SFIT/IQAC/FE-G1-SS/2024-25/R0

Date:25/07/2024

St. Francis Institute of Technology

(Engineering College)

(An Autonomous Institute, Affiliated to University of Mumbai)

S.V.P. Road, Borivli (W), Mumbai

B. E. Third Year Scheme and Syllabus
Computer Engineering

Approved by: - Board of Studies

Approved by: - Academic Council of St. Francis Institute of Technology

w.e.f. Academic Year 2024 – 2025

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AC:
Item No. ____

St. Francis Institute of Technology

Syllabus for Approval

Date:

Sr. No	Heading	Particulars
1.	Title of the Course	Third Year B.E. Computer Engineering
2.	Eligibility for Admission	After Passing Second Year Engineering as per the Ordinance 0.6243
3.	Passing Marks	40%
4.	Ordinances / Regulations (if any)	Ordinance 0.6243
5.	No. of Years / Semesters	8 semesters
6.	Level	~~P.G. /~~ U.G./ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7.	Pattern	~~Yearly~~ / Semester (Strike out which is not applicable)
8.	Status	~~New~~ / Revised (Strike out which is not applicable)
9.	To be implemented from Academic Year	With effect from Academic Year: 2024-2025

Dr. Sincy George
Principal
St Francis Institute of Technology

Dr. Kavita Sonawane
HOD, Computer Engineering Dept.
St Francis Institute of Technology

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education, The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year it will be implemented for 24-25, Third year for 24-25, and 25-26. For Final Year of Engineering it will be implemented for the academic year 2024-25. 2025-26, 2026-27.

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Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C ' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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HOD, Computer Engineering Dept.
St Francis Institute of Technology

Preface by Board of Studies in Computer Engineering

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Second Year Computer Engineering syllabus effective from the Academic Year 2020-21 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting and challenging.

Computer Engineering is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Board of Studies in Computer Engineering

Dr. Kavita Sonawane	:	Chairperson
Dr. Sudip Thepade	:	Subject Expert
Dr. Sunil Mane	:	Subject Expert
Dr. Narendra Shekokar	:	VC Nominee
Mr. Mukesh Jain	:	Industry Expert
Dr. Raj Dabre	:	Alumni
Dr. Padmaja Joshi	:	Special Courses -Expert

1. Program Structure for Third Year B.E Computer Engineering (with Effect from 2024-25)

1.1 Third Year Scheme of the Syllabus

Table 1: Contact hours and credit distribution of courses of T.E Computer Engineering

Course Code	Course	Contact Hours				Credits Assigned			
		Theory (Th)	Practical (P)	Tutorial (T)	Total	Theory (Th)	Practical (P)	Tutorial (T)	Total
Semester VI									
CSC601	System Programming & Compiler Construction	3	--	--	3	3	--	--	3
CSC602	Cryptography & System Security	3	--	--	3	3	--	--	3
CSC603	Mobile Computing	3	--	--	3	3	--	--	3
CSC604	Artificial Intelligence	3	--	--	3	3	--	--	3
CSDLO6 01x	Department Level Optional Course -2	3	--	--	3	3	--	--	3
CSL601	System Programming & Compiler Construction Lab	--	2	--	2	--	1	--	1
CSL602	Cryptography & System Security Lab	--	2	--	2	--	1	--	1
CSL603	Mobile Computing Lab	--	2	--	2	--	1	--	1
CSL604	Artificial Intelligence Lab	--	2	--	2	--	1	--	1
CSL605	Skill base Lab Course: Cloud Computing	--	4	--	4	--	2	--	2
CSM601	Mini Project Lab: 2B	--	**4$**	--	**4**	--	**2**	--	**2**
	Total	**15**	**16**	**--**	**31**	**15**	**08**	--	**23**

*****Should be conducted batch wise and
$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

1.2 Evaluation and Examination Scheme

Table 2: Marks distribution of courses for S.E Computer Engineering

			Theory					Lab		Total
S.No.	**Course Code**	**Course**	**ISE 1**	**ISE 2**	**MSE**	**ESE**	**Total**	**ISE (LAB)**	**P/OE**	
Semester VI										
1	CSC601	System Programming & Compiler Construction	10	10	20	60	100	-	-	100
2	CSC602	Cryptography & System Security	10	10	20	60	100	-	-	100
3	CSC603	Mobile Computing	10	10	20	60	100	-	-	100
4	CSC604	Artificial Intelligence	10	10	20	60	100	-	-	100
5	CSDLO601x	Department Level Optional Course - 2	10	10	20	60	100	-	-	100
6	CSL601	System Programming & Compiler Construction Lab	-	-	-	-	-	25	25	50
7	CSL602	Cryptography & System Security Lab	-	-	-	-	-	25	-	25
8	CSL603	Mobile Computing Lab	-	-	-	-	-	25	-	25
9	CSL604	Artificial Intelligence Lab	-	-	-	-	-	25	25	50
10	CSL605	Skill base Lab Course: Cloud Computing	-	-	-	-	-	50	25	75
11	CSM601	Mini Project : 2B	-	-	-	-	-	25	25	50
Total			**50**	**50**	**100**	**300**	**500**	**175**	**100**	**775**

Department Optional Courses

Department Level Optional Courses	Semester	Code & Course
Department Level Optional Course -2	VI	CSDLO6011: Internet of Things CSDLO6012: Digital Signal & Image Processing CSDLO6013: Quantitative Analysis

Note:

Evaluations includes In Semester Evaluation (ISE), Mid-Semester Examination (MSE), End Semester Examination (ESE), Practical Examination (PE), Oral Examination (OrE) and Project Examination (PrE). Detailed evaluation pattern given in the Examination Conduction rules and Guidelines.

