VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Thindal, Erode - 638 012

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai)
(Accredited by NAAC with 'A' grade)

REGULATIONS 2022

CURRICULUM AND SYLLABUS

M.E. – COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

2	22CPE12	Data Science	PE	4	0	0	3	40	60	100
3	22CPE13	Natural Language Processing	PE	4	0	0	3	40	60	100
4	22CPE14	Software Quality Assurance	PE	4	0	0	3	40	60	100
5	22CPE15	Embedded Software Development	PE	4	0	0	3	40	60	100
Semester - 3		**Professional Elective - 4**								
1	22CPE16	Bio Informatics	PE	4	0	0	3	40	60	100
2	22CPE17	Deep Learning	PE	4	0	0	3	40	60	100
3	22CPE18	Multicore Architecture and Programming	PE	4	0	0	3	40	60	100
4	22CPE19	Advanced Block chain Technologies	PE	4	0	0	3	40	60	100
5	22CPE20	Software Architectures	PE	4	0	0	3	40	60	100
Semester - 3		**Professional Elective - 5**								
1	22CPE21	GPU Computing	PE	4	0	0	3	40	60	100
2	22CPE22	Big Data Mining and Analytics	PE	4	0	0	3	40	60	100
3	22CPE23	Agent Based Intelligent Systems	PE	4	0	0	3	40	60	100
4	22CPE24	Enterprise Application Integration	PE	4	0	0	3	40	60	100
5	22CPE25	Information Storage Management	PE	4	0	0	3	40	60	100

OPEN ELECTIVES

S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
OFFERED BY DEPARTMENT OF BIO MEDICAL ENGINEERING										
1	22BPO01	Biomedical Waste Management in Hospitals	OE	4	0	0	3	40	60	100
2	22BPO02	Introduction to Clinical Trials	OE	4	0	0	3	40	60	100
3	22BPO03	Quality Assurance and Safety in Hospitals	OE	4	0	0	3	40	60	100
4	22BPO04	Telemedicine Technology	OE	4	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING										
1	22CPO01	Principles of Information Security	OE	4	0	0	3	40	60	100
2	22CPO02	Fundamentals of Block Chain	OE	4	0	0	3	40	60	100
3	22CPO03	Big Data Management	OE	4	0	0	3	40	60	100
4	22CPO04	Social Network Analysis	OE	4	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING										
1	22AEO01	Hardware Software Co-Design	OE	4	0	0	3	40	60	100
2	22AEO02	Embedded C	OE	4	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING										
1	22ESO01	Waste to Energy	OE	4	0	0	3	40	60	100
2	22ESO02	Industrial Drives for Automation	OE	4	0	0	3	40	60	100

Chairperson - BoS
Dept. of CSE - VCET

SEMESTER 3										
S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
Theory										
1		Professional Elective - 3	PE	4	0	0	3	40	60	100
2		Professional Elective - 4	PE	4	0	0	3	40	60	100
3		Professional Elective - 5	PE	4	0	0	3	40	60	100
4		Open Elective	OE	4	0	0	3	40	60	100
Practical										
5	22CPL31	Project Work I	EC	0	0	12	6	40	60	100
						Total Credits	18			

SEMESTER 4										
S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
Practical										
1	22CPL41	Project Work II	EC	0	0	24	12	40	60	100
						Total Credits	12			
						Total Programme Credits	72			

* - Audit course is optional

PROFESSIONAL ELECTIVES										
S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
Semester - 2		Professional Elective - 1								
1	22CPE01	Agile Methodologies	PE	4	0	0	3	40	60	100
2	22CPE02	Wireless Communications	PE	4	0	0	3	40	60	100
3	22CPE03	Principles of Programming Languages	PE	4	0	0	3	40	60	100
4	22CPE04	Human Computer Interaction	PE	4	0	0	3	40	60	100
5	22CPE05	Mobile and Pervasive Computing	PE	4	0	0	3	40	60	100
Semester - 2		Professional Elective - 2								
1	22CPE06	Cognitive Computing	PE	4	0	0	3	40	60	100
2	22CPE07	High Performance Computing	PE	4	0	0	3	40	60	100
3	22CPE08	Information Retrieval Techniques	PE	4	0	0	3	40	60	100
4	22CPE09	Compiler Optimization Techniques	PE	4	0	0	3	40	60	100
5	22CPE10	Semantic Web	PE	4	0	0	3	40	60	100
Semester - 3		Professional Elective - 3								
1	22CPE11	Data Visualization Techniques	PE	4	0	0	3	40	60	100

Chairperson - BoS
Dept. of CSE - VCET

	VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)
Department	Computer Science and Engineering
Programme	M.E. – Computer Science and Engineering
Regulations	2022

SUMMARY OF CREDIT

S.No	Course Category	Credits per Semester				Total Credits
		1	2	3	4	
1	FC	4				4
2	PC	14	14			28
3	PE		6	9		15
4	RM	3				3
5	OE			3		3
6	EC		1	6	12	19
7	VC, OC, AC, SC	✓				-
Total Credits / Sem		21	21	18	12	72

FC - Foundation Courses
PC - Professional Core
PE - Professional Elective
RM - Research Methodology and IPR
OE - Open Elective
EC - Employability Enhancement Course (Project, Seminar, Industrial Training, Internship etc.)
VC - Value Added Courses
OC - Online Course
AC - Audit Course
SC - Self Study course

Chairperson - BoS
Dept. of CSE - VCET

	VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)	CURRICULUM
		PG
		R - 2022
Department	Computer Science and Engineering	
Programme	M.E. – Computer Science and Engineering	

SEMESTER 1

S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
Theory										
1	22MAT14	Advanced Mathematics For Computer Science Engineers	FC	4	1	0	4	40	60	100
2	22RMT01	Research Methodology and IPR	RM	4	0	0	3	40	60	100
3	22CPT11	Advanced Data Structures and Algorithms	PC	4	0	0	3	40	60	100
4	22CPT12	Network Design and Technologies	PC	4	1	0	4	40	60	100
5	22CPT13	Advanced Software Engineering	PC	4	0	0	3	40	60	100
6	22CPT14	Security in Computing	PC	4	0	0	3	40	60	100
7		Audit Course – 1*	AC	2	0	0	0	100	0	100
Practical										
8	22CPL11	Advanced Data Structures Laboratory	PC	0	0	3	1	60	40	100
			Total Credits				21			

SEMESTER 2

S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
Theory										
1	22CPT21	Advanced Operating Systems	PC	4	0	0	3	40	60	100
2	22CPT22	Machine Learning Techniques	PC	4	0	0	3	40	60	100
3	22CPT23	Internet of Things and Applications	PC	4	0	0	3	40	60	100
4	22CPC21	Advanced Database Technologies	PC	4	0	2	4	50	50	100
5		Professional Elective - 1	PE	4	0	0	3	40	60	100
6		Professional Elective - 2	PE	4	0	0	3	40	60	100
7		Audit Course - 2*	AC	2	0	0	0	100	0	100
Practical										
8	22CPL21	Machine Learning Techniques Laboratory	PC	0	0	3	1	60	40	100
9	22CPL22	Technical Seminar	EC	0	0	2	1	100	0	100
			Total Credits				21			

Chairperson - BoS
Dept. of CSE - VCET

3	22ESO03	Hybrid Electric Vehicles	OE	4	0	0	3	40	60	100
4	22ESO04	Modern Automotive Electronics Systems	OE	4	0	0	3	40	60	100

AUDIT COURSES

(Registration for any of these courses is optional to students, it will be mentioned in the Grade statement. However, it will not be considered for computation of CGPA)

S. No	Course Code	Course Title	Category	Hours / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
1	22AC01	English for Research Paper Writing	AC	2	0	0	0	100	0	100
2	22AC02	Disaster Management	AC	2	0	0	0	100	0	100
3	22AC03	Constitution of India	AC	2	0	0	0	100	0	100
4	22AC04	Pedagogy Studies	AC	2	0	0	0	100	0	100

L - Lecture Period
T - Tutorial Period
P - Practical Period

CA - Continuous Assessment
SE - Semester Examination
Tot - Total Marks

Chairperson - BoS
Dept. of CSE - VCET

22MAT14	ADVANCED MATHEMATICS FOR COMPUTER SCIENCE ENGINEERS	L	T	P	C
		4	1	0	4

Pre-requisites : Nil

Preamble

The syllabus is designed to familiarize the concept of vector space, linear transformation and the application of inner product space in orthogonalization, formulation and solution of LPP. This course povide the knowledge and training using non- linear programming under limited resources for engineering and business problems.

UNIT 1 VECTOR SPACES **9+3**

Vector spaces – Subspaces - Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT 2 LINEAR TRANSFORMATIONS **9+3**

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors - Diagonalizability.

UNIT 3 INNER PRODUCT SPACES **9+3**

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

UNIT 4 LINEAR PROGRAMMING **9+3**

Formulation – Graphical solution – Simplex method –Transportation model – Initial basic feasible solution -North-west corner rule, Least-cost method, Vogel's approximation method and optimum solution of transportation problem.

UNIT 5 NON- LINEAR PROGRAMMING **9+3**

Constrained Problems – Equality constraints – Lagrange Method – Inequality constraints – Karush – Kuhn-Tucker (KKT) conditions – Quadratic Programming.

Lecture : 45, Tutorial : 15, Total : 60

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand the notations of vector spaces , bases and apply this concept to the solution of problems.

CO2 Develop an understanding of linear transformations and be able to apply that knowledge.

CO3 Learn properties of inner product spaces and determine orthogonality in inner product spaces.

CO4 Formulate and construct mathematical models for linear programming problems and solve the transportation problems.

CO5 Model various real life situations as optimization problems and effect their solution through Non-linear programming.

TEXT BOOKS:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra: Applications Version", Wiley India, New Delhi, 2018.
2. Kanti Swarup, Gupta PK and Manmohan, "Operations Research", 14th Edition, Sultan Chand & Sons, New Delhi,2014.

Chairperson - BoS
Dept. of CSE - VCET

REFERENCES:

1. David C. Lay, "Linear Algebra and its applications",4th Edition, Pearson, New Delhi,2012.
2. Taha, H.A, "Operations Research, An introduction", 10th edition, Pearson education, New Delhi, 2013.

e-Resources:

1. https://nptel.ac.in/courses/111106051/8,"Linear Algebra", Dr.K.C. Sivakumar, Department of Mathematics, IIT Madras.
2. https://nptel.ac.in/courses/112106134/1," Fundamentals of Operations Research" Prof.G. Srinivasan, Department of Management Studies, Indian Institute of Technology, Madras.

Chairperson - BoS
Dept. of CSE - VCET

22RMT01	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		4	0	0	3

Pre-requisites : Nil

Preamble

Research is a scientific and systematic search for information on a particular topic or issue. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment. In sum, research is the search for knowledge, using objective and systematic methods to find solution to a problem. This course also focuses on Intellectual Property Rights and explain the process of patenting.

UNIT 1 RESEARCH PROBLEM FORMULATION 9

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT 2 LITERATURE REVIEW 9

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT 3 TECHNICALWRITING /PRESENTATION 9

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT 4 INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 9

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5 INTELLECTUAL PROPERTY RIGHTS (IPR) 9

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand the research problem and research process.

CO2 Understand research ethics.

Chairperson - BoS
Dept. of CSE - VCET

CO3 Prepare a well-structured research paper and scientific presentations.

CO4 Explore on various IPR components and process of filing.

CO5 Understand the new developments in IPR.

TEXT BOOKS:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Mayall, "Industrial Design", McGraw Hill, 1992
3. Niebel, "Product Design", McGraw Hill, 1974.

Chairperson - BoS
Dept. of CSE - VCET

22CPT11	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		4	0	0	3

Pre-requisites : Data Structures, Design and Analysis of Algorithms

Preamble

A good algorithm usually comes together with a set of good data structures that allow the algorithm to manipulate the data efficiently. This course focuses on advanced data structures heap and trees, and design solutions to complex problems using divide-and-conquer, dynamic programming, back tracking and approximation techniques.

UNIT 1 FUNDAMENTALS **9**

Asymptotic Notations – Properties of Big-oh Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Time-Space Tradeoff.

UNIT 2 SEARCH STRUCTURES **9**

Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT 3 HEAP STRUCTURES **9**

Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps.

UNIT 4 ALGORITHM DESIGN TECHNIQUES **9**

Divide and Conquer - Closest-Points Problem - The Selection Problem. Dynamic Programming Using a Table Instead of Recursion - Ordering Matrix Multiplications - Optimal Binary Search Tree - All-Pairs Shortest Path. Backtracking Algorithms - The Turnpike Reconstruction Problem - Games.

UNIT 5 NP COMPLETE AND APPROXIMATION PROBLEM **9**

NP-Completeness - Polynomial time - Polynomial time verification - NP-complete problems. Approximation Algorithms-The vertex-cover problem-The traveling-salesman problem – The set-covering problem.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Analyze algorithms using various Asymptotic notations.

CO2 Implement appropriate searching technique for an application.

Chairperson - BoS
Dept. of CSE - VCET

CO3 Apply suitable data structures for complex real world problems

CO4 Design efficient algorithms using divide-and-conquer, dynamic programming and backtracking.

CO5 Solve problems using approximation algorithms.

