AC –

Item No.

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Computer Engineering

Second Year with Effect from **AY 2017-18**
Third Year with Effect from **AY 2018-19**
Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

B. E. Computer Engineering (Semester-VII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CSC701	Digital Signal & Image Processing	4	-	-	4	-	-	4
CSC702	Mobile Communication & Computing	4	-	-	4	-	-	4
CSC703	Artificial Intelligence & Soft Computing	4	-	-	4	-	-	4
CSDLO 701X	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course-I	3	-	-	3	-	-	3
CSL701	Digital Signal & Image Processing Lab	-	2	-	-	1	-	1
CSL702	Mobile App. Development. Tech. Lab	-	2	-	-	1	-	1
CSL703	Artificial Intelligence & Soft Computing Lab	-	2	-		1	-	1
CSL704	Computational Lab-I	-	2			1	-	1
CSP705	Major Project-I	-	6			3	-	3
	Total	**19**	**14**	-	**19**	**7**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC701	Digital Signal & Image Processing	20	20	20	80	3	-	--	-	100
CSC702	Mobile Communication & Computing	20	20	20	80	3	-	--	-	100
CSC703	Artificial Intelligence & Soft Computing	20	20	20	80	3	-	--	-	100
CSDLO 701X	Department Level Optional Course -III	20	20	20	80	3	-	--	-	100
ILO701X	Institute Level Optional Course-I	20	20	20	80	3	--	--	-	100
CSL701	Digital Signal & Image Processing Lab	-	-	-	-	-	25	--	--	25
CSL702	Mobile App. Development. Tech. Lab	-	-	-	-	-	25	--	25	50
CSL703	Artificial Intelligence & Soft Computing Lab	--	-	-	-	--	25	25	--	50
CSL704	Computational Lab-I						25	--	25	50
CSP705	Major Project-I	-	-	-	-	-	50	-	25	75
Total		100	100	100	400		150	25	75	750

Sem.	Department Level Optional Course (DLOC)	Institute Level Optional Course (ILOC)
V	CSDLO5011: Multimedia System CSDLO5012: Advance Operating System CSDLO5013: Advance Algorithm	----------
VI	CSDLO6021: Machine Learning CSDLO6022: Advance Database System CSDLO6023: Enterprise Resource Planning CSDLO6024: Advance Computer Network	----------
VII	CSDLO7031: Advance System Security & Digital Forensics CSDLO7032: Big Data & Analytics CSDLO7033: Robotics	ILO7011. Product Lifecycle Management ILO7012. Reliability Engineering ILO7013. Management Information System ILO7014. Design of Experiments ILO7015. Operation Research ILO7016. Cyber Security and Laws ILO7017. Disaster Management & Mitigation Measures ILO7018. Energy Audit and Management ILO7019. Development Engineering
VIII	DLO8011: High Performance Computing DLO8012: Natural Language Processing DLO8013: Adhoc Wireless Network	ILO8021. Project Management ILO8022. Finance Management ILO8023. Entrepreneurship Development and Management ILO8024. Human Resource Management ILO8025. Professional Ethics and CSR ILO8026. Research Methodology ILO8027. IPR and Patenting ILO8028. Digital Business Management ILO8029. Environmental Management

Course Code	Course Name	Credits
CSC701	Digital Signal & Image Processing	4

Course 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.

Course outcomes: On successful completion of the course learner will be able to:

1. Apply the concept of DT Signal and DT Systems.
2. Classify and analyze discrete time signals and systems
3. Implement Digital Signal Transform techniques DFT and FFT.
4. Use the enhancement techniques for digital Image Processing
5. Differentiate between the advantages and disadvantages of different edge detection techniques
6. Develop small projects of 1-D and 2-D Digital Signal Processing.

Prerequisite: Applied Mathematics

Module No.	Unit No.	Topic details	Hrs.
1.0		**Discrete-Time Signal and Discrete-Time System**	**14**
	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 and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution.	
2.0		**Discrete Fourier Transform**	**08**
	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 Parsevals' Energy Theorem). DFT computation using DFT properties.	
	2.3	Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT, Convolution of long sequences, Introduction to 2-D DFT	
3.0		**Fast Fourier Transform**	**06**
	3.1	Need of FFT, Radix-2 DIT-FFT algorithm,	

