ethereum Smart Contracts, Blockchain 1.0, Blockchain 2.0, Blockchain 3.0.

Module:4	**Basic Crypto primitives**	**6 hours**

Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems, Bitcoin Blockchain, Interact with the blockchain, Elliptic curve cryptography, ECDSA, Cryptographic hash functions, SHA-256.

Module:5	**Security & Privacy Issues**	**6 hours**

Building A Bitcoin payment system, Getting started with Bitcoin, Building a payment gateway, Compiling Bitcoin from source, New cryptocurrency, Cloning Bitcoin, Reader coin rebranding, Peer-to-Peer Auctions in Ethereum.

Module:6	**Building Cryptocurrency**	**6 hours**

Applications of blockchain in cyber security, Integrity of information, E-Governance and other contract enforcement mechanisms, Limitations of blockchain as a technology, and myths vs. reality of blockchain technology.

Module:7	**Beyond Cryptocurrency**	**6 hours**

Smart Property, Efficient micro-payments, Coupling Transactions and Payment

(Interdependent Transactions) Public Randomness Source Prediction Markets, Escrow transactions, Green addresses, Auctions and Markets, Multi-party Lotteries.				
Module:8	**Contemporary Issues**			**2 hours**
			Total Lecture hours:	**45 hours**
Text Book(s)				
1.	Narayanan, Arvind, et al. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 1st Edition, 2016.			
2.	Daskalakis, Nikos, and Panagiotis Georgitseas. An Introduction to Cryptocurrencies: The Crypto Market Ecosystem. Routledge, 1st Edition, 2020.			
Reference Books				
1.	Grabowski, Mark. Cryptocurrencies: A Primer on Digital Money. Routledge, 1st Edition, 2019.			
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar / group discussion / field work				
Recommended by Board of Studies		28-10-2021		
Approved by Academic Council		No.64	Date	16-12-2021

NON CREDIT COURSE

Course Code	Course Title	L	T	P	J	C
CHY1002	Environmental Sciences	3	0	0	0	3
Pre-requisite	Chemistry of 12th standard or equivalent	Syllabus version				
		v. 1.1				

Course Objectives:

1. To make students understand and appreciate the unity of life in all its forms, the implications of life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individuals contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.

Expected Course Outcome:

Students will be able to

1. Students will recognize the environmental issues in a problem oriented interdisciplinary perspectives
2. Students will understand the key environmental issues, the science behind those problems and potential solutions.
3. Students will demonstrate the significance of biodiversity and its preservation
4. Students will identify various environmental hazards
5. Students will design various methods for the conservation of resources
6. Students will formulate action plans for sustainable alternatives that incorporate science, humanity, and social aspects
7. Students will have foundational knowledge enabling them to make sound life decisions aswell as enter a career in an environmental profession or higher education.

Module:1	Environment and Ecosystem	7 hours

Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch; Nutrient, water, carbon, nitrogen, cycles; Effect of human activities on these cycles.

Module:2	Biodiversity	6 hours

Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.

Module:3	Sustaining Natural Resources and Environmental Quality	7 hours
Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods.		
Module:4	**Energy Resources**	**6 hours**
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas,Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar- Hydrogen revolution.		
Module:5	**Environmental Impact Assessment**	**6 hours**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government ofIndia (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.		
Module:6	**Human Population Change and Environment**	**6 hours**
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.		
Module:7	**Global Climatic Change and Mitigation**	**5 hours**
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol,Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.		
Module:8	**Contemporary issues :** Lecture by Industry Experts	**2 hours**
Total Lecture hours:		**45 hours**

Text Books

1.	G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.

Reference Books

1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental Science, 4thEdition, John Wiley & Sons, USA.

Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

Recommended by Board of Studies	**12.08.2017**		
Approved by Academic Council	**No. 46**	**Date**	**24.08.2017**

Course code	Course title	L	T	P	J	C
ENG1000	Foundation English - I	0	0	4	0	2
Pre-requisite	Less than 50% EPT score	Syllabus Version				
		v. 1.0				

Course Objectives:

1. To equip learners with English grammar and its application.
2. To enable learners to comprehend simple text and train them to speak and write flawlessly.
3. To familiarize learners with MTI and ways to overcome them.

Expected Course Outcome:

1. Develop the skills to communicate clearly through effective grammar, pronunciation and writing.
2. Understand everyday conversations in English
3. Communicate and respond to simple questions about oneself.
4. Improve vocabulary and expressions.
5. Prevent MTI (Mother Tongue Influence) during usual conversation.