- **ISE** - Includes home assignments, group assignments, quizzes, presentations, experiments, mock tests, tutorials, etc.
- **MSE** - A written assessment covering up to 50% of the syllabus, conducted at mid-semester.
- **ESE** - A written assessment covering 100% of the syllabus, conducted at the end of the semester. Modules covered in the mid-semester exam will have a 30-40 % weightage, with the remaining 60 -70% weightage assigned to the rest of the modules.
- **PE, OrE and PrE** - Practical, Oral, Project examinations are conducted by a pair of internal and external examiner at the end of the semester

2 System Programming & Compiler Construction (CSC601)

2.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSC601	System Programming and Compiler Construction	3	3

2.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

2.3 Course Objectives

S. No.	Objectives
1	To understand the role and functionality of various system programs over application programs.
2	To understand basic concepts, structure and design of assemblers, macro processors, linkers and loaders.
3	To understand the basic principles of compiler design, its various constituent parts, algorithms and data structures required to be used in the compiler.
4	To understand the need to follow the syntax in writing an application program and to learn how the analysis phase of compiler is designed to understand the programmer ‘s requirements without ambiguity
5	To synthesize the analysis phase outcomes to produce the object code that is efficient in terms of space and execution time

2.4 Course Outcomes

The students will be able to:	
CO1	*identify* the relevance of different system programs and also *distinguish* different loaders and linkers, their contribution in developing efficient user applications.
CO2	*analyze* the various data structures and passes of assembler design
CO3	*identify* the need for different features and *designing* of macros.
CO4	*design* Lexical Analyzer of a grammar.
CO5	*construct* different parsers for given context free grammars.
CO6	*justify* the need of synthesis phase to produce object code optimized in terms of high execution speed and less memory

2.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite:		
		Theoretical computer science, Operating system. Computer Organization and Architecture.	
1	**Introduction to System Software**		**2**
	1.1	Concept of System Software, Goals of system software, system program and system programming, Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter,	

		Device Drivers, Operating system, Editors, Debuggers.	
2	**Assemblers**		**7**
	2.1	Elements of Assembly Language programming, Assembly scheme, pass structure of assembler, Assembler Design: Two pass assembler Design and single pass Assembler Design for X86 processor, data structures used.	
3	**Macros and Macro Processor**		**6**
	3.1	Introduction, Macro definition and call, Features of Macro facility: Simple, parameterized, conditional and nested. Design of Two pass macro processor, data structures used.	
4	**Loaders and Linkers**		**6**
	4.1	Introduction, functions of loaders, Relocation and Linking concept, Different loading schemes: Relocating loader, Direct Linking Loader, Dynamic linking and loading.	
5	**Compilers: Analysis Phase**		**10**
	5.1	Introduction to compilers, Phases of compilers: **Lexical Analysis**- Role of Finite State Automata in Lexical Analysis, Design of Lexical analyzer, data structures used **Syntax Analysis**- Role of Context Free Grammar in Syntax analysis, **Types of Parsers:** Top down parser- LL(1), Bottom up parser- SR Parser, Operator precedence parser, SLR. Semantic Analysis, Syntax directed definitions.	
6	**Compilers: Synthesis phase**		**8**
	6.1	**Intermediate Code Generation:** Types of Intermediate codes: Syntax tree, Postfix notation, three address codes: Triples and Quadruples, indirect triple. **Code Optimization:** Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent. **Code Generation:** Issues in the design of code generator, code generation algorithm. Basic block and flow graph.	
		Total Hours	**39**

2.6 Suggested Learning Resources

2.6.1 Textbooks

1. D. M Dhamdhere: Systems programming and Operating Systems, Tata McGraw Hill, Revised Second Edition
2. A. V. Aho, R. Shethi, Monica Lam, J.D. Ulman: Compilers Principles, Techniques and Tools, Pearson Education, Second Edition
3. J. J. Donovan: Systems Programming Tata McGraw Hill, Edition 1991

2.6.2 Reference Books

1. John R. Levine, Tony Mason & Doug Brown, Lex & YACC, O 'Reilly publication, second Edition
2. D, M .Dhamdhere ,Compiler construction 2e, Macmillan publication, second edition .
3. Kenneth C. Louden ,Compiler construction: principles and practices, Cengage Learning
4. Leland L. Beck, System software: An introduction to system programming, Pearson publication, Third Edition

2.6.3 Web Resources :

1. http://www.nptelvideos.in/2012/11/compiler-design.html\
2. https://www.coursera.org/lecture/nand2tetris2/unit-4-1-syntax-analysis-5pC2Z

3 Cryptography and System Security (CSC602)

3.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSC602	Cryptography and System Security	3	3

3.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

3.3 Course Objectives

S. No.	Objectives
1	To introduce classical encryption techniques and concepts of modular arithmetic and number theory.
2	To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3	To explore the design issues and working principles of various authentication protocols, PKI standards and various secure communication standards including Kerberos, IPsec, and SSL/TLS.
4	To develop the ability to use existing cryptographic utilities to build programs for secure communication

3.4 Course Outcomes

The students will be able to:	
CO1	*explain* system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory
CO2	*discuss*, *compare* and *apply* different cryptographic algorithms including secret key cryptography and public key algorithms to solve problems related to confidentiality and authentication
CO3	*apply* different cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
CO4	*apply* different digital signature algorithms to achieve authentication and design secure applications.
CO5	*discuss* network security basics, *analyse* different attacks on networks and *evaluate* the performance of firewalls and security protocols like SSL, IPSec, and PGP
CO6	*analyse* and *apply* system security concept to recognize malicious code

3.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite:		
	Computer Networks		
1	**Introduction - Number Theory and Basic Cryptography**		**8**
	1.1	Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat's and Euler's	

		theorem	
	1.2	Classical Encryption techniques, Symmetric cipher model, mono-alphabetic and polyalphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers	
2	**Symmetric and Asymmetric key Cryptography and key Management**		**11**
	2.1	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC4 algorithm.	
	2.2	Public key cryptography: Principles of public key cryptosystems-The RSA Cryptosystem, The knapsack cryptosystem	
	2.3	Symmetric Key Distribution: KDC, Needham-schroeder protocol. Kerberos: Kerberos Authentication protocol, Symmetric key agreement: Diffie Hellman, Public key Distribution: Digital Certificate: X.509, PKI	
3	**Cryptographic Hash Functions**		**3**
	3.1	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC.	
4	Authentication Protocols & Digital Signature Schemes		**5**
	4.1	User Authentication, Entity Authentication: Password Base, Challenge Response Based	
	4.2	Digital Signature, Attacks on Digital Signature, Digital Signature Scheme: RSA	
5	Network Security and Applications		**9**
	5.1	Network security basics: TCP/IP vulnerabilities (Layer wise), Network Attacks: Packet Sniffing, ARP spoofing, port scanning, IP spoofing	
	5.2	Denial of Service: DOS attacks, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service	
	5.3	Internet Security Protocols: PGP, SSL, IPSEC. Network security: IDS, Firewalls	
6	System Security		**3**
	6.1	Buffer Overflow, malicious Programs: Worms and Viruses, SQL injection	
		Total Hours	**39**

3.6 Suggested Learning Resources

3.6.1 Textbooks

1. William Stallings, “Cryptography and Network Security, Principles and Practice”, 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, “Cryptography & Network Security”, Tata McGraw Hill
3. Behrouz A. Forouzan & Debdeep Mukhopadhyay, “Cryptography and Network Security” 3rd Edition, McGraw Hill

3.6.2 Reference Books

1. Bruce Schneier, “Applied Cryptography, Protocols Algorithms and Source Code in C”, Second Edition, Wiley.
2. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill Education, 2003.
3. Eric Cole, “Network Security Bible”, Second Edition, Wiley, 2011.