Module No.	Unit No.	Topic details	Hrs.
	3.2	DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.	
	3.3	Spectral Analysis using FFT	
4.0		**Digital Image Fundamentals**	**08**
	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.	
5.0		**Image Enhancement in Spatial domain**	**10**
	5.1	Gray Level Transformations, Zero Memory Point Operations,	
	5.2	Histogram Processing, Histogram equalization.	
	5.3	NeighborhoodProcessing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.	
6.0		**Image Segmentation**	**06**
	6.1	Segmentation based on Discontinuities (point, Line, Edge),	
	6.2	Image Edge detection using Robert, Sobel, Previtt masks, Image Edge detection using Laplacian Mask.	
		Total	**52**

Text Books:

1. John G. Proakis, Dimitris and G.Manolakis, 'Digital Signal Processing: Principles, Algorithms, and Applications' 4th Edition 2007, Pearson Education.
2. A. Anand Kumar, 'Digital Signal Processing', PHI Learning Pvt. Ltd. 2013.
3. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, 3rd Edition, 2009,
4. S. Sridhar, 'Digital Image Processing', Oxford University Press, Second Edition, 2012.

Reference Books:

1. Sanjit Mitra, 'Digital Signal Processing: A Computer Based Approach', TataMcGraw Hill, 3rd Edition.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, 'Digital Signal Processing' Tata McGraw Hill Publication 1st Edition (2010).
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, 'Digital Image Processing' TataMcGraw Hill Education Private Ltd, 2009.
4. Anil K. Jain, 'Fundamentals and Digital Image Processing', Prentice Hall of India Private Ltd, 3rd Edition.

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 50% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC702	**Mobile Communication & Computing**	**4**

Course 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.

Course outcomes: On successful completion of course learner will be able:

1. To identify basic concepts and principles in mobile communication & computing, cellular architecture.
2. To describe the components and functioning of mobile networking.
3. To classify variety of security techniques in mobile network.
4. To apply the concepts of WLAN for local as well as remote applications.
5. To describe and apply the concepts of mobility management
6. To describe Long Term Evolution (LTE) architecture and its interfaces.

Prerequisite: Computer Networks

Module No.	Unit No.	Topics	Hrs
1.0	1.1	Introduction to Mobile Computing, Telecommunication Generations, Cellular systems,	06
	1.2	Electromagnetic Spectrum, Antenna ,Signal Propagation, Signal Characteristics, , Multiplexing, Spread Spectrum: DSSS & FHSS	
2.0	2.1	GSM Mobile services, System Architecture, Radio interface, Protocols , Localization and Calling, Handover, security (A3,A5 & A8)	**10**
	2.2	GPRS system and protocol architecture	
	2.2	UTRAN , UMTS core network ; Improvements on Core Network,	
3.0	**3.1**	**Mobile Networking** : Medium Access Protocol, Internet Protocol and Transport layer	**12**
	3.2	Medium Access Control: Motivation for specialized MAC, , Introduction to multiple Access techniques (MACA)	

	3.3	Mobile IP: IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling, Routing (DSDV,DSR)	
	3.4	Mobile TCP : Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission	
4.0	**4.1**	**Wireless Local Area Networks :** Introduction, Infrastructure and ad-hoc network	**08**
	4.2	**IEEE 802.11:**System architecture , Protocol architecture , Physical layer, Medium access control layer, MAC management, 802.11a, 802.11b	
	4.3	Wi-Fi security : WEP ,WPA, Wireless LAN Threats , Securing Wireless Networks	
	4.4	HiperLAN 1 & HiperLAN 2	
	4.5	Bluetooth: Introduction, User Scenario, Architecture, protocol stack	
5.0	**5.1**	**Mobility Management :** Introduction, IP Mobility, Optimization, IPv6	06
	5.2	Macro Mobility : MIPv6, FMIPv6,	
	5.3	Micro Mobility: CellularIP, HAWAII, HMIPv6,	
6.0	**6.1**	**Long-Term Evolution (LTE) of 3GPP :** LTE System Overview, Evolution from UMTS to LTE	10
	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	System Aspects, LTE Higher Protocol Layers, LTE MAC layer, LTE PHY Layer,	
	6.5	Self Organizing Network (SON-LTE),SON for Heterogeneous Networks (HetNet), Introduction to 5G	
		Total	**52**

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1 Jochen Schilller,"Mobile Communication ", Addision wisely,Pearson Education
2 "Wireless Communications & Networks," By William Stallings, Second Edition, Pearson Education
3 Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi

Reference Books:

1 LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency, Seppo Hamalainen, Henning Sanneck , Cinzia Sartori, Wiley publications
2 Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications," Wiley publications
3 Mobility Protocols and Handover Optimization: Design, Evaluation and Application By Ashutosh Dutta, Henning Schulzrinne, IEEE Press, Wiley Publication
4 Michael Gregg, "Build your own security lab," Wiley India edition
5 Emerging Wireless Technologies and the Future Mobile Internet, Dipankar Raychaudhuri, Mario Gerla, Cambridge.
6 Andreas F.Molisch, "Wireless Communications," Second Edition, Wiley Publications.

