BharatiyaVidyaBhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

Revision: SPIT-4-18

Bachelor of Engineering/Technology (B.E./B.Tech)
in
Computer Engineering
(Program Code: UCE)

Final Year Engineering
(Sem. VII and Sem. VIII)
Effective from Academic Year 2018 -19

Board of Studies Approval: 14/12/2017

Academic Council Approval: 20/01/2018

Dr. D. R. Kalbande	Dr. Surendra Rathod	Dr. Prachi Gharpure
Head of Department	Dean Academics	Principal

Principal
Sardar Patel Institute of Technology
Bhavans Andheri Campus
Munshi Nagar, Andheri (West),
Mumbai - 400 058.

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Sem-VII					
Course Code	**Course Name**	**Teaching Scheme (Hrs/week)**			**Credits**
		L	**T**	**P**	**Total**
CPC701	Digital Signal Processing	4	--	--	4
CPC702	Cryptography and System Security	4	--	--	4
CPC703	Artificial Intelligence	4	--	--	4
CPE702X	Elective	4	--	--	4
CPL701	Network threats and attacks Laboratory	-	--	4	2
CPCL701	Digital Signal Processing Lab	--	--	2	1
CPCL702	Cryptography and System Security Lab	--	--	2	1
CPCL703	Artificial Intelligence Lab	--	--	2	1
CPEL702X	Elective II	--	--	2	1
CP701	Project (Stage I)	--	--	6*	3
	Total	**16**	**--**	**18**	**25**

Course Code (CPE702X**)**	**Sem. VII Elective**
CPE7021	Advance Algorithms
CPE7022	Computer Simulation and Modeling
CPE7023	Image Processing
CPE7024	Software Architecture
CPE7025	Soft Computing
CPE7026	ERP and Supply Chain Management

***Work load of learner in Semester VII is equivalent to 6 hours /week.**

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Sem-VIII					
Course Code	**Course Name**	**Teaching Scheme (Hrs/week)**			**Credits**
		L	**T**	**P**	**Total**
CPC801	Data Warehouse and Mining	4	--	--	4
CPC802	Human Machine Interaction	4	--	--	4
CPC803	Parallel and Distributed System	4	--	--	4
CPE803X	Elective-III	4	--	--	4
CPL801	Cloud Computing Lab	--	--	2	1
CPCL801	Data Warehouse and Mining Lab	--	--	2	1
CPCL802	Human Machine Interaction Lab	--	--	2	1
CPCL803	Parallel and Distributed System Lab	--	--	2	1
CPEL803X	Elective-III	-	-	2	1
CP801	Project (Stage II)	--	--	**12	6
	Total	**16**	**--**	**22**	**27**

Course Code (CPE803X**)**	**Sem. VIII Elective**
CPE8031	Machine Learning
CPE8032	Embedded Systems
CPE8033	Adhoc wireless networks
CPE8034	Digital Forensic
CPE8035	Big data Analytics

****Work load of learner in Semester VIII is equivalent to 12 hours /week.**

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Evaluation Scheme

B.E./B.Tech Computer Engineering (SEM VII)					
Course Code	**Course Name**	**Marks**			
		ISE	**MSE**	**ESE**	**Total**
CPC701	Digital Signal Processing	20	20	60	100
CPC702	Cryptography and System Security	20	20	60	100
CPC703	Artificial Intelligence	20	20	60	100
CPE702X	Elective-II	20	20	60	100
CPL701	Network threats and attacks Laboratory	40	--	20	60
CPCL701	Digital Signal Processing Lab	40	--	20	60
CPCL702	Cryptography and System Security Lab	40	--	20	60
CPCl703	Artificial Intelligence Lab	40	--	20	60
CPEL702X	Elective-II Lab	40	--	20	60
CP701	Project (Stage I)	80	--	20	100
	Total				**800**
B.E./B.Tech Computer Engineering (SEM VIII)					
Course Code	**Course Name**	**Marks**			
		ISE	**MSE**	**ESE**	**Total**
CPC801	Data Warehouse and Mining	20	20	60	100
CPC802	Human Machine Interaction	20	20	60	100
CPC803	Parallel and Distributed System	20	20	60	100
CPE803X	Elective-III	20	20	60	100
CPL801	Cloud Computing Lab	40	--	20	60
CPCL801	Data Warehouse and Mining Lab	40	--	20	60
CPCL802	Human Machine Interaction Lab	40	--	20	60
CPCL801	Parallel and Distributed System Lab	40	--	20	60
CPEL803X	Elective-III Lab	40	--	20	60
CP801	Project (Stage II)	150	--	50	200
	Total				**900**

Electives Subjects for B.E.			
Elective-II		**Elective-III**	
Course Code	**Subject Name(CPE702X)**	**Course Code**	**Subject Name(CPE803X)**
CPE7021	Advance Algorithms	CPE8031	Machine Learning
CPE7022	Computer Simulation and Modeling	CPE8032	Embedded Systems
CPE7023	Image Processing	CPE8033	Adhoc wireless networks
CPE7024	Software Architecture	CPE8034	Digital Forensic
CPE7025	Soft Computing	CPE8035	Big data Analytics
CPE7026	ERP and Supply Chain Management		

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SEMESTER - VII

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPC701	Digital Signal Processing	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes		-
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Understand the concept of DT Signal and perform signal manipulation
	CO2	Perform analysis of DT system in time domain
	CO3	Develop FFT flow-graph and Fast DSP Algorithms.
	CO4	Design DSP System for Real Time Signal Processing

Module No.	Topics	Ref.	Hrs.
1	**Discrete Time Signal** Introduction to Digital Signal Processing, Discrete Time Signals,Sampling and Reconstruction, Standard DT Signals, Concept of DigitalFrequency, Representation of DT signal using Standard DT Signals,Signal Manipulations(shifting, addition, subtraction, multiplication),Classification of Signals, Linear Convolution formulation(withoutmathematical proof), Circular Convolution formulation(withoutmathematical proof), Matrix Representation of Circular Convolution,Linear by Circular Convolution. Auto and Cross Correlation formula evaluation	1,3, 4,8	**12**
2	**Discrete Time System** Introduction to Discrete Time System, Classification of DT Systems(Linear/Non Linear, Causal/Non Causal, Time Invariant/Time VariantSystems, Stable/ Unstable), BIBO Time Domain Stability Criteria. LTIsystem, Concept of Impulse Response and Step Response, Concept of IIR System and FIR System, Output of IIR and FIR DTsystem using Time Domain Linear Convolution formula Method.	1,2, 3,4, 7	**08**
3	**Discrete Fourier Transform** Introduction to DTFT, DFT, Relation between DFT and DTFT, Propertiesof DFT without mathematical proof (Scaling and Linearity, Periodicity,Time Shift and Frequency Shift, Time Reversal, Convolution PropertyandParsevals' Energy Theorem). DFT computation using DFT properties, Transfer function of DT System in frequency domain using DFT. Linearand Circular Convolution using DFT. Response of FIR system calculationin frequency domain using DFT.	1,3, 8	**08**

4	**Fast Fourier Transform** Radix-2 DIT-FFT algorithm, DIT-FFT Flowgraph for N=4, 6 & 8, InverseFFT algorithm. Spectral Analysis using FFT, Comparison of complex andreal, multiplication and additions of DFT and FFT.	1,3, 8	**06**
5	**DSP Algorithms** Carls' Correlation Coefficient Algorithm, Fast Circular ConvolutionAlgorithm, Fast Linear Convolution Algorithm, Linear FIR filteringusing Fast Overlap Add Algorithm and Fast Overlap Save Algorithm.	1,3, 8,9	**08**
6	**DSP Processors and Application of DSP** Need for Special architecture of DSP processor, Difference between DSPprocessor& microprocessor, A general DSP processor TMS320C54XXseries, Case study of Real Time DSP applications to Speech SignalProcessing and Biomedical Signal Processing.	5,8	**06**
		Total	**48**

References:

[1] Ashok Ambardar, 'Digital Signal Processing', Cengage Learning, 2007, ISBN : 978-81-315-0179-5.

[2] Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Pearson Education ISBN 0-201-59619- 9

[3] S. Salivahanan, A. Vallavaraj, C. Gnanapriya, 'Digital Signal Processing' TataMcgraw Hill Publication First edition (2010). ISBN 978-0-07-066924-6.

[4] AvtarSignh, S.Srinivasan,"Digital Signal Processing', Thomson Brooks/Cole, ISBN : 981-243-254-4

[5] B. Venkatramani, M. Bhaskar ,"Digital Signal Processor', TataMcGraw Hill, Second Edition, (2001). ISBN : 978-0-07-070256-1.

[6] SanjitMitra, 'Digital Signal Processing : A Computer Based Approach' , TataMcGraw Hill, Third Edition

[7] Dr, ShailaApte, "Digital Signal Processing,", Wiley India, Second Edition,2013ISBN : 978-81-2652142-5

[8] ProakisManolakis, 'Digital Signal Processing : Principles, Algorithms and Applications' Fourth 2007, Pearson Education, ISBN 81-317-1000-9.

[9] Monson H. Hayes, "Schaums Outline of Digital Signal Processing" McGraw Hill Internationalsecond edition. ISBN : 978-00-7163509-7

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPC702	Cryptography and System Security	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		-
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Understand the principles and practices of cryptographic techniques.
	CO2	Understand a variety of generic security threats and vulnerabilities, and identify & analyze particular security problems for given application.
	CO3	Appreciate the application of security techniques and technologies in solving real-life security problems in practical systems.
	CO4	Design security protocols and methods to solve the specific security problems.
	CO5	Familiar with current research issues and directions of security.

Module No.	Topics	Ref.	Hrs.
1	**Introduction** Security Attacks, Security Goals, Computer criminals, Methods ofdefense, Security Services, Security Mechanisms	1-6	**06**
2	**Basics of Cryptography** Symmetric Cipher Model, Substitution Techniques, TransportationTechniques, Other Cipher Properties- Confusion, Diffusion, Block andStream Ciphers.	1-6	**06**
3	**Secret Key Cryptography** Data Encryption Standard(DES), Strength of DES, Block CipherDesign Principles and Modes of Operations, Triple DES, InternationalData Encryption algorithm, Blowfish, CAST-128.	1-6	**06**
4	**Public Key Cryptography** Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange	1-6	**04**
5	**Cryptographic Hash Functions** Applications of Cryptographic Hash Functions, Secure HashAlgorithm, Message Authentication Codes – Message Authentication Requirements and Functions, HMAC, Digital signatures, DigitalSignature Schemes, Authentication Protocols, Digital Signature Standards.	1-6	**06**
6	**Authentication Applications** Kerberos, Key Management and Distribution, X.509	1-6	**06**

	DirectoryAuthentication service, Public Key Infrastructure, Electronic MailSecurity: Pretty Good Privacy, S/MIME.		
7	**Program Security, Operating System Security, Database Security, IDS and Firewalls** Secure programs, Non-malicious Program Errors, Malicious Software–Types, Viruses, Virus Countermeasures, Worms, Targeted MaliciousCode, Controls against Program Threats, Memory and Address protection, File Protection Mechanism, User Authentication, Security Requirement, Reliability and Integrity, Sensitive data, Inference,Multilevel DatabasesIntruders, Intrusion Detection, Password Management, Firewalls-Characteristics, Types of Firewalls, Placement of Firewalls, FirewallConfiguration, Trusted systems.	1-6	**08**
8	**IP Security** Overview, Architecture, Authentication Header, Encapsulating SecurityPayload, Combining security Associations, Internet Key Exchange, WebSecurity: Web Security Considerations, Secure Sockets Layer andTransport Layer Security, Electronic Payment, Non-cryptographic protocol Vulnerabilities, DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities-Phishing, Buffer Overflow, Format String Attacks, SQL Injection.	1-6	**06**
		Total	**48**

References:

[1] William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, 5th edition.