3.6.3 Web Resources :

1. https://github.com/cmin764/cmiN/blob/master/FII/L3/SI/book/W.Stallings%20-%20Cryptography%20and%20Network%20Security%206th%20ed.pdf
2. https://docs.google.com/file/d/0B5F6yMKYDUbrYXE4X1ZCUHpLNnc/view

4 Mobile Computing (CSC603)

4.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSC603	Mobile Computing	3	3

4.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

4.3 Course Objectives

S. No.	Objectives
1	To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
2	To explore both theoretical and practical issues of mobile computing.
3	To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.
4	To discuss the architecture of WLAN in detail so that the students can understand the basic ad – hoc network.
5	To explore the knowledge of mobile IP and IPV6 protocol to provide the security and manage the cellular network properly.
6	To discuss all generation of mobile communication and LTE in detail so that they can implement it in detail in

4.4 Course Outcomes

The students will be able to:	
CO1	*identify* basic concepts and principles in computing, cellular architecture.
CO2	*describe* the components and functioning of mobile networking.
CO3	*classify* variety of security techniques in mobile network.
CO4	*apply* the concepts of WLAN for local as well as remote applications.
CO5	*implement* the security management program.
CO6	*describe* Long Term Evolution (LTE) architecture and its interfaces.

4.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite:		
	Computer Networks		
1	**Introduction to Mobile Computing**		**4**
	1.1	Introduction to Mobile Computing, Telecommunication Generations, Cellular systems,	
	1.2	Electromagnetic Spectrum, Antenna, Signal Propagation, Signal Characteristics, Multiplexing, Spread Spectrum: DSSS & FHSS, Co-channel interference	
2	**GSM Mobile services**		**8**

	2.1	GSM Mobile services, System Architecture, Radio interface, Protocols, Localization and Calling, Handover, security (A3, A5 & A8)	
	2.2	GPRS system and protocol architecture	
	2.3	UTRAN, UMTS core network; Improvements on Core Network,	
3	**Mobile Networking**		**8**
	3.1	Medium Access Protocol, Internet Protocol and Transport layer	
	3.2	Mobile IP: IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling.	
	3.3	Mobile TCP: Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission	
4	**Wireless Local Area Networks**		**6**
	4.1	Wireless Local Area Networks: Introduction, Infrastructure and ad-hoc network	
	4.2	IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium access control layer, MAC management, 802.11a, 802.11b standard	
	4.3	Wi-Fi security: WEP, WPA, Wireless LAN Threats, Securing Wireless Networks	
	4.4	Bluetooth: Introduction, User Scenario, Architecture, protocol stack	
5	**Mobility Management**		**6**
	5.1	Mobility Management: Introduction, IP Mobility, Optimization, IPv6	
	5.2	Macro Mobility: MIPv6, FMIPv6	
	5.3	Micro Mobility: CellularIP, HAWAII, HMIPv6	
6	**Long-Term Evolution (LTE) of 3GPP**		**7**
	6.1	Long-Term Evolution (LTE) of 3GPP: LTE System Overview, Evolution from UMTS to LTE	
	6.2	LTE/SAE Requirements, SAE Architecture	
	6.3	EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to LTE-Advanced	
	6.4	Self-Organizing Network (SON-LTE), SON for Heterogeneous Networks (HetNet), Comparison between Different Generations (2G, 3G, 4G and 5G), Introduction to 5G	
		Total Hours	**39**

4.6 Suggested Learning Resources

4.6.1 Textbooks

1. Jochen Schilller, “Mobile Communication”, Addision wisely, Pearson Education
2. William Stallings “Wireless Communications & Networks”, Second Edition, Pearson Education
3. Christopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications”, Wiley publications
4. Raj Kamal, “Mobile Computing”, 2/e, Oxford University Press-New

4.6.2 Reference Books

1. Seppo Hamalainen, Henning Sanneck , Cinzia Sartori, “LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency”, Wiley publications
2. Ashutosh Dutta, Henning Schulzrinne “Mobility Protocols and Handover Optimization: Design, Evaluation and Application”, IEEE Press, Wiley Publication
3. Michael Gregg, “Build your own security lab”, Wiley India edition

4. Dipankar Raychaudhuri, Mario Gerla, “Emerging Wireless Technologies and the Future Mobile Internet”, Cambridge
5. Andreas F. Molisch, “Wireless Communications”, Second Edition, Wiley Publication

4.6.3 Web Resources :

1. https://www.coursera.org/learn/smart-device-mobile-emerging-technologies
2. https://nptel.ac.in/courses/106/106/106106167/

5 Artificial Intelligence (CSC604)

5.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSC604	Artificial Intelligence	3	3

5.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

5.3 Course Objectives

S. No.	Objectives
1	To conceptualize the basic ideas and techniques underlying the design of intelligent systems.
2	To make students understand and Explore the mechanism of mind that enables intelligent thought and action.
3	To make students understand advanced representation formalism and search techniques.
4	To make students understand how to deal with uncertain and incomplete information.

5.4 Course Outcomes

The students will be able to:	
CO1	*develop* a basic understanding of AI building blocks presented in intelligent agents.
CO2	*realize* the basic techniques used to build an intelligent system.
CO3	*apply* an appropriate search technique used in problem solving method.
CO4	*analyze* the strength and weaknesses of AI approaches for knowledge– intensive problem solving as well as design models for reasoning with uncertainty
CO5	*use* planning and learning methods to solve intensive problem with Optimal solution
CO6	*design* and *develop* AI applications in real world scenarios.

