GOVERNMENT COLLEGE OF ENGINEERING - BARGUR

KRISHNAGIRI- 635 104, TAMILNADU

(An Autonomous Institution Affiliated to Anna University – Chennai)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.E. – CSE – CURRICULUM AND SYLLABUS

AUTONOMOUS - REGULATION – 2018

M.E - COMPUTER SCIENCE AND ENGINEERING

(AUTONOMOUS - REGULATIONS – 2018)

For the candidates admitted from the Academic Year 2018-2019

CURRICULUM

S.NO	COURSE CODE	COURSE TITLE	L	T	P	C
FOUNDATION CORE						
1.	18CSFC01	Mathematical Foundations of Computer Science	3	1	0	4
						TOTAL CREDITS: 4
PROGRAM CORE						
1.	18CSPC02	Advances in Data Structures and Algorithm Analysis	3	1	0	4
2.	18CSPC03	Object Oriented Systems Engineering	3	0	0	3
3.	18CSPC04	Networking Technologies	3	0	0	3
4.	18CSPC05	Advances in Data Structures and Algorithm Analysis Laboratory	0	0	4	2
5.	18CSPC06	Cloud and Virtualization Techniques	3	1	0	4
6.	18CSPC07	Data Storage Technologies	3	0	0	3
7.	18CSPC08	Compiler Optimization Techniques	3	0	0	3
8.	18CSPC09	Cloud and Virtualization Techniques Laboratory	0	0	4	2
						TOTAL CREDITS: 24
PROFESSIONAL ELECTIVES						
S.NO	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
Professional Electives - I						
1.	18CSPE01	Machine Learning	3	0	0	3
2.	18CSPE02	Wireless Sensor Networks	3	0	0	3
3.	18CSPE03	Multi-core architecture	3	0	0	3
Elective Laboratory - I						
4.	18CSPE04	Machine Learning Using Python Laboratory	0	0	4	2
5.	18CSPE05	Wireless Sensor Networks Laboratory	0	0	4	2

6.	18CSPE06	Multicore Programming Using Open MP	0	0	4	2
Professional Electives - II						
7.	18CSPE07	Ethical Hacking	3	0	0	3
8.	18CSPE08	Network On chip	3	0	0	3
9.	18CSPE09	Internet of Things	3	0	0	3
Professional Elective - III						
10.	18CSPE10	Big Data Analytics	3	0	0	3
11.	18CSPE11	Computer Vision	3	0	0	3
12.	18CSPE12	Linux System Programming	3	0	0	3
Elective Laboratory - II						
13.	18CSPE13	Data Analytics Laboratory	0	0	4	2
14.	18CSPE14	Image Processing Laboratory	0	0	4	2
15.	18CSPE15	Linux System Programming Laboratory	0	0	4	2
Professional Elective - IV						
16.	18CSPE16	Cognitive Science	3	0	0	3
17.	18CSPE17	GPU Computing	3	0	0	3
18.	18CSPE18	Digital Forensics	3	0	0	3
Professional Elective - V						
19.	18CSPE19	Mobile Application and Services	3	0	0	3
20.	18CSPE20	Software Project Management	3	0	0	3
21.	18CSPE21	Bioinformatics	3	0	0	3
TOTAL CREDITS : 19						
OPEN ELECTIVES						
S.NO	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1.	-	To be chosen from Elective offered by Other Department	3	0	0	3
TOTAL CREDITS : 3						

EMPLOYABILITY ENHANCEMENT COURSES						
S.NO	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1.	18CSEE10	Mini Project with Seminar	2	0	4	2
2.	18CSEE11	Project Phase I	0	0	20	6
3.	18CSEE12	Project Phase II	0	0	32	12
						TOTAL CREDITS: 20
						OVERALL TOTAL CREDITS : 70
AUDIT COURSES						
S.NO	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
Audit Course - I (For Semester - I)						
1.	18ZAC001	Disaster Management	2	0	0	0
2.	18ZAC002	English for Research paper writing	2	0	0	0
3.	18ZAC003	Research Methodology and IPR	2	0	0	0
4.	18SAC004	Stress Management	2	0	0	0
5.	18SAC005	Pedagogy Studies	2	0	0	0
6.	18SAC006	Principles of Management	2	0	0	0
7.	18SAC007	Professional Ethics in Engineering	2	0	0	0
8.	18SAC008	Engineering Economics and Financial Accounting	2	0	0	0
9.	18SAC009	Industrial Automation and Robotics	2	0	0	0
						TOTAL CREDITS (AUDIT COURSES): 0
OPEN ELECTIVES OFFERED BY CSE						
S.NO	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1.	18CSOE01	Python Programming	3	0	0	3
2.	18CSOE02	Software Engineering	3	0	0	3
3.	18CSOE03	Android Application Development	3	0	0	3
4.	18CSOE04	Essentials of Cloud Computing	3	0	0	3
5.	18CSOE05	Computer Vision	3	0	0	3
6.	18CSOE06	High Performance Computing	3	0	0	3

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CURRICULUM

(Semester wise)

SEMESTER – I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	18CSFC01	Mathematical Foundations of Computer Science	FCC	4	3	1	0	4
2.	18CSPC02	Advances in Data Structures and Algorithm Analysis	PCC	4	3	1	0	4
3.	18CSPC03	Object Oriented Systems Engineering	PCC	3	3	0	0	3
4.	18CSPC04	Networking Technologies	PCC	3	3	0	0	3
5.	-	Professional Elective - I	PEC	3	3	0	0	3
6.	-	Professional Elective - II	PEC	3	3	0	0	3
7.	-	Audit Course - I	AC	2	2	0	0	0
PRACTICALS								
8.	18CSPC05	Advances in Data Structures and Algorithm Analysis Laboratory	PCC	4	0	0	4	2
9.	-	Elective Laboratory - I	PEC	4	0	0	4	2
			TOTAL	**30**	**20**	**2**	**8**	**24**

SEMESTER – II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	18CSPC06	Cloud and Virtualization Techniques	PCC	4	3	1	0	4
2.	18CSPC07	Data Storage Technologies	PCC	3	3	0	0	3
3.	18CSPC08	Compiler Optimization Techniques	PCC	3	3	0	0	3
4.	-	Professional Elective - III	PEC	3	3	0	0	3

5.	-	Professional Elective - IV	PEC	3	3	0	0	3
6.	-	Audit Course - II	AC	2	2	0	0	0
PRACTICALS								
7.	18CSPC09	Cloud and Virtualization Techniques Laboratory	PCC	4	0	0	4	2
8.	-	Elective Laboratory - II	PEC	4	0	0	4	2
9.	18CSEE10	Mini Project with Seminar	EEC	4	0	0	4	2
			TOTAL	**30**	**17**	**1**	**12**	**22**

SEMESTER – III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	-	Professional Elective - V	PEC	3	3	0	0	3
2.	-	Open Elective - I	OEC	3	3	0	0	3
3.	18ZAC003	Research Methodology and IPR	AC	2	2	0	0	0
PRACTICALS								
4.	18CSEE11	Project Phase - I	EEC	20	0	0	20	6
			TOTAL	**28**	**8**	**0**	**20**	**12**