[2] Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2nd edition.

[3] Behrouz A Fourouzan, DebdeepMukhopadhyay, "Cryptography and Network", TMH, 2nd edition.

[4] Behrouz A. Forouzan,"Cryptography and Network Security", TMH

[5] Charles P. Pfleeger,"Security in Computing", Pearson Education.

[6] Matt Bishop, "Computer Security Art and Science", Addison-Wesley.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPC703	Artificial Intelligence	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes	-	
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Ability to develop a basic understanding of AI building blocks presented in intelligent agents.
	CO2	Ability to choose an appropriate problem solving method and knowledge representation technique.
	CO3	Ability to analyze the strength and weaknesses of AI approaches to knowledge – intensive problem solving.
	CO4	Ability to design models for reasoning with uncertainty as well as the use of unreliable information.
	CO5	Ability to design and develop the AI applications in real world scenario.

Module No.	Topics	Ref.	Hrs.
1	**Introduction to Artificial Intelligence** 1.1Introduction , History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Componentsof AI Program, Foundations of AI, Sub-areas of AI,Applications of AI, Current trends in AI.	1-10	**04**
2	**Intelligent Agents** 2.1Agents and Environments, The concept of rationality, Thenature of environment, The structure of Agents, Types ofAgents, Learning Agent.	1-10	**04**
3	**Problem solving** 3.1Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems. 3.2Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, DepthFirst Iterative Deepening(DFID), Informed Search Methods:Greedy best first Search ,A* Search , Memory boundedheuristic Search. 3.3 Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search,Genetic algorithms. 3.4 Adversarial Search: Games, Optimal strategies, The minimax algorithm, Alpha-Beta Pruning.	1-10	**14**
4	**Knowledge and Reasoning**		

	Knowledge based Agents, The Wumpus World, ThePropositional logic, First Order Logic: Syntax and Semantic,Inference in FOL, Forward chaining, backward Chaining, Knowledge Engineering in First-Order Logic, Unification, Resolution, Introduction to logic programming (PROLOG), Uncertain Knowledge and Reasoning:Uncertainty, Representing knowledge in an uncertaindomain, The semantics of belief network, Inference in beliefnetwork.		
5	**Planning and Learning** The planning problem, Planning with state space search,Partial order planning, Hierarchical planning, Conditional Planning, Learning: Forms of Learning, Inductive Learning, Learning Decision Tree, Expert System: Introduction, Phases in building Expert Systems, ES Architecture, ES vs Traditional System.	1-10	**10**
6	**Applications** Natural Language Processing(NLP), Expert Systems.	1-10	**04**
		Total	**48**

References:

[1] Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.

[2] SarojKaushik "Artificial Intelligence" ,Cengage Learning.

[3] George F Luger "Artificial Intelligence" Low Price Edition , Pearson Education., Fourth edition.

[4] Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.

[5] Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition

[6] Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

[7] Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.

[8] Patrick Henry Winston , "Artificial Intelligence", Addison-Wesley, Third Edition.

[9] Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

[10] N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE7021	Elective-IIAdvanced Algorithms	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes		CSC303 (Data Structure) CSC402 (Analysis of Algorithm)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Able to design algorithms and employ appropriate advanced data structures for solving computing problems efficiently;
	CO2	Able to analyze the various algorithms from different domains
	CO3	Have an idea of applications of algorithms in a variety of areas, including linear programming, computational geometry and maximum flow.
	CO4	To understand the role of Optimization by using linear programing.

Module No.	Topics	Ref.	Hrs.
1	**Introduction** 1.1 Asymptotic notations Big O, Big Θ,,Big Ω,ο,ωnotations ,Proofs of master theorem, applyingtheorem to solve problems	1,2	**03**
2	**Advanced Data Structures** 2.1 Red-Black Trees: properties of red-black trees , Insertions , Deletions 2.2 B-Trees and its operations 2.3Binomial Heaps: Binomial trees and binomial heaps, Operation on Binomial heaps	1,2	**09**
3	**Dynamic Programing** 3.1 matrix chain multiplication, cutting rod problem and its analysis	1,2	**06**
4	**Graph algorithms** 4.1 Bellman ford algorithm, Dijkstra algorithm, Johnson's All pairshortest path algorithm for sparse graphs	1,2	**06**
5	**Maximum Flow** 5.1 Flow networks , the ford Fulkerson method ,max bipartitematching , push Relabel Algorithm , The relabel to frontalgorithm	1,2	**08**
6	**Linear Programing** 6.1Standard and slack forms, Formulating problems as linearprograms, simplex algorithm, Duality, Initial basic feasiblesolution	1,2	**08**
7	**Computational Geometry**	1,2	**08**

	7.1 Line Segment properties, Determining whether any pair ofsegment intersects, finding the convex hull, Finding the closestpair of points.		
		Total	**48**

References:

[1] T.H. Coreman , C.E. Leiserson, R.L. Rivest, and C. Stein, "Introduction to algorithms",2nd edition , PHI publication 2005

[2] Ellis Horowitz ,SartajSahni , S. Rajsekaran. "Fundamentals of computer algorithms" University press

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE7022	Elective-II Computer Simulation and Modeling	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	-
At end of successful completion of this course, student will be able to	

Course Outcomes		
	CO1	Apply simulation concepts to achieve in business, science, engineering, industry and services goals
	CO2	Demonstrate formulation and modeling skills.
	CO3	Perform a simulation using spreadsheets as well as simulation language/package
	CO4	Generate pseudorandom numbers using the Linear Congruential Method
	CO5	Evaluate the quality of a pseudorandom number generator using statistical tests
	CO6	Analyze and fit the collected data to different distributions

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction to Simulation. Simulation Examples. General Principles.	1,2,3	15
2	2.1	Statistical Models in simulation. Queuing Models	1,2,3	8
3	3.1	Random Number Generation. Testing random numbers (Refer to Third edition) Random Variate Generation: Inverse transform technique, Direct Transformation for the Normal Distribution, Convolution Method, Acceptance-Rejection Technique (only Poisson Distribution)	1,2,3	9
4	4.1	Analysis of simulation data: Input modeling, verification and calibration,Validation of Simulation , Models. Estimation of absolute performance.	1,2,3	12
5	5.1	Application on case study on: Processor and Memory Simulation, Manufacturing and Material Handling	1,2,3	4
			Total	48

References:

[1] Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, "Discrete Event System Simulation; Third Edition", Prentice-Hall

[2] Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, "Discrete Event System Simulation; Fifth Edition", Prentice-Hall

[3] Averill M Law,"System Modeling & Analysis", TMH, 4th Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE7023	Elective-IIIImage Processing	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	-	
At end of successful completion of this course, student will be able to		
Course Outcome	CO1	Understand the concept of Digital Image and Video Image
	CO2	Explain image enhancement and Segmentation technique.
	CO3	Develop fast image transform flowgraph.
	CO4	Solve Image compression and decompression techniques.
	CO5	Perform Binary Image Processing Operations.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Digital Image and Video Fundamentals: 1.1 Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization, Representation of Digital Image, Connectivity, Image File Formats : BMP, TIFF and JPEG. ColourModels(RGB, HSI, YUV) Introduction to Digital Video, Chroma Sub-sampling, CCIR standards for Digital Video.	1,2,3	06
2	2.1	Image Enhancement: Gray Level Transformations, Zero Memory Point Operations, Histogram, Processing, Neighbourhood Processing, Spatial Filtering, Smoothing and Sharpening Filters. Homomorphic Filtering.	1,2,3	09
3	3.1	Image Segmentation and Representation: Detection of Discontinuities, Edge Linking using Hough TransformThresholding, Region based Segmentation, Split and Merge Technique, Image Representation and Description, Chain Code, Polygonal Representation, Shape Number, Moments.	1,2,3	09

4	**4.1**	Image Transform: Introduction to Unitary Transform, Discrete Fourier Transform(DFT), Properties of DFT, Fast Fourier Transform(FFT), Discrete Hadamard Transform(DHT), Fast Hadamard Transform(FHT), Discrete Cosine Transform(DCT), Discrete Wavelet Transform(DWT)	1,2,3	**09**
5	**5.1**	Image Compression: Introduction, Redundancy, Fidelity Criteria.	1,2,3	**09**
	5.2	Lossless Compression Techniques : Run Length Coding, Arithmetic Coding, Huffman Coding, Differential PCM		
	5.3	Lossy Compression Techniques: Improved Gray Scale Quantization, Vector Quantization, JPEG, MPEG-1.		
6	**6.1**	Binary Image Processing: Binary Morphological Operators, Hit-or-Miss Transformation, Boundary Extraction, Region Filling, Thinning and Thickening, Connected Component Labeling, Iterative Algorithm and Classical Algorithm.	1,2,3	**06**
			Total	**48**

References:

[1] Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,

[2] S. Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,

[3] Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition.

[4] S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2012.

[5] RobertHaralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.

[6] Dwayne Phillps, "Image Processing in C", BPB Publication, 2006

[7] B. Chandra and D.DuttaMajumder, "Digital Image Processing and Analysis", Prentice Hall of India Private Ltd, 2011

[8] Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", Prentice Hall of India Private Ltd, Third Edition

[9] Fred Halshall, "Multimedia Communications: Applications, Networks Protocols and Standards,", Pearson Education 2001

[10] David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Pearson Education, Limited, 2011

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE7024	Elective-II Software Architecture	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes	-

At end of successful completion of this course, student will be able to

Course Outcomes		
	CO1	Visualize the architectural concepts in development of large, practical software-intensive applications.
	CO2	Rather than focusing on one method, notation, tool, or process, this new course widely surveys software architecture techniques, enabling us to choose the right tool for the job at hand.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	**Basic Concepts:**	1,2,3	3
	1.1	Concepts of Software Architecture		
	1.2	Models.		
	1.3	Processes.		
	1.4	Stakeholders		
2	2	**Designing Architectures:**	1,2,3	2
	2.1	The Design Process.		
	2.2	Architectural Conception.		
	2.3	Refined Experience in Action: Styles and Architectural Patterns.		
	2.4	Architectural Conception in Absence of Experience.		
3	3	Connectors	1,2,3	6
	3.1	Connectors in Action: A Motivating Example.		
	3.2	Connector Foundations.		
	3.3	Connector Roles.		
	3.4	Connector Types and Their Variation Dimensions.		
	3.5	Example Connectors		
4	4	**Modeling**	1,2,3	4
	4.1	Modeling Concepts.		
	4.2	Ambiguity, Accuracy, and Precision.		
	4.3	Complex Modeling: Mixed Content and Multiple Views.		