5.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite:		
	Discrete Mathematics, Data Structures		
1	**Introduction to Artificial Intelligence**		**4**
	1.1	Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI.	
2	**Intelligent Agents**		**4**
	2.1	Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent.	
	2.2	Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems.	
3	**Problem Solving**		**10**

	3.1	Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search.	
	3.2	Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Genetic algorithms	
	3.3	Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning	
4	**Knowledge and Reasoning**		**12**
	4.1	Knowledge based Agents, Brief Overview of propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining.	
	4.2	Knowledge Engineering in First-Order Logic, Unification, Resolution	
	4.3	Uncertain Knowledge and Reasoning: Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Simple Inference in belief network	
5	**Planning and Learning**		**5**
	5.1	The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning.	
	5.2	Learning: Forms of Learning, Theory of Learning, PAC learning. Introduction to statistical learning (Introduction only) Introduction to reinforcement learning: Learning from Rewards, Passive Reinforcement Learning, Active reinforcement Learning	
6	**AI Applications**		**4**
	6.1	A. Introduction to NLP- Language models, Grammars, Parsing B. Robotics - Robots, Robot hardware, Problems Robotics can solve C. AI applications in Healthcare, Retail, Banking	
		Total Hours	**39**

5.6 Suggested Learning Resources

5.6.1 Textbooks

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition" Pearson Education, 2020.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011
3. George F Luger, "Artificial Intelligence" Low Price Edition, Fourth edition, Pearson Education.,2005

5.6.2 Reference Books

1. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.

5.6.3 Web Resources:

1. https://nptel.ac.in/courses/106/105/106105078/
2. https://thestempedia.com/blog/simple-ai-and-machine-learning-projects-for-students-and-beginners
3. https://nptel.ac.in/courses/106/105/106105079/

6 Internet of Things (CSDLO6011)

6.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDLO6011	Internet of Things	3	3

6.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

6.3 Course Objectives

S. No.	Objectives
1	To equip students with the fundamental knowledge and basic technical competence in the field of Internet of Things (IoT).
2	To emphasize on core IoT functional Stack to build assembly language programs. To learn the Core IoT Functional Stack
3	To understand the different common application protocols for IoT and apply IoT knowledge to key industries that IoT is revolutionizing.
4	To examines various IoT hardware items and software platforms used in projects for each platform that can be undertaken by a beginner, hobbyist, student, academician, or researcher to develop useful projects or products.

6.4 Course Outcomes

The students will be able to:	
CO1	*understand* the concepts of IoT and the Things in IoT.
CO2	*emphasize* core IoT functional Stack and understand application protocols for IoT.
CO3	*apply* IoT knowledge to key industries that IoT is revolutionizing.
CO4	*examine* various IoT hardware items and software platforms used in projects.
CO5	*develop* small-scale IoT applications using embedded programming and IoT platforms (e.g., Google Cloud IoT, AWS IoT, Azure IoT).
CO6	*collect, process,* and *analyze* IoT-generated data using cloud computing and edge computing, and *apply* basic data analytics and AI techniques for decision-making in IoT applications.

6.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite:		
	C Programming, Digital Logic and Computer Architecture, Microprocessor, Computer Networks.		
1	**Introduction to Internet of Things (IoT)**		**7**
	1.1	What is IoT? - IoT and Digitization	
	1.2	IoT Impact – Connected Roadways, Connected Factory, Smart Connected Buildings, Smart Creatures	
	1.3	Convergence of IT and OT, IoT Challenges	
	1.4	The oneM2M IoT Standardized Architecture	
	1.5	The IoT World Forum (IoTWF) Standardized Architecture	
	1.6	IoT Data Management and Compute Stack – Design considerations and	

		Data related problems, Fog Computing, Edge Computing, The Hierarchy of Edge, Fog and Cloud	
2	**Things in IoT**		**7**
	2.1	Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications	
	2.2	Actuators - Definition, Principles, Classifications, Types, Characteristics and Specifications	
	2.3	Smart Object – Definition, Characteristics and Trends	
	2.4	Sensor Networks – Architecture of Wireless Sensor Network, Network Topologies	
	2.5	Enabling IoT Technologies - Radio Frequency Identification Technology, MicroElectro-Mechanical Systems (MEMS), NFC (Near Field Communication), Bluetooth Low Energy (BLE), LTE-A (LTE Advanced), IEEE 802.15.4– Standardization and Alliances, ZigBee.	
3	**The Core IoT Functional Stack**		**6**
	3.1	Layer 1 – Things: Sensors and Actuators Layer	
	3.2	Layer 2 – Communications Network Layer, Access Network Sublayer, Gateways and Backhaul Sublayer, Network Transport Sublayer, IoT Network Management Sublayer	
	3.3	Layer 3 – Applications and Analytics Layer, Analytics Vs. Control Applications, Data Vs. Network Analytics, Data Analytics Vs. Business Benefits, Smart Services	
4	**Application Protocols for IoT**		**7**
	4.1	The Transport Layer	
	4.2	IoT Application Transport Methods	
	4.3	Application Layer Protocol Not Present	
	4.4	SCADA - Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation, SCADA Transport over LLNs with MAP-T,	
	4.5	Generic Web-Based Protocols	
	4.6	IoT Application Layer Protocols – CoAP and MQTT	
5	**Domain Specific IoTs**		**6**
	5.1	Home Automation – Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors	
	5.2	Cities – Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance	
	5.3	Environment – Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection	
	5.4	Energy – Smart Grids, Renewable Energy Systems, Prognostics	
	5.5	Retail – Inventory Management, Smart Payments, Smart Vending Machines	
	5.6	Logistics – Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring	
	5.7	Agriculture – Smart Irrigation, Green House Control	
	5.8	Industry – Machine Diagnostics & Prognosis, Indoor Air Quality Monitoring	
	5.9	Health & Lifestyle – Health & Fitness Monitoring, Wearable Electronics	
6	**Create your own IoT**		**6**
	6.1	IoT Hardware - Arduino, Raspberry Pi, ESP32, Cloudbit/Littlebits, Particle Photon, Beaglebone Black.	
	6.2	IoT Software - languages for programming IoT hardware, for middleware applications and API development, for making front ends, REST and JSON-LD	

	6.3	A comparison of IoT boards and platforms in terms of computing	
	6.4	A comparison of IoT boards and platforms in terms of development environments and communication standards	
	6.5	A comparison of boards and platforms in terms of connectivity	
	6.6	A comparison of IoT software platforms	
		Total Hours	**39**

6.6 Suggested Learning Resources

6.6.1 Textbooks

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1 st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017.
2. Hakima Chaouchi, “The Internet of Things - Connecting Objects to the Web”, 1 st Edition, Wiley, 2010.
3. Perry Lea, “Internet of things For Architects”, 1 st Edition, Packt Publication, 2018
4. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – Hands-On Approach”, 2 nd Edition, Universities Press, 2016.