SEMESTER – IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	18CSEE12	Project Phase - II	EEC	32	0	0	32	12
			TOTAL	**32**	**0**	**0**	**32**	**12**

TOTAL CREDITS: 70

Note:
FCC - Foundation Core Course, PCC - Professional Core Course, PEC - Professional Elective Course, EEC - Employability Enhancement Course, AC- Audit course, OEC - Open Elective Course

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COMPARISON OF CREDITS

SEMESTER	AICTE CREDITS	AUTONOMY CREDITS
SEMESTER - I	18	24
SEMESTER - II	18	22
SEMESTER - III	16	12
SEMESTER - IV	16	12
TOTAL	**68**	**70**

S.NO	CATEGORY	AICTE CREDITS	AUTONOMY CREDITS
1.	Foundation core	-	4
2.	Program Core (PC)	16	24
3.	Program Elective (PE)	19	19
4.	Open Electives (OE)	3	3
5.	Audit Course (AC) (Mandatory)	2	0
	Audit Course 1 & 2 (AC)	0	0
6.	Employability Enhancement Course (EEC)	28	20
TOTAL CREDITS		**68**	**70**

CREDIT SUMMARY

S.No	Subject Area	Credits Per Semester				Credits Total	% of Total Credits	AICTE Suggested Breakup of Credits
		1	2	3	4			
1	FC	4				**4**	**6**	**-**
2	PC	12	12			**24**	**34**	**22**
3	PE	8	8	3		**19**	**27**	**15**
4	OE			3		**3**	**4**	**3**
5	EEC		2	6	12	**20**	**29**	**26**
6	AC	√	√	√	√	**-**	**-**	**2**
	Total	**24**	**22**	**12**	**12**	**70**	**100**	**68**

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PROGRAM SPECIFIC OUTCOMES

1. An ability to design and develop hardware and software in emerging technology environments like cloud computing, machine learning and Linux systems. (Orientation towards Systems Programming)
2. Knowledge of data management system like data acquisition, big data so as to enable students in solving problems using the techniques of data analytics like pattern recognition and knowledge discovery. (Orientation towards Data Sciences)
3. An ability to design and develop real time applications using Android, Raspberry Pi and Arduino systems. (Orientation towards Mobile and Real time application Development)
4. Acquire enough knowledge in design and maintenance of various networks and protocols.(Orientation towards networking)

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PROGRAM OUTCOMES

1. An understanding of the theoretical foundations and the limits of computing.
2. An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.
3. An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society.
4. Understanding and ability to use advanced computing techniques and tools.
5. An ability to undertake original research at the cutting edge of computer science & its related areas.
6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.
7. An understanding of professional and ethical responsibility.
8. An ability to communicate effectively with a wide range of audience.
9. An ability to learn independently and engage in lifelong learning.
10. An understanding of the impact of IT related solutions in an economic, social and environment context.

SYLLABI

SEMESTER – I

FOUNDATION CORE

18CSFC01	MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Random variables and distributions.*
- *Correlation and regression analysis.*
- *Tests of sampling.*

UNIT I	PROBABLITY AND RANDOM VARIABLES	12

Probability-axioms of probability-conditional probability-Baye's theorem-random variables-probability function-moments-moment generating functions and their properties - binomial, poisson, geometric, uniform, Exponential, Gamma and Normal distribution- Function of a random variable.

UNIT II	TWO DIMENSIONAL RANDOM VARIABLES	12

Joint distribution – Marginal and Conditional distribution - Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III	ESTIMATION THEORY	12

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT IV	TESTING OF HYPOTHESIS	12

Sampling distribution – Type I and type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distribution for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V	MULTIVARIATE ANALYSIS	12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components - Principal components from standardized variables

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Basic probability theory and random variables.

2.	Solve Marginal and conditional distributions
3.	Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
4.	Use statistical tests in testing hypotheses on data.
5.	Explore analysis of multivariate data, such as multivariate normal density, calculating descriptive statics testing for multivariate normality.

REFERENCES:

1.	*Devore,J.L.,Probality and statistics for engineering and the sciences 9th Edition,Cengage learning,2016.*
2.	*Dallas E.Johnson,applied multivariate methos for data analysis,Thomson and Duxbury press,1998.*
3.	*Gupta S.C,and Kapoor V.K., fundamentals of mathematical statistics,11 Edition,Sultan and Sons,Newdelhi,2014.*
4.	*Johnson,R.A.,Miller, I and Freund J.,"Miller and Freund's probability and statistics for engineers",8th Edition,Pearson Education Asia,2015.*
5.	*Richard A.Johnson and Dean W.Wichern,applied multivariate statistician analysis,6th Edition, Pearson Education Asia,2007*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1		1			3	3		2	
CO2		2				3		2				2		3
CO3			2	1					3	2		2		
CO4	3		2		3		1	1		1	1		3	2
CO5		2		3		2			3				3	

(1- Low, 2- Moderate, 3-High)

PROGRAM CORE

18CSPC02	ADVANCES IN DATA STRUCTURES AND ALGORITHM ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Divide and Conquer, Dynamic programming and Greedy Algorithms techniques.*
- *Multithreaded algorithms and Linear programming and polynomial multiplication using Fast Fourier Transforms.*
- *String matching, computational geometry, Notions of NP-Completeness and approximation algorithms.*

UNIT I	HIERARCHICAL DATA STRUCTURES	12

Binary trees, BST, red black trees, AVL trees, threaded binary tree, Huffman trees, splay trees, b-Trees, B+ trees , trie, 2 -3 trees

UNIT II	HEAPS & INTRODUCTION TO ALGORITHMS ANALYSIS	12

Heaps, binomial heaps, Fibonacci heaps, hashing

Role of Algorithms in Computing – Analyzing algorithms – Designing algorithms – Growth of functions – Divide and Conquer – Probabilistic analysis – Randomized algorithms

UNIT III	DYNAMIC PROGRAMMING AND GRAPH ALGORITHMS	12

Dynamic programming : Rod cutting, Matrix-chain multiplication, Elements of dynamic programming, Optimal binary search trees– Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Huffman codes

Elementary Graph Algorithms – Minimum Spanning trees: Kruskal and Prims Algorithm – Single source shortest paths: – All pairs shortest paths: Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs – Maximum Flow.

UNIT IV	ADVANCED ALGORITHMS I	12

Multithreaded algorithms: Multithreaded matrix multiplication , Multithreaded merge sort – Matrix operations: Solving systems of linear equations, Inverting matrices, Symmetric positive-definite matrices and least-squares approximation – Linear programming – Polynomials and FFT

UNIT V	ADVANCED ALGORITHMS II	12

String matching: Naive string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm– Computational Geometry – NP-Completeness – Approximation algorithms

	TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Acquire knowledge in various advanced data structures and Understand various techniques of algorithm analysis.
2.	Explore and solve various algorithms under dynamic programming and graph algorithms.
3.	Solve problems using multithreaded algorithms and linear programming.
4.	Solve polynomial multiplication using Fast Fourier Transforms and . identify problems that are NP-Complete and generate near-optimal solutions.
5.	Apply String matching algorithms, Computational geometry algorithms to solve problem.