	4.4	Evaluating Modeling Techniques.		
	4.5	Specific Modeling Techniques		
5	**5**	**Analysis**	**1,2,3**	**8**
	5.1	Analysis Goals.		
	5.2	Scope of Analysis.		
	5.3	Architectural Concern being Analyzed.		
	5.4	Level of Formality of Architectural Models.		
		Type of Analysis.		
		Analysis Techniques		
6	**6**	**Implementation and Deployment**	**1,2,3**	**4**
	6.1	Concepts.		
	6.2	Existing Frameworks.		
	6.3	Software Architecture and Deployment		
	6.4	Software Architecture and Mobility.		
7	**7**	**Conventional Architectural styles**	**1,2,3**	**5**
	7.1	Pipes and Filters		
	7.2	Event- based, Implicit Invocation		
	7.3	Layered systems		
	7.4	Repositories		
	7.5	Interpreters		
	7.6	Process control		
8	**8**	**Applied Architectures and Styles**	**1,2,3**	**8**
	8.1	Distributed and Networked Architectures.		
	8.2	Architectures for Network-Based Applications.		
	8.3	Decentralized Architectures.		
	8.4	Service -Oriented Architectures and Web Services.		
9	**9**	**Designing for Non-Functional Properties**	**1,2,3**	**4**
	9.1	Efficiency.		
	9.2	Complexity.		
	9.3	Scalability and Heterogeneity.		
	9.4	Adaptability.		
	9.5	Dependability.		
10	**10**	**Domain-Specific Software Engineering**	**1,2,3**	**4**
	10.1	Domain-Specific Software Engineering in a Nutshell.		
	10.2	Domain-Specific Software Architecture.		
	10.3	DSSAs, Product Lines, and Architectural Styles.		
			Total	**48**

References:

[1] "Information Technology Project Management", Jack T. Marchewka, 3rd edition, Wiley India, 2009.
[2] S. J. Mantel, J. R. Meredith and etl.. "Project Management" 1st edition, Wiley India, 2009.
[3] John M. Nicholas, "Project Management for Business and Technology", 2nd edition, Pearson Education.
[4] Joel Henry, "Software Project Management, A realworld guide to success", Pearson Education, 2008.
[5] Gido and Clements, "Successful Project Management", 2nd edition, Thomson Learning.
[6] Hughes and Cornell, "Software Project Management", 3rd edition, Tata McGraw Hill

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE7025	Elective-IISoft Computing	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		Programming Languages (C, C++, Java) Basic Mathematics
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Identify the various characteristics of soft computing techniques.
	CO2	Apply the supervised and unsupervised learning algorithm for real world applications.
	CO3	Apply &design fuzzy controller system.
	CO4	Appreciate the importance of optimizations and its use in computer engineering fieldsand other domains.
	CO5	Understand the efficiency of a hybrid system and how Neural Network and fuzzylogic can be hybridized to form a Neuro-fuzzy network and its various applications.

Module No.	Topics	Ref.	Hrs.
1	**Introduction to Soft Computing** Soft computing Constituents, Characteristics ofNeuroComputing and Soft Computing, Difference between HardComputing and Soft Computing, Concepts of Learning andAdaptation.	1-9	**04**
2	**Neural Networks** Basics of Neural Networks: Introduction to Neural Networks, Biological NeuralNetworks, McCulloch Pitt model, Supervised Learning algorithms: Perceptron (Single Layer, Multilayer), Linear separability,Delta learning rule, Back Propagation algorithm, Un-Supervised Learning algorithms: Winner take all, Self- Organizing Maps, Learning VectorQuantization.	1-9	**14**
3	**Fuzzy Set Theory** Classical Sets and Fuzzy Sets, Classical Relations and FuzzyRelations, Properties of membership function, Fuzzyextension principle, Fuzzy Systems- fuzzification,defuzzification and fuzzy controllers.	1-9	**14**
4	**Hybrid system** Introduction to Hybrid Systems, Adaptive NeuroFuzzyInferenceSystem(ANFIS).	1-9	**04**
5	**Introduction to Optimization Techniques**		**06**

	Derivative based optimization- Steepest Descent, Newton method. Derivative free optimization- Introduction to EvolutionaryConcepts.		
6	**Genetic Algorithms and its applications:** Inheritance Operators, Cross over types, inversion andDeletion, Mutation Operator, Bit-wise Operators,Convergence of GA, Applications of GA.	1-9	**06**
		Total	**48**

References:

[1] Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley.

[2] S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.

[3] S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.

[4] J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.

[5] Jacek.M.Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.

[6] Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.

[7] Zimmermann H.S "Fuzzy Set Theory and its Applications" Kluwer Academic Publishers.

[8] Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

[9] Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE7026	Elective-IIEnterprise Resource Planning and Supply Chain Management (ERP & SCM)	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes	-	
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	To conceptualize the basic structure of ERP and SCM
	CO2	To identify implementation strategy used for ERP and SCM.
	CO3	To apply design principles for various business module in ERP and SCM.
	CO4	To apply different emerging technologies for implementation of ERP and SCM.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction:** What is an Enterprise, Introduction to ERP, Need for ERP, Structure of ERP, Scope and Benefits, Typical business processes	1,2,3	02
2	2.1	**ERP and Technology:** ERP and related technologies, Business Intelligence, E-business and E-commerce, Business Process Reengineering,	1,2,3	04
3	3.1	**ERP and Implementation:** ERP implementation and strategy, Implementation Life cycle, Pre-implementation task, requirement definition , implementation methodology**)**	1,2,3	06
4	4.1	**ERP Business Modules** Modules: Finance, manufacturing, human resources, quality management, material management, marketing. Sales distribution and service	1,2,3	08
5	5.1	**Extended ERP:** Enterprise application Integration (EAI), open source ERP, cloud ERP	1,2,3	04

Supply Chain Management (SCM)				
6	**6.1**	**Introduction and strategic decisions in SCM** Drivers of Supply chain, Strategic decisions in SCM, Business Strategy, CRM strategy, SRM strategy, SCOR model.	**1,2,3**	**08**
7	**7.1**	**Information Technology in SCM:** Types of IT Solutions like Electronic Data Inter change (EDI), Intranet/ Extranet, Data Mining/ Data Warehousing and Data Marts, E-Commerce, E- Procurement, Bar coding, RFID, QR CODE	**1,2,3**	**06**
8	**8.1**	**Mathematical modelling for SCM:** Introduction, Considerations in modelling SCM systems, Structuring the logistics chain, overview of models: models on transportation problem, assignment problem, vehicle routing problem, Model for vendor analysis, Make versus buy model	**1,2,3**	**06**
9	**9.1**	**Agile Supply Chain:** Introduction, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain..	**1,2,3**	**02**
10	**10.1**	**Cases of Supply Chain:** 10.1 Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food	**1,2,3**	**02**
			Total	**48**

References:

[1] V.K. Garg& N.K. Venkatakrishnan,"Enterprise Resource Planning: concepts & practices", PHI.

[2] R. P. Mohanty, S. G. Deshmukh, "Supply Chain Management Theories & Practices",Dreamtech Press.

[3] Alexis Leon, "ERP Demystified: II Edition", McGraw Hill .

[4] Rahul Altekar, "Enterprise wide resource planning: Theory & practice", PHI.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPL701	Network threats and attacks Laboratory	--	--	4	--	--	2	2
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		20		60

Pre-requisite Course Codes		CPL601(Network Programming Lab)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Use network-based tools for network analysis
	CO2	Use techniques for Network scanning
	CO3	Identify network vulnerability
	CO4	Use tools to simulate intrusion detection system
	CO5	To understand and install a firewall

Exp. No.	Experiment Details	Ref.	Marks
1	**Title: Study the use of network reconnaissance** tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars. **Objective:** Objective of this module to how to gather information about the networks by using different n/w reconnaissance tools. **Scope**: Network analysis using network based tools **Technology:** Networking	1,3	5
2	**Title:Study of packet sniffer tools like wireshark, ethereal, tcpdump** etc. You should be able to use the tools to do the following 1. Observer performance in promiscuous as well as non-promiscuous mode. 2. Show that packets can be traced based on different filters. **Objective:** Objective of this module is to observer the performance in promiscuous & non-promiscuous mode & to find the packets based on different filters. **Scope:** Packet grapping, message and protocol analysis **Technology:** Networking	1,2	5
3	**Title: 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, etc. **Objective:** objective of this module to learn nmap installation & use this to scan different ports. **Scope:** used for ip spoofing and port scanning **Technology:** Networking	1,4	5
4	**Title:** Use the Nessus tool to scan the network for vulnerabilities. **Objective**:Objective of the module is scan system and network	1,3	5

	analysis. **Scope:** It used for system analysis, security and process analysis **Technology:** Networking		
5	**Title**: Install IDS (e.g. SNORT) and study the logs. **Objective**: Simulate intrusion detection system using tools such as snort **Scope:** It is used for intrusion detection system vulnerability scans **Technology:** Networking	1,2	**5**
6	**Title**: Use of iptables in linux to create firewalls. **Objective:** To study how to create and destroy firewall security parameters. **Scope**: system security and network security **Technology**: Networking	1,2	**5**
7	**Title:** Mini project **Objective:** To implement Networking concepts **Scope:** To understand Network & system tools **Technology:** Networking		**10**
		Total Marks	**40**

References:

[1]Chris McNab,"Network Security Assessment", O'Reilly

[2]Andrew Lockhart, "Network Security Hacks", O'Reilly

[3]DafyddStuttard& Marcus Pinto, "The Web Application Hacker's Handbook 2nd Edition", Wiley Publication(2014).

[4]DaviOttenheimer& Matthew Wallace, "Securing the Virtual Environment", Willey Publication(2012).

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPCL701	Digital Signal Processing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPC701(Digital Signal Processing)
At end of successful completion of this course, student will be able to		
Course Outcomes	CPC701.1	Develop a program to sample a Continuous Time Signal and convert it to DT Signal.
	CPC701.2	Calculate convolution and correlation of a DT signals and verify the results using mathematical formula
	CPC701.3	Develop a function to perform DFT, FFT and Fast DSP Algorithms of N point signal.
	CPC701.4	Study Real Time Signal Processing
	CPC701.5	To implement any signal processing operation on one dimensional signal.

Exp. No.	Experiment Details	Ref.	Marks
1	To study sampling and reconstruction of signal	1,8	5
2	To perform Discrete Correlation	1,2,3,8	5
3	To perform Discrete Convolution	2,3	5
4	To perform Discrete Fourier Transform	6,7,8	5
5	To perform Fast Fourier Transform	6,7,8	5
6	To perform filtering of Long Data Sequence	1,6,7,8	5
7	To perform real time signal processing.	5	5
8	Application of Digital Signal Processing.	1,3,8	5
		Total Marks	40

References:

[1] Ashok Ambardar, "*Digital Signal Processing* " , Cengage Learning, 2007,

[2] Emmanuel, Ifeachor, Barrie, Jervis, "*Digital Signal Processing: A Practical Approach*", Pearson Education

[3] S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital *Signal Processing* "TataMcgraw Hill Publication First edition (2010).