TEXT BOOKS:

1. Mark Allen Weiss," Data Structures and Algorithms in C++", Pearson, Third Edition, 2011.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India, New Delhi, 2009

REFERENCES:

1. E. Horowitz, S. Sahni and S. Rajasekaran, Fundamentals of Computer Algorithms, Second Edition, University Press, 2008.
2. David P. Williamson, David B. Shmoys, —The Design of Approximation Algorithmsl, Cambridge University Press, 2011
3. Jon Kleinberg, "Algorithm Design", Addison-Wesley, 2013

Chairperson - BoS
Dept. of CSE - VCET

22CPT12	NETWORK DESIGN AND TECHNOLOGIES	L	T	P	C
		4	1	0	4

Pre-requisites : Engineering Mathematics, Probability and Queuing theory

Preamble

Network design is a category of systems design that deals with data transport mechanisms. As with other systems' design disciplines, network design follows an analysis stage, where requirements are generated, and precede implementation, where the system (or relevant system component) is constructed. The objective of network design is to satisfy data communication requirements while minimizing expense. Requirement scope can vary widely from one network design project to another based on geographic particularities and the nature of the data requiring transport.

UNIT 1 NETWORK DESIGN **9+3**

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios – Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.

UNIT 2 NETWORK PERFORMANCE CHARACTERISTICS **9+3**

Performance Characteristics – Requirement Analysis: Concepts –User, Device, Network Requirements – Process –Developing RMA ,Delay, Capacity Requirements – Flow Analysis – Identifying and Developing Flows –Flow Models –Flow Prioritization –Specification.

UNIT 3 DELAY MODELS IN DATA NETWORK **9+3**

Random variables - Stochastic process –Link Delay components – Queuing Models – Little's Theorem – Birth & Death process – Queuing Disciplines.

UNIT 4 ROUTING IN DATA NETWORKS **9+3**

Issues in routing- routing algorithms- broadcasting- routing models, optimal routing and topological design – feasible methods for optimal routing- flow control – Quality of service and scheduling in routers: Integrated services- Differentiated services – Resource allocation –packet scheduling

UNIT 5 NETWORK TECHNOLOGIES **9+3**

Introduction – Wireless Networks: IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX – Cellular Networks: GSM – Mobility Management and call control –

Chairperson - BoS
Dept. of CSE - VCET

GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Software Defined Networks: Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays.

Lecture : 45, Tutorial : 15, Total : 60

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Identify the components required for designing a network.

CO2 Design a network with high performance using different networking technologies.

CO3 Apply suitable queuing technique to improve the quality of service in network.

CO4 Apply suitable routing/ scheduling technique to improve the quality of service in data networks.

CO5 Discuss different network technologies and choose the optimal technology for a given network model.

TEXT BOOKS:

1. James D Maccabe, " **NETWORK ANALYSIS, ARCHITECTURE AND DESIGN**", Elsevier, 3rd edition (Unit I & 2)
2. Dimitri P. Bertsekas and Robert G. Gallager, "**DATA NETWORKS**", PRENTICS HALL, 2nd edition ,2019 (Unit 3,4)
3. Paul Goransson, Chuck Black, "**SOFTWARE DEFINED NETWORKS: A COMPREHENSIVE APPROACH** ", Morgan Kauffman , 2014
4. Martin Sauter, "**FROM GSM to LTE, AN INTRODUCTION TO MOBILE NETWORKS AND MOBILE BROADBAND**", Wiley, 2014.

REFERENCES:

1. Nader F.Mir " Computer and Communication Network" ,Pearson Education.2016
2. Larry Peterson and Bruce Davie, —Computer Networks: A Systems Approachǁ, 5 th edition, Morgan Kauffman, 2011
3. Thomas D.Nadeau and Ken Gray, —SDN – Software Defined Networksǁ, O"Reilly Publishers, 2013.
4. Erik Dahlman, Stefan Parkvall, Johan Skold, —4G: LTE/LTE-Advanced for Mobile Broadbandǁ, Academic Press, 2013.
5. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, —Next-Generation Wireless Technologiesǁ, Springer, 2013.

Chairperson - BoS
Dept. of CSE - VCET

22CPT13	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		4	0	0	3

Pre-requisites : Software Engineering

Preamble

Software Engineering is the application of engineering to the development of software in a systematic method. Starting with basic life cycle model concepts, it would discuss requirements specification, design, and testing issues. This course targets to understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.

UNIT 1 SOFTWARE PROCESS &MODELING 9

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modeling – Principles – Requirements Engineering – Scenario-based Modeling – Class-based Modeling – Functional Modeling – Behavioral Modeling.

UNIT 2 SOFTWARE DESIGN 9

Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern Based Design.

UNIT 3 SYSTEM DEPENDABILITY AND SECURITY 9

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design – Security Testing and Assurance.

UNIT 4 SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING 9

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

Chairperson - BoS
Dept. of CSE - VCET

UNIT 5 SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT 9

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing – Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Identify appropriate process models based on the Project requirements.
CO2	Architect and design using architectural styles and design patterns.
CO3	Describe the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
CO4	Discuss the basic notions of a web service, web service standards, and service oriented architecture.
CO5	Test the software products by using black box testing, white box testing, unit testing and integration testing to software project development.

TEXT BOOKS:

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.

REFERENCES:

1. Software Architecture In Practice, 3 rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018.
2. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018.
3. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd, 2018.

Chairperson - BoS
Dept. of CSE - VCET

22CPT14	SECURITY IN COMPUTING	L	T	P	C
		4	0	0	3

Pre-rcquisites : Computer Networks

Prcamble

Able to learn the basic concepts in computer security including software vulnerability analysis and defense,networking and wireless security, applied cryptography, as well as ethical, legal, social and economic facets of security.

UNIT 1 INTRODUCTION TO MATHEMATICAL FOUNDATIONS OF CRYPTOGRAPHY **9**

Integer arithmetic, Modular arithmetic, Congruence and Matrices - Algebraic Structures – Primes Chinese Remainder Theorem.

UNIT 2 SYMMETRIC ENCRYPTION TECHNIQUES AND KEY MANAGEMENT **9**

Substitution Ciphers – Transposition Ciphers – Classical Ciphers – DES – AES – Modes of operation - Key Channel Establishment for symmetric Cryptosystems.

UNIT 3 ASYMMETRIC CRYPTOSYSTEMS **9**

The Diffie-Hellman Key Exchange Protocol - Discrete Logarithm Problem- - Public-key Cryptosystems: RSA Cryptosystem and cryptanalysis – rabin cryptosystem - ElGamal Cryptosystem -Need for Stronger Security notions for Public-key Cryptosystems. Combination of Asymmetric and Symmetric Cryptography. Key Channel Establishment for Public key Cryptosystems.

UNIT 4 AUTHENTICATION **9**

Authentication Protocols Principles – Authentication protocols for Internet Security – SSH Remote login protocol – Kerberos Protocol – SSL and TLS – Message Integrity-Message Authentication– Attacks on Digital Signature - Digital Signature Schemes.

UNIT 5 MANAGEMENT AND INCIDENTS **9**

Security planning - Incident response and business continuity planning - Risk analysis -Handling natural and human-caused disasters **Legal and Ethical issues in Security:** Protecting Programs and Data – Information and the Law – Rights of Employees and Employers – Software Failures – Computer Crime – Privacy – Ethical Issues in Computer Security.

Chairperson - BoS
Dept. of CSE - VCET

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Apply the mathematical foundations in security principles.

CO2 Make use of symmetric encryption techniques for security problems.

CO3 Employ different asymmetric encryption techniques for enhancing security.

CO4 Apply authentication protocols in the design of the secured applications.

CO5 Analyse the legal and ethical issues of security and management.

TEXT BOOKS:

1. William Stallings, Network Security Essentials: Applications and Standards, Pearson Education, 6th Edition 2017.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", 5th Edition, Prentice Hall, 2018. (V unit).

REFERENCES:

1. Mao W., "Modern Cryptography – Theory and Practice", 1st Edition, Pearson Education, 2004.
2. Behrouz A.Forozan, - Cryptography and Network Security, Tata McGraw-Hill, Special Indian Edition,2007.
3. Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, Security in Computing, Pearson Education, 5th Edition, 2015.

Chairperson - BoS
Dept. of CSE - VCET

22CPL11	ADVANCED DATA STRUCTURES LABORATORY	L T P C
		0 0 3 1

Preamble:

A good algorithm usually comes together with a set of good data structures that allow the algorithm to manipulate the data efficiently. This course focuses on developing advanced data structures heap and trees, and design solutions to complex problems using dynamic programming and back tracking techniques

LIST OF EXPERIMENTS

1. Implement operations of Binary Search Trees
2. Perform rotations in an AVL Tree
3. Implement operations on Splay Trees (Insertion, Deletion and Search)
4. Implement operations on B-Trees (Insertion, Deletion and Search)
5. Create Min/Max Heap and perform the operations on it
6. Implement operations on Leftist Heap
7. Implement operation Skew Heap
8. Implementation of Divide and Conquer Technique
9. Implementation of Dynamic Programming
10. Implementation of Backtracking algorithm

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of the course, students will be able to:

1. Achieve programming skill to convert a problem to a programming logic
2. Apply suitable data structure for the problem in hand.
3. Implement various tree structures like AVL, Splay trees and B-Trees.
4. Implement various types of heaps like Leftist heap, Skew heap.
5. Implement various real-world problems using appropriate design technique.

Chairperson - BoS
Dept. of CSE - VCET

22CPT21	ADVANCED OPERATING SYSTEMS	L	T	P	C
		4	0	0	3

Pre-requisites : Basic Programming languages

Preamble

To *learn the fundamentals of Operating Systems and gain knowledge on Distributed operating system concepts that include architecture, Mutual exclusion algorithms, Deadlock detection algorithms & agreement protocols.*

To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols.

UNIT 1 FUNDAMENTALS OF OPERATING SYSTEMS **9**

Overview – Synchronization Mechanisms – Processes and Threads – Process Scheduling – Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques.

UNIT 2 DISTRIBUTED OPERATING SYSTEMS **9**

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

UNIT 3 DISTRIBUTED RESOURCE MANAGEMENT **9**

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol –Non blocking Commit Protocol – Security and Protection.

UNIT 4 REAL TIME AND MOBILE OPERATING SYSTEMS **9**

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing – Mobile Operating Systems – Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system.

UNIT 5 CASE STUDIES **9**

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System - Interprocess Communication. iOS and

Chairperson - BoS
Dept. of CSE - VCET

Android: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Discuss the various synchronization, scheduling and memory management issues.
CO2	Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.
CO3	Discuss the various resource management techniques for distributed systems.
CO4	Identify the different features of real time and mobile operating systems.
CO5	Modify existing open source kernels in terms of functionality or features used.

TEXT BOOKS:

1. MukeshSinghal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.

REFERENCES:

1. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition,O'Reilly, 2005.
2. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India,2006.
3. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

Chairperson - BoS
Dept. of CSE - VCET

22CPT22	MACHINE LEARNING TECHNIQUES	L	T	P	C
		4	0	0	3

Pre-requisites : Probability and Statistics

Preamble

To understand the basics of Machine Learning (ML) and the methods of Machine Learning. To know about the implementation aspects of machine learning, concepts of Data Analytics and Machine Learning and implement use cases of ML.

UNIT 1 MACHINE LEARNING BASICS **9**

Introduction to Machine Learning (ML) - Essential concepts of ML – Types of learning- Machine learning methods based on Time – Dimensionality – Linearity and Non linearity - Early trends in Machine learning-Data Understanding Representation and visualization.

UNIT 2 MACHINE LEARNING METHODS **9**

Linear methods – Regression -Classification –Perceptron and Neural networks – Decision trees – Support vector machines – Probabilistic models —Unsupervised learning – Featurization.

UNIT 3 MACHINE LEARNING IN PRACTICE **9**

Ranking – Recommendation System - Designing and Tuning model pipelines- Performance measurement – Azure Machine Learning – Open-source Machine Learning libraries – Amazon's Machine Learning Tool Kit: Sagemaker.

UNIT 4 MACHINE LEARNING AND DATA ANALYTICS **9**

Machine Learning for Predictive Data Analytics – Data to Insights to Decisions – Data Exploration– Information based Learning – Similarity based learning – Probability based learning –Error based learning – Evaluation – The art of Machine learning to Predictive Data Analytics.

UNIT 5 APPLICATIONS OF MACHINE LEARNING **9**

Image Recognition – Speech Recognition – Email spam and Malware Filtering – Online fraud detection–Medical Diagnosis.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand the basics of ML.

CO2 Explain various Machine Learning methods.

Chairperson - BoS
Dept. of CSE - VCET

CO3 Demonstrate various ML techniques using standard packages.

CO4 Explore knowledge on Machine learning and Data Analytics.

CO5 Apply ML to various real time examples.

TEXT BOOKS:

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020
2. John D. Kelleher, Brain Mac Namee, Aoife D' Arcy, Fundamentals of Machine learning for Predictive Data Analytics, Algorithms, Worked Examples and case studies, MIT press,2015.

REFERENCES:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, 2011.
2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020.
3. Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021.