Course Code	Course Name	Credits
CSC703	**Artificial Intelligence & Soft Computing**	**4**

Course Objectives (CO):

1 To conceptualize the basic ideas and techniques of AI and SC.

2 To distinguish various search techniques and to make student understand knowledge representation and planning.

3 To become familiar with basics of Neural Networks and Fuzzy Logic.

4 To familiarize with Hybrid systems and to build expert system.

Course Outcomes: Students should be able to -

1 Identify the various characteristics of Artificial Intelligence and Soft Computing techniques.

2 Choose an appropriate problem solving method for an agent to find a sequence of actions to reach the goal state.

3 Analyse the strength and weakness of AI approaches to knowledge representation, reasoning and planning.

4 Construct supervised and unsupervised ANN for real world applications.

5 Design fuzzy controller system.

6 Apply Hybrid approach for expert system design.

Pre-requisites: Basic Mathematics, Algorithms

Module No.	**Unit No.**	**Topics**	**Hrs.**
1.0		**Introduction to Artificial Intelligence(AI) and Soft Computing**	4
	1.1	Introduction and Definition of Artificial Intelligence.	
	1.2	Intelligent Agents : Agents and Environments ,Rationality, Nature of Environment, Structure of Agent, types of Agent	
	1.3	Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.	
2.0		**Problem Solving**	10
	2.1	Problem Solving Agent, Formulating Problems, Example Problems	
	2.2	Uninformed Search Methods: Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Method: A* Search	
	2.3	Optimization Problems: Hill climbing Search, Simulated annealing, Genetic algorithm	
3.0		**Knowledge, Reasoning and Planning**	10
	3.1	Knowledge based agents	
	3.2	First order logic: syntax and Semantic, Knowledge Engineering in FOL Inference in FOL : Unification, Forward Chaining, Backward Chaining and Resolution	
	3.3	Planning Agent, Types of Planning: Partial Order, Hierarchical Order, Conditional Order	
4.0		**Fuzzy Logic**	12

	4.1	Introduction to Fuzzy Set: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, membership functions,	
	4.2	Fuzzy Logic: Fuzzy Logic basics, Fuzzy Rules and Fuzzy Reasoning	
	4.3	Fuzzy inference systems: Fuzzification of input variables, defuzzification and fuzzy controllers.	
5.0		**Artificial Neural Network**	12
	5.1	Introduction – Fundamental concept– Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron	
	5.2	Neural Network Architecture: Perceptron, Single layer Feed Forward ANN, Multilayer Feed Forward ANN, Activation functions, Supervised Learning: Delta learning rule, Back Propagation algorithm.	
	5.3	Un-Supervised Learning algorithm: Self Organizing Maps	
6.		**Expert System**	4
	6.1	Hybrid Approach - Fuzzy Neural Systems	
	6.2	Expert system : Introduction, Characteristics, Architecture, Stages in the development of expert system,	
		Total	52

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
2. Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
3. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
4. S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
5. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Reference Books:

1. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
3. Zimmermann H.S "Fuzzy Set Theory and its Applications"Kluwer Academic Publishers.
4. Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.
5. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
6. JacekM.Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSDLO7031	**Advanced System Security and Digital Forensics**	**4**

Course Objectives:

1. To understand cyber attacks and defence strategies.
2. To understand underlying principles of access control mechanisms.
3. To explore software vulnerabilities, attacks and protection mechanisms of wireless networks and protocols, mobile devices and web applications.
4. To develop and mitigate security management and policies.
5. To understand and explore techniques used in digital forensics.

Course Outcomes: At the end of the course learner will able to

1. Understand cyber attacks and apply access control policies and control mechanisms.
2. Identify malicious code and targeted malicious code.
3. Detect and counter threats to web applications.
4. Understand the vulnerabilities of Wi-Fi networks and explore different measures to secure wireless protocols, WLAN and VPN networks.
5. Understand the ethical and legal issues associated with cyber crimes and be able to mitigate impact of crimes with suitable policies.
6. Use different forensic tools to acquire and duplicate data from compromised systems and analyse the same.