[4] AvtarSignh, S.Srinivasan, "*Digital Signal Processing'*, Thomson Brooks/Cole

[5] B. Venkatramani, M. Bhaskar ,"*Digital Signal Processor'*, TataMcGraw Hill, 2nd Edition,

[6] SanjitMitra, "*Digital Signal Processing : A Computer Based Approach*" , TataMcGraw Hill, Third Edition

[7] Dr, ShailaApte, "*Digital Signal Processing*,", Wiley India, 2nd Edition,2013

[8] ProakisManolakis, *"Digital Signal Processing : Principles, Algorithms and Applications"*

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPCL702	Cryptography and System Security Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPC702(Cryptography and System Security)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Understand working of Public key Cryptographic technique.
	CO2	To develop and Secure any application using different methods
	CO3	To implement different session hijacking techniques
	CO4	To analyze different SQL injection attacks on application

Exp. No.	Experiment Details	Ref.	Marks
1	Simulation of RSA algorithm.	1,3	5
2	Implement MD5 algorithm	1,3,4	5
3	Implement Blowfish attack.	1,3,4	5
4	Simulation of Deffie-Hellman key exchange algorithm.	1,4	5
5	Implement Pretty Good Privacy (PGP) security method.	1,3,4	5
6	Implement SSL web security method.	1,2,4	5
7	Simulation of session Hijacking attack.	1,3,4	5
8	Simulation of SQL injection	1,3,4	5
		Total Marks	40

References:

[1] [1] William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, 5th edition.

[2] Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2nd edition.

[3] Behrouz A Fourouzan, DebdeepMukhopadhyay, "Cryptography and Network", TMH, 2nd edition.

[4] Behrouz A. Forouzan,"Cryptography and Network Security", TMH

[5] Charles P. Pfleeger,"Security in Computing", Pearson Education.

[6] Matt Bishop, "Computer Security Art and Science", Addison-Wesley.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPCL703	Artificial Intelligence Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPC703(Artificial Intelligence)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Ability to analyze and learn problem formulation method(such as state space search)
	CO2	Students will be able to learn different informed and uninformed searching techniques.
	CO3	Students will be able to describe logic programming and basic constructs used in AI programming
	CO4	Students will be able to develop/demonstrate/ build simple intelligent systems using different AI techniques.

Exp. No.	Experiment Details	Ref.	Marks
1	Implementation of Water Jug problem. Problem: Given 3 jugs of capacities: 12, 8 and 5 liters. Our 12 L jug is completely filled. Using these 3 jugs split the water to obtain exactly 6 Liters.	1,3	5
2	Implementation of Tic-Tac-Toe problem with MinMax Algorithm	1	5
3	Implementing N-Queen problem using Backtracking	1	5
4	Study Experiment on Predicate logic	1,3	5
5	Prolog Program to find Sublists of the given list & Reverse of the list	2	5
6	Implementation of Reasoning concept for family tree using Prolog	2	5
7	Study Experiment on OpenNLP	1,4	5
8	Mini Project		5
		Total Marks	40

References:

[1] Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition", Pearson Education.

[2] Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, ThirdEdition.

[3] Elaine Rich and Kevin Knight "Artificial Intelligence "Third Edition

[4] Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

[5] Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL7021	Elective-IIAdvanced Algorithm Laboratory	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE7021(Advanced Algorithm)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Ability to apply and implement learned algorithm design techniques and data structures to solve problems.
	CO2	Ability to implement different operations of red-black trees and binomial heaps.
	CO3	To demonstrate dynamic programming algorithms.
	CO4	Ability to implement Graph algorithms in solving variety of problems.

Exp. No.	Experiment Details	Ref.	Marks
1	Usethe B-treeinsertion/search algorithms towrite a B-tree ADT anduseitinyourprogramtoconstructadictionaryrepresentingthebooktitlehel dinvariouslibraries.Theprogramthenshouldanswerqueriestothedictionarya boutbooktitles.	1	5
2	Implementation of Red-Black trees and its various operations.	1	5
3	Implementation of Binomial Heaps and its various operations	1	5
4	Implementation of Dynamic programing: matrix chain multiplication Cutting rod example	1	5
5	Implementation of Bellman ford , Johnson's algorithm for sparse graphs	1	5
6	Implementation of Ford Fulkerson algorithm , push -relabel to front methods	1,2	5
7	Program to Find closest pair of points, Determining the convex hull	1,3	5
8	Implementation of Simplex algorithm	1	5
		Total Marks	40

References:

[1] T.H.Coremen , C.E. Leiserson,R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd edition , PHI publication 2005.

[2] John Kleinberg, Eva Tardos, "Algorithm Design", Pearson

[3] Ellis Horowitz ,SartajSahni , S. Rajsekaran. "Fundamentals of computer algorithms" University press.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL7022	Elective-IIComputer Simulation and Modeling Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE7022 (Computer Simulation and Modeling)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Design and Perform Queue- single server, multi-server, classic case-dump truck
	CO2	Design and Perform Inventory – Lead time=0, lead time fixed, lead time probabilistic
	CO3	Design and Perform Reliability problem
	CO4	Design and Perform statistical models
	CO5	Design and Perform Random number generate and test
	CO6	Design and Perform Goodness of fit test and Output analysis

Exp. No.	Experiment Details	Ref.	Marks
1	Design and Perform Queue- single server, multi-server, classic case- dump truck using spreadsheets and/or simulation language/package	**1,2,3**	**5**
2	Design and Perform Inventory – Lead time=0, lead time fixed, lead time probabilistic using spreadsheets and/or simulation language/package	**1,2,3**	**5**
3	Design and Perform Reliability problem using spreadsheets and/or simulation language/package	**1,2,3**	**5**
4	Design and Perform statistical models using spreadsheets and/or simulation language/package	**1,2,3**	**5**
5	Design and Perform Random number generate and test using spreadsheets and/or simulation language/package	**1,2,3**	**5**
6	Design and Perform Goodness of fit test using spreadsheets and/or simulation language/package.	**1,2,3**	**5**
7	Design and Perform Output analysis – Point estimate and Confidence Interval using spreadsheets and/or simulation language/package.	**1,2,3**	**10**
	Total Marks		**40**

References:

[1]Jerry Banks, John Carson, Barry Nelson, and David M. Nicol,"Discrete Event System Simulation; Third Edition", Prentice-Hall

[2] Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, "Discrete Event System Simulation; Fifth Edition", Prentice-Hall

[3] Averill M Law, "System Modeling & Analysis: 4th Edition" TMH.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL7023	**Elective-IIIImage Processing**	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE7023(Image Processing)
At end of successful completion of this course, student will be able to		
Course Outcomes	**CO1**	write a code for Image Enhancement using Zero Memory Point Operations and Histogram Processing Technique
	CO2	Implement Image Segmentation UsingHorizontal and Vertical Line Detection Segmentation Split and Merge Technique
	CO3	Write a Program for Image Compression and De-compression Using Arithmetic Coding and Decoding and Huffman Coding and Decoding.
	CO4	Write a Program for Binary Image Processing Using Hit or Miss Transform and Connected Component Algorithm.

Exp. No.	Experiment Details	Ref.	Marks
1	Write a Program for Image Enhancement using Zero Memory Point Operations.	1,2,3	**5**
2	Write a Program for Image Enhancement using Histogram Processing Technique	1,2,3	**5**
3	Implement Image Segmentation usingHorizontal and Vertical Line Detection	1,2,3	**5**
4	Write a Program for Image Segmentation usingSplit and Merge Technique	1,2,3	**5**
5	Write a Program for Image Compression and De-compression Using Arithmetic Coding and Decoding	1,2,3	**5**
6	Write a Program for Image Compression and De-compression Using Huffman Coding and Decoding	1,2,3	**5**
7	Write a Program for Binary Image Processing Using Hit or Miss Transform.	1,2,3	**5**
8	Write a Program for Binary Image Processing Using Connected Component Algorithm	1,2,3	**5**
		Total Marks	**40**

References:

[1] Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,

[2] S. Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,

[3] Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition.

[4] .S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2012.

[5] Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL7024	Elective-II Software Architecture	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes	CPE7024 (Software Architecture)	
At end of successful completion of this course, student will be able to		
Pre-requisite Course Codes	Learner will be able to…	
Course Outcomes	**CO1**	Design and program Modeling and Visualization
	CO2	Program Integrate Software Component
	CO3	Implement Connectors using middleware
	CO4	Design and Program Wrapper to connect two applications with different architectures
	CO5	Design and Program for Creating web service
	CO6	Program and Design Architecture for any specific domain

Exp. No.	Experiment Details	Ref.	Marks
1	Write a Program for Modeling using xADL	1-6	5
2	Write a Program for Visualization using xADL 2.0	1-6	5
3	Write a Program to Integrate software components using a middleware	1-6	5
4	Write a Program Using middleware to implement connectors	1-6	5
5	Write a Program for Wrapper to connect two applications with different architectures	1-6	5
6	Write a Program for Creating web service	1-6	5
7	Write a Program to Design Architecture for any specific domain	1-6	5
8	Perform Analysis-Case Study	1-6	5
		Total Marks	**40**

References:

[1] "Information Technology Project Management", Jack T. Marchewka, 3rd edition, Wiley India, 2009.

[2] S. J. Mantel, J. R. Meredith and etl.. "Project Management" 1st edition, Wiley India, 2009.

[3] John M. Nicholas, "Project Management for Business and Technology", 2nd edition, Pearson Education.

[4] Joel Henry, "Software Project Management, A realworld guide to success", Pearson Education, 2008.

[5] Gido and Clements, "Successful Project Management", 2nd edition, Thomson Learning.

[6] Hughes and Cornell, "Software Project Management", 3rd edition, Tata McGraw Hill

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL7025	Elective-II Soft Computing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE7025(Soft Computing)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Differentiate various Transfer Functions.
	CO2	Apply the supervised and unsupervised learning algorithm.
	CO3	Apply &design fuzzy controller system.
	CO4	Apply Genetic algorithm for basic optimization problem.

Exp. No.	Experiment Details	Ref.	Marks
1	To implement Mc-Culloch Pitts Model.	1-5	5
2	To implement Transfer/Activation Functions. i) A symmetric hard limit transfer function. ii) A Binary step activation function. iii) A Bipolar step activation function. iv) A saturating linear transfer function. v) A hyperbolic tangent sigmoid (tansig) transfer function. vi) A log-sigmoid transfer function	1-5	5
3	To implement Basic Neural Network learning rules. PROBLEM TO DISTINGUISH BETWEEN APPLES AND ORANGES A produce dealer has a warehouse that store a variety of fruits &vegetables.When fruit is brought to the warehouse , a various types of fruits may be mixed together. The dealer wants a machine that will sort the fruit according to type . There is a conveyer belt on which the fruit is loaded .This conveyer passes through a set of sensors, which measure three properties of fruits :shape , texture and weight. Bias= < Any Value> Type of sensor | Output of sensor | Condition Shape sensor | 1 | if fruit is approx. round	1-5	5

	0	if fruit is elliptical.	
Texture Sensor	1	If surface is smooth	
	0	If surface is rough	
Fruit sensor	1	Apple	
	0	Orange	

A) Design a perceptronto recognize these patterns using Joone Editor.

B) Write a C++/JAVA/Python program to design a perceptron to recognize these patterns.

4	To implement Heabbian Learning algorithm.	1-5	**5**
5	To implement Multi layer Perceptron Learning algorithm.	1-5	**5**
6	To implement Fuzzy Sets and Fuzzy Relations	1-5	**5**
7	To implement Fuzzy Controllers	1-5	**5**
8	To implement a simple application using Genetic Algorithm.	1-5	**5**
	Total Marks		**40**

References:

[1] Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.

[2] S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.

[3] S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.

[4] Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.