Chairperson - BoS
Dept. of CSE - VCET

22CPT23	INTERNET OF THINGS AND APPLICATIONS	L	T	P	C
		4	0	0	3

Pre-requisites : Network Design and Technologies

Preamble

IoT is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enable these objects to connect and exchange data. The explosive growth of the "Internet of Things" is changing our world and the rapid drop in price for typical IoT components is allowing people to innovate new designs and products at home. This course covers the importance of IoT in society, the current components of typical IoT devices and trends for the future. IoT design considerations, constraints and interfacing between the physical world and your device are also explored.

UNIT 1 FUNDAMENTALS AND APPLICATIONS **9**

Introduction to IoT – Definition, Characteristics, functional requirements, motivation, Physical design - things in IoT, IoT protocols, Logical Design - functional blocks, communication models, Communication APIs, Applications – Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry

UNIT 2 IoT DESIGN & SYSTEM MANAGEMENT **9**

IoT &M2M – Machine to Machine, Difference between IoT & M2M, Software Defined Network, Network function virtualization, IoT system management – SNMP, NETCONF, YANG, IoT Design methodology.

UNIT 3 IoT PROTOCOLS & SYSTEM **9**

Protocols – HTTP, UPnP, CoAP, MQTT, XMPP. IoT systems logical design using python - python data types & data structures, control flow, functions or modules. Modules & package of python, python packages of interest for IoT-JSON, XML, HTTP & URL Lib, SMTP Lib. Exemplary Device: Raspberry Pi - Linux on Raspberry Pi – Programming Raspberry Pi with Python

UNIT 4 IoT CLOUD & DATA ANALYTICS **9**

Introduction to Cloud storage Models – WAMP – Xively Cloud for IoT – Python Web Application Framework-Django – Designing a RESTful based Web API. Data Analytics for IoT – Apache Hadoop, Apache Oozie.

UNIT 5 IoT SECURITY **9**

Chairperson - BoS
Dept. of CSE - VCET

IoT attacks - Phase attacks, Attacks as per architecture, Attacks based on components. Security Protocols - Time-Based Secure Key Generation and Renewal - Security access algorithms for unidirectional data transmissions, Security access algorithms for bidirectional data transmissions.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Explain the fundamentals of IoT and discuss the areas of its applications

CO2 Describe the design of an IoT system and its management

CO3 Discuss the different protocols used in the design of an IoT system

CO4 Explain about cloud storage models, application frameworks and data analytics for IoT

CO5 Describe the security issues in IoT

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things - A hand on approach" ,Universities Press (India) Private Limited, 2014
2. Pethuru Raj, Anupama C. Raman, "The Internet of Things – Enabling Technologies, Platforms and Use cases" , CRC Press, Taylor & Francis Group, 2017.

REFERENCES:

1. William Stallings, Lawrie Brown, "Computer Security: Principles and Practice", Third Edition, Pearson, 2014.
2. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations," 1st edition, CRC Press, 2016
3. Rajkumar Buyya, "Internet of Things – Principles and Paradigms" , Published by Morgan Kaufmann, Elsevier, 2016.

Chairperson - BoS
Dept. of CSE - VCET

22CPC21	ADVANCED DATABASE TECHNOLOGIES	L	T	P	C
		4	0	2	4

Pre-requisites : Database Management Systems, Object Oriented Programming

Preamble

Databases are designed to support data storage, processing, and retrieval activities related to data management. This course focuses on technologies and methodologies of database queries, XML and metadata queries, and applications of database query systems, aiming at providing a single account of technologies and practices in advanced database query systems.

UNIT 1 COOPERATIVE TRANSACTION MODEL 9

Parallel and Distributed Databases: Architecture of parallel databases, Parallel query evaluation, Parallelizing individual operations, Sorting Joins. Distributed Databases: Concepts, Data fragmentation, Replication and allocation techniques for distributed database design, Query processing, Concurrency control and recovery in distributed databases.

UNIT 2 ENHANCED DATABASE MODELS 9

Object–Oriented Databases: Need of Object-oriented databases, Complex Data Types, Structured Types and Inheritance, Object Identity and Reference, ODL and OQL, Implementing O-R Features, Persistent Programming Languages, Object-Oriented versus Object Relational, Example of Object oriented and object relational database implementation, comparison of RDBMS, OODBMS, ORDBMS. Mobile Database: Overview, Features, Advantages and Disadvantages, Mobile databases in Android System

UNIT 3 XML DATABASES 9

XML Databases: Structured Semi structure and unstructured data, XML hierarchical tree data model, Documents DTD and XML schema, XML Documents & Database, XML query and transformation, Storage of XML data, Xpath. XQuery, Join and Nesting Queries, XML database applications.

UNIT 4 LEARNING THE NOSQL BASICS 9

Introduction to NoSQL: Characteristics of NoSQL, NoSQL Storage types, Advantages and Drawbacks, NoSQL Products Interfacing and interacting with NoSQL: Storing Data In and Accessing Data from MongoDB, Redis, HBase and Apache Cassandra, Language Bindings for NoSQL Data Stores Understanding the storage architecture: Working with Column Oriented Databases, HBase Distributed Storage Architecture.

UNIT 5 INFORMATION RETRIEVAL AND WEB SEARCH 9

IR concepts – Retrieval Models – Queries in IR system – Text Preprocessing – Inverted Indexing – Evaluation Measures – Web Search and Analytics – Ontology based Search - Current trends

List of Experiments:

1. Create different types that include attributes and methods. Define tables for these types by adding a sufficient number of tuples. Demonstrate insert, update and delete operations on these tables. Execute queries on them.
2. Create an XML database and demonstrate insert, update and delete operations on these tables. Issue queries on it.

Chairperson - BoS
Dept. of CSE - VCET

3. Demonstrate the Accessing and Storing and performing CRUD operations in
    1. HBase
    2. Apache Cassandra
4. Demonstrate MapReduce in MongoDB to count the number of female (F) and male (M) respondents in the database.
5. Demonstrate the use of data management and operations using NoSQL in the Cloud.

Lecture : 45, Practical : 15, Total : 60

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Outline the concept of parallel and distributed databases and its architecture.
CO2	Form professional competencies related to design and implementation of non-relational databases, including object-oriented, parallel and Distributed.
CO3	Explore XML and Mobile databases and have a solid grasp on business intelligence tools and XML.
CO4	Use NoSQL database systems and manipulate the data associated with it
CO5	Apply knowledge of information retrieval concepts on web databases.

TEXT BOOKS:

1. Henry F. Korth, Abraham Silberschatz, and S. Sudharshan, "Database System Concepts", McGraw Hill, New Delhi, 2011.
2. Professional NoSQL By Shashank Tiwari, Wrox-John Wiley & Sons, Inc, 2011.

REFERENCES:

1. Database Management Systems by Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 3rd Edition, 2014
2. Getting Started with NoSQL, Gaurav Vaish, Packt Publishing Ltd, 2013
3. R. Elmasri, and S. B. Navathe, "Fundamentals of Database Systems", Pearson Education/Addison Wesley,New Delhi, 2011.

Chairperson - BoS
Dept. of CSE - VCET

22CPL21	MACHINE LEARNING TECHNIQUES LABORATORY	L T P C 0 0 3 1

Preamble:

To get practical knowledge on implementing machine learning algorithms in real time problem for getting solutions. To implement supervised learning and their applications. To understand unsupervised learning like clustering and EM algorithms. To understand the theoretical and practical aspects of probabilistic graphical models.

LIST OF EXPERIMENTS

11. Implement the concept of decision trees with suitable data set from real world problem and classify the data set to produce new sample.
12. Detecting Spam mails using Support vector machine.
13. Implement facial recognition application with artificial neural network.
14. Study and implement amazon toolkit: Sagemaker.
15. Implement character recognition using Multilayer Perceptron.
16. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
17. Implement sentiment analysis using random forest optimization algorithm.
18. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
19. Choose best machine learning algorithm to implement online fraud detection.
20. Mini-project: students work in team on any socially relevant problem that needs a machine learning based solution, and evaluate the model performance.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1	Understand the implementation procedures for the machine learning algorithms.
CO2	Design Java/Python programs for various Learning algorithms.
CO3	Apply appropriate Machine Learning algorithms to data set
CO4	Identify and apply Machine Learning algorithms to solve real world problems

SOFTWARE:

- Python/Java with ML packages

Chairperson - BoS
Dept. of CSE - VCET

22CPL31	PROJECT WORK I	L T P C
		0 0 12 6

Preamble:

This course helps to improve the learning skill of the students. It integrates knowledge and skills from various areas through more complex and multidisciplinary projects. It enhances the Autonomous learning and work, finding solution for the unstructured problems that need research. Autonomy will lead to research and the search for information and in that context is essential to develop their ability to discern which information is reliable and which is not.

GUIDELINE FOR REYIEW AND EVALUATION

The student individually must work on a topic approved by the head of the departrnent under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Apply Engineering fundamentals to analyze domain specific issues to identify problem statement with objectives and scope.
CO2	Investigate the identified problem and review state of the art literature survey to synthesis system requirements.
CO3	Identify the risk/impact/technique and interpret the suitable standards related to the problem statement and design appropriate procedures/methods.
CO4	Develops modules using discipline specific tools and implement the modules to achieve a valid conclusion.
CO5	Prepare documents related to their findings for detailed presentation, defend the findings and conclude with oral/ written presentation.

Chairperson - BoS
Dept. of CSE - VCET

22CPL41	PROJECT WORK II	L T P C
		0 0 24 12

Preamble:

This course helps to improve the learning skill of the students. It integrates knowledge and skills from various areas through more complex and multidisciplinary projects. It enhances the Autonomous learning and work, finding solution for the unstructured problems that need research. Autonomy will lead to research and the search for information and in that context is essential to develop their ability to discern which information is reliable and which is not.

GUIDELINE FOR REYIEW AND EVALUATION

Individual student should select a topic and that should be approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Apply Engineering fundamentals to analyze domain specific issues to identify problem statement with objectives and scope.
CO2	Investigate the identified problem and review state of the art literature survey to synthesis system requirements.
CO3	Identify the risk/impact/technique and interpret the suitable standards related to the problem statement and design appropriate procedures/methods.
CO4	Develops modules using discipline specific tools and implement the modules to achieve a valid conclusion.
CO5	Prepare documents related to their findings for detailed presentation, defend the findings and conclude with oral/ written presentation.

Chairperson - BoS
Dept. of CSE - VCET

22CPE01	AGILE METHODOLOGIES	L	T	P	C
		4	0	0	3

Pre-requisites : Advanced Software Engineering

Preamble

Agile software development is an approach to software development under which requirements and solutions evolve through the collaborative effort of self-organizing and cross functional teams and their end users. It advocates adaptive planning, evolutionary development, empirical knowledge, and continual improvement, and it encourages rapid and flexible response to change.

UNIT 1 AGILE METHODOLOGY **9**

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

UNIT 2 AGILE PROCESSES **9**

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT 3 AGILITY AND KNOWLEDGE MANAGEMENT **9**

Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT 4 AGILITY AND REQUIREMENTS ENGINEERING **9**

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT 5 AGILITY AND QUALITY ASSURANCE **9**

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Compare agile software development to traditional software development models and identify the benefits of transitioning to agile.
CO2	Apply SCRUM, Crystal, Extreme programming methodologies in software development life cycle process to overcome the pitfalls of using traditional waterfall model.
CO3	Analyze the use of knowledge management to enable agility in agile software development environments.
CO4	Apply agile practices such as test-driven development, standup meetings, and pair programming in the software engineering practices to address their impact in software development .
CO5	Apply agile metrics to measure the development process of software in agile software development environments.

TEXT BOOKS:

1. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.
2. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.

REFERENCES:

1. Craig Larman, "Agile and Iterative Development: A Manager's Guide", Addison-Wesley, 2004.
2. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.

Chairperson - BoS
Dept. of CSE - VCET

22CPE02	WIRELESS COMMUNICATIONS	L	T	P	C
		4	0	0	3

Pre-requisites : Network design and technologies

Preamble

To learn the concepts of wireless communication. To know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.

UNIT 1 WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-free space, two ray. Small scale fading- channel classification- channel models – COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading –shadowing Distributions, Link power budget Analysis.

UNIT 2 CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels.

UNIT 3 DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, Channel unknown at the transmitter.

UNIT 4 MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

UNIT 5 MULTI USER SYSTEMS 9

Review of Multiple Access Techniques, Scheduling, power control, Uplink and Downlink channel capacity, multiuser diversity, MIMO-MU systems.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Analyze the wireless channel characteristics and identify appropriate channel models.

CO2 Understand the mathematics behind the capacity calculation under different channel Conditions.

Chairperson - BoS
Dept. of CSE - VCET

CO3 Understand the implication of diversity combining methods and the knowledge of channel.

CO4 Understand the concepts in MIMO Communications.

CO5 Understand multiple access techniques and their use in different multi-user scenarios.

TEXT BOOKS:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. Harry R. Anderson, "Fixed Broadband Wireless System Design", John Wiley, India, 2003.

REFERENCES:

1. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2006.
2. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.