6.6.2 Reference Books

1. Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, 1 st Edition, Wiley, 2014.
2. Donald Norris, “Raspberry Pi – Projects for the Evil Genius”, 2 nd Edition, McGraw Hill, 2014.
3. Anand Tamboli ,“Build Your Own IoT Platform”, 1 st Edition, Apress, 2019.

6.6.3 Web Resources:

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/108/108/108108098/
3. https://nptel.ac.in/courses/106/105/106105195/
4. https://www.coursera.org/specializations/IoT

7 Digital Signal & Image Processing (CSDLO6012)

7.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDLO6012	Digital Signal & Image Processing	3	3

7.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

7.3 Course Objectives

S. No.	Objectives
1	To understand the fundamental concepts of digital signal processing and Image processing
2	To explore DFT for 1-D and 2-D signal and FFT for 1-D signal
3	To apply processing techniques on 1-D and Image signals
4	To apply digital image processing techniques for edge detection

7.4 Course Outcomes

The students will be able to:	
CO1	*understand* the concept of DT Signal and DT Systems
CO2	*classify* and *analyze* discrete time signals and systems
CO3	*implement* Digital Signal Transform techniques DFT and FFT
CO4	*use* the enhancement techniques for digital Image Processing
CO5	*apply* image segmentation techniques
CO6	*design* and *develop* applications in speech processing, biomedical imaging, and multimedia processing.

7.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite :		
	Applied Engineering Mathematics		
1	**Discrete-Time Signal and Discrete-Time System**		**10**
	1.1	Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations (shifting, reversal, scaling, addition, multiplication).	
	1.2	Classification of Discrete-Time Signals, Classification of Discrete-Systems	
	1.3	Linear Convolution formulation for 1-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, Concept of LTI system, Output of DT system using Time Domain Linear Convolution.	
2	**Discrete Fourier Transform**		**5**
	2.1	Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT	

	2.2	Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parseval's Energy Theorem). DFT computation using DFT properties.	
	2.3	Convolution of long sequences, Introduction to 2-D DFT	
3	**Fast Fourier Transform**		**4**
	3.1	Need of FFT, Radix-2 DIT-FFT algorithm,	
	3.2	DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.	
	3.3	Spectral Analysis using FFT	
4	**Digital Image Fundamentals**		**5**
	4.1	Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization	
	4.2	Representation of Digital Image, Connectivity	
	4.3	Image File Formats: BMP, TIFF and JPEG.	
5	**Image Enhancement in Spatial domain**		**09**
	5.1	Gray Level Transformations, Zero Memory Point Operations	
	5.2	Histogram Processing, Histogram equalization.	
	5.3	Neighborhood processing, Image averaging, Image Subtraction, Smoothing Filters - Low pass averaging, Sharpening Filters-High Pass Filter, High Boost Filter, Median Filter for reduction of noise	
6	**Image Segmentation**		**6**
	6.1	Fundamentals, Segmentation based on Discontinuities and Similarities	
	6.2	Point, line and Edge Detection, Image edge detection using Robert, Prewitt and Sobel masks, Image edge Detection using Laplacian mask	
	6.3	Region based segmentation: Region Growing, Region Splitting and Merging	
		Total Hours	**39**

7.6 Suggested Learning Resources

7.6.1 Textbooks

1. John G. Proakis, Dimitris and G .Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Edition, Pearson Education, 2007
2. A. Anand Kumar, "Digital Signal Processing", 2nd Edition, PHI Learning Pvt. Ltd. 2014.
3. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education Asia, 4th Edition, 2018.
4. S. Sridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2012.

7.6.2 Reference Books

1. Sanjit Mitra, "Digital Signal Processing: A Computer Based Approach", 4th Edition, Tata McGraw Hill, 2013
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, "Digital Signal Processing", 2nd Edition, Tata McGraw Hill Publication, 2011.
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing", 3rd Edition, Tata McGraw Hill Education Private Ltd, 2009.
4. Anil K. Jain, "Fundamentals of Digital Image Processing", 4th Edition, Prentice Hall of India Private Ltd,.1989

7.6.3 Web Resources:

1. https://nptel.ac.in/courses/
2. https://swayam.gov.in

8 Quantitative Analysis (CSDLO6013)

8.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDLO6013	Quantitative Analysis	3	3

8.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

8.3 Course Objectives

S. No.	Objectives
1	Introduction to the basic concepts in Statistics
2	Understand concept of data collection & sampling methods.
3	Introduction to Regression, Multiple Linear Regression
4	Draw interference using Statistical inference methods
5	Tests of hypotheses

8.4 Course Outcomes

The students will be able to:	
CO1	*recognize* the need of Statistics and Quantitative Analysis
CO2	*apply* the data collection and the sampling methods.
CO3	*analyze* using concepts of Regression.
CO4	*analyze* using concepts of Multiple Linear Regression
CO5	*formulate* Statistical inference drawing methods.
CO6	*apply* Testing of hypotheses

8.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisite:		
	Applied Mathematics		
1	**Introduction to Statistics**		**6**
	1.1	Functions – Importance – Uses and Limitations of Statistics. Statistical data– Classification, Tabulation, Diagrammatic & Graphic representation of data	
2	**Data Collection & Sampling Methods**		**6**
	2.1	Primary & Secondary data, Sources of data, Methods of collecting data. Sampling – Census & Sample methods –Methods of sampling, Probability Sampling and Non-Probability Sampling.	
3	**Introduction to Regression**		**8**
	3.1	Mathematical and Statistical Equation – Meaning of Intercept and Slope – Error term – Measure for Model Fit –R2 – MAE – MAPE.	
4	**Introduction to Multiple Linear Regression**		**8**
	4.1	Multiple Linear Regression Model, Partial Regression Coefficients, Testing Significance overall significance of Overall fit of the model,	

		Testing for Individual Regression Coefficients	
5	**Statistical inference**		**6**
	5.1	Random sample -Parametric point estimation unbiasedness and consistence - method of moments and method of maximum likelihood.	
6	**Tests of hypotheses**		**5**
	6.1	Null and Alternative hypotheses. Types of errors. Neyman-Pearson lemma-MP and UMP tests.	
		Total Hours	**39**

8.6 Suggested Learning Resources

8.6.1 Textbooks

1. Agarwal, B.L. (2006):-Basic Statistics. Wiley Eastern Ltd., New Delhi
2. Gupta, S. P. (2011):-Statistical Methods. Sultanchand & Sons, New Delhi
3. Sivathanupillai, M &Rajagopal, K. R. (1979):-Statistics for Economics Students.
4. Hogg ,R.V. and Craig, A.T.(2006), An introduction to mathematical statistics, Amerind publications.