[5] Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL7026	Elective-II Enterprise Resource Planning and Supply Chain Management Lab(ERP & SCM)	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE7026(Enterprise Resource Planning and Supply Chain Management)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	To understand the technical aspects of ERP and SCM systems.
	CO2	Identify the factors that lead to the development and implementation of ERP systems.
	CO3	Create process model that assist with process improvement and ERP implementation.
	CO4	Discuss the advantages and disadvantages of implementing ERP system.

Exp. No.	Experiment Details	Ref.	Marks
1	Simulating business processes of an Enterprise.	1-6	5
2	Designing a web portal for an Enterprise using E-business Models.	1-6	5
3	Implementing Business Intelligence.	1-6	5
4	Study of Open source ERP.	1-6	5
5	Study of Cloud ERP.	1-6	5
6	To study Business process agility.	1-6	5
7	To implement E-procurement model.	1-6	5
8	Design of SCM model.	1-6	5
	Total Marks		40

References:

[1] Sandeep Desai, Abhishek Srivastava, "ERP to E^2 ERP: A Case study approach", PHI.
[2] David Olson, "Managerial Issues of ERP system", McGraw Hill.
[3] V.K. Garg& N.K. Venkatakrishnan ,"Enterprise Resource Planning : concepts &practices", PHI.
[4] R. P. Mohanty, S. G. Deshmukh,, "Supply Chain Management Theories & Practices",Dreamtech Press.
[5] Alexis Leon, "ERP Demystified: II Edition", McGraw Hill .
[6] Rahul Altekar, "Enterprise wide resource planning: Theory &practice",PHI.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CP701	Project (Stage I)	--	--	6	--	--	3	3
		Examination Scheme						
		ISE		MSE		ESE		Total
		Phase-I:40 Phase-II:40		--		20		100

Guidelines for Project

- **Students should do literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem.**
- **Students should attempt solution to the problem by experimental/simulation methods.**
- **The solution to be validated with proper justification and report to be compiled in standard format.**

- **Guidelines for Assessment of Project I**

- **Project I should be assessed based on following points Quality of problem selected**
- **Clarity of Problem definition and Feasibility of problem solution Relevance to the specialization**
- **Clarity of objective and scope**
- **Breadth and depth of literature survey**

- **Project I should be assessed through a presentation by the student project group to a panel ofInternal examiners appointed by the Head of the Department/Institute of respective Programme.**

SEMESTER – VIII

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPC801	Data Warehouse and Mining	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		CSC404 (Database Management System) CPC603 (Distributed Database)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Discuss the need of data warehouse and the concepts of data warehousing.
	CO2	Describe the ETL process and illustrate the OLAP operations
	CO3	Express the concepts of data mining, data exploration , preprocessing
	CO4	Apply algorithms in data mining and data warehousing; assess the strengths and weaknesses of the algorithms, identify the application area of algorithms

Module No.	Topics	Ref.	Hrs.
1	**Introduction to Data Warehousing** The Need for Data Warehousing; Increasing Demand for StrategicInformation; Inability of Past Decision Support System; Operational V/sDecisional Support System; Data Warehouse Defined;Benefits of DataWarehousing;Features of a Data Warehouse;TheInformationFlowMechanism;Role of Metadata; Classification of Metadata; Data WarehouseArchitecture; Different Types of Architecture;Data Warehouse and DataMarts; Data Warehousing Design Strategies.	1,3	**04**
2	**Dimensional Modeling** Data Warehouse Modeling Vs Operational Database Modeling; DimensionalModelVs ER Model; Features of a Good Dimensional Model; The StarSchema; How Does a Query Execute? The Snowflake Schema; Fact Tablesand Dimension Tables; The Factless Fact Table; Updates To DimensionTables: Slowly Changing Dimensions, Type 1 Changes, Type 2 Changes,Type 3 Changes, Large Dimension Tables, Rapidly Changing or LargeSlowly Changing Dimensions, Junk Dimensions, Keys in the DataWarehouse Schema, Primary Keys, Surrogate Keys & Foreign Keys;Aggregate Tables; Fact Constellation Schema or Families of Star.	1,3	**06**
3	**ETL Process** Challenges in ETL Functions; Data Extraction; Identification of	1,2,3	**06**

	DataSources; Extracting Data: Immediate Data Extraction, Deferred DataExtraction; Data Transformation: Tasks Involved in Data Transformation,Data Loading: Techniques of Data Loading, Loading the Fact Tables andDimension Tables Data Quality; Issues in Data Cleansing.		
4	**Online Analytical Processing (OLAP)** Need for Online Analytical Processing; OLTP V/s OLAP; OLAP and Multidimensional Analysis; Hypercubes; OLAP Operations inMultidimensional Data Model;OLAP Models: MOLAP, ROLAP, HOLAP,DOLAP;	1,3,6,9	**04**
5	**Introduction to data mining** What is Data Mining; Knowledge Discovery in Database (KDD), What canbe Data to be Mined, Related Concept to Data Mining, Data MiningTechnique, Application and Issues in Data Mining	1,3,4,5	**02**
6	**Data Exploration** Types of Attributes; Statistical Description of Data; Data Visualization;Measuring similarity and dissimilarity.	1,7	**02**
7	**Data Preprocessing** Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	1,8	**04**
8	**Classification** Basic Concepts; Classification methods:Decision Tree Induction: Attribute Selection Measures, Tree pruning, Bayesian Classification: Naïve Bayes' Classifier, Prediction: Structure of regression models; Simple linear regression, Multiple linear regression, Model Evaluation & Selection: Accuracy and Error measures, Holdout,Random Sampling, Cross Validation, Bootstrap; Comparing Classifierperformance using ROC Curves, Combining Classifiers: Bagging, Boosting, Random Forests.	1,4,8	**06**
9	**Clustering** What is clustering? Types of data, Partitioning Methods (K-Means, K-Medoids) Hierarchical Methods(Agglomerative, Divisive, BRICH),Density-Based Methods (DBSCAN, OPTICS)	1,4,8	**06**
10	**Mining Frequent Pattern and Association Rule** Market Basket Analysis, FrequentItemsets, Closed Itemsets, andAssociation Rules; Frequent Pattern Mining, Efficient and Scalable FrequentItemset Mining Methods, The Apriori Algorithm for finding FrequentItemsets Using Candidate Generation, Generating Association Rules fromFrequentItemsets, Improving the Efficiency of Apriori, A pattern growthapproach for mining Frequent Itemsets; Mining Frequent itemsetsusingvertical data formats; Mining	1,4	**08**

	closed and maximal patterns; Introduction toMiningMultilevel Association Rules andMultidimensionalassociationRules; From Association Mining to Correlation Analysis, Pattern EvaluationMeasures; Introduction to Constraint-Based Association Mining.		
		Total	**48**

References:

[1] Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition
[2] PaulrajPonniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India
[3] ReemaTheraja "Data warehousing", Oxford University Press.
[4] M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education
[5] Randall Matignon, "Data Mining using SAS enterprise miner ", Wiley Student edition.
[6] Alex Berson , S. J. Smith, "Data Warehousing, Data Mining & OLAP" , McGraw Hill.
[7] VikramPudi&Radha Krishna, "Data Mining", Oxford Higher Education.
[8] Daniel Larose, "Data Mining Methods and Models", Wiley India.
[9] P.S.Deshpande, "*SQL & PL/SQL for Oracle 11 g*", dreamtech PRESS.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPC802	Human Machine Interaction	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		CPL501(Web Technology) CPC602 (Software Engineering)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Identify the various design principles used for interacting between human and machine.
	CO2	Apply human psychology of everyday actions and UI design process for real world applications.
	CO3	Implement mobile, windows and web based application.
	CO4	Evaluate and justify UI design
	CO5	Create application for social and technical task.

Module No.	Topics	Ref.	Hrs.
1	**Introduction** Introduction to Human Machine Interface, Hardware, software andoperating environment to use HMI in various fields, The psychopathology of everyday things – complexity of modern devices;human-centered design; fundamental principles of interaction; Psychologyof everyday actions- how people do things; the seven stages of action andthree levels of processing; human error	1-8	**10**
2	**Understanding goal directed design** Goal directed design; Implementation models and mental models;Beginners, experts and intermediates – designing for different experiencelevels; Understanding users; Modeling users – personas and goals.	1-8	**08**
3	**GUI** benefits of a good UI; popularity of graphics; concept of directmanipulation; advantages and disadvantages; characteristics of GUI;characteristics of Web UI; General design principles.	1-8	**08**
4	**Design guidelines** perception, Gesalt principles, visual structure, reading is unnatural,color,vision, memory, six behavioral patterns, recognition and recall, learning,factors affecting learning, time.	1-8	**08**

5	**Interaction styles** Menus; windows; device based controls, screen based controls.	1-8	**06**
6	**Communication** Text messages; feedback and guidance; graphics, icons and images;colours.		**08**
		Total	**48**

References:

[1] Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale "Human Computer Interaction", Prentice Hall.
[2] Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.
[3] Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.
[4] Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.
[5] Donald A. Normann, "Design of everyday things", Basic Books; Reprint edition 2002.
[6] Donald A. Norman, "The design of everyday things", Basic books.
[7] Rogers Sharp Preece, "Interaction Design:Beyond Human Computer Interaction", Wiley.
[8] Guy A. Boy "The Handbook of Human Machine Interaction", Ashgate publishing Ltd.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPC803	Parallel and Distributed System	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		-
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Apply the principles and concept in analyzing and designing the parallel and distributedsystem
	CO2	Reason about ways to parallelize problems.
	CO3	Gain an appreciation on the challenges and opportunities faced by parallel and distributedsystems.
	CO4	Understand the middleware technologies that support distributed applications such asRPC, RMI and object based middleware.
	CO5	Improve the performance and reliability of distributed and parallel programs.

Module No.	Topics	Ref.	Hrs.
1	**Introduction** Parallel Computing, Parallel Architecture, Architectural ClassificationScheme, Performance of Parallel Computers, Performance Metrics forProcessors, Parallel Programming Models, Parallel Algorithms.	1-4	**06**
2	**Pipeline Processing** Introduction, Pipeline Performance, Arithmetic Pipelines, PipelinedInstruction Processing, Pipeline Stage Design, Hazards, DynamicInstruction Scheduling,	1-4	**06**
3	**Synchronous Parallel Processing** Introduction, Example-SIMD Architecture and Programming Principles,SIMD Parallel Algorithms, Data Mapping and memory in arrayprocessors, Case studies of SIMD parallel Processors	1-4	**06**
4	**Introduction to Distributed Systems** Definition, Issues, Goals, Types of distributed systems, DistributedSystem Models, Hardware concepts, Software Concept, Models ofMiddleware, Services offered by middleware, Client Server model.	1-4	**06**
5	**Communication** Layered Protocols, Remote Procedure Call, Remote Object Invocation,Message Oriented Communication, Stream Oriented	1-4	**04**

	Communication		
6	**Resource and Process Management** Desirable Features of global Scheduling algorithm, Task assignmentapproach, Load balancing approach, load sharing approach, Introductionto process management, process migration, Threads, Virtualization,Clients, Servers, Code Migration	1-4	**06**
7	**Synchronization** Clock Synchronization, Logical Clocks, Election Algorithms, MutualExclusion, Distributed Mutual Exclusion-Classification of mutualExclusion Algorithm, Requirements of Mutual Exclusion Algorithms,Performance measure, Non Token based Algorithms: LamportAlgorithm,Ricart–Agrawala's Algorithm, Maekawa's Algorithm Token Based Algorithms: Suzuki-Kasami'sBroardcastAlgorithms,Singhal'sHeurastic Algorithm, Raymond's Tree based Algorithm,Comparative Performance Analysis.	1-4	**08**
8	**Consistency and Replication** Introduction, Data-Centric and Client-Centric Consistency Models, Replica Management. Distributed File Systems Introduction, good features of DFS, File models, File Accessing models,File-Caching Schemes, File Replication, Network File System(NFS),Andrew File System(AFS), HadoopDistributed File System and MapReduce.	1-4	**06**
		Total	**48**

References:

[1] M.R. Bhujade, "Parallel Computing", 2nd edition, New Age International Publishers 2009.