REFERENCES:	
1.	*Thomas H. Cormen, Charles E. Leiseron, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, PHI learning Pvt. Ltd., 2011.*
2.	*Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications Pvt. Ltd., 2008.*
3.	*Michael R. Garey, D. S. Johnson, "Computers and Intractability: A Guide to the Theory of NP-Completeness", W. H. Freeman, 1979.*
4.	*Reema Thareja, "Data structures using C", Second Edition, Oxford University Press.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P010**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1			3			3		2	
CO2						1	2		3			1		3
CO3			2	2	1					2				
CO4	3	2				1		1			3		2	1
CO5					3		2		1	1		2		

(1- Low, 2- Moderate, 3-High)

18CSPC03	OBJECT ORIENTED SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Problem Solving, Project Organization and Communication, Analysis Concepts and Analysis Activities*
- *UML Deployment Diagrams , Interface Specification, Rationale Concepts.*
- *Configuration Management Activities and Software Life Cycle.*

UNIT I	INTRODUCTION	9

Software Engineering - Modelling - Problem Solving - Knowledge Acquisition – Rationale-Software Engineering Concepts- Participants and Roles - Systems and Models - Work Products
Activities, Tasks, and Resources-Functional and Non functional Requirements - Notations, Methods, and Methodologies -Software Engineering Development Activities -System Concepts – Project Organization – Communication – Project Management - Requirements Elicitation -Managing Software Development , Modelling with UML – Project Organization and Communication.

UNIT II	DEALING WITH COMPLEXITIES	9

Requirements Elicitation – Overview- Concepts - Activities -Managing Requirements Elicitation - Analysis -Overview of Analysis - Analysis Concepts - Analysis Activities: From Use Cases to Objects - Managing Analysis - System Design: Overview -Concepts - System Design Activities: From Objects to Subsystems

UNIT III	SYSTEM DESIGN	9

Addressing Design Goals - An Overview of System Design Activities Concepts - UML Deployment Diagrams. System Design Activities - Object Design - An Overview Reuse Concepts Reuse Activities - Managing Reuse - An Overview of Interface Specification -Concepts - Interface Specification - Managing Object

UNIT IV	MAPPING MODELS TO CODE	9

Introduction An Overview of Mapping -Mapping Concepts - Mapping Activities -Managing Implementation -Testing -Overview -Concepts -Managing Testing -Rationale Management - Overview of Rationale- Rationale Concepts - Rationale Activities: From Issues to Decisions
Managing Rationale

UNIT V	MANAGING TRANSFORMATION	9

Overview of Configuration Management -Concepts - Configuration Management Activities
- Managing Configuration Management - Project Management - Introduction: - An Overview -Tasks

and Activities - Classical Project Management Activities - Agile Project Management Activities - Software Life Cycle -Standard for Developing Life Cycle Processes -Characterizing the Maturity of Software Life Cycle Models	
	TOTAL : 45 PERIODS
OUTCOMES:	Upon completion of this course, the students will be able to:
1.	To prepare object oriented design for small/ medium scale problem.
2.	To evaluate the appropriate life cycle model for the system under consideration
3.	To apply the various tools and patterns while developing software
4.	Testing the software against usability
5.	Testing the software against deployment and maintenance
REFERENCES:	
1.	*Bernd Bruegge, Alan H Dutoit, "Object-Oriented Software Engineering", Second Edition, Pearson Education, 2010*
2.	*Craig Larman, "Applying UML and Patterns", Third Edition, Pearson Education, 2005*
3.	*Stephen Schach, "Software Engineering" Seventh Edition, McGraw-Hill, 2007.*
4.	*Ivar Jacobson, Grady Booch, James Rumbaugh, "The Unified Software Development Process", Pearson Education, 1999.*
5.	*Alistair Cockburn, "Agile Software Development" Second Edition, Pearson Education, 2007*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1		1		3		3		2	3
CO2	2					1		3		3			2	1
CO3			1	3		2	2		2		2	1		
CO4	3		2		3			1		2			1	
CO5	3	1			3		2		1		3	1	2	3

(1- Low, 2- Moderate, 3-High)

18CSPC04	NETWORKING TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Network architecture ,services and Network Infrastructures.*
- *Cellular networks and their security features.*
- *Centralized and Distributed Control and Data Planes and SDN Framework*

UNIT I	NETWORK ARCHITECTURE AND QoS	9

Overview of TCP/IP Network Architecture – Integrated Services Architecture – Approach – Components – Services – Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.

UNIT II	WIRELESS NETWORKS	9

EEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e– Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack –Security – Profiles

UNIT III	CELLULAR NETWORKS	9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security

UNIT IV	4G NETWORKS	9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G

UNIT V	SOFTWARE DEFINED NETWORKS	9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Identify the different features of integrated and differentiated services
2.	Demonstrate various protocols of wireless networks
3.	Demonstrate various protocols of cellular networks
4.	Discuss the features of 4G and 5G networks
5.	Knowledge about software defined networks.

REFERENCES:	
1.	*William Stallings, "High Speed Networks and Internets: Performance and Quality of Service", Prentice Hall, Second Edition, 2002.*
2.	*Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.*
3.	*Savo G Glisic, "Advanced Wireless Networks – 4G Technologies", John Wiley & Sons,2007.*
4.	*Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.*
5.	*Martin Sauter, "Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0", Wiley, 2009.*
6.	*Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks", O'Reilly Publishers, 2013.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1		3			1		1	2	3
CO2		2				1		1	2		1			1
CO3		1				2		1	2		2			1
CO4	3			2	1		2			2		3	2	
CO5			2						1		2			

(1- Low, 2- Moderate, 3-High)

18CSPC05	ADVANCES IN DATA STRUCTURES AND ALGORITHM ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Design of algorithms using Divide and Conquer, Dynamic programming approach.*
- *Design of algorithms using Greedy and Back Tracking Techniques.*
- *Implementation of Graph algorithms and Matrix operations.*

LIST OF EXPERIMENTS

1. Implement operations of red black tree, splay tree, b tree, b+ tree and hashing techniques.
2. Implement operations of AVL trees,2-3 trees,tries.
3. Implement an algorithm that combines k sorted lists in time O(n log k) where n is the total number of elements.
4. Implement an algorithm to solve Matrix Multiplication problem and maximum value contiguous subsequence using dynamic programming approach.
5. Implement an algorithm based on greedy approach to solve knapsack problem and Activity Selection Problem.
6. Implement Merge Sort algorithm using Divide and Conquer approach.
7. Implement stack operations and calculate the amortized cost.
8. Implement Graph Traversal algorithms.
9. Implement algorithms to construct Minimum Spanning Trees.
10. Implement shortest path and Maximum Flow algorithms.
11. Implement String Matching Algorithms.
12. Implement Computational Geometry algorithms.