Chairperson - BoS
Dept. of CSE - VCET

22CPE03	PRINCIPLES OF PROGRAMMING LANGUAGES	L	T	P	C
		4	0	0	3

Pre-requisites : Mathematical Foundations of Computer Science, Computer Programming and Data Structures

Preamble

This course is an introduction to the theory and design of programming languages. To develop high-assurance software - software for which we can give strong evidence that the software will do what it is supposed to do and nothing more - a formal description of the 'meaning' and behaviour of programs is required. Hence two fundamental aspects of the study of programming languages are their syntax, and their formal semantics. High-assurance software is not only needed for safety-critical software, but also for program transformations, such as carried out by optimizing compilers.

UNIT 1 INTRODUCTION **9**

Preliminary Concepts: Reasons for Studying Concepts of Programming Languages, Programming Domains, Language Evaluation Criteria, Influences on Language Design, Language Categories, Language Design Trade-Offs, Implementation Methods, Programming Environments Syntax and Semantics: General Problem of Describing Syntax and Semantics, Formal Methods of Describing Syntax, Attribute Grammars, Describing the Meanings of Programs.

UNIT 2 DATA TYPES AND CONTROL STRUCTURES **9**

Names, Bindings, and Scopes: Introduction, Names, Variables, Concept of Binding, Scope, Scope and Lifetime, Referencing Environments, Named Constants Data Types: Introduction, Primitive Data Types, Character String Types, User Defined Ordinal Types, Array, Associative Arrays, Record, Union, Tuple Types, List Types, Pointer and Reference Types, Type Checking, Strong Typing, Type Equivalence Expressions and Statements: Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed-Mode Assignment Control Structures – Introduction, Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands.

UNIT 3 FUNCTIONS AND ABSTRACT DATA TYPE **9**

Subprograms and Blocks: Fundamentals of Sub-Programs, Design Issues for Subprograms, Local Referencing Environments, Parameter Passing Methods, Parameters that Are Subprograms, Calling Subprograms Indirectly, Overloaded Subprograms, Generic Subprograms, Design Issues for Functions, User Defined Overloaded Operators, Closures, Coroutines Implementing Subprograms: General Semantics of Calls and Returns, Implementing Simple Subprograms, Implementing Subprograms with Stack-Dynamic Local Variables, Nested Subprograms, Blocks, Implementing Dynamic Scoping Abstract Data Types: The Concept of Abstraction, Introductions to Data Abstraction, Design Issues, Language Examples, Parameterized ADT, Encapsulation Constructs, Naming Encapsulations.

UNIT 4 EXCEPTION HANDLING **9**

Concurrency: Introduction, Introduction to Subprogram Level Concurrency, Semaphores, Monitors, Message Passing, Java Threads, Concurrency in Function Languages, Statement Level Concurrency. Exception Handling and Event Handling: Introduction, Exception Handling in Ada, C++, Java, Introduction to Event Handling, Event Handling with Java and C#.

UNIT 5 FUNCTIONAL PROGRAMMING LANGUAGES **9**

Introduction, Mathematical Functions, Fundamentals of Functional Programming Language, LISP, Support for Functional Programming in Primarily Imperative Languages, Comparison of Functional and

Chairperson - BoS
Dept. of CSE - VCET

Imperative Languages Logic Programming Language: Introduction, an Overview of Logic Programming, Basic Elements of Prolog, Applications of Logic Programming. Scripting Language: Pragmatics, Key Concepts, Case Study: Python – Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Understand fundamental concepts, Syntax and Semantics of programming languages.
CO2	Understand on data types, binding, scope, expression and statement on programming languages.
CO3	Understand on subprograms and blocks, abstract data types in programming languages.
CO4	Analyze the concurrency and exception handling mechanism in programming languages.
CO5	Evaluate the functional programming language, logic programming language and scripting language.

TEXT BOOKS:

1. Concepts of Programming Languages Robert. W. Sebesta 10/E, Pearson Education.
2. Programming Language Design Concepts, D. A. Watt, Wiley Dreamtech, 2007.

REFERENCES:

1. Programming Languages, 2nd Edition, A.B. Tucker, R. E. Noonan, TMH.
2. Programming Languages, K. C. Louden, 2nd Edition, Thomson, 2003.

Chairperson - BoS
Dept. of CSE - VCET

22CPE04	HUMAN COMPUTER INTERACTION	L	T	P	C
		4	0	0	3

Pre-requisites : NIL

Preamble

To learn the guidelines in designing user interfaces .Describe what interaction design is and how it relates to human computer interaction and other fields. Use, adapt and extend classic design standards, guidelines, and patterns.

UNIT 1 FOUNDATIONS OF HCI 9

The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity Paradigms.

UNIT 2 DESIGN & SOFTWARE PROCESS 9

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

UNIT 3 MODELS AND THEORIES 9

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT 4 MOBILE HCI 9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT 5 WEB INTERFACE DESIGN 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Describe the capabilities of both humans and computers.

CO2 Design effective dialog for HCI.

Chairperson - BoS
Dept. of CSE - VCET

CO3 Identify the stake holder's requirements and choose the appropriate models.

CO4 Develop mobile HCI using mobile elements and tools.

CO5 Widen significant user interface.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ┼Human Computer Interaction┼, 3rd Edition, Pearson Education, 2004 (UNIT 1,2,3).
2. Brian Fling, ┼Mobile Design and Development┼, First Edition , O'Reilly Media Inc.,2009 (UNIT –4).

REFERENCES:

1. Bill Scott and Theresa Neil, ┼Designing Web Interfaces┼, First Edition, O'Reilly, 2009. (UNIT-5).

Chairperson - BoS
Dept. of CSE - VCET

22CPE05	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		4	0	0	3

Pre-requisites : Network design and technologies

Preamble

This course provides an understanding of wireless and mobile communication concepts through various layers of mobile networking. It also helps to realize the pervasive and context aware computing architectures, systems and applications.

UNIT 1 Introduction to Wireless Environment *9*

Introduction to wireless communication-Wireless Transmission - Medium Access Control- Wireless MAC protocols –Comparison of 2G, 3G,4G looking ahead 5G systems.

UNIT 2 Mobile Communication *9*

GSM - Bluetooth - Mobile network layer-Mobile transport layer - File system support for mobility support - Mobile execution environments and applications.

UNIT 3 Pervasive Communication *9*

Pervasive computing principles - Characteristics of pervasive computing environments - Applications and case study - Pervasive Web Application architecture - Pervasive computing and web based applications - Voice enabling pervasive computing- PDA in pervasive computing- User interface issues in pervasive computing.

UNIT 4 Context Aware Computing *9*

Structure and Elements of Context-aware Pervasive Systems: Abstract architecture – Infrastructures - Middleware and toolkits, Context-aware mobile services: Context for mobile device users – Location-based services- Ambient service- Enhancing Context-aware mobile services and Context aware artifacts.

UNIT 5 Context-Aware Pervasive System *9*

Context-aware sensor networks – A framework for Context aware sensors – Context-aware security systems – Constructing Context-aware pervasive system- Future of Content aware systems.

Lecture : 45, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Describe the operation and performance of wireless protocols.

CO2 Apply the concepts and principles of various mobile communication technologies.

CO3 Illustrate architecture of pervasive computing and identify the applications of pervasive

Chairperson - BoS
Dept. of CSE - VCET

computing.

CO4 Explain the concepts of context aware computing.

CO5 Explain the concepts of context aware pervasive system.

TEXT BOOKS:

1. Schiller Jochen, "Mobile Communication", 2nd Edition, PHI/Pearson Education, 2009.
2. Burkhardt Jochen, Henn Horst and Hepper Stefan, Schaec Thomas and Rindtorff Klaus, "Pervasive Computing Technology and Architecture of Mobile Internet Applications", Addison Wesley Reading, 2007.

REFERENCES:

1. Seng Loke, "Context-Aware Pervasive Systems: Architectures for a New Breed of Applications", 1st Edition, Auerbach Publications, 2006.

Chairperson - BoS
Dept. of CSE - VCET

22CPE06	COGNITIVE COMPUTING	L	T	P	C
		4	0	0	3

Pre-requisites : Basics of Artificial Intelligence and Machine Learning

Preamble

This course covers the foundation of cognitive computing, natural language processing in support of cognitive systems, relationship between big data and cognitive computing and foundations of cognitive system for health care applications.

UNIT 1 PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE 9

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT 2 COMPUTATIONAL INTELLIGENCE 9

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.

UNIT 3 PROBABILISTIC PROGRAMMING LANGUAGE 9

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration – Other basic computation.

UNIT 4 IMPLEMENTING THE INFERENCE MODELS OF COGNITION 9

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

UNIT 5 IMPLEMENTING THE LEARNING MODELS OF COGNITION 9

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's Razor – Learning (Deep) Continuous Functions – Mixture Models.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand the underlying theory behind cognition.

CO2 Connect to the cognition elements computationally.

CO3 Implement mathematical functions through WebPPL.

CO4 Develop a cognitive inference model.

CO5 Develop a cognitive learning model.

TEXT BOOKS:

1. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences", The MIT Press, 1999.

REFERENCES:

1. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

Chairperson - BoS
Dept. of CSE - VCET

22CPE07	HIGH PERFORMANCE COMPUTING	L	T	P	C
		4	0	0	3

Pre-requisites : Parallel Computing

Preamble

This course gives a brief understanding on the need and working of modern high performance processors. The techniques to achieve parallelism and the techniques used to design algorithm for parallel environment are discussed. The working principle on how the jobs on clusters are submitted and managed using a scheduler, transferring of files, and use software through environment modules will be learnt during the course.

UNIT 1 MODERN PROCESSORS 9

Stored-program computer architecture - General-purpose cache-based microprocessor architecture - Memory hierarchies - Multicore processors -Multithread processors - Vector processors – Basic optimization techniques for serial code - Common sense optimizations - Simple measures – large impact - Role of compilers.

UNIT 2 OPTIMIZATION AND PARALLEL COMPUTERS 9

Data access optimization - Balance analysis and light speed estimates - Storage order – Taxonomy of parallel computing paradigms - Shared memory computers - Distributed memory computers - Hierarchical systems - Networks - Basics of parallelization – Parallelism - Parallel scalability

UNIT 3 INTRODUCTION TO PARALLEL COMPUTING 9

Motivating parallelism - Scope of parallel computing - Parallel programming platforms: Implicit parallelism trends in microprocessor architectures - Limitations - Dichotomy –Physical organizations - Communication costs - Routing mechanisms for interconnected networks.

UNIT 4 PRINCIPLES OF PARALLEL ALGORITHM DESIGN 9

Preliminaries - Decomposition techniques – Recursive, Data, Exploratory, Speculative and Hybrid decomposition - Characteristics of tasks and interactions -Mapping techniques for load balancing - Methods for containing interaction overheads –Parallel algorithm models

UNIT 5 SORTING AND GRAPH ALGORITHMS 9

Issues in sorting on parallel computing - Sorting networks – Bubble sorts and its variants – Quick sort - Graph algorithms - Definition and representation – Prim's algorithm - Dijkstra's algorithm - All pairs shortest path - Transitive closure - Connected components.

Chairperson - BoS
Dept. of CSE - VCET

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Discuss the basic working principle of modern multi-core processors.

CO2 Explain the techniques to access data in shared environment for process running parallel.

CO3 Analyze the factors that help in achieving parallelism.

CO4 Apply algorithm design techniques to design algorithm for parallel computing

CO5 Describe the algorithms for sorting and Graph.

TEXT BOOKS:

1. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall, 2011. (I & II Unit)
2. Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Introduction to parallel computing, Second edition, Addison-Wesley 2009. (III to V Units)

REFERENCES:

1. John Levesque and Gene Wagenbreth, High Performance Computing: Programming and Applications, Chapman & Hall, 2010.
2. John L. Hennessy and David Patterson, Computer Architecture-A Quantitative Approach, Elsevier, 2012.
3. V. Rajaraman and C. Siva Ram Murthy, "Parallel Computers – Architecture and Programming", Prentice-Hall of India, 2003.

Chairperson - BoS
Dept. of CSE - VCET

22CPE08	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		4	0	0	3

Pre-requisites : Nil

Preamble

This course discusses about the basic concepts of IR, and various modeling techniques with different ways of indexing and searching mechanisms to build a text or multimedia based IR system.

UNIT 1 INTRODUCTION AND CLASSIC IR MODELS **9**

Information Retrieval - The IR Problem - The IR System - Modeling – Boolean Model – Term Weighting – TF-IDF Weighting – Vector Model – Latent Semantic Indexing Model – Neural Network Model - Probabilistic Models - Retrieval Evaluation – Retrieval Metrics.

UNIT 2 RELEVANCE FEEDBACK AND QUERY LANGUAGE **9**

A Framework for feedback methods - Explicit Relevance feedback - Implicit feedback through local analysis - Global analysis - Documents: Metadata - Documents formats - Queries - Query Language – Query Properties.

UNIT 3 INDEXING AND SEARCHING **9**

Static and Dynamic Inverted Indices – Index Construction and Index Compression-Searching the Web – Structure of the Web –IR and web search – Static and Dynamic Ranking – Link Analysis - –hubs and authorities – Page Rank and HITS algorithms -XML Retrieval

UNIT 4 WEB RETRIEVAL AND WEB CRAWLING **9**

The Web – Search Engine Architectures – Cluster Based Architecture – Distributed Architectures – Search Engine Ranking – User Interaction –Browsing – Web Crawling – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

UNIT 5 CLASSIFICATION AND CLUSTERING **9**

Text Classification and Naïve Bayes – Decision Tree induction – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Describe the basic concepts of information retrieval and apply term weighting strategy in various models.