[2] Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and

[3] George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design" (4th Edition), Addison Wesley/Pearson Education.

[4] Pradeep K Sinha, "Distributed Operating Systems : Concepts and design", IEEE computer society press

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE8031	Elective-III Machine Learning	4	--	-	4	--	-	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes	-

At end of successful completion of this course, student will be able to

Course Outcomes	CO1	Ability to analyze and appreciate the applications which can use Machine Learning Techniques
	CO2	Ability to understand regression, classification, clustering methods.
	CO3	Ability to understand the difference between supervised and unsupervised learning methods.
	CO4	Ability to appreciate Dimensionality reduction techniques.
	CO5	Students would understand the working of Reinforcement learning.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Machine Learning:** What is Machine Learning? , Key Terminology, Types of Machine Learning, Issues in Machine Learning, Applications of Machine Learning, How to choose Right Algorithm, Steps in Developing a Machine Learning Application	1,2,3,4	6
2	2.1	**Learning with Regression:** Linear Regression, Logistic Regression	1,2,4,5	4
3	3.1	**Learning with Trees:** Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART)	1,2,7	8
4	4.1	**Support Vector Machine:** Maximum Margin Linear Separator, Quadratic Programming Solution to finding maximum margin separators, Kernels for learning non-linear functions	1,2,4	6
5	5.1	**Learning with Classification:** Rule based Classification, Classification by Back propagation, Bayesian Belief Networks, Hidden Markov Model	1,2,6	6
6	6.1	**Dimensionality Reduction:**	1,2,5	6

		Dimensionality Reduction Techniques, Principal Component Analysis, Independent Component Analysis		
7	**7.1**	**Learning with Clustering:** K-means Clustering, Hierarchical Clustering, Expectation Maximization Algorithm, Supervised Learning after Clustering, Radial Basis Functions	1,2,6	6
8	**8.1**	**Reinforcement Learning:** Introduction, Elements of Reinforcement Learning, Model based Learning, Temporal Difference Learning, Generalization, Partially Observable States	1,2,6	6
			Total	**48**

References:

[1] Peter Harrington "Machine Learning In Action", DreamTech Press.

[2] EthemAlpaydın, "Introduction to Machine Learning", MIT Press.

[3] Tom M.Mitchell "Machine Learning" McGraw Hill.

[4] Stephen Marsland, "Machine Learning An Algorithmic Perspective" CRC Press.

[5] William W.Hsieh, "Machine Learning Mehods in the Environmental Sciences", Cambridge.

[6] Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

[7] Margaret.H.Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE8032	Elective-III Embedded Systems	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes		-
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Describe the special requirements that are imposed on embedded systems.
	CO2	Describe the key properties of microprocessor and digital signal processor.
	CO3	Sketch a design of an embedded system around a microprocessor or DSP.
	CO4	Explain how microprocessor, memory, peripheral components and buses interact in an embedded system.
	CO5	Evaluate how architectural and implementation decisions influence performance and power dissipation

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to computational technologies**	1,2	08
	1.2	Review of computation technologies (ARM, RISC, CISC, PLD, SOC), architecture, event managers hardware multipliers, pipelining.	1,2	
	1.3	Hardware/Software co-design. Embedded systems architecture and design process.	1,2	
2	2.1	**Program Design and Analysis**	1,3	08
	2.2	Integrated Development Environment (IDE), assembler, linking and loading. Program-level performance analysis and optimization , energy and power analysis and program size optimization, program validation and testing.	1,3	
	2.3	Embedded Linux, kernel architecture, GNU cross platform tool chain. Programming with Linux environment	1,3	
3	3.1	**Process Models and Product development life cycle management**	3,5	08
	3.2	State machine models: finite-state machines (FSM), finite-state machines, with data-path model (FSMD), hierarchical/concurrent state machine model (HCFSM),	3,5	

	3.3	program-state machine model (PSM), concurrent, process model. Unified Modeling Language (UML), applications of UML in embedded systems. IP-cores, design process model. Hardware software co-design, embedded product development life cycle management.	3,5	
4	**4.1**	**High Performance 32-bit RISC Architecture**	3,6	08
	4.2	ARM processor family, ARM architecture, instruction set, addressing modes, operating modes,	3,6	
	4.3	interrupt structure, and internal peripherals. ARM coprocessors, ARM Cortex-M3.	3,6	
5	**5.1**	**Processes and Operating Systems**	8,10	08
	5.2	Introduction to Embedded Operating System, multiple tasks and multiple processes. Multi rate systems, preemptive real-time operating systems,	8,10	
	5.3	Operating system performance and optimization strategies. Examples of real-time operating systems.	8,10	
6	**6.1**	**Real-time Digital Signal Processing (DSP)**		08
	6.2	Introduction to Real-time simulation, numerical solution of the mathematical		
	6.3	Convolution, DFT, FIR filter and IIR Filter implementation on ARM. Open Multimedia Application s Platform (OMAP).		
			Total	**48**

References:

[1] Embedded Systems an Integrated Approach – Lyla B Das, Pearson.
[2] Computers as Components – Marilyn Wolf, Third Edition Elsevier.
[3] Embedded Systems Design: A Unified Hardware/Software Introduction – Frank Vahid and Tony Givargis, John Wiley & Sons.
[4] An Embedded Software Primer – David E. Simon – Pearson Education Sough Asia.
[5] ARM System Developer's Guide Designing and Optimizing System Software – Andrew N. Sloss, Dominic Sysmes and Chris Wright – Elsevier Inc.
[6] Embedded Systems, Architecture, Programming and Design – Raj Kamal – Tata McGraw Hill.
[7] Embedded Linux – Hollabaugh, Pearson Education.
[8] Embedded Realtime Systems Programming – Sriram V Iyer, Pankaj Gupta – Tata McGRaw Hill.
[9] Fundamentals of Microcontrollers and Applications in Embedded Systems – Ramesh Gaonkar – Penram International Publishing (India) Pvt. Ltd.
[10] Embedded / Real-Time Systems: Concepts, Design & Programming – Dr. K. V. K. K. Prasad – Dreamtech Press, India.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE8033	Elective-III Adhoc Wireless Networks	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		CPC504(Computer Networks)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Define characteristics and features of Adhoc Networks.
	CO2	Appreciate the designing of MAC protocol for Adhoc networks.
	CO3	Implement few protocols.
	CO4	Apply security principles for routing

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction**		04
	1.2	Introduction to wireless Networks. Characteristics of Wireless channel, Issues in Ad hoc wireless networks, Adhoc Mobility Models:- Indoor and outdoor models	1,3	
	1.3	Adhoc Networks: Introduction to adhoc networks – definition, characteristics features, applications.	1,3	
2	2.1	**MAC Layer**		10
	2.2	MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals, and Classification of a MAC protocol, Contention based protocols with reservation mechanisms.	2,3	
	2.3	Scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15, 802.16, HIPERLAN.	2,3	
3	3.1	**Network Layer**		10
	3.2	Routing protocols for Ad hoc wireless Networks: Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table driven routing protocol, On- demand routing protocol.	3,4	
	3.3	Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.	3,4	
4	4.1	**Transport Layer**		07

	4.2	Transport layer protocols for Ad hoc wireless Networks: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks.	2,5	
	4.3	Classification of transport layer solutions, TCP over Ad hoc wireless Networks, Other transport layer protocols for Ad hoc wireless Networks.	2,5	
5	**5.1**	**Security**		07
	5.2	Security: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning,	2,4	
	5.3	Network security attacks, Key management, Secure routing in Ad hoc wireless Networks.	2,4	
6	**6.1**	**QoS**		07
	6.2	Quality of service in Ad hoc wireless Networks: Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks	1,3	
	6.3	Classification of QoS solutions, MAC layer solutions, network layer solutions	2,4	
			Total	**45**

References:

[1] Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education, 2007.
[2] Charles E. Perkins, "Adhoc Networking", Addison – Wesley, 2000.
[3] C. K. Toh,"Adhoc Mobile Wireless Networks", Pearson Education, 2002.
[4] Matthew Gast, "802.11 Wireless Networks: The Definitive Guide", 2nd Edition, O'Reilly Media, April 2005.
[5] Stefano Basagni, Marco Conti, Silvia Giordan and Ivan Stojmenovic, "Mobile Adhoc Networking", Wiley-IEEE Press, 2004.
[6] Mohammad Ilyas, "The handbook of Adhoc Wireless Networks", CRC Press, 2002.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE8034	Elective-III Digital Forensics	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes		CPC702(Cryptography and System Security)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Understand the role of digital forensics.
	CO2	An ability to analyze a problem, and identify and define the Computing requirements appropriate to its solution.
	CO3	Better understand the research challenges of digital forensics
	CO4	An understanding of professional, ethical, legal, security and social issues and responsibilities.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction:**		09
	1.2	Introduction of Cybercrime: Types, The Internet spawns crime, Worms versus viruses, Computers' roles in crimes, Introduction to digitalforensics.	1,2	
	1.3	Introduction to Incident - Incident Response Methodology – Steps - Activities in Initial Response, Phase after detection of an incident.	1,2	
2	2.1	**Initial Response and forensic duplication**		08
	2.2	Initial Response & Volatile Data Collection from Windows system - Initial Response & Volatile Data Collection from Unix system – Forensic.	2,3	
	2.3	Duplication: Forensic duplication: Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic, Duplicate/Qualified Forensic Duplicate of a Hard Drive.	2,3	
3	3.1	**Preserving and Recovering Digital Evidence**		09
	3.2	File Systems: FAT, NTFS - Forensic Analysis of File Systems – Storage	1,2	
	3.3	Fundamentals: Storage Layer, Hard Drives Evidence Handling: Types of Evidence, Challenges in evidence handling, Overview of evidencehandling procedure	1,2	
4	4.1	**Network Forensics**		07
	4.2	Intrusion detection; Different Attacks in network, analysis	1,5	

		Collecting		
	4.3	Network Based Evidence - Investigating Routers - Network Protocols - Email Tracing- Internet Fraud.	1,5	
5	**5.1**	**System investigation**		08
	5.2	Data Analysis Techniques - Investigating Live Systems (Windows & Unix) Investigating	2,3	
	5.3	Hacker Tools - Ethical Issues – Cybercrime.	2,3	
6	**6.1**	**Bodies of law**		07
	6.2	Levels of law: Local laws, State laws, Federal laws, International laws , Levels of culpability: Intent, Knowledge, Recklessness, Negligence.	2,4	
	6.3	Level and burden of proof : Criminal versus civil cases ,Vicarious liability, Laws related to computers: CFAA, DMCA, CAN Spam, etc.	2,4	
			Total	**48**

References:

[1] Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGrawHill, 2006

[2] Peter Stephenson, "Investigating Computer Crime: A Handbook for Corporate Investigations", Sept 1999

[3] Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001

[4] Skoudis. E., Perlman. R. Counter Hack: A Step-by-Step Guide to Computer Attacks and Effective Defenses.Prentice Hall Professional Technical Reference. 2001.