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Implement the operations of various trees and hashing techniques.
2.	Implement the operations of String matching algorithms.
3.	Implement the operations of Divide and conquer approach.
4.	Implement the operations of various graph algorithms
5.	Implement the operations of Computational Geometry algorithms

COURSE ARTICULATION MATRIX:														
	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1			1		1	3		2	
CO2							2		3			1		3
CO3		3	1			2			1				2	
CO4	1			2			2			3		2		
CO5			3		1						2			2
(1- Low, 2- Moderate, 3-High)														

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVES – I

18CSPE01	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *The characteristics of machine learning that make it useful to real-world problems and the basic underlying concepts, Characteristics of supervised machine learning algorithms.*
- *Unsupervised algorithms for clustering, Instance-based learning and Principal Component Analysis.*
- *The inference and learning algorithms for the hidden Markov model and Bayesian networks and few machine learning tools.*

UNIT I	SUPERVISED LEARNING (REGRESSION / CLASSIFICATION)	9

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Nave Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models :Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking – Getting Started with Python.

UNIT II	LINEAR MODELS	9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation of Error – Multilayer Perceptron in Practice – Examples of using the MLP – Deriving Back Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Interpolations and Basis Functions – Linear Discriminant Analysis – Principal components Analysis – Factor Analysis – Independent Components Analysis – Locally Linear Embedding – Isomap.

UNIT III	SUPPORT VECTOR MACHINES AND EVOLUTIONARY MODELS	9

Optimal Separation – Kernels – The Support Vector Machine Algorithm – Extensions to the SVM – The Genetic Algorithm – Generating Offspring: Genetic Operators – Using Genetic Algorithms – Genetic Programming – Combining Sampling with Evolutionary Learning – Reinforcement Learning – Overview – Example: Getting Lost – Markov Decision Processes – Values – The Difference between Sarsa and Q-Learning – Uses of Reinforcement Learning.

UNIT IV	TREE AND UNSUPERVISED LEARNING	9

Learning with Trees – Using Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Classification Example – Decision by Committee: Ensemble Learning – Boosting – Bagging – Random Forests – Different Ways to combine Classifiers – Unsupervised Learning – The K-Means Algorithm – Vector Quantisation – The Self-Organising Feature Map.

UNIT V	GRAPHICAL MODELS AND OPTIMISATION	9
Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods – Energetic Learning – The Hopfield Network – Stochastic Neurons – The Boltzmann Machine – Deep Learning – Optimisation and search – Going Downhill – Least-Squares Optimisation – Conjugate Gradients – Search: Three Basic Approaches – Exploitation and Exploration – Simulated Annealing.		
		TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Extract features that can be used for a particular machine learning approach in various IOT applications
2.	To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3.	To mathematically analyse various machine learning approaches and paradigms
4.	Explain and discuss the basic concepts and architecture of reinforcement learning algorithms.
5.	Explain and discuss the basic concepts of un-supervised machine learning

REFERENCES:	
1.	*Stephen Marsland,"Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.*
2.	*Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012*
3.	*Ethem Alpaydin,"Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014.*
4.	*Jason Bell,"Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1		1		2		3		2	1
CO2		2			1	3				3	1			3
CO3	2		3	2			3	1				1	2	
CO4			1		2			3		1				
CO5		1					3		2			2		

(1- Low, 2- Moderate, 3-High)

18CSPE02	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Wireless Sensor Networks and Architecture of Wireless Sensor Networks*
- *Networking of Sensors and Establishment of Infrastructure for WSN*
- *Sensor Network platforms and tools*

UNIT I	INTRODUCTION	8

Challenges For Wireless Sensor Networks - Comparison of Sensor Network with Ad Hoc Network - Single Node Architecture - Hardware Components - Energy Consumption of Sensor Nodes - Network Architecture - Sensor Network Scenarios - Design Principles. .

UNIT II	PHYSICAL LAYER	9

Channel And Communication Fundamentals - Physical Layer and Transceiver Design Consideration in Wireless Sensor Networks–IEEE Standards: Bluetooth, IEEE 802.11b – Representative sensor nodes -WINS, μamps

UNIT III	DATA LINK LAYER	9

MAC Protocols -Fundamentals of Wireless MAC Protocols, Low Duty Cycle Protocols and Wakeup Concepts – Contention Based Protocols – Schedule Based Protocols - Link Layer Protocols - Error Control – Framing - Traffic -Adaptive Medium Access Protocol (TRAMA) -The IEEE 802.15.4 MAC Protocol.

UNIT IV	NETWORK LAYER	9

Gossiping and Agent-Based UniCast Forwarding – Energy Efficient Unicast, Broadcast and Multicast - Geographic Routing - Mobile Nodes - Data Centric and Content Based Networking - LEACH, PEGASIS - Location Based Routing - GF, GAF, GEAR, GPSR - Real Time Routing Protocols - TEEN, APTEEN, SPEED, RAP - Data Aggregation.

UNIT V	SENSOR PROGRAMMING AND APPLICATIONS	10

Programming Challenges in Wireless Sensor Networks - Tiny Operating System –Event Driven Programming -Contiki OS - Techniques for Protocol Programming. Applications - Environmental Disaster Monitoring, Habitat Monitoring, Military Battlefield Awareness, Underwater Acoustic And Deep Space Networks, Wireless Body Area Networks (WBAN) for Health-Monitoring - Open Issues and Design Challenges

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand the concepts of wireless sensor networks
2.	Analyze the functionalities of various layers of wireless sensor networks..
3.	Able to do sensor programming and develop applications.
4.	Explain the characteristics , requirements and applications of Wireless Sensor Networks
5.	Establish Infrastructure for WSN and Use Sensor Network platforms and tools

REFERENCES:

1.	*Holger Karl and Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, USA, 2007.*
2.	*Kazemsohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Networks, Technology, Protocols and Applications", Wiley Interscience, USA, 2007*
3.	*Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach", Elsevier Publication, USA, 2004*
4.	*Sudip Misra, Isaac Woungang and Subhas Chandra Misra, "Guide to Wireless Sensor Networks", Springer Publication, 2006*
5.	*Sitharama Iyengar S, Nandan Parameshwaran, Balkrishnan N and Chuka D Okye, "Fundaments of Sensor Network Programming , Applications and Technology" , John Wiley & Sons, USA, 2011*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		2		3	1		2			3	1		3	1
CO2	3	2		2		3		1	2			3	2	
CO3	3		1		1		3			1	3		2	3
CO4			2					1				2		
CO5		1				3			1		3			2

(1- Low, 2- Moderate, 3-High)

18CSPE03	MULTI-CORE ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Fundamentals of Computer Design , Multithreading and Memory Technology and Optimizations*
- *Symmetric and Distributed Shared Memory Architectures ,Interconnection Networks.*
- *Graphics Processing Units and Vector Architecture.*

UNIT I	FUNDAMENTALS OF COMPUTER DESIGN AND ILP	9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges – Limitations of ILP – Multithreading – SMT and CMP Architectures – The Multicore era.

UNIT II	MEMORY HIERARCHY DESIGN	9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III	MULTIPROCESSOR ISSUES	9

Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization Issues – Models of Memory Consistency – Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT IV	MULTICORE ARCHITECTURES	9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers, Cloud Computing –Architectures and Issues – Case Studies.

UNIT V	VECTOR, SIMD AND GPU ARCHITECTURES	9

Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism.