8.6.2 Reference Books

1. Arora, P.N., SumeetArora, S. Arora (2007):- Comprehensive Statistical Methods. Sultan Chand, New Delhi
2. Montgomery,D.C. ,Peck E.A, & Vining G.G.(2003). Introduction to Linear Regression Analysis. John Wiley and Sons,Inc.NY
3. Mood AM, Graybill FA, and Boes, D.C.(1985), Introduction to the theory of statistics, McGrawhill Book Company, New Delhi.
4. Kapur, J.N. and Saxena,H.C.(1970), Mathematical statistics, Sultan Chand & company, New Delhi..

8.6.3 Web Resources :

1. NPTEL Course : Data Analytics with Python

9 System Programming and Compiler Construction Lab (CSL601)

9.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL601	System Programming and Compiler Construction Lab	2	1

9.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	25	25	-	-	50

9.3 Course Objectives

S. No.	Objective
1	To explore and analyze the roles and functionalities of various system programs in relation to application programs
2	To implement concepts and design of assemblers, macro processors, linkers, and loaders.
3	To design and implement a lexical analyzer for a compiler, enabling students to understand tokenization and lexical analysis processes.
4	To implement key phases of compiler design, including intermediate code generation and final code generation.
5	To utilize the outcomes of the analysis phase to generate object code optimized for space and execution time.

9.4 Course Outcomes

The students will be able to:	
CO1	*generate* machine code by implementing two pass assemblers.
CO2	*implement* Two pass macro processor.
CO3	*parse* the given input string by constructing Top down/Bottom-up parser.
CO4	*identify* and *validate* tokens for given high level language and *implement* synthesis phase of compiler.
CO5	*explore* LEX & YACC tools.

9.5 Course Contents

S. No.	Suggested List of Experiments
1	a) Study of different system programs b) To create your own Library in C Language
2	Implementations of two pass Assembler.
3	Implementation of Two pass Macro Processor.
4	Implementation of Lexical Analyzer.
5	Implementation of Parser (Any one).
6	Implementation of Intermediate code generation phase of compiler.
7	Implementation of code generation phase of compiler.
8	Study and implement experiments on LEX, YACC.
9	Implementation of Code Optimization Techniques
10	Study of the comparison on various loader schemes

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

ISE: Experiments = 15 marks,
Mock Practical Exam = 10 marks
Oral & Practical exam will be based on the entire syllabus.

9.6 Suggested Learning Resources:

9.6.1 Reference Books

1 Andrew W. Appel Princeton University. Jens Palsberg Modern Compiler. Implementation in Java, Second Edition. Purdue University. CAMBRIDGE University press @2002.
2 Charles N. Fischer, Richard J. LeBlanc Crafting a compiler with C , Pearson Education 2007

10 Cryptography and System Security Lab (CSL602)

10.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL602	Cryptography & System Security Lab	2	1

10.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	25	-	-	-	25

10.3 Course Objectives

S. No.	Objective
1	To apply various encryption techniques
2	To study and implement various security mechanism
3	To explore the network security concept and tools

10.4 Course Outcomes

The students will be able to:	
CO1	*apply* the knowledge of symmetric and asymmetric cryptography to implement simple ciphers.
CO2	*explore* the different network reconnaissance tools to gather information about networks.
CO3	*explore* and *use* tools like sniffers, port scanners and other related tools for analysing packets in a Network.
CO4	*set up* firewalls and intrusion detection systems using open-source technologies and to *explore* email security.
CO5	*explore* various attacks like buffer-overflow and web application attack.

10.5 Course Contents

S. No.	Suggested List of Experiments
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers.
2	Implementation and analysis of RSA crypto system.
3	Implementation of Diffie Hellman Key exchange algorithm
4	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs.
5	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, ns lookup to gather information about networks and domain registrars.
6	Study of packet sniffer tools: wireshark: 1. Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters.
7	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, xmas scan etc.
8	Detect ARP spoofing using nmap and/or open-source tool ARPWATCH and wireshark. Use arping tool to generate gratuitous arps and monitor using wireshark
9	Simulate DOS attack using Hping, hping3 and other tools
10	Simulate buffer overflow attack using Ollydbg, Splint, Cpp check etc

11	a. Set up IPSEC under LINUX. b. Set up Snort and study the logs.
12	Setting up personal Firewall using iptables
13	Explore the GPG tool of linux to implement email security
14	SQL injection attack, Cross-Cite Scripting attack simulation
15	Case Study /Seminar: Topic beyond syllabus related to topics covered.

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

ISE: Experiments=15 mark
Assignment=5
Oral =5 marks

10.6 Suggested Learning Resources:

10.6.1 Reference Books

1. William Stallings, "Cryptography and Network Security, Principles and Practice", 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill
3. Behrouz A. Forouzan & Debdeep Mukhopadhyay, "Cryptography and Network Security" 3rd Edition, McGraw Hill

10.6.2 Web Resources :

1. https://github.com/cmin764/cmiN/blob/master/FII/L3/SI/book/W.Stallings%20-%20Cryptography%20and%20Network%20Security%206th%20ed.pdf

11 Mobile Computing Lab (CSL603)

11.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL603	Mobile Computing Lab	2	1

11.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	25	-	-	-	25

11.3 Course Objectives

S. No.	Objective
1	To learn the mobile computing tools and software for implementation.
2	To understand the security algorithms in mobile networks.
3	To learn security concepts.
4	To understand wireless network.
5	To understand about wireless access point.
6	To design and implement applications using GUI and GPS

11.4 Course Outcomes

The students will be able to:	
CO1	*develop* and *demonstrate* mobile applications using various tools
CO2	*articulate* the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it
CO3	*develop* and *carry out* simulation of frequency reuse, hidden/exposed terminal problem.
CO4	*implement* security algorithms for mobile communication network
CO5	*demonstrate* simulation and *compare* the performance of Wireless LAN answering system etc.
CO6	*implementation* of any real time application.