[5] Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000

[6] Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to computer forensics investigation "Course technology, 4th edition

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPE8035	Elective-III Big Data Analytics	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		-
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Identify challenges in big data management and inadequacy of existing technology to analyze big data.
	CO2	Apply scalable algorithms based on Hadoop and Map Reduce to perform Big Data Analytics..
	CO3	Apply NoSQL tools to solve big data problems.
	CO4	Use stream data model to provide real time analysis of big data.
	CO5	Discover information from social network graphs.

Module No.	Topics	Ref.	Hrs.
1	**Introduction to Big Data** Introduction to Big Data, Big Data characteristics, types of Big Data,Traditional vs. Big Data business approach, Case Study of Big DataSolutions.	1-5	**03**
2	**Introduction to Hadoop** What is Hadoop? Core Hadoop Components; HadoopEcosystem;Physical Architecture; Hadoop limitations.	1-5	**03**
3	**NoSQL** What is NoSQL? NoSQL business drivers; NoSQL case studies NoSQL data architecture patterns: Key-value stores, Graph stores,Column family (Bigtable) stores, Document stores, Variations of NoSQLarchitectural patterns; Using NoSQL to manage big data: What is a big data NoSQLsolution?Understanding the types of big data problems; Analyzing big data with ashared-nothing architecture; Choosing distribution models: master-slaveversus peer-to-peer; Four ways that NoSQL systems handle big dataproblems	1-5	**04**
4	**MapReduce and the New Software Stack** Distributed File Systems: Physical Organization of Compute Nodes,	1-5	**06**

	Large- Scale File-System Organization. MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks Combiners, Details of MapReduce Execution, Coping With Node Failures, Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce,Relational-Algebra Operations, Computing Selections by MapReduce,Computing Projections by MapReduce, Union, Intersection, and Difference byMapReduce, Computing Natural Join by MapReduce, Grouping andAggregation by MapReduce, One MapReduce Step.		
5	**Finding Similar Items** Applications of Near-Neighbor Search, Jaccard Similarity of Sets,Similarity of Documents, Collaborative Filtering as a Similar-Sets Problem, Distance Measures: Definition of a Distance Measure, Euclidean, Distances, Jaccard Distance, Cosine Distance, Edit Distance, HammingDistance.	1-5	**03**
6	**Mining Data Streams** The Stream Data Model: A Data-Stream-Management System,Examples of Stream Sources, Stream Querie, Issues in Stream Processing, Sampling Data in a Stream: Obtaining a Representative Sample, TheGeneral Sampling Problem, Varying the Sample Size. Filtering Streams: The Bloom Filter, Analysis. 6.4 Counting Distinct Elements in a StreamThe Count-Distinct Problem, The Flajolet-Martin Algorithm, CombiningEstimates, Space Requirements. Counting Ones in a Window:The Cost of Exact Counts, The Datar-Gionis-Indyk-MotwaniAlgorithm,Query Answering in the DGIM Algorithm, Decaying Windows.	1-5	**06**
7	**Link Analysis** PageRank Definition, Structure of the web, dead ends, Using Page ranking a search engine, Efficient computation of Page Rank: PageRankIteration Using MapReduce, Use of Combiners to Consolidate the Result Vector, Topic sensitive Page Rank, link Spam, Hubs and Authorities.	1-5	**05**
8	**Frequent Itemsets** Handling Larger Datasets in Main MemoryAlgorithm of Park, Chen, and Yu, The Multistage Algorithm, The Multihash Algorithm, The SON Algorithm and MapReduce, Counting Frequent Items in a StreamSampling Methods for Streams, Frequent Itemsets in Decaying Windows	1-5	**05**
9	**Clustering** CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm,Initializing& Merging Buckets, Answering Queries	1-5	**05**
10	**Recommendation Systems** A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	1-5	**04**

11	**Mining Social-Network Graphs** Social Networks as Graphs, Clustering of Social-Network Graphs, DirectDiscovery of Communities, SimRank, Counting triangles using Map-Reduce	1-5	**04**
		Total	**48**

References:

[1] AnandRajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press,

[2] Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.

[3] Dan McCreary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.

[4] Bill Franks , "Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley

[5] Chuck Lam, "Hadoop in Action", Dreamtech Press

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPL801	Cloud Computing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		-
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Understand fundamentals of cloud computing and Summarize various cloud delivery models.
	CO2	Create and run virtual machines on open source OS.
	CO3	Implement Infrastructure, Storage as a Service.
	CO4	Install and appreciate security features for cloud.

Exp. No.	Experiment Details	Ref.	Marks
1	**Title: Study and implementation of Infrastructure as a Service.** **Concept:** Infrastructure as a Service**.** **Objective:** In this module student will learn Infrastructure as a Service and implement it by using OpenStack. **Scope:** Installing OpenStack and use it as Infrastructure as a Service. **Technology:** Quanta Plus /Aptana /Kompozer	1,4	**5**
2	**Title: Implementation of identity management.** **Concept:** Identity Management in cloud **Objective:** this lab gives an introduction about identity management incloud and simulate it by using OpenStack **Scope:** installing and using identity management feature of OpenStack **Technology:** OpenStack	1,4	**5**
3	**Title: Study and installation of Storage as Service**. **Concept:** Storage as Service (SaaS) **Objective:** is that, students must be able to understand the concept ofSaaS , and how it is implemented using ownCloud which givesuniversal access to files through a web interface. **Scope:** is to installation and understanding features of ownCloudasSaaS**.** **Technology:** ownCloud	3	**5**
4	**Title: User Management in Cloud.** **Concept:** Administrative features of Cloud Management ,UserManagement **Objective:** is to understand how to create, manage user and group ofusers accounts. **Scope:** Installing and using Administrative features of ownCloud. **Technology:** ownCloud	3	**5**

5	**Title: Study and implementation of Single-Sign-On** **Concept:** Single Sign On (SSO),openID **Objective:** is to understand the concept of access control in cloud and single sign on (SSO), Use SSO and advantages of it, and also studentsshould able to implementation of it. **Scope:** installing and using JOSSO **Technology:** JOSSO	2	**5**
6	**Title: Write a program for web feed** **Concept:** Web feed and RSS **Objective:** this lab is to understand the concept of form and controlvalidation **Scope:** Write a program for web feed. **Technology:** PHP, HTML	5	**5**
7	**Title: Mini project.** **Concept:** using different features of cloud computing creating owncloud for institute, organization etc. **Objective:** is student must be able to create own cloud using differentfeatures which are learned in previous practices. **Scope:** creating a cloud like social site for institute. **Technology:** any open system used for cloud		**10**
		Total Marks	**40**

References:

[1] GautamShroff,"Enterprise Cloud Computing" Cambridge,2010.

[2] Ronald Krutz and Russell Dean Vines,"Cloud Security", Wiley - India, 2010,ISBN:978-0-470-58987-8.

[3] Aditya Patawar , "Getting Started with OwnCloud", Packt Publishing Ltd, 2013.

[4] www.openstack.org

[5] https://www.rss.com/

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPCL801	Data Warehousing and Mining Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPC801(Data Warehousing and Mining)
At end of successful completion of this course, student will be able to		
Course Outcomes	CPC801.1	Create dimensional modeling and implement dimension table, fact table and OLAP operations.
	CPC801.2	Develop Classification, Clustering and Association Mining algorithms using languages any like Java, C#.
	CPC801.3	Use WEKA tool to implement Classification, Clustering and Association Mining.
	CPC801.5	Use R tool to implement Clustering/Association Rule/Classification Algorithms.
	CPC801.4	Observe the features of any one BI tool.

Exp. No.	Experiment Details	Ref.	Marks
1	One case study given to a group of 3 /4 students, of a data mart/ data warehouse. a. Write Detail Statement Problem and creation of dimensional modeling(creation star and snowflake schema) b. Implementation of all dimension table and fact table c. Implementation of OLAP operations.	1,2,3,4,7	5
2	Implementation of classifier like Decision tree, Naïve Bayes, Random Forest using any languages like Java	1,5,8	5
3	Use WEKA to implement like Decision tree, Naïve Bayes, Random Forest.	1,5	5
4	Implementation of clustering algorithm like K-means, K-Medoids, Agglomerative, Divisive using languages any like Java, C# , etc.	1,5,8	5
5	Use WEKA to implement the following Clustering Algorithms – K-means, Agglomerative, and Divisive.	1,5	5
6	Implementation Association Mining like Apriori, FPM using languages like Java, C#, etc. and using WEKA Tool	1,5,9	5
7	Use R tool to implement Clustering/Association Rule/ Classification Algorithms.	1,5,9	5

8	Detailed study of any one BI tool like Oracle BI, SPSS, Clementine, and XLMiner etc. (paper Assignment)	1,6	**5**
		Total Marks	**40**

References:

[1] Han, Kamber and Pei "*Data Mining Concepts and Techniques*", Morgan Kaufmann 3rd Edition

[2] ReemaTheraja "*Data warehousing*", Oxford University Press.

[3] PaulrajPonniah, "*Data Warehousing: Fundamentals for IT Professionals*", Wiley India

[4] P.S.Deshpande, "*SQL & PL/SQL for Oracle 11 g*", dreamtech PRESS.

[5] Margaret H. Dunham, "*Data Mining Introductory and Advanced Topics*", Pearson Education

[6] Randall Matignon, "*Data Mining using SAS enterprise miner* ", Wiley Student edition.

[7] Alex Berson , S. J. Smith, "*Data Warehousing, Data Mining & OLAP*" , McGraw Hill.

[8] VikramPudi&Radha Krishna, "*Data Mining*", Oxford Higher Education

[9] Daniel Larose, "*Data Mining Methods and Models*", Wiley India.

[10] J. Millman and A. Grabel, "*Microelectronics*", Tata McGraw Hill, 2nd Edition.

[11] Jan M. Rabaey, AnanthaChandrakasan and BorivojeNikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPCL802	Human Machine Interaction Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPC802(Human Machine Interaction)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	To design user centric interfaces.
	CO2	To design innovative and user friendly interfaces.
	CO3	To apply HMI in their day-to-day activities.
	CO4	To criticize existing interface designs, and improve them.
	CO5	To Design application for social Task.
	CO6	To Design application for Technical Tasks.

Exp. No.	Experiment Details	Ref.	Marks
1	**Know your client** a. Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector. b. Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector. c. Design a site that can help people to sell their handmade products in metro cities. d. Design a site that can connect housewives and keep them engaged.	1-8	5
2	**Goal oriented design** - Design an experience for passengers whose flight /train is delayed.	1-8	5
3	**Design Principles** - Understand principles of good UI design by heuristic evaluation. Design UI that would connect all college students to the events happening on-campus during the college festival. User should be able to browse all events sorted on time, category and place. The user should also be able to subscribe to events and get notified about their start time and also be able to send invites to friends to attend an event with them	1-8	5

4	**Menus & Navigation** – Redesign of a user interface(Suggest and implement changes in Existing User Interface	1-8	**5**
5	**Windows & Screen controls** – **a.** Design a navigator for a student new in your Institute. **b.** Design a navigator for a person new in tourist city/ village. **c.** Motor paralysis for differently able people. **d.** ATM design with localization	1-8	**5**
6	**Icons** - Design appropriate icons pertaining to a given domain (Eg. Greeting cards)	1-8	**5**
7	**Colors** – Design a personal website for an Artisan. Use statistical graphics for better visualization.	1-8	**5**
8	To calculate screen complexity of existing Graphical User Interface and redesign the interface to minimize the screen complexity.	1-8	**5**
		Total Marks	**40**

References:

[1] Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.