Prerequisite: Cryptography and System Security

Module No.	Unit No.	Detailed Content	Hrs.
1	**Introduction & Access Control**		08
	1.1	Cyber-attacks, Vulnerabilities, Defence Strategies and Techniques, Authentication Methods and Protocols, Defence in Depth Strategies.	
	1.2	Access Control Policies: DAC, MAC, Multi-level Security Models: Biba Model, Bell La Padula Model, Single Sign on, Federated Identity Management.	
2	**Program & OS Security**		08
	2.1	Malicious and Non-Malicious programming errors, Targeted Malicious codes: Salami Attack, Linearization Attack, Covert Channel, Control against Program threats.	
	2.2	Operating System Security: Memory and Address protection, File Protection Mechanism, User Authentication.	
	2.3	Linux and Windows: Vulnerabilities, File System Security.	
3	**Web Application Security**		12
		OWASP, Web Security Considerations, User Authentication and Session	

		Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, Web Service Security, OAuth 2.0	
4	**Wireless Security**		08
		Wi-Fi Security, WEP, WPA, WPA-2, Mobile Device Security- Security Threats, Device Security, GSM and UMTS Security, IEEE 802.11/802.11i Wireless LAN Security, VPN Security.	
5	**Legal and Ethical issues**		06
	5.1	Cybercrime and its types, Intellectual property, Privacy, Ethical issues.	
	5.2	Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, case studies of ethics.	
6	**Digital Forensics**		10
		Introduction to Digital Forensics, Acquiring Volatile Data from Windows and Unix systems, Forensic Duplication Techniques, Analysis of forensic images using open source tools like Autopsy and SIFT, Investigating logs from Unix and windows systems, Investigating Windows Registry.	

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wile**y**

Reference Books:

1. Computer Security, Dieter Gollman, Third Edition, Wiley
2. Digital Forensics by Nilakshi Jain & Kalbande, Wiley.
3. Incident Response & Computer Forensics by Kevin Mandia, Chris Prosise, Wiley.
4. Cyber Security. Nina Godbole, Sunit Belapure, Wiley.

Digital references:

1. https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

Theory Examination:

1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

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Laboratory/ Experimental Work

 # The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.

Lab Outcome:

Learner will able to

1. Analyze static code and program vulnerabilities using open source tools.
2. Explore and analyze network vulnerabilities using open source tools.
3. Explore and analyze different security tools to detect web application and browser vulnerabilities.
4. Explore and analyze different tools to secure wireless networks and routers, and mobile devices and perform penetration testing, and analyze its impact.
5. Understand and implement AAA using RADIUS and TACACS.
6. Explore various forensics tools in Kali Linux and use them to acquire, duplicate and analyze data and recover deleted data.

Sr. No	Description
1	Static code analysis using open source tools like RATS, Flawfinder etc.
3	Vulnerability scanning using Nessus, Nikto (Kali Linux)
4	Explore web-application vulnerabilities using open source tools like Wapiti, browser exploitation framework (BeEf), etc.
5	Detect SQL injection vulnerabilities in a website database using SQLMap
6	Performing a penetration testing using Metasploit (Kali Linux)
7	Exploring Router and VLAN security, setting up access lists using Cisco Packet tracer(student edition)
8	Exploring VPN security using Cisco Packet tracer(student edition)
9	Exploring Authentication and access control using RADIUS, TACACS and TACACS+
10	Install and use a security app on an Android mobile (e.g. Droidcrypt)
11	Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data: dd, dcfldd, foremost, scalpel, debugfs, wireshark, tcptrace, tcpflow
12	Analysis of forensic images using open source tools like Autopsy, SIFT, FKT Imager
13	Use of steganographic tools like OpenStego, to detect data hiding or unauthorized file copying

14.	Use Password cracking using tools like John the Ripper/Cain and Abel/ Ophcrack to detect weak passwords.

Reference Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, Tim Boyles, Sybex.
3. Web Application Hacker's Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India
4. Network Infrastructure Security, Randy Waver, Dawn Weaver, Cengage Learning.
5. Incident Response & Computer Forensics by Kevin Mandia, Chris Prosise, Wiley.

Digital References:

http://www.opentechinfo.com/learn-use-kali-linux/

Course Code	Course/Subject Name	Credits
CSDLO7032	Big Data Analytics	4

Course Objectives:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce programming skills to build simple solutions using big data technologies such as MapReduce and scripting for NoSQL, and the ability to write parallel algorithms for multiprocessor execution.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
5. To provide an indication of the current research approaches that is likely to provide a basis for tomorrow's solutions.