11.5 Course Contents

S. No.	Suggested List of Experiments
1	Implementation a Bluetooth network with application as transfer of a file from one device to another.
2	To implement a basic function of Code Division Multiple Access (CDMA).
3	Implementation of GSM security algorithms (A3/A5/A8)
4	Illustration of Hidden Terminal/Exposed terminal Problem. Consider two Wi-fi base stations (STA) and an access point (AP) located along the x-axis. All the nodes are fixed. The AP is situated at the middle of the two STA, the distance of separation being 150 m. [variable]. Node #0 and node #1 are the hidden terminals. Both are transmitting some data to the AP (almost at same rate) at the same time. The loss across the wireless link between each STA and the AP is fixed at 50 dB irrespective of the distance of separation. To study how RTS/CTS helps in wireless networks, 1. No RTS/CTS is being sent. 2. Nodes do exchange RTS/CTS packets. Compare the no. of packet retransmissions required in both the cases (as obtained in the output) and compare the results.
5	To setup & configuration of Wireless Access Point (AP). Analyze the Wi-Fi

	communication range in the presence of the access point (AP) and the base station (BS). Consider BS and AP are static. Find out the maximum distance to which two way communications is possible. Try multiple iterations by adjusting its distance in the code and test it.
6	Study of security tools (like Kismet, Netstumbler)
7	Develop an application that uses GUI components.
8	Write an application that draws basic graphical primitives on the screen.
9	Develop an application that makes use of database.
10	Develop a native application that uses GPS location information.
11	Implement an application that creates an alert upon receiving a message.
12	Implementation of income tax/loan EMI calculator and deploy the same on real devices (Implementation of any real time application)

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

ISE: Experiments=15 marks
Assignment=5
Attendance =5 marks

11.6 Suggested Learning Resources:

11.6.1 Reference Books

1. Jochen Schilller, "**Mobile Communication**", Addision wisely, Pearson Education
2. William Stallings "**Wireless Communications & Networks**", Second Edition, Pearson Education
3. Christopher Cox, "**An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications**", Wiley publications
4. Raj Kamal, **"Mobile Computing"**, 2/e, Oxford University Press-New Reference Books

11.6.2 Web Resources

1. https://nptel.ac.in/courses/106/106/106106147/
2. https://www.coursera.org/learn/smart-device-mobile-emerging-technologies

12 Artificial Intelligence Lab (CSL604)

12.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL604	Artificial Intelligence Lab	2	1

12.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	25	25	-	-	50

12.3 Course Objectives

S. No.	Objective
1	To realize the basic techniques to build intelligent systems
2	To apply appropriate search techniques used in problem solving
3	To create knowledge base for uncertain data

12.4 Course Outcomes

The students will be able to:	
1	Identify languages and technologies for Artificial Intelligence
2	Understand and implement uninformed and informed searching techniques for real world problems.
3	Create a knowledge base using any AI language.
4	Design and implement expert systems for real world problems.

12.5 Course Contents

S. No.	Suggested List of Experiments
1	One case study on AI applications published in IEEE/ACM/Springer or any prominent journal.
2	Assignments on State space formulation and PEAS representation for various AI applications
3	Program on uninformed search methods.
4	Program on informed search methods.
5	Program on Game playing algorithms.
6	Program for first order Logic
7	Planning Programming
8	Implementation for Bayes Belief Network
9	Implementation of Prolog program in the form of mini project for Family Tree.
10	Case study of Natural Language Processing

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

ISE: Experiments=15 marks
Assignment=5,
Attendance =5 marks

Oral & Practical exam will be based on the entire syllabus.

12.6 Suggested Learning Resources:

12.6.1 Reference Books

1 Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
2 Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
3 Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4 Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.

12.6.2 Web Resources

1 https://nptel.ac.in/courses/106/105/106105078/
2 https://thestempedia.com/blog/simple-ai-and-machine-learning-projects-for-students-and-beginners
3 https://nptel.ac.in/courses/106/105/106105079/

13 Skill based Lab course: Cloud Computing (CSL605)

13.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL605	Cloud Computing	2+2*	2

13.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	50	-	25	-	75

13.3 Course Objectives

S. No.	Objective
1	To make students familiar with key concepts of virtualization.
2	To make students familiar with various deployment models of cloud such as private, public, hybrid and community so that they star using and adopting appropriate type of cloud for their application.
3	To make students familiar with various service models such as IaaS, SaaS, PaaS, Security as a Service (SECaaS) and Database as a Service.
4	To make students familiar with security and privacy issues in cloud computing and how to address them.

13.4 Course Outcomes

The student will be able to	
1	*implement* different types of virtualization techniques.
2	*analyze* various cloud computing service models and *implement* them to solve the given problems.
3	*design* and *develop* real world web applications and *deploy* them on commercial cloud(s).
4	*explain* major security issues in the cloud and mechanisms to address them.
5	*explore* various commercially available cloud services and *recommend* the appropriate one for the given application.
6	*implement* the concept of containerization

13.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Pre-requisites		
1	Title: Introduction and overview of cloud computing. Objective: To understand the origin of cloud computing, cloud cube model, NIST model, characteristics of cloud, different deployment models, service models, advantages and disadvantages.		**2**
2	Title: To study and implement Hosted Virtualization using VirtualBox& KVM. Objective: To know the concept of Virtualization along with their types,		**2**

	structures and mechanisms. This experiment should have demonstration of creating and running Virtual machines inside hosted hypervisors like VirtualBox and KVM with their comparison based on various virtualization parameters.	
3	Title: To study and Implement Bare-metal Virtualization using Xen, HyperV or VMware Esxi. Objective: To understand the functionality of Bare-metal hypervisors and their relevance in cloud computing platforms. This experiment should have demonstration of install, configure and manage Bare Metal hypervisor along with instructions to create and run virtual machines inside it. It should also emphasize on accessing VMs in different environments along with additional services provided by them like Load balancing, Auto-Scaling, Security etc.	**4**
4	Title: To study and Implement Infrastructure as a Service using AWS/Microsoft Azure. Objective: To demonstrate the steps to create and run virtual machines inside Public cloud platform. This experiment should emphasize on creating and running Linux/Windows Virtual machine inside Amazon EC2 or Microsoft Azure Compute and accessing them using RDP or VNC tools.	**4**
5	Title: To study and Implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service. Objective: To demonstrate the steps to deploy Web applications or Web services written in different languages on AWS Elastic Beanstalk/ Microsoft Azure App Service.	**4**
6	Title: To study and Implement Storage as a Service using Own Cloud/ AWS S3, Glaciers/ Azure Storage. Objective: To understand the concept of Cloud storage and to demonstrate the different types of storages like object storage, block level storages etc. supported by Cloud Platforms like Own Cloud/ AWS S3, Glaciers/ Azure Storage.	**4**
7	Title: To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/ MongoDB Lab/ Firebase. Objective: To know the concept of Database as a Service running on cloud and to demonstrate the CRUD operations on different SQL and NOSQL databases running on cloud like AWS RDS, AZURE SQL/ Mongo Lab/ Firebase.	**2**
8	Title: To study and Implement Security as a Service on AWS/Azure Objective: To understand the Security practices available in public cloud platforms and to demonstrate various Threat detection, Data protection and Infrastructure protection services in AWS and Azure.	**3**
9	Title: To study and implement Identity and Access Management (IAM) practices on AWS/Azure cloud. Objective: To understand the working of Identity and Access Management IAM in cloud computing and to demonstrate the case study based on Identity and Access Management (IAM) on AWS/Azure cloud platform.	**2**
10	Title: To study and Implement Containerization using Docker Objective: To know the basic differences between Virtual machine and Container. It involves demonstration of creating, finding, building, installing, and running Linux/Windows application containers inside local machine or cloud platform.	**4**
11	Title: To study and implement container orchestration using Kubernetes Objective: To understand the steps to deploy Kubernetes Cluster on local	**4**