[2] Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.

[3] Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.

[4] Donald A. Normann, " Design of everyday things",Basic Books; Reprint edition 2002.

[5] Brian Fling, "Mobile Design and Development", First Edition , O'Reilly Media Inc., 2009.

[6] Rogers Sharp Preece,"Interaction Design:Beyond Human Computer Interaction",,Wiley.

[7] Guy A. Boy "The Handbook of Human Machine Interaction", Ashgate publishing Ltd.

[8] Kalbande,Kanade,Iyer,"Galitz's Human Machine Interaction",Wiley Publications.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPCL803	Parallel and Distributed Systems Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPC803(Parallel and Distributed Systems)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	The student gains clear understanding of fundamental principles of Parallel and Distributed Systems.
	CO2	The student understands the message communication, remote procedure call and Remote method invocation (RPC and RMI) along with group communication.
	CO3	Emphasis is on developing applications using current distributed computing technologies like EJB, CORBA.
	CO4	Analyze different token based and non-token based algorithms for the design and development of distributed systems subject to specific design and performance constraints.

Exp. No.	Experiment Details	Ref.	Marks
1	A program to implement simple calculator operations like addition, subtraction, multiplication and division using RPC.	2,3	5
2	Write a program to show the object communication using RMI. a)RMI based application program to display current date and time. b)RMI based application program that converts digits to words, e.g. 123 will be converted to one two three.	2,3	5
3	To implement CORBA mechanism by java program.	3	5
4	Implement Load Balancing Program in Java.	1	5
5	Show the implementation of logical lamport clock synchronization algorithm.	1	5
6	Implement Suzuki Kasami Token Based Algorithm.	1	5
7	Case Study on Distributed File System- AFS, NFS and HDFS.	2	5
8	Mini Project		5
		Total Marks	40

References:

[1] M.R. Bhujade, "Parallel Computing", 2nd edition, New Age International Publishers2009.

[2] Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education, Inc., 2007, ISBN: 0-13-239227-5.

[3] George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design" (4th Edition), Addison Wesley/Pearson Education.

[4] Pradeep K Sinha, "Distributed Operating Systems: Concepts and design", IEEE Computer society press

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL8031	Elective -III Machine Learning Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes	CPE8031(Machine Learning)

At end of successful completion of this course, student will be able to

Course Outcomes	CO1	Implement Regression Methods
	CO2	Implement Classification
	CO3	Implement Clustering
	CO4	Apply the Dimensionality Reduction Techniques

Exp. No.	Experiment Details	Ref.	Marks
1	To implement Linear /Logistic Regression	1-7	5
2	To implement Single layer Perceptron Learning algorithm	1-7	5
3	To implement ID3	1-7	5
4	To implement Support Vector Machine	1-7	5
5	To implement Bayesian Classification	1-7	5
6	To implement K-nearest Neighbor	1-7	5
7	To implement K-means Clustering	1-7	5
8	To implement Agglomerative Clustering	1-7	5
		Total Marks	40

References:

[1] Peter Harrington "Machine Learning In Action", DreamTech Press.
[2] EthemAlpaydın, "Introduction to Machine Learning", MIT Press.
[3] Tom M.Mitchell "Machine Learning" McGraw Hill.
[4] Stephen Marsland, "Machine Learning An Algorithmic Perspective" CRC Press.
[5] William W.Hsieh, "Machine Learning Mehods in the Environmental Sciences", Cambridge.
[6] Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.
[7] Margaret.H.Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL8032	Elective-III Embedded Systems Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE8032(Embedded Systems)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Design microcontroller based embedded systems for various applications.
	CO2	Produce efficient code for embedded systems
	CO3	Define the properties of a real-time operating system.
	CO4	Develop drivers for external peripheral devices as per requirement.

Exp. No.	Experiment Details	Ref.	Marks
1	Tostudy the In-Circuit Emulator (ICE) and In-Circuit Debugger (ICD) troubleshooting tools.	1,2	5
2	Interfacing of LCD module with ARM Processors.	2,3	5
3	Program to interface stepper motor.		5
4	To develop Device Driver (Drivers for CAN, Drivers for USB, Drivers for Ethernet).	2,4	5
5	To study Real Time Operating System (RTOS).	2,3	5
6	Converting existing Windows and Linux as RTOS by configuring QNX Neutrino (using Virtual Machine).	1,4	5
7	Implement a semaphore for any given task switching using RTOS on microcontroller board.	2,5	5
8	Program for exploration of (process creation, Thread creation)using Embedded Real Time Linux.	5,6	5
		Total Marks	40

References:

[1] Dr. K.V.K.K. Prasad, "Embedded /Real-Time System: Concepts, Design & Programming", Dreamtech, Edition 2010.

[2]. Andrew. N. Sloss, DomnicSymes, Chris Wright, "ARM System Developer's Guide", Elsevier, edition 2004.

[3]. KarimYaghmour , "Building Embedded Linux Systems", 2003 O'Reilly & Associates, 2. Rajkamal, "Embedded Sytems ", TMH.

[4]. David Simon, "Embedded systems software primer", Pearson .

[5]. Steve Furber, "ARM System-on-Chip Architecture", Pearson.

[6]. Iyer,Gupta, "Embedded real systems Programming", TMH.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL8033	Elective-III Adhoc Wireless Networks Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE8033(Adhoc Wireless Networks)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Describe the unique issues in ad-hoc/sensor networks.
	CO2	Describe current technology trends for the implementation and deployment of wireless ad-hoc networks.
	CO3	Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks.
	CO4	Discuss the challenges in designing routing and transport protocols for wireless Ad-hoc networks.

Exp. No.	Experiment Details	Ref.	Marks
1	Installation of NS2 in Ubuntu 12.04 Linux.	1,4	5
2	Build and exchange data in simple infrastructure and Adhoc network by using personal computer and Android based mobile.	1,3	5
3	Develop sample wireless network in which a. Implement AODV and AOMDV protocol. b. Calculate the time to receive reply from the receiver using NS2. C .Generate graphs which show the transmission time for packet.	1,3	5
4	Implement wireless network. Capture data frame and identify fields using NS2.	2,4	5
5	Configure Wireless Access Point (WAP) and build different networks.	3,4	5
6	Implement Mobile device as a wireless access point.	1,4	5
7	Communicate between two different networks which has following specifications: a. One network has Class A network with "Tora protocol" b. Second has Class B network "AODV protocol"	2,3	5
8	Case study on Security in wireless Ad hoc wireless Networks.	1,3	5
		Total Marks	40

References:

[1] Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education, 2007.
[2] Charles E. Perkins, "Adhoc Networking", Addison – Wesley, 2000.
[3] C. K. Toh,"Adhoc Mobile Wireless Networks", Pearson Education, 2002.
[4] Matthew Gast, "802.11 Wireless Networks: The Definitive Guide", 2nd Edition, O'Reilly Media, April 2005.
[5] Stefano Basagni, Marco Conti, Silvia Giordan and Ivan Stojmenovic, "Mobile Adhoc Networking", Wiley-IEEE Press, 2004.
[6] Mohammad Ilyas, "The handbook of Adhoc Wireless Networks", CRC Press, 2002.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL8034	Elective-III Digital Forensics Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE8034(Digital Forensics)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Identify issues and analysis of networking.
	CO2	An ability to use current techniques, skills, and tools necessary for computing practice.
	CO3	An ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs.
	CO4	Better appreciate the difficulty of the task of a digital forensics analyst.

Exp. No.	Experiment Details	Ref.	Marks
1	Study and Analysis of Network.	1,3	5
2	Listing and Tracking Network Related Process.	1,4	5
3	Collecting Information about given Domain.	2,4	5
4	Windows/ Linux Log Analysis.	3,4	5
5	Project/Case Work – Topic Approval for Synopsis	4,5	5
6	Project/Case Work – Objective and Work Plan	3,5	5
7	Project/Case Work – Review of Literature, Documentation, Presentation.	2,5	5
8	Digital and Cyber forensic case documentation.	6,7	5
	Total Marks		**40**

References:

[1] Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGrawHill, 2006

[2] Peter Stephenson, "Investigating Computer Crime: A Handbook for Corporate Investigations", Sept 1999

[3] Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001

[4] Skoudis. E., Perlman. R. Counter Hack: A Step-by-Step Guide to Computer Attacks and Effective Defenses.Prentice Hall Professional Technical Reference. 2001.

[5] Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000
[6] Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to computer forensics investigation "Course technology, 4th edition

Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CPEL8035	Elective-III Big Data Analytics Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		20		60

Pre-requisite Course Codes		CPE8035(Big Data Analytics)
At end of successful completion of this course, student will be able to		
Course Outcomes	CO1	Identify challenges in big data management and inadequacy of existing technology to analyze big data.
	CO2	Apply scalable algorithms based on Hadoop and Map Reduce to perform Big Data Analytics..
	CO3	Apply NoSQL tools to solve big data problems.
	CO4	Use stream data model to provide real time analysis of big data.
	CO5	Discover information from social network graphs.

Exp. No.	Experiment Details	Ref.	Marks
1	Study of Hadoop Ecosystem and execute word count program.	1,2	5
2	Mapreduce program on Hadoop.	1,2	5
3	Programming in NoSQL.	1,2,3	5
4	Use Pig scripting to solve Big Data problem.	1,4,5	5
5	Implement a Frequent Itemset algorithm using Map Reduce.	1,2,3	5
6	Implement a Clustering algorithm using Map Reduce.	1,2,3	5
7	Implement a Data streaming algorithm using Map Reduce.	1,2,3	5
8	Mini Project. One real life large data application to be implemented (Use standard Datasets available on the web)	1,2,3	5
		Total Marks	40

References:

[1] AnandRajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press,

[2] Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.

[3] Dan McCreary and Ann Kelly "Making Sense of NoSQL" – A guide for managers

and the rest of us, Manning Press.

[4] Bill Franks , "Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley

[5] Chuck Lam, "Hadoop in Action", Dreamtech Press

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CP801	Project (Stage II)	--	--	12	--	--	6	6
		Examination Scheme						
		ISE			MSE		ESE	Total
		Phase-III:50 Phase-IV:50 TPP:25 PE:25			--		50	200

TPP: Technical Paper Presentation; PE: Project Exhibition

Guidelines for Assessment of Project II

- **Project II should be assessed based on following points**
- **Quality of problem selected**
- **Clarity of Problem definition and Feasibility of problem solution**
- **Relevance to the specialization / Industrial trends**
- **Clarity of objective and scope**
- **Quality of work attempted**
- **Validation of results**
- **Quality of Written and Oral Presentation**

- **Report should be prepared as per the guidelines issued by the University of Mumbai.**
- **Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiners approved by the University of Mumbai**
- **Students should be motivated to publish a paper based on the work in Conferences/students competitions**