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Identify the limitations of ILP and the need for multicore architectures.
2.	Discuss the issues related to multiprocessing and suggest solutions.

3.	Point out the salient features of different multicore architectures and how they exploit Parallelism.
4.	Critically analyze the different types of inter connection networks.
5.	Design a memory hierarchy and optimize it.

REFERENCES:

1.	*John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Fifth edition, Morgan Kaufmann / Elsevier, 2012.*
2.	*Darryl Gove, "Multicore Application Programming: For Windows, Linux, and Oracle Solaris", Pearson, 2011.*
3.	*David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kauffman, 2010.*
4.	*Wen– mei W. Hwu, "GPU Computing Gems", Morgan Kaufmann / Elsevier, 2011*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3			2			1	2		2	3		2	3
CO2	3				1	3	2	1				3		1
CO3			2	2	1					3	2		1	
C04	3	2		3		2			1			1		
C05		3	2		1		3			1	3		2	1

(1- Low, 2- Moderate, 3-High)

ELECTIVE LABORATORY - I

18CSPE04	MACHINE LEARNING USING PYTHON LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Design and implement Bayesian belief networks and various Decision tress.*
- *Design and implement Linear and logistic regression.*
- *Design and implement Principal Component Analysis.*

LIST OF EXPERIMENTS

To complete the programming assignments, you will need to use Python packages.

Develop machine learning code to illustrate

1. Bayesian belief networks
2. Decision trees
3. Linear regression
4. Logistic regression
5. Regularized linear and logistic regression
6. Supervised Learning - Multiclass classification
7. Multiclass classification using Back propagation neural network
8. Support vector machines
9. Unsupervised learning – K means clustering
10. Principal Component Analysis
11. Anomaly Detection using the Multivariate Gaussian Distribution
12. Recommender Systems – Collaborative Filtering
13. Reinforcement learning
14. Character recognition
15. Analyze financial data to predict loan defaults.

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develop applications of machine learning algorithms using Python.
2.	Develop and implement various regression algorithms.

3.	Develop character recognition .
4.	Analyze financial data to predict loan defaults.
5.	Develop applications of unsupervised learning.

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO 4**
CO1	3	2		2	1				2	2	3	1	2	3
CO2			1				3					2		
CO3	1				1					3				
CO4			2					3				1		
CO5		2				2								1
(1- Low, 2- Moderate, 3-High)														

18CSPE05	WIRELESS SENSOR NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Design and implement various selectors and players.*
- *Design and simulate WSN.*
- *Automatic controlling of devices and equipments.*

LIST OF EXPERIMENTS

Hardware required

- *Wireless Sensor Network Development Board (802.15.4),*
- *Arduino Uno R3,*
- *Sensor module Kit,*
- *Xbee radios, Xbee USB Adapter,*
- *One or two XBee Explorers,*
- *Three XBee ZBs with wire antenna,*
- *One or two XBee modules*

Develop the following exercises

1. Blinking LED - Configurate the XBee modules and the Arduino to blink a LED at the receiver part.
2. Chatting through XBees
3. Sunset alarm
4. Melody Selector – In one node, select the melody to be played and in the second one the order has to be received and the melody be played
5. Morse code player - Reproduce the characters from the sender side into Morse code
6. Activate a fan depending on temperature
7. Measuring light pollution
8. Remotely controlling a car
9. Sensing positioning data using GPS and transmitting it.
10. Simulating WSNs made up of motes running TinyOS using the TinyOS simulation framework TOSSIM
11. Sound detection
12. Visualization in WSN
13. Contiki OS – Hello World
14. COOJA simulation
15. Multiple nodes - Broadcast and Unicast

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develop various applications using wireless sensor networks.
2.	Develop applications on automation.
3.	Develop various applications on selectors .
4.	Develop various applications on code players.
5.	Develop various applications on visualization .

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3		2		2		1			1	3	1	2	3
CO2		1				1		2			2		1	
CO3				3			3		2					1
CO4	2													
CO5			1			3		1			2		2	

(1- Low, 2- Moderate, 3-High)

18CSPE06	MULTICORE PROGRAMMING USING OPEN MP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Design and implement application for testing compiler.*
- *Design and implement matrix.*
- *Developing and implement threads.*

LIST OF EXPERIMENTS

1. Simple example program that can be used to test the compiler.
2. Develop a program that sends a row (a column) of a matrix from one process to another.
3. Write a program that sends a block of a matrix from one process to another.
4. Write numbers 0-99 to a file in parallel using MPI I/O. Verify the write by reading the file with different number of processes than in writing.
5. Write numbers 0-99 to a file. Distribute the numbers to the processes in strides, (e.g. 0, 4, 8, ... for rank 0 with 4 processes) but have the numbers in the correct order in the file.
6. Write an array that is ditributed in two dimension to a file using MPI I/O.
7. Incorporate calls to omp_get_num_threads() into the code and print its value within and outside the parallel region.
8. Implement a simple dot product of two vectors. Try to parallelize the code by using omp parallel or omp for pragmas
9. Write a simple program that uses omp_get_num_threads and omp_get_thread_num library functions and prints out the total number of active threads as well as the id of each thread.
10. Implement simple summation of two vectors C=A+B. Add the computation loop and add the parallel region with the work sharing directives so that the vector addition is executed in parallel.

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develop application using Open MP and high performance computing.
2.	Develop application for threads.
3.	Knowledge about parallel regions.
4.	Knowledge about files.

5.	Implementation of computational loops.

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3		2	2		1			1		3	3	2	1
CO2		1				2				3		2		
CO3							1	3			2			
CO4	2				2					2				
CO5				1					2				1	3

(1- Low, 2- Moderate, 3-High)

PROFESSIONAL ELECTIVES – II

18CSPE07	ETHICAL HACKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Introduction to Hacking, WHOIS Tools and Cracking Passwords.*
- *Scanning Methodology and Enumeration Procedure*
- *Windows OS Vulnerabilities , Security Assessments and Vulnerabilities.*

UNIT I	INTRODUCTION TO HACKING	9

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Foot printing – Information Gathering Methodology – Foot printing Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range –Meta Search Engines.

UNIT II	SCANNING AND ENUMERATION	9

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools.

UNIT III	SYSTEM HACKING	9

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges –Executing Applications – Key loggers and Spyware

UNIT IV	PROGRAMMING FOR SECURITY PROFESSIONALS	9

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT V	PENETRATION TESTING	9

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Demonstrate basics of information security.

2.	Apply different scanning approaches for security.
3.	Design a system hacking tool.
4.	Program for security professionals.
5.	Do security assessment.