CO2 Carry out relevance feedback and describe query properties.

Chairperson - BoS
Dept. of CSE - VCET

CO3 Describe searching techniques on web and evaluate relevance scoring and ranking for web.

CO4 Describe web retrieval process and make use of web crawler for information retrieval.

CO5 Discuss how to apply document text mining techniques in information retrieval.

TEXT BOOKS:

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, —Modern Information Retrieval: The concepts and Technology behind Search, (ACM Press Books), Second Edition, 2011.
2. Christopher D. Manning, Prabhakar Raghavan, HinrichSchutze, —Introduction to Information Retrieval||, Cambridge University Press, First South Asian Edition, 2008.

REFERENCES:

1. Bruce Croft, Donald Metzler and Trevor Strohman, "Search Engines: Information Retrieval in Practice", First Edition Addison Wesley, 2009.
2. Implementing and Evaluating Search Engines||, The MIT Press, Cambridge, Massachusetts London, England, 2010

Chairperson - BoS
Dept. of CSE - VCET

22CPE09	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		4	0	0	3

Pre-requisites : Compiler Design

Preamble

The purpose of this course is to create awareness among students about techniques for designing a compiler. This course covers the fundamental concepts code optimization and code generation. Students can apply this knowledge in design, development and optimization of compilers

UNIT 1 INTRODUCTION 9

Language Processors - The Structure of a Compiler – The Evolution of Programming Languages - The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics – Syntax Definition –Syntax Directed Translation-Parsing-Lexical Analysis-Symbol tables-Intermediate Code Generator.

UNIT 2 MACHINE-INDEPENDENT OPTIMIZATION 9

Principal Sources of Optimization– Data Flow Analysis-Foundations of Dataflow analysis-Constant Propagaton-Partial Redundancy Elimination-Loops in Flow Graphs-Region Based Analysis-Symbolic Analysis

UNIT 3 INSTRUCTION LEVEL PARALLELISM 9

Process Architecture –Code scheduling constraints- Basic-Block Scheduling- Global Code Scheduling – Software Pipelining.

UNIT 4 OPTIMIZING FOR PARALLELISM AND LOCALITY 9

Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse Array data dependence Analysis.Finding Synchronization - Free Parallelism – Synchronization Between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.

UNIT 5 INTERPROCEDURAL ANALYSIS 9

Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Interprocedural Analysis – Context - Sensitive Pointer-Analysis - Datalog Implementation by Binary Decision Diagrams.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Identify the various sources of optimization

CO2 illustrate the Technology in optimization and algorithm to solve the frameworks

CO3 Identify the sources of optimization of parallel execution of instructions

CO4 Apply the process of optimization using various techniques

CO5 Explore interprocedural analysis to reach a given point in the code.

TEXT BOOKS:

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers : Principles, Techniques and Tools", Second Edition, Pearson Education, 2008
2. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence - based Approach", Morgan Kaufmann Publishers, 2002

REFERENCES:

1. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003
2. Kenneth C Loudenm, "Compiler Construction: Principles and Practice", First Edition, Course Technology Inc., 1997
3. Steven Muchnick, "Advanced Compiler Design and Implementation", First Edition, Morgan Kaufmann, 1997

Chairperson - BoS
Dept. of CSE - VCET

22CPE10	SEMANTIC WEB	L	T	P	C
		4	0	0	3

Pre-requisites : NIL

Preamble

The Semantic Web is an extension of the World Wide Web through standards by the World Wide Web Consortium (W3C). The standards promote common data formats and exchange protocols on the Web, most fundamentally the Resource Description Framework (RDF). The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.

UNIT 1 INTRODUCTION **9**

Semantic web layers – Semantic web technologies – XML – Structuring – Namespaces – Addressing –Querying – Processing XML.

UNIT 2 RDF AND QUERYING THE SEMANTIC WEB **9**

RDF: Basic Ideas – RDF schema – RDF and RDF schema in RDF schema – An axiomatic semantics forRDF and RDF schema – A Direct Inference System for RDF and RDFS - Querying in SPARQL.

UNIT 3 ONTOLOGY **9**

Ontology engineering – Introduction – Constructing ontologies – Reusing ontologies - Semiautomatic Ontology Acquisition – Ontology Mapping - On-To Knowledge semantic web architecture.

UNIT 4 LOGIC AND INFERENCE **9**

Logic – Description logics – Rules – Monotonic rules – syntax – semantics and examples – Non-monotonic rules –Motivation – syntax – Examples – Rule markup in XML.

UNIT 5 APPLICATIONS OF SEMANTIC WEB TECHNOLOGIES **9**

Case Study – Horizontal information products at Elsevier – Openacademia – Bibster – Data Integration at Audi –Skill finding at Swiss Life – Think tank portal at Enersearch – e-learning – web services – other scenarios.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Describe the fundamental concepts of the semantic web.

CO2 Outline for semantic syntax and schema.

CO3 Design ontology using Web Ontology Language (OWL).

CO4 Differentiate monotonic and non-monotonic rules.

Chairperson - BoS
Dept. of CSE - VCET

CO5 Apply Semantic web technology to real world applications.

TEXT BOOKS:

1. Grigorous Antoniou and Van Hermelen, "A Semantic Web Primer", PHI Learning Private Limited,Second Edition, 2010.
2. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, "Foundations of Semantic Web Technologies",Chapman & Hall/CRC, 2009.

REFERENCES:

1. James Hendler, Henry Lieberman and Wolfgang Wahlster, "Spinning the Semantic Web: Bringingthe world wide web to its full potential", The MIT Press, 2005.
2. Shelley Powers, "Practical RDF", O"reilly publishers, 2009.

Chairperson - BoS
Dept. of CSE - VCET

22CPE11	DATA VISUALIZATION TECHNIQUES	L	T	P	C
		4	0	0	3

Pre-requisites : Probability and statistics

Preamble

Data visualization is the graphical representation of information and data. It provides an accessible way to see and understand trends, outliers, and patterns in data. Data visualization technologies are essential to analyze massive amounts of information and make data-driven decisions.

UNIT 1 CORE SKILLS FOR VISUAL ANALYSIS **9**

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT 2 TIME-SERIES, RANKING, AND DEVIATION ANALYSIS **9**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT 3 DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS **9**

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT 4 INFORMATION DASHBOARD DESIGN **9**

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT 5 DATA VISUALIZATION TOOLS **9**

Data Visualization Tools– Rank Analysis Tools- Trend Analysis Tools- Multivariate Analysis Tools- Distribution Analysis Tools- Correlation Analysis Tools- Geographical Analysis Tools.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Introduce visual perception and core skills for visual analysis.

CO2 Understand visualization for time-series, ranking , deviation analysis.

CO3 Discuss visualization for distribution, Correlation Multivibrate analysis.

CO4 Describe issues and best practices in information dashboard design.

CO5 Discuss the various tools for Data Visualization

TEXT BOOKS:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.

REFERENCES:

1. Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016
2. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

Chairperson - BoS
Dept. of CSE - VCET

22CPE12	DATA SCIENCE	L	T	P	C
		4	0	0	3

Pre-requisites : Machine Learning Techniques

Preamble

Data Science is one of the most influential field of science with many real time applications in engineering, information technology, medicine and finance. Data Science is about drawing useful conclusions from large and diverse data sets through exploration, prediction, and inference.

UNIT 1 STATISTICAL INTERFERENCE AND EXPLORATORY DATA ANALYSIS **9**

Introduction-Population and samples, Data Preparation, Exploratory Data Analysis-Summarizing Data, Data Distribution, Outlier Treatment, Measuring Symmetry, Continuous Distribution, Kernel Density, Estimation: Sample and Estimated Mean, Variance and Standard Scores, Covariance, and Pearson's and Spearman's Rank Correlation. Case Studies.

UNIT 2 LEARNING MODELS **9**

Generalities Concerning Learning Models -Support Vector Machines- Random Forest- Ending the Learning Process - A Toy Business Case Clustering-Similarity and Distances - Defining Metrics to Measure Clustering Quality -Taxonomies of Clustering Techniques - Case Study.

UNIT 3 REGRESSION MODELS **9**

Introduction, types of regression. Simple regression- Types, Making predictions, Cost function, Gradient descent, Training, Model evaluation. Multivariable regression: Growing complexity, Normalization, making predictions, initialize weights, Cost function, Simplifying with matrices, Bias term, Model evaluation -Case Study.

UNIT 4 RECOMMENDATION AND SENTIMENT ANALYSIS **9**

Working of recommendation systems- Content-Based Filtering - Collaborative Filtering- Hybrid Recommenders - Modeling User Preferences - Evaluating Recommenders . Case Study Statistical Natural Language Processing for Sentiment Analysis - Data Cleaning - Text Representation - Bi-Grams and n-Grams - Cases Study.

UNIT 5 DATA LEAKAGE AND MODEL EVALUATION **9**

Data Mining Competitions - To Be a Good Modeler - Data Leakage - Market Predictions - Amazon Case Study: Big Spenders - Jewelry Sampling Problem - IBM Customer Targeting- Breast Cancer Detection -Pneumonia Prediction - How to Avoid Leakage - Evaluating Models - Accuracy Probabilities

Chairperson - BoS
Dept. of CSE - VCET

Matter,- Choosing an Algorithm.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand the basics of statistical interference and data analysis.

CO2 Discuss about the Learning models

CO3 Describe the regression models for data analysis.

CO4 Understand the working and evaluation of recommendation systems and sentiment analysis.

CO5 Describe the data leakage and evaluation models for accuracy

TEXT BOOKS:

1. Laura Igual and Santi Segui, Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications,Springer; 1st ed. 2017 edition.
2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.

REFERENCES:

1. Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R Authors: Heumann, Christian, Schomaker, Michael, Shalabh, Publisher" Springer 2016.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1,Cambridge University Press.

Chairperson - BoS
Dept. of CSE - VCET

22CPE13	NATURAL LANGUAGE PROCESSING	L	T	P	C
		4	0	0	3

Pre-requisites : Machine Learning Techniques

Preamble

This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

UNIT 1 INTRODUCTION **9**

Knowledge in speech and language processing-Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of Speech – Tagging – Overview of Hidden Markov and Maximum Entropy Models.

UNIT 2 SPEECH **9**

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition architecture - Advanced Topics - Computational Phonology.

UNIT 3 SYNTAX **9**

Formal Grammars of English - Parsing with Context-Free Grammars - Lexicalized and Probabilistic Parsing - Features and Unification - Language and Complexity.

UNIT 4 SEMANTICS AND PRAGMATICS **9**

Representing meaning – Concepts of Semantic analysis - Lexical Semantics - Word Sense Disambiguation -Computational Discourse.

UNIT 5 NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION **9**

Natural Language Generation: Introduction- Architectures of NLG systems generation- Generation tasks and representation- Applications of NLG. Machine Translation: Machine translation approaches- Direct machine Translation – Rule –based machine translation – Corpus based machine translation.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Apply formal and statistical models for word processing.

CO2 Make use of Computation Phonology a for Speech recognition and Text to Speech conversion.

Chairperson - BOS
Dept. of CSE - VCET

CO3	Demonstrate the knowledge on syntactic analysis to extract the dependency of words with other words in the document.
CO4	Apply Semantic analysis technique in word sense disambiguation.
CO5	Explain the various approaches used in machine translation.

TEXT BOOKS:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Pearson Publication, 2014.
2. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

REFERENCES:

1. Breck Baldwin, "Language Processing with Java and Ling Pipe Cookbook" ,Atlantic Publisher, 2015.
2. Richard M Reese, "Natural Language Processing with Java", O'Reilly Media, 2015.
3. NitinIndurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman & Hall/Crc: Machine Learning & Pattern Recognition,2010.

Chairperson - BoS
Dept. of CSE - VCET

22CPE14	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		4	0	0	3

Pre-requisites : Advanced Software Engineering

Preamble

Software quality assurance is a continuous validation process to test every product that is developed during the project to ensure it meets the customer needs.. Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. The real challenge to deliver successful software product relies on sound testing strategies and tools. Effective software testing maintains software quality.

UNIT 1 SOFTWARE QUALITY ASSURANCE **9**

Introduction to software quality - challenges – objectives – quality factors – components of SQA– contract review – development and quality plans – SQA components in project life cycle – SQA defect removal policies – Reviews.

UNIT 2 SOFTWARE TESTING **9**

Definitions – Strategies – Classifications – Implementation – Assuring the quality of software maintenance components – CASE tools and their effect on software quality.

UNIT 3 COMPONENTS OF SOFTWARE QUALITY **9**

Procedures and work instructions – Staff training and certification – Corrective and preventive actions– Configuration Management – Documentation control. Management components – Project progress control – Costs of software quality

UNIT 4 SOFTWARE QUALITY STANDARDS **9**

Quality management standards - Certification according to ISO 9000 – Bootstrap methodology – SPICE project. Project process standards – Structure and content of IEEE software engineering standards – Software life cycle processes – verification and validation - reviews

UNIT 5 SOFTWARE MANAGEMENT **9**

Management and its role in SQA – SQA unit – trustees, committees, forums and their tasks.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Explain the various components of SQA used to construct the organization's SQA system

CO2 Identify an appropriate test design for a given test object and Explain the contribution of CASE

Chairperson - BoS
Dept. of CSE - VCET

	tools for software quality maintenance.
CO3	Analyze the tasks involved in establishment and maintenance of a controlled documents list and in Project progress control
CO4	Identify the general principles of quality management according to various software quality standards.
CO5	Describe the managements' responsibility to ensure software quality

TEXT BOOKS:

1. Daniel Galin, Software Quality Assurance – from theory to implementation, Pearson Education, 2009
2. Alan C Gillies, Software Quality – Theory and Management, Second Edition, Thomson, 2003.