Module:1	**Essentials of grammar**	**3 Hours**
Understand basic grammar-Parts of Speech Activity: Grammar worksheets on parts of speech		
Module:2	**Vocabulary Building**	**3 Hours**
Vocabulary development; One word substitution Activity: Elementary vocabulary exercises		
Module:3	**Applied grammar and usage**	**4 Hours**
Types of sentences; Tenses Activity: Grammar worksheets on types of sentences; tenses		
Module:4	**Rectifying common errors in everyday conversation**	**4 Hours**
Detect and rectify common mistakes in everyday conversation Activity: Common errors in prepositions, tenses, punctuation, spelling and other parts of speech; Colloquialism		
Module :5	**Jumbled sentences**	**2 Hours**
Sentence structure; Jumbled words to form sentences; Jumbled sentences to form paragraph/ short story Activity: Unscramble a paragraph / short story		
Module:6	**Text-based Analysis**	**4 Hours**
Wings of Fire -Autobiography of APJ Abdul Kalam (Excerpts) Activity: Enrich vocabulary by reading and analyzing the text		

Module:7	**Correspondence**	**3 Hours**
Letter, Email, Application Writing Activity: Compose letters; Emails, Leave applications		
Module:8	**Listening for Understanding**	**4 Hours**
Listening to simple conversations & gap fill exercises Activity: Simple conversations in Received Pronunciation using audio-visual materials.		
Module:9	**Speaking to Convey**	**6 Hours**
Self-introduction; role-plays; Everyday conversations Activity**:** Identify and communicate characteristic attitudes, values, and talents; Working and interacting within groups		
Module:10	**Reading for developing pronunciation**	**6 Hours**
Loud reading with focus on pronunciation by watching relevant video materials Activity: Practice pronunciation by reading aloud simple texts; Detecting syllables; Visually connecting to the words shown in relevant videos		
Module:11	**Reading to Contemplate**	**4 Hours**
Reading short stories and passages Activity: Reading and analyzing the author's point of view; Identifying the central idea.		
Module:12	**Writing to Communicate**	**6 Hours**
Paragraph Writing; Essay Writing; Short Story Writing Activity: Writing paragraphs, essays and short- stories		
Module:13	**Interpreting Graphical Data**	**6 Hours**
Describing graphical illustrations; interpreting basic charts, tables, and formats Activity: Interpreting and presenting simple graphical representations/charts in the form of PPTs		
Module:14	**Overcoming Mother Tongue Influence (MTI) in Pronunciation**	**5 Hours**
Practicing common variants in pronunciation Activity: Identifying and overcoming mother tongue influence.		
	Total Laboratory Hours	**60 Hours**

Text Book / Workbook	
1.	Wren, P.C., & Martin, H. (2018).High School English Grammar & Composition N.D.V. PrasadaRao (Ed.). NewDelhi: S. Chand & Company Ltd.
2.	McCarthy, M. O'Dell, F.,& Bunting, J.D. (2010).Vocabulary in Use(High Intermediate students book with answers). Cambridge University Press
Reference Books	
1.	Watkins, P.(2018).Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers. Cambridge University Press.
2.	Mishra, S., &Muralikrishna, C. (2014).Communication Skills for Engineers. Pearson Education

	India			
3	Lewis, N. (2011).Word Power Made Easy. Goyal Publisher			
4	https:/americanliterature.com/short-short-stories			
5	Tiwari, A., &Kalam, A. (1999).Wings of Fire - An Autobiography of Abdul Kalam. Universities Press (India) Private Limited.			
Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments				
List of Challenging Experiments (Indicative)				
1.	Rearranging scrambled sentences			**8 hours**
2.	Identifying errors in oral and written communication			**12 hours**
3.	Critically analyzing the text			**8 hours**
4.	Developing passages from hint words			**8 hours**
5.	Role-plays			**12 hours**
6.	Listening to a short story and analyzing it			**12 hours**
	Total Laboratory Hours			**60 hours**
Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments				
Recommended by Board of Studies	**08-06-2019**			
Approved by Academic Council	**55**	**Date**	**13-06-2019**	

Course code	Course title	L	T	P	J	C
ENG2000	Foundation English - II	0	0	4	0	2
Pre-requisite	51% - 70% EPT Score / Foundation English I	Syllabus version				
		v.1.0				

Course Objectives:

1. To practice grammar and vocabulary effectively
2. To acquire proficiency levels in LSRW skills in diverse social situations.
3. To analyze information and converse effectively in technical communication.

Expected Course Outcome:

1. Accomplish a deliberate reading and writing process with proper grammar and vocabulary.
2. Comprehend sentence structures while Listening and Reading.
3. Communicate effectively and share ideas in formal and informal situations.
4. Understand specialized articles and technical instructions and write clear technical correspondence.
5. Critically think and analyze with verbal ability.