REFERENCES:

1.	*Patrick Engebretson, "The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy", Syngress Media, Second Revised Edition, 2013.*
2.	*Michael T. Simpson, Kent Backman, James E. Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning, 2012.*
3.	*Ec-Council, "Ethical Hacking and Countermeasures: Attack Phases", Delmar Cengage Learning, 2009.*
4.	*Jon Erickson, "Hacking: The Art of Exploitation", No Starch Press, Second Edition, 2008.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2			1			3	3		2	3
CO2		2			1		2		1			3		
CO3	3			2		1		2		2	1			1
CO4	3	2			3	2			2				2	
CO5			2	3			1	3		1	3	1	2	3

(1- Low, 2- Moderate, 3-High)

18CSPE08	NETWORK ON CHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Classification of ICNs and virtual channels.*
- *Deterministic routing algorithms, Routing in MINs and Router architecture.*
- *NoC Architectures and emerging trends.*

UNIT I	ICN ARCHITECTURES	9

Introduction - Classification of ICNs - Topologies - Direct networks – Indirect networks-Performance analysis.

UNIT II	SWITCHING TECHNIQUES	9

Basic switching techniques - Virtual channels - Hybrid switching techniques Optimizing switching techniques - Comparison of switching techniques - Deadlock, livelock and Starvation

UNIT III	ROUTING ALGORITHMS	9

Taxonomy of routing algorithms - Deterministic routing algorithms –Partially adaptive algorithms - Fully adaptive algorithms - Routing in MINs - Routing in switch-based networks with irregular topologies – Resource allocation policies- Flow control.

UNIT IV	NETWORK-ON-CHIP	9

NoC Architectures - Router architecture - Area, energy and reliability constraints - NoC design alternatives - Quality-of Service (QoS) issues in NoC architectures

UNIT V	EMERGING TRENDS	9

Fault-tolerance issues - Emerging on-chip interconnection technologies- 3D NoC- Simulation

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand major components involved in the ICN architecture.
2.	Analyze switching techniques for optimizing the network.
3.	Design and implement routing algorithms and flow control

4.	Analyze and Design alternatives of NoC - Quality-of Service (QoS) issues
5.	Simulate and assess the performance of a given on-chip network.

REFERENCES:

1.	*Natalie D. Enright Jerger, Li-ShiuanPeh, "On-Chip Networks (Synthesis Lectures on Computer Architecture)", Morgan and Claypool, 2008.*
2.	*Giovanni De Micheli, Luca Benini, "Networks on Chips: Technology and Tools", Morgan Kaufmann, 2006.*
3.	*Fayez Gebali, HaythamElmiligi, Mohamed Wathed El-Kharashi, "Networks-on-Chips: Theory and Practice", CRC Press, 2009*
4.	*Jose Duato, SudhakarYalamanchili, Lionel Ni, "Interconnection Networks: An Engineering Approach", Morgan Kaufmann, 2003.*
5.	*William James Dally, Brian Towles, "Principles and Practices of Interconnection Networks", Morgan Kaufmann, 2004.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		3	1			2	3		2	1
CO2		2	2		1		2		2			3	2	
CO3	3					3		1			1			3
CO4		2		1					3			1	2	
CO5	3		2		1		2			3	3		1	2

(1- Low, 2- Moderate, 3-High)

18CSPE09	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Fundamental characteristics of IoT and its applications*
- *Standardization efforts for IoT*
- *Data link and network layer functionality of IoT*

UNIT I	INTRODUCTION TO IoT	9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II	IoT ARCHITECTURE	9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III	IoT PROTOCOLS	9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

UNIT IV	BUILDING IoT WITH RASPBERRY PI & ARDUINO	9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V	CASE STUDIES AND REAL-WORLD APPLICATIONS	9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Analyze various protocols for IoT
2.	Develop web services to access/control IoT devices.

3.	Design a portable IoT using Rasperry Pi
4.	Deploy an IoT application and connect to the cloud.
5.	Analyze applications of IoT in real time scenario

REFERENCES:

1.	*Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015*
2.	*Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.*
3.	*Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.*
4.	*Jan Ho¨ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.*
5.	*Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		3	1	3		1	3		2	1
CO2		2	3		1		2					2		3
CO3	3		2	2	1				2		1			
CO4	3			2			2	3		1		3	2	
CO5	2		2			1	1		2		3		2	1

(1- Low, 2- Moderate, 3-High)

SEMESTER – II

PROGRAM CORE

18CSPC06	CLOUD AND VIRTUALIZATION TECHNIQUES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Basic underlying concepts, Characteristics, issues and challengesof cloud computing.*
- *Cloud computing architecture and virtualization.*
- *Real-world cloud applications.*

UNIT I	INTRODUCTION TO CLOUD COMPUTING	9

Introduction: The Vision of Cloud Computing – Defining a Cloud – A Cloud Computing Reference Model –Characteristics and Benefits – Challenges Ahead – Historical Developments – Building Cloud Computing Environments. Cloud Computing Architecture: The Cloud Reference Model – Architecture – Infrastructure-as-a-Service – Hardware-as-a-Service – Platform-as-a-Service – Software-as-a-Service – Types of Clouds – Economics of the Cloud – Open challenges.

UNIT II	CLOUD PLATFORMS AND CLOUD APPLICATIONS	12

Cloud Platforms in Industry: Amazon Web Services – Google AppEngine – Microsoft Azure. Cloud Applications: Scientific Applications – Business and Consumer Applications. Advances in Cloud Computing: Energy Efficiency in Clouds – Market-based Management of Clouds – Federated Clouds/InterCloud – Third-party Cloud Services.

UNIT III	VIRTUAL MACHINES	12

Introduction to Virtual Machines: Computer Architecture – Virtual Machine Basics – Process Virtual Machines – System Virtual Machines. Process Virtual Machines: Virtual Machine Implementation – Compatibility – State Mapping – Memory Architecture Emulation – Instruction Emulation – Exception Emulation – Operating System Emulation – Code Cache Management – System Environment.

UNIT IV	HIGH-LEVEL LANGUAGE VIRTUAL MACHINES	12

High-Level Language Virtual Machine Architecture: The Pascal P-Code Virtual Machine – Object-Oriented High-Level Language Virtual Machines – The Java Virtual Machine Architecture – Completing the Platform: APIs – The Microsoft Common Language Infrastructure: A Flexible High-Level Language Virtual Machine. High-Level Language Virtual Machine Implementation: Dynamic Class Loading – Implementing Security – Garbage Collection – Java Native Interface – Basic Emulation – High-Performance Emulation.

UNIT V	SERVER VIRTUALIZATION	15
Introduction to Server Virtualization – Types of Server Virtualization Technologies – Physical Partitioning – Logical Partitioning – Server Virtualization Concepts – Virtual Hardware – Uses of Server Virtualization – Server Virtualization Platforms.		
		TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Acquire knowledge of cloud computing and virtualization.
2.	Deploy legacy OSs on virtual machines
3.	Analyze the intricacies of server, storage and network virtualizations
4.	Design and develop applications on virtual machine platforms
5.	Utilize various hypervisors for virtualization.