REFERENCES:

1. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Edition, Pearson, 2003
2. Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2008.
3. Kshirasagar Naik and PriyadarshiTripathy (Eds), "Software Testing and Quality Assurance: Theory and Practice", John Wiley, 2008

Chairperson - BoS
Dept. of CSE - VCET

22CPE15	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		4	0	0	3

Pre-requisites : NIL

Preamble

To understand the architecture of embedded processor, microcontroller and peripheral devices. To interface memory and peripherals with embedded systems. To study the embedded network environment. To understand challenges in Real time operating systems.

UNIT 1 EMBEDDED PROCESSORS **9**

Embedded Computers - Characteristics of Embedded Computing Applications- Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description -Behavioral Description - ARM Processor – Intel ATOM Processor.

UNIT 2 EMBEDDED COMPUTING PLATFORM **9**

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging –Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT 3 EMBEDDED NETWORK ENVIRONMENT **9**

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design – Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT 4 REAL-TIME CHARACTERISTICS **9**

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm -Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT 5 SYSTEM DESIGN TECHNIQUES **9**

Design Methodologies - Requirement Analysis - Specification – System Analysis and Architecture Design - Quality Assurance - Design Examples -Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Understand different architectures of embedded processor, microcontroller and peripheral devices interface memory and peripherals with embedded systems.
CO2	Work with embedded network environment.
CO3	Understand challenges in Real time operating systems.
CO4	Design and analyze applications on embedded systems.
CO5	Promoting embedded system.

TEXT BOOKS:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013.
2. Andrew N Sloss, D. Symes, C. Wright, "Arm system developers guide", Morgan Kauffman/Elsevier, 2006.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on-Approach" VPT First Edition, 2014.
2. C. M. Krishna and K. G. Shin, "Real-Time Systems", McGraw-Hill, 1997.
3. Jane.W.S. Liu, "Real-Time systems", Pearson Education Asia. 7. Michael J. Pont, "Embedded C", Pearson Education , 2007.

Chairperson - BoS
Dept. of CSE - VCET

22CPE16	BIO INFORMATICS	L	T	P	C
		4	0	0	3

Pre-requisites : NIL

Preamble

This course discusses about basics of Bioinformatics and its applications in the field of datamining, data warehousing, pattern matching and other fields of Computer Science.

UNIT 1 INTRODUCTION **9**

Need for Bioinformatics technologies – Overview of Bioinformatics technologies – Structural bioinformatics – Data format and processing – secondary resources- Applications – Role of Structural bioinformatics in system biology.

UNIT 2 DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS **9**

Bioinformatics data – Data ware housing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture- Applications in bioinformatics.

UNIT 3 MODELING FOR BIOINFORMATICS **9**

Hidden Markov modeling for biological data analysis – Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling.

UNIT 4 PATTERN MATCHING AND VISUALIZATION **9**

Gene regulation – motif recognition and motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences.

UNIT 5 MICROARRAY ANALYSIS **9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding , spot extraction , normalization, filtering – Data Analysis for pattern discovery, Gene regulatory network analysis.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Deploy the data warehousing and data mining techniques in Bioinformatics

CO2 Model bioinformatics based applications

CO3 Employ the pattern matching and visualization techniques in bioinformatics

CO4 Work on the protein sequences

CO5 Apply the Microarray technologies for genome expression

TEXT BOOKS:

1. Yi-Ping Phoebe Chen (Ed), "Bio Informatics Technologies", First Indian Reprint, Springer Verlag,2007.
2. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2005.

REFERENCES:

1. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2003.
2. Burton. E. Tropp, "Molecular Biology: Genes to Proteins ", 4th edition, Jones and Bartlett Publishers, 2011.
3. P. Baldi, S Brunak , Bioinformatics, "A Machine Learning Approach ", MIT Press, 1998.

Chairperson - B
Dept. of CSE - V

22CPE17	DEEP LEARNING	L	T	P	C
		4	0	0	3

Pre-requisites : Machine Learning Techniques

Preamble

This course covers the basics of machine learning, neural networks and deep learning. Model for deep learning technique and the various optimization and generalization mechanisms are included. Major topics in deep learning and dimensionality reduction techniques are covered. The objective of this course is to present the mathematical, statistical and computational challenges of building neural networks and study the concepts of deep learning.

UNIT 1 INTRODUCTION 9

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression) - Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT 2 DEEP NETWORKS 9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning..

UNIT 3 DIMENTIONALITY REDUCTION 9

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet – Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.

UNIT 4 OPTIMIZATION AND GENERALIZATION 9

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.

UNIT 5 CASE STUDY AND APPLICATIONS 9

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection- BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Understand basics of deep learning.
CO2	Implement various deep learning models.
CO3	Realign high dimensional data using reduction techniques
CO4	Analyze optimization and generalization in deep learning and explore the deep learning applications
CO5	Discuss deep learning case study and applications.

TEXT BOOKS:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Chairperson - BoS
Dept. of CSE - VCET

22CPE18	MULTICORE ARCHITECTURE AND PROGRAMMING	L	T	P	C
		4	0	0	3

Pre-requisites : Computer Architecture, Operating systems

Preamble

The multicore Architecture's improve the performance gains onto the software developer who must direct how work is distributed among the cores. The main goal of this course is to deal with parallel programming techniques like shared memory programming distributed memory programming with MIP and GPU.

UNIT 1 MULTI-CORE PROCESSORS **9**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Shared Memory vs Distributed Memory Architectures – Cache coherence - Performance Issues –Parallel program design.

UNIT 2 PARALLEL PROGRAM CHALLENGES **9**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT 3 SHARED MEMORY PROGRAMMING WITH OpenMP **9**

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search.

UNIT 4 DISTRIBUTED MEMORY PROGRAMMING WITH MPI **9**

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD- programs– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm

UNIT 5 GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA **9**

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event

Chairperson – BoS
Dept. of CSE - VCET

model – Command-Queue - Event Object - case study. Introduction to CUDA programming.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Compare the features of multicore processors in SIMD and MIMD systems using Instruction level parallelism and Thread level parallelism.
CO2	Write the parallel program to increase the performance and scalability in Concurrent computing and Distributed Computing.
CO3	Illustrate a parallel program in Shared Memory architecture using OpenMP libraries to achieve better performance.
CO4	Illustrate a parallel program in Distributed Memory architecture using MPI libraries to achieve better performance.
CO5	Design graphical processing paradigms using OPENCL and CUDA programming

TEXT BOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011 (unit 2)

REFERENCES:

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
2. Rob Farber, —CUDA application design and development||, Morgan Haufmann, 2011.
3. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, —OpenCL programming guide||, Addison Wesley, 2011

Chairperson - BoS
Dept. of CSE - VCET

22CPE19	ADVANCED BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		4	0	0	3

Pre-requisites : Basic Engineering Mathematics, Data Structures

Preamble

Blockchain is a self-sustaining, peer to peer distributed database ledger technology for managing and recording transactions with no central regulatory and ownership involvement. It is like an online bank ledger, open to both parties in a transaction. Blockchain gained increasing importance because of its relevance in facilitating a single shared version of the truth for any digital asset.

UNIT 1 GETTING STARTED WITH BLOCK CHAIN **9**

What is Blockchain – Centralized Vs. Decentralized Systems – Layers of Blockchain – Why is Blockchain Important – Blockchain uses and Use Cases.

UNIT 2 WORKING OF BLOCK CHAIN **9**

Cryptographic basics for crypto currency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.

UNIT 3 WORKING OF BITCOIN **9**

Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

UNIT 4 WORKING OF ETHERIUM **9**

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.

UNIT 5 ENTERPRISE BLOCKCHAIN AND ITS CHALLENGES **9**

Blockchain Vs Distributed Databases, How does an enterprise view blockchain?, Types of blockchain technology, what is blockchain in business?, Blockchain for business – how does the blockchain work?, Business benefits of blockchain, Challenges in enterprise adoption, Zcash.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Identify and explain the key benefits of block chain for a business or a network environment.

CO2 Classify the components of block chain, explain the roles of the components in developing block chain system and build a new revenue streams to a given business scenario.

CO3 Articulate the core components of Bitcoin Network with the necessary scriplets and Design a

Chairperson - BoS
Dept. of CSE - VCET

	Bitcoin Wallet for a given P2P network specification.
CO4	Describe Ethereum Eco system, Ethereum Virtual Machine and Encoding schemes and Develop a DApp for a given business model.
CO5	Investigate the given business model and critique the strengths and flaws of block chain implementation.

TEXT BOOKS:

1. Bikramaditya Singhal, Gautam Dhameja and Priyansu Sekhar Panda, "Beginning Blockchain – A Beginner's Guide to Building Blockchain Solutions",Apress Publication, 2018.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

REFERENCES:

1. Michael J. Casey and Paul Vigna , "The Truth Machine – The Blockchain and the Future of Everything",St.Martin's Press,2018.
2. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015.
3. Neil Hoffman, Gary McAllen, "Blockchain: Everything You Need to Know About Blockchain Technology and How It Works" – Amazon Kindle Edition.

Chairperson - BoS
Dept. of CSE - VCET

22CPE20	SOFTWARE ARCHITECTURES	L	T	P	C
		4	0	0	3

Pre-requisites : Advanced Software Engineering

Preamble

The importance of Software Architecture in a large scale software industries and apply different Architecture Styles for software design along with a activity of constructing a software system as software design and the resulting artifacts as software architecture.

UNIT 1 INTRODUCTION **9**

Basic Concepts of Software Architecture - Architecture business cycle - architectural patterns - reference models - architectural structures, views - Introduction to Styles - Simple Styles - Distributed and Networked Architectures-Architecture for network based applications - Decentralized Architectures.

UNIT 2 DESIGN METHODOLOGIES **9**

Structured Design - Design Practices – Stepwise Refinement – Incremental Design – Structured System Analysis and Design – Jackson Structured Programming – Jackson System Development

UNIT 3 ARCHITECTURE DESCRIPTION, DOCUMENTATION AND EVALUATION **9**

Early Architecture Description Languages –Domain and Style Specific ADLs –Extensible ADLs - Documenting Software architecture -Architecture Evaluation –ATAM

UNIT 4 ARCHITECTURE DESIGN **9**

Typical Architectural Design - Data Flow - Independent Components - Call and Return - Using Styles in Design – choices of styles – Architectural design space – Theory of Design Spaces – Design space of Architectural Elements – Design space of Architectural styles..

UNIT 5 CREATING AN ARCHITECTURE **9**

Understanding Quality Attributes - Functionality and Architecture –Architecture and Quality Attributes-System Quality Attributes –Quality attribute Scenarios in Practice - Introducing Tactics - Availability Tactics –Modifiability Tactics –Performance Tactics -Security Tactics –Testability Tactics –Usability Tactics –Relationship of Tactics to Architectural Patterns –Architectural Patterns and Styles.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Develop software applications starting from software architecture for various software systems.
CO2	Demonstrate the software design for various software systems architectures
CO3	Apply the uses of different architectural styles and frameworks for to learn and evaluate existing software architectures

Chairperson - BoS
Dept. of CSE - VCET

CO4 Depict systems requirement with the help of different architectural styles

CO5 Design methods for improving software quality from the perspective of software architecture

TEXT BOOKS:

1. Len Bass, Paul Clements, Rick Kazman, —Software Architecture in Practice, Third Edition, Addison,Wesley, 2012.
2. Richard N.Taylor, NenadMedvidovic and Eric M.Dashofy, —Software Architecture, Foundations, Theory and Practice‖, Wiley 2010.

REFERENCES:

1. Hong Zhu, —Software Design Methodology from Principles to Architectural Styles‖, Elsevier, 2015.
2. Ramesh Gopalaswamy, "Managing and global Software Projects", Tata Mc Graw Hill. Tenth Reprint 2011
3. Roger S.Pressman, "Software Engineering - A Practitioner's Approach", 7th Edition McGraw Hill, 2010

Chairperson - BoS
Dept. of CSE - VCET

22CPE21	GPU COMPUTING	L	T	P	C
		4	0	0	3

Pre-requisites : NIL

Preamble

To understand the architecture of embedded processor, microcontroller and peripheral devices.To interface memory and peripherals with embedded systems. To study the embedded network environment. To understand challenges in Real time operating systems.

UNIT 1 INTRODUCTION 9

History, GPU Architecture, Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel Programming, CUDA OpenCL / OpenACC, Kernels Launch parameters, Thread hierarchy, Warps/Wavefronts, Threadblocks/Workgroups, Streaming multiprocessors, 1D/2D/3D thread mapping, Device properties, Simple Programs.

UNIT 2 MEMORY 9

Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories.

UNIT 3 SYNCHRONIZATION & FUNCTIONS 9

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU

Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

UNIT 4 SUPPORT & SYSTEMS 9

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects

Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

UNIT 5 CASE STUDIES 9

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning.