Course Outcomes: Learner will be able to…

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
1. Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop, Mapreduce and NoSQL in big data analytics.
2. Collect, manage, store, query and analyze various forms of Big Data.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
5. Solve Complex real world problems in various applications like recommender systems, social media applications, health and medical systems, etc.

Prerequisite:
Some prior knowledge about Java programming, Basics of SQL, Data mining and machine learning methods would be beneficial.

Module	Detailed Contents	Hrs.
01	**Introduction to Big Data and Hadoop** 1.1 Introduction to Big Data, 1.2 Big Data characteristics, types of Big Data, 1.3 Traditional vs. Big Data business approach, 1.4 Case Study of Big Data Solutions. 1.5 Concept of Hadoop 1.6 Core Hadoop Components; Hadoop Ecosystem	06

02	**Hadoop HDFS and MapReduce** 2.1 Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization. 2.2 MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. 2.3 Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce 2.4 Hadoop Limitations	10
03	**NoSQL** 3.1 Introduction to NoSQL, NoSQL Business Drivers, 3.2 NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study 3.3 NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.	06
04	**Mining Data Streams:** 4.1 The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. 4.2 Sampling Data techniques in a Stream 4.3 Filtering Streams: Bloom Filter with Analysis. 4.4 Counting Distinct Elements in a Stream, Count-Distinct Problem, Flajolet-Martin Algorithm, Combining Estimates, Space Requirements 4.5 Counting Frequent Items in a Stream, Sampling Methods for Streams, Frequent Itemsets in Decaying Windows. 4.6 Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.	12
05	**Finding Similar Items and Clustering** 5.1 Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance. 5.2 CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing & Merging Buckets, Answering Queries	08
	Real-Time Big Data Models 6.1 PageRank Overview, Efficient computation of	

06	PageRank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. 6.2 A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering. 6.3 Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph.	10

Text Books:

1. CreAnand Rajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press,
2. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.

References books:

1. Bill Franks , "Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley
2. Chuck Lam, "Hadoop in Action", Dreamtech Press
3. Jared Dean, "Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners", Wiley India Private Limited, 2014.
4. 4. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010.
6. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006.
7. Vojislav Kecman, "Learning and Soft Computing", MIT Press, 2010.

Term Work:

Assign a case study for group of 3/4 students and each group to perform the following experiments on their case-study; Each group should perform the exercises on a large datasetcreated by them.

The distribution of marks for term work shall be as follows:

- Programming Exercises: .... (10) Marks.
- Mini project: ..... (10) Marks.
- Attendance (Theory & Practical) ..... (05) Marks.

TOTAL: ..... (25) Marks.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

Oral examination:
An oral exam will be held based on the above syllabus.

Suggested Practical List:

1. Hadoop HDFS Practical:
   -HDFS Basics, Hadoop Ecosystem Tools Overview.
   -Installing Hadoop.
   -Copying File to Hadoop.
   -Copy from Hadoop File system and deleting file.
   -Moving and displaying files in HDFS.
   -Programming exercises on Hadoop.
2. Use of Sqoop tool to transfer data between Hadoop and relational database servers.
   a. Sqoop - Installation.
   b. To execute basic commands of Hadoop eco system component Sqoop.
3. To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.
4. Experiment on Hadoop Map-Reduce / PySpark:
2. -Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc.
5. Create HIVE Database and Descriptive analytics-basic statistics, visualization using Hive/PIG/R.
6. Write a program to implement word count program using MapReduce.
7. Implementing DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language.
8. Implementing any one Clustering algorithm (*K*-Means/CURE) using Map-Reduce.
9. Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc.
10. Implement PageRank using Map-Reduce.
11. Implement predictive Analytics techniques (regression / time series, etc.) using R/ Scilab/ Tableau/ Rapid miner.
12. **Mini Project:** One real life large data application to be implemented (Use standard Datasets available on the web).

 # The Experiments for this course are required to be performed and to be evaluated

in CSL704: Computational Lab-1.

Course Code	Course Name	Credits
CSDLO7033	**Robotics**	**4**

Course objectives:

1 To know basics of a typical robot and its characteristics.
2 To analyse mathematically kinematic modelling of a typical robot manipulator.
3 To identify actuators, sensors and control of a robot for different applications.
4 To apply task planning and vision algorithms.

Course outcomes: On successful completion of course learner will be able to:

1. Describe typical robot and its characteristics.
2. Analyse kinematics parameters of robotic manipulator.
3. Identify actuators, sensors and control of a robot for different applications.
4. Design task plan and motion for a robot.
5. Apply Robotics to solve day to day problems using vision algorithms.
6. Use robot programming languages and acquire skills to program robots.