REFERENCES:	
1.	*Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S, "Mastering Cloud Computing", Tata McGraw Hill Education Private Limited, New Delhi, 2013.*
2.	*James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.*
3.	*David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.*
4.	*Kumar Reddy, Victor Moreno, "Network virtualization", Cisco Press, July, 2006.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		3		3	1		3				2	3
CO2		2			1		2	2		1	3	1		
CO3			2	2					1				1	
CO4	3	2				2		2		2	1			1
CO5			2		1	3			2			1		3
(1- Low, 2- Moderate, 3-High)														

18CSPC07	DATA STORAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Data base design and data center environment*
- *Data storage and Retrieval Techniques*
- *Securing and managing storage infrastructure and backups.*

UNIT I	INTRODUCTION TO STORAGE AND MANAGEMENT	9

Introduction to Information Storage - Data Center Environment – Database Management System (DBMS) - Host - Connectivity – Storage - Disk Drive Components - Intelligent Storage System - Components of an Intelligent Storage System - Storage Provisioning – Types of Intelligent Storage Systems.

UNIT II	STORAGE NETWORKING TECHNOLOGIES	9

Fibre Channel Storage Area Networks – Fibre Channel: Overview – SAN and Its Evolution – Components of FC SAN – FC Connectivity – Switched Fabric Ports – FC Architecture – IP SAN and FcoE – FCIP – Network-Attached Storage – General-Purpose Servers versus NAS Devices – Benefits of NAS- File Systems and Network File Sharing – Components of NAS – NAS I/O Operation – NAS Implementations – NAS File-Sharing Protocols – Object-Based Storage Devices – Content-Addressed Storage – CAS Use Cases.

UNIT III	BACKUP AND RECOVERY	9

Business Continuity – Information Availability – BC Terminology – BC Planning Life Cycle – Failure Analysis – Business Impact Analysis – Backup and Archive – Backup Purpose – Backup Considerations – Backup Granularity – Recovery Considerations – Backup Methods – Backup Architecture – Backup and Restore Operations – Backup Topologies – Data Deduplication for Backup – Data Archive – Archiving Solution Architecture.

UNIT IV	SECURING AND MANAGING STORAGE INFRASTRUCTURE	9

Information Security Framework – Storage Security Domains – Security Implementations in Storage Networking – Monitoring the Storage Infrastructure – Storage Infrastructure Management Activities – Storage Infrastructure Management Challenges – Information Lifecycle Management – Storage Tiering.

UNIT V	CLOUD DATA CENTER MANAGEMENT	9

Data Center Evolution - Mainframes to the Cloud - The Data Center Evolution - Computer Networks – Ethernet - Enterprise versus Cloud Data Centers - Movement to the Cloud. Switch Fabric Technology - Switch Fabric Architecture Overview - Switch Fabric Topologies - Congestion

Management - Flow Control - Traffic Management - Switch Chip Architecture Examples. Cloud Data Center Networking Topologies - Traditional Multitiered Enterprise Networks - Data Center Network Switch Types - Flat Data Center Networks - Rack Scale Architectures - Network Function Virtualization. Data Center Networking Standards - Ethernet Data Rate Standards - Virtual Local Area Networks - Data Center Bridging - Improving Network Bandwidth - Remote Direct Memory Access.

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Identify the components of managing the data center .
2.	Evaluate storage architectures, including storage subsystems SAN, NAS, IPSAN,CAS
3.	Understand the business continuity, backup and recovery methods.
4.	Understand data center strategies involved in cloud computing.
5.	Understand logical and physical components of a storage infrastructure.

REFERENCES:	
1.	*EMC Corporation, "Information Storage and Management", Wiley India, 2nd Edition, 2011 (First Four units)*
2.	*Gary Lee, "Cloud Networking - Understanding Cloud-based Data Center Networks", Elsevier, 2014 (Fifth Unit)*
3.	*Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2017.*
4.	*Marc Farley, "Building Storage Networks", Tata McGraw Hill, Osborne,2nd Edition, 2001.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1		1		3	2		2		3	2	3
CO2		1		3	1				1		1			
CO3	3		2			2	1			2	3		2	1
CO4				1				3	2			1		3
CO5	1					1				2			1	

(1- Low, 2- Moderate, 3-High)

18CSPC08	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Intermediate Representations and Control and Data flow analysis*
- *Early and loop Optimization and Procedure optimization and scheduling*
- *Interprocedural analysis and memory hierarchy optimization*

UNIT I	INTERMEDIATE REPRESENTATIONS	9

Introduction to compiler technologies - Review of compiler Structure - Intermediate Representations - - Run Time Support: Data representations and Instructions - Register Usage - The local stack frame - Run time Stack - Parameter Passing - Procedure Prologues, Epilogues, Calls and Returns - Code sharing and position independent code -- Producing Code Generators Automatically.

UNIT II	FLOW ANALYSIS	9

Control Flow Analysis – Data-Flow Analysis: Iterative data flow analysis, Lattices of flow functions, Control-Tree-based Data-Flow Analysis, Structural analysis, Interval analysis - Dependence Analysis and Dependence Graphs - Alias Analysis.

UNIT III	EARLY OPTIMIZATIONS AND LOOP OPTIMIZATIONS	9

Introduction to optimization: Importance of Individual optimizations, Order and repetition of optimizations - Early Optimization: Constant folding, Scalar replacement of aggregates, Algebraic simplifications and Reassociation, Value Numbering, Copy and Constant Propagation - Redundancy Elimination - Loop Optimizations.

UNIT IV	PROCEDURE OPTIMIZATIONS AND SCHEDULING	9

Procedure Optimizations - Register Allocation - Code Scheduling – Control-Flow and Low- Level Optimizations: Unreachable-code elimination, Straightening, If and Loop simplification, Loop inversion, Unswitching, Branch Optimizations, Tail merging, Conditional moves, Dead-code elimination, Branch prediction.

UNIT V	INTERPROCEDURAL ANALYSIS AND MEMORY HIERARCHY OPTIMIZATION	9

InterProcedural Analysis and Optimizations: Interprocedural Control-Flow Analysis, Interprocedural Data-Flow Analysis, Interprocedural Alias Analysis, Interprocedural Constant Propagation, Interprocedural Optmization, Interprocedural Register allocation – Optimization for the Memory Hierarchy: Impact of data and Instruction Caches, Instruction-Cache Optimizations.

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Identify the different optimization techniques that are possible for a sequence of code
2.	Design performance enhancing optimization techniques
3.	Manage procedures with optimal overheads
4.	Ensure better utilization of resources
5.	Eliminate redundancy from IR and Target Code

REFERENCES:	
1.	*Steven Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufman Publishers, 1997.*
2.	*Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2014.*
3.	*Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.*
4.	*Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2012.*
5.	*Randy Allen and Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufman, 2001.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1			1	3		3	1	2	3
CO2		2			1		3			1			2	1
CO3	3		2	2		3			1		2	1		
CO4	3		2		3			1		3	3		1	3
CO5		1				2			2			2		

(1- Low, 2- Moderate, 3-High)

18CSPC09	CLOUD AND VIRTUALIZATION TECHNIQUES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Installation of various hypervisors.*
- *Designing a open source network*
- *Implementation of various scheduling mechanisms.*

LIST OF EXPERIMENTS

1. Installation of various hypervisors and instantiation of VMs with image file using open source hypervisors such as Virtual Box, VMWare Player, Xen and KVM.
2. Client server communication between two virtual machine instances, execution of chat application.
3. Creation of simple network topology using open source network virtualization tools (like mininet and others).
4. Implementation of simple network protocols using open source network controllers (like OpenDaylight).
5. Implementation of various scheduling mechanisms using open source cloud simulator.
6. Familiarization and usage of the following cloud services with open source cloud tools (like Eucalyptus, Openstack, Open Nebula and others)
    a. scheduling mechanisms
    b. load balancing mechanisms
    c. hashing and encryption mechanisms
7. Familiarization and usage of collaborative applications (SaaS).
8. Implementing applications using Google App Engine (PaaS).
9. Develop MapReduce application (example-URL Pattern count and others) using Hadoop cluster set up (Single node and multi node).