Module:1	Grammatical Aspects	4 hours

Sentence Pattern, Modal Verbs, Concord (SVA), Conditionals, Connectives
Activity : Worksheets, Exercises

Module:2	Vocabulary Enrichment	4 hours

Active & Passive Vocabulary, Prefix and Suffix, High Frequency Words
Activity : Worksheets, Exercises

Module:3	Phonics in English	4 Hours

Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker
Activity : Worksheets, Exercises

Module:4	Syntactic and Semantic Errors	2 Hours

Tenses /SVA/Articles/ Prepositions/ Punctuation & Right Choice of Vocabulary
Activity : Worksheets, Exercises

Module:5	Stylistic errors	2 Hours

Dangling Modifiers, Parallelism, Standard English, Ambiguity, Redundancy, Brevity
Activity : Worksheets, Exercises

Module:6	Listening and Note making	6 Hours

Intensive and Extensive Listening - Scenes from plays of Shakespeare (Eg: Court scene in *The Merchant of Venice*, Disguise Scene in *The Twelfth Night*, Death of Desdemona in *Othello*, Death scene in *Julius Caesar* and Balcony scene from *Romeo and Juliet*)
Activity : Summarizing; Note-making and drawing inferences from Short videos

Module:7	**Art of Public Speaking**	**6 Hours**
Impromptu, Importance of Non-verbal Communication, Technical Talks, Dynamics of Professional Presentations – Individual & Group Activity : Ice Breaking; Extempore speech; Structured technical talk and Group presentation		
Module:8	**Reading Comprehension Skills**	**4 Hours**
Skimming, scanning, comprehensive reading, guessing words from context, understanding text organization, recognizing argument and counter-argument; distinguishing between main information and supporting detail, fact and opinion, hypothesis versus evidence; summarizing and note-taking, Critical Reasoning Questions – Reading and Discussion Activity: Reading of Newspapers Articles and Worksheets on Critical Reasoning from web resources		
Module: 9	**Creative Writing**	**4 Hours**
Structure of an essay, Developing ideas on analytical/ abstract topics Activity: Movie Review, Essay Writing on suggested Topics, Picture Descriptions		
Module: 10	**Verbal Aptitude**	**6 hours**
Word Analogy, Sentence Completion using Appropriate words, Sentence Correction Activity: Practicing the use of appropriate words and sentences through web tools.		
Module: 11	**Business Correspondence**	**4 hours**
Formal Letters- Format and purpose: Business Letters - Sales and complaint letter Activity: Letter writing- request for Internship, Industrial Visit and Recommendation		
Module: 12	**Career Development**	**6 hours**
Telephone Etiquette, Resume Preparation, Video Profile Activity: Preparation of Video Profile		
Module: 13	**Art of Technical Writing - I**	**4 hours**
Technical Instructions, Process and Functional Description Activity: Writing Technical Instructions		
Module: 14	**Art of Technical Writing – II**	**4 hours**
Format of a Report and Proposal Activity: Technical Report Writing, Technical Proposal		
	Total Lecture hours:	**60 hours**
Text Book / Workbook		
1.	Sanjay Kumar & Pushp Lata, Communication Skills, 2nd Edition, OUP, 2015	
2	Wren & Martin, High School English Grammar & Composition, Regular ed., ND: Blackie ELT Books, 2018	
Reference Books		

1	Peter Watkins, Teaching and Developing Reading Skills: Cambridge Handbooks for Language Teachers, Cambridge, 2018
2	Aruna Koneru, Professional Speaking Skills, OUP, 2015.
3	J.C.Nesfield, English Grammar English Grammar Composition and Usage, Macmillan. 2019.
4	Richard Johnson-Sheehan, Technical Communication Today, 6th edition, ND: Pearson, 2017.
5	Balasubramaniam, Textbook of English Phonetics For Indian Students, 3rd Edition , S. Chand Publishers, 2013.

Web Resources

1. https://www.hitbullseye.com/Sentence-Correction-Practice.php
2. https://hitbullseye.com/Critical-Reasoning-Practice-Questions.php

Mode of Evaluation: Presentation, Discussion, Role Play, Assignments , FAT

List of Challenging Experiments (Indicative)		
1.	Reading and Analyzing Critical Reasoning questions	8 hours
2.	Listening and Interpretation of Videos	12 hours
3.	Letter to the Editor	6 hours
4.	Developing structured Technical Talk	12 hours
5.	Drafting SOP (Statement of Purpose)	10 hours
6.	Video Profile	12 hours
	Total Laboratory Hours	**60 hours**

Mode of Evaluation: Presentation, Discussion, Role Play, Assignments , FAT

Recommended by Board of Studies	**08.06.2019**		
Approved by Academic Council	**55**	**Date**	**13-06-2019**