	systems, deploy applications on Kubernetes, creating a Service in Kubernetes, develop Kubernetes configuration files in YAML and creating a deployment in Kubernetes using YAML,	
12	Mini-project: Design a Web Application hosted on public cloud platform [It should cover the concept of IaaS, PaaS, DBaaS, Storage as a Service, Security as a Service etc.]	**4**
	Total Hours	**26**

Sr. No	Suggested List of Experiments
1	Assignment based on selection of suitable cloud platform solution based on requirement analysis considering given problem statement
2	Assignment on recent trends in cloud computing and related technologies
3	Assignment on comparative study of different computing technologies [Parallel, Distributed, Cluster, Grid, Quantum)
4	Comparative study of different hosted and bare metal Hypervisors with suitable parameters along with their use in public/private cloud platform
5	Assignment on explore and compare the similar type of services provided by AWS and Azure [Any ten services]

ISE: Experiments=15 marks
Mini Project = 25 marks
Assignments= 5 marks
Attendance =5 marks

Mini Project based on the content of the syllabus (Group of 2-3 students)
Oral exam will be based on the entire syllabus.

13.6 Suggested Learning Resources

13.6.1 Textbooks

1. Bernard Golden, "Amazon Web Services for Dummies", John Wiley & Sons, Inc.
2. Michael Collier, Robin Shahan, "Fundamentals of Azure, Microsoft Azure Essentials", Microsoft Press.
3. RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, "Mastering Cloud Computing", Tata McGraw-Hill Education.

13.6.2 Reference Books

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley publishing.
2. John Paul Mueller, "AWS for Admins for Developers", John Wiley & Sons, Inc.
3. Ken Cochrane, Jeeva S. Chelladhurai, NeependraKhare , "Docker Cookbook - Second Edition", Packt publication
4. Jonathan Baier, "Getting Started with Kubernetes-Second Edition", Packt Publication.

12.6.3 Web Resources

1. https://www.nist.gov/system/files/documents/itl/cloud/NIST_SP-500-291_Version2_2013_June18_FINAL.pdf
2. https://phoenixnap.com/kb/ubuntu-installkvm\
3. https://docs.aws.amazon.com/
4. https://docs.microsoft.com/en-us/azure
5. https://docs.docker.com/get-started/
6. https://kubernetes.io/docs/home/

14 Mini Project 2B (CSM601)

14.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSM601	Mini Project 2B	04	02

14.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	25	-	-	25	50

14.3 Course Objectives

S. No.	Objectives
1	To understand and identify the problem
2	To apply basic engineering fundamentals and attempt to find solutions to the problems.
3	Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
4	To develop communication skills and improve teamwork amongst group members and inculcate the process of self-learning and research.

14.4 Course Outcomes

The students will be able to:	
1	*identify* societal/research/innovation/entrepreneurship problems through appropriate literature surveys
2	*identify* Methodology for solving above problem and apply engineering knowledge and skills to solve it
3	*validate*, *verify* the results using test cases/benchmark data/theoretical/ inferences/experiments/simulations
4	*analyze* and *evaluate* the impact of solution/product/research/innovation /entrepreneurship towards societal/environmental/sustainable development
5	*use* standard norms of engineering practices and project management principles during project work
6	*communicate* through technical report writing and oral presentation. ● The work may result in research/white paper/ article/blog writing and publication ● The work may result in business plan for entrepreneurship product created ● The work may result in patent filing.
7	*gain* technical competency towards participation in Competitions, Hackathons, etc.
8	*demonstrate* capabilities of self-learning, leading to lifelong learning.
9	*develop* interpersonal skills to work as a member of a group or as leader

14.5 Guidelines for Mini Project

Guidelines for Mini Project	
1	Mini project may be carried out in one or more form of following: Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of

	software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.
2	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
3	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
4	Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
5	A logbook may be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6	Faculty supervisors may give inputs to students during mini project activity; however, focus shall be on self-learning.
7	Students under the guidance of faculty supervisor shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. Software requirement specification (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report.
9	With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project 2 in semesters V and VI.
10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above, gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis.

In-Semester Evaluation: Distribution of marks for In-Semester Evaluation shall be done based on following:

In-Semester Evaluation		
Distribution of In-Semester Evaluation marks for both semesters shall be as below:		Marks 25
1	Marks awarded by guide/supervisor based on logbook	10
2	Marks awarded by review committee	10
3	Quality of Project report	05

Mid-term Evaluation and End-Semester Evaluation should be done based on the performance indicators mentioned below and scaled down to 5 for each.

The final certification and acceptance of ISE ensures the satisfactory performance on the above aspects.

Oral and Practical: Oral and Practical examination (Final Project Evaluation) of Mini Project should be conducted by the panel of Internal and External examiners approved by CoE at the end of the semester.

14.6 Mini Project Evaluation parameters are as follows:

PERFORMANCE INDICATORS (PI)	Quality and clarity of the problem GA	Application of software Engg best practices GA	Objective and scope GA	Identification of methodologies GA	Synopsis and Presentation IA
Maximum Marks	5	5	5	5	5

GA – Group Assessment
IA – Individual Assessment

Poor	Average	Good	Very Good	Excellent
1	2	3	4	5