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Define terminology commonly used in parallel computing, such as efficiency and speedup.
CO2	Describe common GPU architectures and programming models.
CO3	Implement efficient algorithms for common application kernels, such as matrix multiplication.
CO4	Given a problem, develop an efficient parallel algorithm to solve it.
CO5	Given a problem, implement an efficient and correct code to solve it, analyze its performance, and give convincing written and oral presentations explaining the achievements.

TEXT BOOKS:

1. David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-On Approach, 2nd Edition, Publisher: Morgan Kaufman, 2012, ISBN: 9780124159921.

REFERENCES:

1. Shane Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Chairperson - BoS
Dept. of CSE - VCET

22CPE22	BIG DATA MINING AND ANALYTICS	L	T	P	C
		4	0	0	3

Pre-requisites : Database Management Systems, Data Warehousing and Mining

Preamble

Data mining is an interdisciplinary topic involving, databases, machine learning and algorithms. Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge could help us understand world better, and in many contexts enable us to make better decisions. This course will expose to the data analytics practices executed in the business world. The course will introduce the key areas of analytical process and deals about how data is created, stored, accessed, and analyzed using HADOOP, R and NoSQL.

UNIT 1 DATA MINING **9**

Introduction to Data Mining – Types of data and patterns to be mined-Technologies-Targeted Applications – Major Issues in Data Mining- Data Preprocessing

UNIT 2 DATA ANALYSIS **9**

Classification: Decision Tree & Naïve Bayes - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT 3 INTRODUCTION TO BIG DATA **9**

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT 4 HADOOP FRAMEWORK **9**

Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using Map Reduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT 5 BIG DATA FRAMEWORKS **9**

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Describe the basic concepts of data mining.
CO2 Analyze data by utilizing Classification, Cluster and implement using R
CO3 Leverage the insights from big data analytics
CO4 Analyze data by utilizing using HADOOP framework
CO5 Use various NoSql alternative database models depending on application

Chairperson - BoS
Dept. of CSE, VCET

TEXT BOOKS:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams

with Advanced Analytics|, Wiley and SAS Business Series, 2012.
2. Jiawei Han, Micheline Kamber , Jian Pei, "Data Mining: Concepts and Techniques", Third Edition , 2013

REFERENCES:

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
2. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012

Chairperson - BoS
Dept. of CSE - VCET

22CPE23	AGENT BASED INTELLIGENT SYSTEMS	L	T	P	C
		4	0	0	3

Pre-requisites : Nil

Preamble

To learn the basic concepts of agent design, understand about the agents learning and intelligent assistance. To explore agent communication and cooperation. To study multi agent communication and cooperation. To understand multi agent decision making concepts

UNIT 1 INTRODUCTION **9**

Introduction - Interaction with agent - Direct manipulation to Delegation - Interface agents - Designing agents - Direct manipulation versus agents: Paths to predictable, Controllable and Comprehensible interfaces.

UNIT 2 AGENTS FOR LEARNING AND INTELLIGENT ASSISTANCE **9**

Agents for information sharing and coordination - Agents that reduce work and information overload - Programming agent - Life like computer characteristics - Software agents for cooperative learning.

UNIT 3 AGENT COMMUNICATION AND COLLABORATION **9**

Agent based framework for interoperability - Agent for information gathering - Industrial strength open agent architecture - Communicative actions - Mobile agents.

UNIT 4 MULTIAGENT COMMUNICATION AND COOPERATION **9**

Ontology fundamentals – Ontology languages - RDF – Construction an Ontology –Software Tools for OntologyCommunication : Speech acts – Agent communication languages - Working together: Cooperative Distributed Problem Solving - Task Sharing - Result Sharing - Handling inconsistency - Coordination - Multi agent planning and synchronization.

UNIT 5 MULTI AGENT DECISION MAKING **9**

Multi agent interactions – Utilities and Preferences- Solution concepts-Competitive and Zero-sum Interactions-The Prisoner's Dilemma-Making group decisions – Social welfare functions-Voting procedures-Properties-Strategic Manipulation.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Formulate a problem and propose an agent framework

CO2 Work with the agents for learning and intelligent assistance

CO3 Construct interface for agent communication and cooperation

CO4 Work with multi agent systems

CO5 Construct decision framework for multi agent systems

TEXT BOOKS:

1. Jeffrey M Bradshaw, "Software Agents", The MIT Press, 2010 2. Michael Wooldridge, "An Introduction to Multi Agent Systems", second edition John Wiley and Sons ltd., 2009.
2. Yoav Shoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game theoretic and Logical foundations", Cambridge, 2008.

REFERENCES:

1. Tomas Salamon, 'design of Agent Based Models: Developing Computer Simulations for a better understanding of social Processes", Academic series, 2011.
2. John Fulcher, L.C.Jain, "Computational Intelligence : A Compendium, Studies in Computational Intelligence", Vol.115, Springer,2008.

Chairperson - BoS
Dept. of CSE - VCET

22CPE24	ENTERPRISE APPLICATION INTEGRATION	L	T	P	C
		4	0	0	3

Pre-requisites : Service Oriented Architecture

Preamble

Enterprise Application Integration (EAI) is an integration framework composed of a collection of technologies and services which form a "middleware framework" to enable integration of systems and applications across an enterprise.EAI assists in unrestricted sharing of data and business processes among any connected applications or data sources in the enterprise without making major changes to the applications or data structures.

UNIT 1 INTRODUCTION **9**

Overview: Services in Software - Business Problem Addressed by SOA .Sockets& Data sharing: File-Based Data Sharing – Sockets. Remote Procedure Call: Types of Function Calls - Types of Functions - Restricted RPC - Remote Procedure Call (RPC) –Port Mapper.

UNIT 2 INTEGRATION PATTERNS **9**

Distributed objects & Application Servers: CORBA Overview - CORBA Model- Application Servers. Messaging: Overview - Channels - Messages -End Points. Enterprise service bus: Routing and Scalable Connectivity - Protocol Transformation - Data/Message Transformation - Core Functionalities - Optional Features - Logical Components – Deployment Configurations - Types of ESBs - Practical Usage Scenarios.

UNIT 3 INTEGRATING APPLICATIONS **9**

Integrating Mainframe Applications: Mainframe Application Types - Preliminaries - Summary of Point-to-Point Integration - ESB-based Integration Options. Integrating Package Applications: Adapters- J2EE Connector Architecture (JCA) - Introduction to SAP and Its Interfaces- Web Sphere Adapter for SAP Software - Exposure as Web Services.

UNIT 4 WEB SERVICES **9**

XML: Overview-XML Namespaces - XML Schemas - XML Processing/Parsing Models- SOAP Messages . SOAP: SOAP Messages-SOAP Elements - SOAP Attributes and Processing Model - SOAP Message Exchange Types - SOAP HTTP Binding. WSDL: Overview - Containment Structure - Elements of Abstract Interface Description - Elements of the Implementation Part - Logical Relationships - SOAP

Chairperson - BoS
Dept. of CSE - VCET

Binding.

UNIT 5 DEVELOPING WEB SERVICES **9**

UDDI Registry: Overview and Basic Data Model -tModel- Categorization and Identification Schemes - Binding Template - Use of WSDL in the UDDI Registry. Web Services Implementation: Implementation Choices -Building Web Service Clients - Building Web Services - Bottom-Up Approach - Commercial Tools. BPEL: Overview of Integration Through Service Composition (BPEL).

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Describe the concepts, tools and techniques of the enterprise systems integration using Service-Oriented Architecture (SOA) and Remote Procedure Call (RPC).
CO2	Discuss the concept of Messaging and Enterprise Service Bus routing using CORBA.
CO3	Apply the process of constructing and integrating an enterprise integration project for solving the problems of data and process integration using J2EE Connector Architecture (JCA) and SAP.
CO4	Discuss the concept and process to propagate communication between the client and server applications using XML, SOAP and WSDL.
CO5	Apply the concept of UDDI registry for building and implementing web services.

TEXT BOOKS:

1. Waseem Roshen, "SOA Based Enterprise Integration", Tata Mc Graw Hill, 2009.
2. G Hohpe and B Woolf, "Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions", Addison Wesley Professional, 2003

REFERENCES:

1. George Mentzas and Andreas Frezen (Eds), "Semantic Enterprise Application Integration for Business Processes: Service-oriented Frameworks", Business Science Reference, 2010.
2. D Linthicum, "Next Generation Application Integration: From Simple Information to Web Services", Addison Wesley, 2003
3. Martin Fowler, "Patterns of Enterprise Application Architecture", Addison- Wesley, 2003.

Chairperson - BoS
Dept. of CSE - VCET

22CPE25	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		4	0	0	3

Pre-requisites : Database Systems

Preamble

Information Storage and Management (ISM) is the Knowledge gap in understanding varied components of information storage infrastructure in classic and virtual environments. It provides a comprehensive learning on storage technology, which will enable to make more informed decisions in an increasingly complex IT environment. It builds a strong understanding of underlying storage technologies and prepares you to learn advanced concepts, technologies and products. Storage networking technologies such as FC-SAN, IP-SAN, NAS, object-based and unified storage; business continuity solutions such as backup and replication.

UNIT 1 STORAGE TECHNOLOGY **9**

Introduction to Information storage management, Challenges in data storage and data management , Solutions available for data storage , Core elements of data center infrastructure , Role of each element in supporting business activities.

UNIT 2 STORAGE SYSTEMS ARCHITECTURE **9**

Evolution of storage architecture , Key characteristics of data center , Physical and logical components of a connectivity environment , Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications , RAID implementation, RAID techniques, RAID levels, impact of RAID on disk performance.

UNIT 3 INTRODUCTION TO NETWORKED STORAGE **9**

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the appropriateness of the different networked storage options for different application environments.

UNIT 4 INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS **9**

Business continuity (BC)- BC planning lifecycle-failure analysis and solution , Disaster recovery (DR) , architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication

Chairperson - BoS
Dept. of CSE - VCET

technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

UNIT 5 SECURING STORAGE AND STORAGE VIRTUALIZATION **9**

Information security, Risk traid, Storage security domains, Monitoring storage management , Storage infrastructure management activities , Storage infrastructure management challenges , Virtualization technologies , block-level and file-level virtualization technologies and processes.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Select from various storage technologies to suit for required application.
CO2	Explain the concept of RAID and different RAID levels and their implementations and benefits.
CO3	Describe the benefits of the different network storage options for different application environments.
CO4	Discuss the different role in providing disaster recovery and business continuity capabilities.
CO5	Use the storage security framework and practice storage monitoring and management activities.

TEXT BOOKS:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting DigitalInformation", Wiley, India, 2011
2. Marc Farley, -Building Storage Networks||, Tata McGraw Hill, Osborne, 2001.

REFERENCES:

1. Robert Spalding, -Storage Networks: The Complete Reference—, Tata McGraw Hill , Osborne, 2003.
2. Meeta Gupta ,Storage Area Network Fundamentals, Pearson Education Limited,2002

Chairperson - BoS
Dept. of CSE - VCET

22CPO01	PRINCIPLES OF INFORMATION SECURITY	L	T	P	C
		4	0	0	3

Pre-requisites : Network Security

Preamble

Information security, sometimes shortened to InfoSec, is the practice of preventing unauthorized access, use, disclosure, disruption, modification, inspection, recording or destruction of information. The information or data may take any form, e.g. electronic or physical.Information security's primary focus is the balanced protection of the confidentiality, integrity and availability of data.

UNIT 1 SECURITY REQUIREMENTS AND SECURE SDLC **9**

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC.

UNIT 2 SECURITY INVESTIGATION **9**

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues.

UNIT 3 SECURITY ANALYSIS **9**

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk - Systems: Access Control Mechanisms.

UNIT 4 LOGICAL DESIGN **9**

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity.

UNIT 5 PHYSICAL DESIGN **9**

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel.

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Explain security principles and components in information management using security SDLC for a business environment.

CO2 Identify security threats and attacks and apply a security policy to overcome the threats in a given

Chairperson - BOS
Dept. of CSE - VCET

environment.

CO3 Identify and analyze risk factors, vulnerabilities to provide a security solution for managing the risks.

CO4 Analyze security models and frameworks and use best practices and standards to develop a security policy for an organization.

CO5 Apply security technologies for informational protection in an organization.

TEXT BOOKS:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Sixth Edition, Cengage Learning, 2017.
2. Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, John Wiley & Sons, 2008

REFERENCES:

1. Micki Krause, Harold F. Tipton, — Handbook of Information Security Management, Vol 1-3 CRCPress LLC, 2004.
2. Matt Bishop, — Computer Security Art and Science, Pearson/PHI, 2002.

Chairperson - BoS
Dept. of CSE - VCET

22CPO02	FUNDAMENTALS OF BLOCKCHAIN	L	T	P	C
		4	0	0	3

Pre-requisites : Basics of Data Structures and Distributed systems.

Preamble

Blockchain is a self-sustaining, peer to peer distributed database ledger technology for managing and recording transactions with no central regulatory and ownership involvement. The widespread popularity of digital cryptocurrencies has led the foundation of Blockchain. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different application domains.