Prerequisite: Mathematical concepts of Geometry, Matrices Algebra, knowledge of Basic Electronics.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction and Fundamentals of Robotics**	**08**
	1.1	Types of automation, Introduction, definition of a Robot, Classification of Robots, Robotics, History of Robotics, Advantages and Disadvantages of Robots, Robot Applications	
	1.2	Tasks involved in Robotics, Robot Components, Robot characteristics and classification, Degrees of Freedom, Robot joints, Robot Coordinates, Robot Reference frames, Programming Modes, Robot Workspace, Work Envelop.	
2.0		**Direct and Inverse Kinematics**	**08**
	2.1	**Direct (Forward) Kinematics:** Homogeneous coordinates, Link coordinates, Coordinate frame, coordinate transform, Arm equations, An example – Four Axis SCARA.	
	2.2	**Inverse Kinematics:** Inverse kinematics problem, Tool Configuration, An example – Four Axis SCARA.	
		Sensors, Actuators and Drive Systems	**08**

3.0	**3.1**	**Sensors:** Characteristics, Utilization, Types - Position, Velocity, Acceleration, Force and Pressure, Torque, Visible Light and Infrared, Touch and Tactile, Proximity, Range Finders sensors.	
	3.2	**Actuators and Drive System:** Characteristics, Hydraulic Actuators, Pneumatic Devices, Electric Motors	
4.0		**Robot Task and Motion Planning**	**10**
	4.1	Reactive Paradigms: Overview, Attributes of reactive paradigm	
	4.2	Task level programming, Uncertainty, Configuration Space, Gross motion planning, Fine-motion planning, Simulation of Planner motion, Source and goal scene, Task planner Simulation.	
	4.3	Robot Motion Planning: Concept of motion planning, BUG 1, BUG 2 and Tangent Bug Algorithms	
5.0		**Robot Vision**	**10**
	5.1	Image Representation, Template Matching, Polyhedral Objects	
	5.2	Shape Analysis, Iterative Processing	
	5.3	Perspective Transformations, Structured Illumination , Camera Calibration	
6.0		**Expert Systems, Robot Language and Fuzzy Logic**	**12**
	6.1	Introduction to Expert Systems, Expert system Characteristics, Robot as a Expert System, Robot Languages: Classification of Robot Languages, Computer Control and Robot Software, VAL System, and Language.	
	6.2	Introduction, Fuzzy set, Fuzzification, Fuzzy Inference Rule Base, Defuzzification, Applications of Fuzzy Logic in Robotics.	
		Total	**52**

Text Books:

1. Introduction Robotics - Analysis, Control, Applications by Saeed B. Niku, Second Edition, Wiley India.
2. Fundamentals of Robotics – Analysis and Control by Robert J. Schilling, Pearson
3. Introduction to AI robotics by Robin Murphy, PHI.

4. Robotics Technology and Flexible Automation by S. R. Deb, TMH.
5. Artificial Intelligence by Rich, Knight and Nair, TMH.
6. Introduction to Fuzzy Sets by M Ganesh PHI

Reference Books:

1. Robotics – Control, Sensing, Vision, and Intelligence by K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Tata McGraw Hill
2. Principles of Robot Motion – Theory, Algorithms and Implementation by Howie Choset, Lynch, PHI
3. Introduction to Fuzzy Logic using Matlab,By: S.N.Sivanandam,S.N.Deepa,P Sumathi , Springer Publications

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work :

The distribution of marks for term work shall be as follows:

• Programming Exercises: .... (10) Marks.
• Mini project: ..... (10) Marks.
• Attendance (Theory & Practical) ..... (05) Marks.
TOTAL: ..... (25) Marks.

Suggested List of Experiments:

1 Representation of Various Robots and there all Specification (Study Experiment)

2 Co-ordinate Transform of a Robot

3 Fundamental Rotation

4 Composite Rotation

5 BFS and DFS

6 Homogeneous Rotation

7 Run Length Encoding

8 Shrink and swell Operator

9 BUG1 Algorithm

10 Bug2 Algorithm

11 Tangent Bug Algorithm

12 Edge detection algorithm

13 Case Study of CNC Machine

14 Designing a Robot Manipulator for Pre defined Task

Students can perform experiments based on Theory Syllabus or any 12 experiments from above list of experiments or experiments framed by teachers.

 # The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.

Course Code	Course Name	Credits
ILO 7011	**Product Life Cycle Management**	**03**

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to…

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Sr. No.	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:** Sustainable Development,	05

	Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO 7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Sr. No	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:**Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO 7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Sr. No.	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO 7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Sr. No	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology	07

	5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO 7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Sr. No.	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05

04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Course Code	Course Name	Credits
ILO 7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Sr. No.	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
ILO 7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Sr. No.	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures:	09

	5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO 7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Sr. No	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity,	10

	factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	**Development Engineering**	**03**

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to…

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Sr. No.	Module Contents	Hrs
01	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	**08**
02	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	**04**
03	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	**06**
04	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
05	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.	**10**

	Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	
06	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately
40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved

References:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory andPractice, Vol. 4, No.4, pp.395 – 407

Lab Code	Lab Name	Credits
CSL701	**Digital Signal and Image Processing Lab**	**1**

Lab Outcome: The learner will be able to

1. Sample and reconstruct the signal.
2. Implement and apply operations like Convolution, Correlation, DFT and FFT on DT signals
3. Implement spatial domain Image enhancement techniques.
4. Implement Edge detection techniques using first order derivative filters.

Description:

Implementation of programs can be in C or C++ or any computational software. A List of ten experiments is given below, are needed to be performed covering all syllabus modules. Additional experiments within the scope of the syllabus can be added.

Suggested List of Experiments:

1. Sampling and Reconstruction
2. To perform Discrete Correlation
3. To perform Discrete Convolution
4. To perform Discrete Fourier Transform
5. To perform Fast Fourier Transform
6. Implementation of Image negative, Gray level Slicing and Thresholding
7. Implementation of Contrast Stretching ,Dynamic range compression & Bit plane Slicing
8. Implementation of Histogram Processing
9. Implementation of Image smoothing/ Image sharpening
10. Implementation of Edge detection using Sobel and Previtt masks

Term Work:

- Laboratory work will be based on above syllabus of CSC701 - 'Digital Signal and Image Processing' with minimum 10 experiments to be incorporated.
- The distribution of marks for term work shall be as follows:

Lab Performance	15 Marks
Assignments	05 Marks
Attendance (Theory & practical)	05 Marks

Lab Code	Lab Name	Credits
CSL702	Mobile Application Development Lab	1

Lab Outcome:

1. To develop and demonstrate mobile applications using various tools
2. Students will articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it.
3. Students will able to carry out simulation of frequency reuse , hidden terminal problem
4. To develop security algorithms for mobile communication network
5. To demonstrate simulation and compare the performance of Wireless LAN
6. To implement and demonstrate mobile node discovery and route maintains.

Description: The softwares like Android Studio, J2ME, NS2, NS3 and any other software which is suitable are recommended for performing the practicals.

Suggested List of Experiments:

Sr. No.	Title of Experiments
01	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell. Design a game based application on the above concept.
02	To understand the cellular frequency reuse concept to find the cell clusters within certain geographic area. Design a game based application on the above concept.
03	Implementation a Bluetooth network with application as transfer of a file from one device to another.
04	To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonality and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.
05	To implement Mobile node discovery
06	Implementation of GSM security algorithms (A3/A5/A8)
07	Illustration of Hidden Terminal Problem (NS-2) Consider two Wifi 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.**

08	To setup & configuration of Wireless Access Point (AP) using NS3. 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.
09	Develop an application that writes data to the SD card.
10	Develop an application that uses GUI components.
11	Write an application that draws basic graphical primitives on the screen.
12	Develop an application that makes use of database.
13	Develop a native application that uses GPS location information.
14	Implement an application that creates an alert upon receiving a message.
15	Implementation of income tax/loan EMI calculator and deploy the same on real devices.

Digital Material (if Any):

1. http://www.isi.edu/nsnam/ns/ : NS-2 software download
2. https://nsnam.isi.edu/nsnam/index.php/NS_manual
3. https://www.nsnam.org/ : Ns-3 Software Download
4. http://vlssit.iitkgp.ernet.in/ant/ant/

Text Books:

1. Jochen Schilller,"Mobile Communication ", Addision wisely,Pearson Education
2. "Wireless Communications & Networks," By William Stallings, Second Edition, Pearson Education
3. Ekram Hossain and Teerawat Issariyakul, "Introduction to Network Simulator NS-2," Springer , Second Edition.
4. Michael Burton, "Android Appliocation Development for Dummies, " A wiley brand
5. Marko Gargenta & Masumi Nakamura, " Learning Android," O'reilly publications
6. James Keogh, "The complete reference J2ME, " Mcgraw-Hill.