UNIT 1 CORE OF BLOCKCHAIN **9**

Layers of Blockchain - Blockchain transaction – Public Ledgers – trustless system – Elements of blockchain – types – Byzantine General Problems – benefits –challenges – Components and structure of blockchain - decentralization Vs distributed systems.

UNIT 2 CRYPTOGRAPHIC BLOCKCHAIN **9**

Basics of Crypto currencies - Principles – classical cryptography- types – symmetric – asymmetric – digital signatures – smart contracts - Distributed Consensus Mechanisms - Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT 3 CORE OF BITCOIN **9**

Introduction - History & Philosophy of Bit coin –Bitcoin Core Architecture - Cryptocurrencies - Transactions (Inputs & Outputs & Constraints) – Bit coin's Protocol– Bit coin Scripting System-Bit coin Mining Mechanics.

UNIT 4 ETHEREUM **9**

Introducing Ethereum - Components of Ethereum - Ethereum accounts - Ethereum network – Ethereum Wallets, Concept of Gas, Gas limits - Ethereum virtual machine - Ethereum Ecosystem.

UNIT 5 HYPERLEDGER AND ENTERPRISE BLOCKCHAINS **9**

History - Hyperledger projects - Hyperledger Fabric - Hyperledger Iroha -Hyperledger Indy - IBM Blockchain Platform Hyperledger. Business benefits of blockchain - Example use cases - Challenges in enterprise adoption - Example Enterprise Applications.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Identify and explain the key benefits of block chain for a business or a network environment.
CO2	Describe Cryptography functions and consensus mechanisms.
CO3	Articulate the core components of Bitcoin Network with the necessary scriplets and Design a Bitcoin Wallet for a given P2P network specification.
CO4	Describe Ethereum Eco system, Ethereum Virtual Machine and Encoding schemes and Develop a DApp for a given business model.
CO5	Classify the components of block chain, explain the roles of the components in developing block chain system and build a new revenue streams to a given business scenario.

TEXT BOOKS:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Sixth Edition, Cengage Learning, 2017.
2. Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, John Wiley & Sons, 2008

REFERENCES:

1. Micki Krause, Harold F. Tipton, — Handbook of Information Security Management, Vol 1-3 CRCPress LLC, 2004.
2. Matt Bishop, — Computer Security Art and Science, Pearson/PHI, 2002.

Chairperson - BoS
Dept. of CSE - VCET

22CPO03	BIG DATA MANAGEMENT	L	T	P	C
		4	0	0	3

Pre-requisites : Fundamentals of Databases

Preamble

The course covers foundational techniques and tools required for big data analytics. It focuses on concepts, principles and techniques applicable to any technology environment and industry and establishes a baseline for additional real-world experience. It provides an in-depth knowledge on managing big data applications, giving insight on real-world big data management.

UNIT 1 FUNDAMENTALS OF BIG DATA **9**

Types Of Digital Data-Characteristics of Data-Evolution of Big Data- Definition of Big Data- Challenges of Big Data- Traditional Business Intelligence (BI) versus Big Data-A Typical Data Warehouse Environment-A Typical Hadoop Environment- Changing in the Realms of Big Data- Coexistence of Big Data and Data Warehouse.

UNIT 2 INTRODUCTION TO BIG DATA ANALYTICS **9**

Definition of Big Data Analytics-Sudden Hype Around Big Data Analytics-Classification of Analytics-Greatest Challenges that Prevent Businesses from Capitalizing on Big Data-Top Challenges Facing Big Data- Importance of Big Data Analytics- Data Science-Data Scientist-Terminologies Used in Big Data Environment- Basically Available Soft State Eventual Consistency(BASE)- Top Analytics Tools.

UNIT 3 INTRODUCTION TO HADOOP **9**

Introducing Hadoop: RDBMS versus Hadoop-Distributed Computing Challenges- History of Hadoop - Hadoop Overview –Hadoop Distributors- Hadoop Distributed File System- Processing Data with Hadoop-Managing Resources and Application with Hadoop YARN-Interacting with Hadoop Ecosystem.

UNIT 4 NOSQL DATABASE SYSTEMS **9**

Introduction to NoSQL – CAP theorem - MongoDB : Data types – MongoDB Query Language – Cassandra: Features of Cassandra- Data types – CRUD- Collections Alter Commands – Import and Export- Querying system tables.

UNIT 5 MAP REDUCE PROGRAMMING **9**

Introduction to Mapreduce Programming: Mapper- Reducer-Combiner-Partitioner-Searching-Sorting-Compression.

TOTAL : 45 PERIODS

Chairperson - BoS
Dept. of CSE - VCET

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Describe the need for big data and different types of digital data.

CO2 Explain big data analytic techiques , various NoSQL systems and their features.

CO3 Analyze Hadoop ecosystem components, Hadoop Architecture and HDFS.

CO4 Explain the concept for MongoDB.

CO5 Apply Map-Reduce based Big data applications.

TEXT BOOKS:

1. Seema Acharya and Subhashini C: Big Data and Analytics, Second Edition, Wiley India Pvt. Ltd, 2019.
2. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman: Big data for dummies, First Edition,John Wiley & Sons Inc,2013.

REFERENCES:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", 3rd Edition, Cambridge University Press, 2020.
2. Chuck Lam, "Hadoop in Action", 2nd Edition, Manning Publications, 2011.

Chairperson - BoS
Dept. of CSE - VCET

22CPO04	SOCIAL NETWORK ANALYSIS	L	T	P	C
		4	0	0	3

Pre-requisites : Nil

Preamble

Social Network Analysis studies the application in social network analysis. It also explores some of the evolution of the social network and model and visualize the social network with Social Network Analysis and its applications in real time systems.

UNIT I INTRODUCTION **9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT 2 MODELING AND VISUALIZATION **9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships

UNIT 3 MINING COMMUNITIES **9**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT 4 EVOLUTION **9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT 5 APPLICATIONS **9**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and

Chairperson - BoS
Dept. of CSE - VCET

Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Apply the concepts of internals components for analysis of social networks distribution

CO2 Utilize the model and visualizing for making the context of social networking

CO3 Analyzing the behaviour of the users in the social network by the mining algorithm

CO4 Evolving the prediction that are possible next outcome of the social network

CO5 Demonstrate the social network in real time applications

TEXT BOOKS:

1. Charu C. Aggarwal, —Social Network Data Analytics‖, Springer; 2014
2. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, —Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012

REFERENCES:

1. Przemyslaw Kazienko, Nitesh Chawla,‖Applications of Social Media and Social Network Analysis‖, Springer,2015
2. Przemysław Kazienko & Nitesh Chawla , Applications of Social Media and Social Network Analysis - Springer,2015
3. Charles Kadushin, "Understanding Social Networks: Theories, Concepts, and Findings", Oxford University Press, 2012
4. Mehmet Kaya and Reda Alhajj "Influence and Behavior Analysis in Social Networks and Social Media – Springer - 2019

Chairperson - BoS
Dept. of CSE - VCET

22AC01	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

UNIT 1 INTRODUCTION TO RESEARCH PAPER WRITING 9

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences ,Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT 2 PRESENTATION SKILLS 9

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT 3 TITLE WRITING SKILLS 9

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT 4 RESULT WRITING SKILLS 9

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT 5 VERIFICATION SKILLS 9

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL : 45 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand that how to improve your writing skills and level of readability.
CO2 Learn about what to write in each section.
CO3 Understand the skills needed when writing a Title.
CO4 Understand the skills needed when writing the Conclusion.
CO5 Ensure the good quality of paper at very first-time submission.

TEXT BOOKS & REFERENCE BOOKS:

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

Chairperson - BoS
Dept. of CSE - VCET

22AC02	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

Pre-requisites : NIL

Preamble

This course is useful to provide students an exposure to disasters- their significance and types and knowledge on relationship between vulnerability- disasters- disaster prevention and risk reduction.

UNIT 1 INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT 2 REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT 3 DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.

UNIT 4 DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT 5 RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

TOTAL : 30 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Identify and explain the types of disasters- causes and their impact on environment and society.
CO2	Identify and explain the vulnerability and various types of hazards.
CO3	Draw the hazard and vulnerability profile of India- Scenarios in the Indian context- Disaster damage assessment and management.
CO4	Apply the remote sensing and GIS techniques for predicting the natural disasters.
CO5	Discuss how to work on recovery & risk assessment due to disasters.

TEXT BOOKS:

1. Singhal J.P, —Disaster Management‖, Laxmi Publications- 2010.
2. Tushar Bhattacharya, —Disaster Science and Management‖, McGraw Hill India Education Pvt. Ltd.- 2012.

REFERENCES:

1. Gupta Anil, K.Sreeja, S. Nair, —Environmental Knowledge for Disaster Risk Management- NIDM‖, New Delhi- 2011.
2. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
3. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.

Chairperson – BoS
Dept. of CSE - VCET

22AC03	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

Preamble

Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. To address the growth of Indian opinion regarding modern Indian intellectuals' Constitutional. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.

UNIT 1 HISTORY ANDPHILOSOPHY OF THE INDIAN CONSTITUTION **6**

History:History, Drafting Committee, (Composition & Working), Philosophy:Preamble, SalientFeatures

UNIT 2 CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES **6**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT 3 ORGANS OF GOVERNANCE **6**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT 4 LOCAL ADMINISTRATION **6**

District's Administration head: Role and importance, Municipalities: Introduction, Mayor and roleof Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 5 ELECTION COMMISSION **6**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL : 30 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1	Describe the emergence and evolution of Indian Constitution, structure and composition of Indian Constitution and federalism in the Indian context.
CO2	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO3	List the functions of Centre, States and District Administrations, Fundamental rights needed to develop human personality in free society.
CO4	Identify different levels of Panchayat Raj system and its working.
CO5	Elaborate the role of Election Commission and its power to conduct free and fair election throughout India.

REFERENCES:

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

Chairperson - BoS
Dept. of CSE - VCET

22AC04	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

Preamble

The general aims of the course are that the student should acquire knowledge of pedagogical theories of relevance to work with people. Learning outcomes On completion of the course, the student should - describe the basic view of different pedagogical orientations - apply concepts related to learning theory - describe and reflect on different theories of motivation and learning - account for different forms of supervision.

UNIT 1 Dimensions of Learning **6**

Dimensions of Individual development: Physical, Cognitive, Affective, Social and Moral their interrelationships and implications for teachers - Key Cognitive Processes: Perception, Attention, Memory, Language, Thinking, Problem Solving, Emotions and Motivation. - Stages of Development-Developmental tasks with focus on processes of growth and development across various stages from Infancy to Post Adolescence and their significance to Learning.

UNIT 2 Learning Theories **6**

Theories of Learning (Concepts, Principles and applicability is different learning situations): -Thorndike, Pavlov, Skinner, Kohler, Guthrie -Piaget, Rogers, Bandura ,Vygotsky - Distinction between learning as Construction of Knowledge and Learning as Transmission and Reception of Knowledge- Meaning of Cognition and its role in learning. Socio-Cultural factors influencing Cognition and Learning - Understanding processes that facilitate Construction of Knowledge : (i) Experiential Learning and Reflection (ii) Social Mediation (iii) Negotiability (iv) Situated Learning and Cognitive Apprenticeship (v) Meta-cognition - Role of a teacher in a teaching-learning context: (a) Transmitter of knowledge (b) Model (c) Facilitator (d) Negotiator (e) Learner

UNIT 3 Outcome Based Education **6**

Introduction – Accreditation – Approach to design Outcome based learning – Instructional design for active learning (ADDIE model,etc.,) – Accreditation - Framing Vision, Mission- Graduate attributes , Program outcomes and Program Educational Objectives - Bloom's Taxonomy – Writing Learning outcomes for a course – Assessment and Evaluation – Assessment Methods - Evaluation.

Assignment/ Activity: Course Module devclopment for a course.

UNIT 4 Teaching and Learning **6**

Traditional Teaching methods- Outcome based Modern teaching methods – Good Teaching Attributes - Active Learning methods (Problem based learning, Cooperative Learning, Focused groups) - Flipped classroom.

Assignment / Activity: Innovative Teaching methods

UNIT 5 Research in Education **6**

What is educational research – Overview of educational research process – Ethics in educational

Chairperson - BoS
Dept. of CSE - VCET

research- Qualitative research methods and Quantitative research methods.

TOTAL :30 PERIODS

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Explain different dimensions of learning

CO2 Apply suitable learning theory for the class

CO3 Use outcome based education approaches to their class

CO4 Exhibit different teaching methods for active learning

CO5 Apply the concepts and tools of qualitative and quantitative research methods in education.

TEXT BOOKS & REFERENCE BOOKS:

1. Dr.V V Rao, "Outcome based education and accreditation" , Notion press, 2015
2. Mukunda Sarma and Kishor Kumar, "Educational Theories and practices: Towards a new social", Mittal publications, January 2021.
3. Dale H. Schunk, "Learning Theories: An Educational Perspective", Springer 2007
4. Raymond P Perry , John C Smart, , "Scholarship teaching and learning in Higher education : An evidence based perspective", Springer 2007
5. Book chapter by Harry G Murray , "Low inference teaching behaviors and college teaching effectiveness: Recent developments and controversies" , 2012
6. Craig A Mertler, Thoudand oaks, California," Introduction to educational research", SAGE publications, 2016

Chairperson - BoS
Dept. of CSE - VCET