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): …… (15) Marks.

Assignments: ……..... (05) Marks.

Attendance (Theory + Practical)…… (05) Marks

TOTAL: …… (25) Marks.

Oral & Practical exam will be based on the above and CSC702: Mobile Communication & Computing syllabus.

Lab Code	Lab Name	Credits
CSL703	**Artificial Intelligence & Soft Computing Lab**	**1**

Lab Outcomes: Learner will be able to

1 To realize the basic techniques to build intelligent systems

2 To create knowledge base and apply appropriate search techniques used in problem solving.

3 Apply the supervised/unsupervised learning algorithm.

4 Designfuzzy controller system.

Description: The current applications from almost all domains, like games, robots, expert system, optimization or even the search engines are becoming smarter. We have moved to the era of knowledge processing from data and information processing. Therefore learning these technologies practically is very essential for a student to gain the proficiency. They will also learn and be able to appreciate the use of fusion of basic techniques.

LAB	**Topic / Activity**	**Explanation of Activity**
Lab 1	• Identify the problem • PEAS Description • Problem formulation	Select a problem statement relevant to AI
Lab 2	Introduce AI programming Language	Introduce PROLOG programming.
Lab 3	• Start Implementation • Knowledge Representation and Create Knowledge Base	Use AI programming languages Or C/JAVA
Lab 4	Implement search algorithms to reach goal state	Identify and analyse Algorithm to solve the problem
Lab 5	To implement Mc-Culloch Pitts Model for a problem	Apply to solve AND / OR/ XOR, etc.
Lab 6	To implement Fuzzy Controller system	Design an automobile or washing machine controller, etc. and implement
Lab 7	To implement Basic Supervised / Unsupervised Neural Network learning rules for a problem.	Design a NN using a learning method to generate knowledge for classification.
Lab 8	Case study on Hybrid Systems	Study the designing of Neuro Fuzzy systems
Lab 9	Case study of an Application	Printed Character Recognition, Face Recognition, etc.

Term Work:

1. Labs 1-4 are to design and implement an intelligent system using AI techniques.
2. Labs 5-7 are to design and implement an Intelligent System using SC techniques.
3. Perform any one from Lab 8 and lab 9.

The distribution of marks for term work shall be as follows:

Lab Performance (Experiments /case studies):	15
Assignment	05
Attendance (Theory & Practical)	05

Oral examination will be based on the above and **CSC703**: '**AI and SC**' Syllabus.

Lab Code	Lab Name	Credits
CSL703	**Computational Lab-I**	**1**

Lab Outcome: After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Description:
Design and implementation of any case study/ applications /experiments / mini project based on departmental level optional courses using modern tools.

Term work:

The distribution of marks for **term work** shall be as follows:

Lab/ Experimental Work	:	15
Report/ Documentation	:	05
Attendance (Theory & Practical)	:	05

Practical & Oral examination is to be conducted based on respective departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.

Course Code	Title	Credit
CSP705	**Major Project- I**	**3**

Objective: The Project work enables students to develop further skills and knowledge gained during the programme by applying them to the analysis of a specific problem or issue, via a substantial piece of work carried out over an extended period. For students to demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Guidelines:

1. **Project Topic:**
   - To proceed with the project work it is very important to select a right topic. Project can be undertaken on any subject addressing IT programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
   - Project work must be carried out by the group of at least two students and maximum three and must be original.
   - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
   - The project work can be undertaken in a research institute or organization/company/any business establishment.
   - Student must consult internal guide along with external guide (if any) in selection of topic.
   - Head of department and senior staff in the department will take decision regarding selection of projects.
   - Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
   - In case of industry projects, visit by internal guide will be preferred.

2. **Project Report Format:**

   At the end of semester a project report should preferably contain at least following details:-

   - Abstract
   - Introduction
   - Literature Survey
     - Survey Existing system
     - Limitation Existing system or research gap
     - Problem Statement and Objective
     - Scope
   - Proposed System
     - Analysis/Framework/ Algorithm
     - Details of Hardware & Software
     - Design details
     - Methodology (your approach to solve the problem)

- Implementation Plan for next semester
- Conclusion
- References

3. **Term Work:**
   Distribution of marks for term work shall be as follows:
   a. Weekly Attendance on Project Day
   b. Project work contribute
   c. Project Report (Spiral Bound)
   d. Term End Presentation (Internal)

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

4. **Oral & Practical :**
   Oral &Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-I.