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Run and work on virtual machines.
2.	Implement applications by simulated software.
3.	Implement Map reduce application to analyse the data.
4.	Familiarization and usage of the cloud services
5.	Familiarization and usage of collaborative applications

COURSE ARTICULATION MATRIX:														
	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1		1		3		2	3
CO2	2		3		1		2	2		3	1	1	2	
CO3	3		2	2	1			3			1		2	1
CO4		1				1				2				
CO5				3					3				1	
(1- Low, 2- Moderate, 3-High)														

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVES – III

18CSPE10	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Understand the competitive advantages of big data analytics*
- *Understand the big data frameworks*
- *Learn data analysis methods and to learn stream computing*

UNIT I	INTRODUCTION TO BIG DATA AND DATA ANALYTICS	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. Data Analytics Lifecycle: Discovery - Data Preparation - Model Planning - Model Building - Communicating Results - Operationalizing - Role of the Data Scientist.

UNIT II	PREDICTIVE ANALYTICS	9

Data Collection - Sampling - Preprocessing - Linear Regression - Logistic Regression - Decision Trees - Neural Networks - Support Vector Machines - Ensemble Methods - Multiclass Classification Techniques - Evaluating Predictive Models.

UNIT III	DESCRIPTIVE AND SURVIVAL ANALYTICS	9

Association Rules - Sequence Rules - Segmentation - Survival Analysis Measurements - Kaplan Meier Analysis - Parametric Survival Analysis - Proportional Hazards Regression - Extensions of Survival Analysis Models - Evaluating Survival Analysis Models.

UNIT IV	MINING OF MASSIVE DATA SETS	9

Mining Data Streams - Advertising on the Web - Recommendation Systems - Mining Social - Network Graphs - Large-Scale Machine Learning - Applications.

UNIT V	FRAMEWORKS AND TOOLS	9

Map Reduce Framework - Hadoop - Spark. Tools: Pig - Hive. R Programming. NoSQL Databases: Need - Characteristics - Properties - Key-value Stores - Column Family Stores. Open Source Big Data Store :Hbase.

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:

1.	Understand how to leverage the insights from big data analytics
2.	Analyze data by utilizing various statistical and data mining approaches
3.	Perform analytics on real-time streaming data
4.	Use different frameworks such as Hadoop, Spark and Tools like Pig, etc.
5.	Understand the various NoSql alternative database models

REFERENCES:

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.	*David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.*
3.	*Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley, USA, 2014.*
4.	*Ohlhorst and Frank J, "Big Data Analytics: Turning Big Data into Big Money", Wiley, USA, 2012.*
5.	*Anand Rajaraman and Jeffrey D. Ullman, "Mining of Massive Datasets",2011.*
6.	*Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packet Publishing, Birmingham, Mumbai, 2013.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1		3		3		2	1
CO2		2	1		3		2	1		2	1	3	2	
CO3	3		2	2	1				1					3
CO4	2				2		3					3		3
CO5	3	2		2		1		1		2	3		1	

(1- Low, 2- Moderate, 3-High)

18CSPE11	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *To review image processing techniques for computer vision.*
- *To understand shape and region analysis.*

To understand Hough Transform and its applications to detect lines, circles, ellipses.

UNIT I	LOW LEVEL VISION	9

Images and Imaging Operations – Image Filtering and Morphology – The Role of Thresholding – Edge detection – Corner,Interest Point and Invariant Feature Detection – Texture Analysis.

UNIT II	INTERMEDIATE LEVEL VISION	9

Binary Shape Analysis – Boundary Pattern Analysis – Line, Circle and Ellipse Detection – The generalized Hough Transform – Object Segmentation and Shape Models.

UNIT III	MACHINE LEARNING AND DEEP LEARNING NETWORKS	9

Basic Classification Concepts – Machine Learning: Probabilistic Methods – Deep Learning Networks.

UNIT IV	3D VISION AND MOTION	9

Three Dimensional World – Tackling the Perspective n-point Problem – Invariants and Perspective – Image Transformations and Camera Calibration – Motion.

UNIT V	APPLICATIONS	9

Face Detection and Recognition: the Impact of Deep Learning – Surveillance – The Basic Geometry – Foreground-Background Separation – Particle Filters – Chamfer Matching, Tracking, and Occlusion – Combining Views from Multiple Cameras – Human Gait analysis – Application: In-Vehicle Vision System: Locating the Roadway – Location of Road Markings – Location of Road signs – Location of Vehicles – Locating Pedestrians.

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develope the practical skills necessary to build computer vision applications.
2.	To have gained exposure to object and scene recognition and categorization from images
3.	Implement fundamental image processing techniques required for computer vision.
4.	Develop applications using computer vision techniques.
5.	Implement motion related techniques.

REFERENCES:	
1.	*E. R. Davies, "Computer Vision Principles,Algorithms,Applications,Learning", Fifth Edition, Academic Press, 2018.*
2.	*Computer Vision: Algorithms and Applications by Richard Szeliski,2010*
3.	*Deep Learning, by Goodfellow, Bengio, and Courville,2016*
4.	*Dictionary of Computer Vision and Image Processing, by Fisher et al, 2013*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		1	1	2		3	3		2	3
CO2	3		1		1		2		2		1	1	2	
CO3		1				2		1					2	
CO4	3		2		3				1			3		
CO5				3		1								1
(1- Low, 2- Moderate, 3-High)														

18CSPE12	LINUX SYSTEM PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *To study about system programming and linux programming concepts .*
- *To understand input and output.*
- *To understand process management ,Threading and memory management .*

UNIT I	INTRODUCTION AND FILE I/O	9

System Programming – APIs and ABIs – Standards – Concepts of Linux Programming. File I/O: Opening files – Reading – Writing – Synchronized I/O – Direct I/O – Closing Files – Seeking – Positional reads and writes – Truncating Files – Multiplexed I/O – Kernel Internals.

UNIT II	BUFFERED I/O AND ADVANCED I/O	9

Buffered I/O: User Buffered I/O – Standard I/O – Opening files – Opening and Closing streams – Reading from and writing to streams – Seeking a stream – Flushing a Stream – Errors and End-of-File – Obtaining the Associated File Descriptor – Controlling the Buffering – Thread Safety – Critiques of Standard I/O. Advance I/O: Scatter/Gather I/O – Event Poll – Mapping files into Memory – Advice for Normal File I/O – Synchronized, Synchronous and Asynchronous Operations – I/O Schedulers and I/O Performance.

UNIT III	PROCESS MANAGEMENT	9

Programs, Processes and Threads – The Process ID – Running a New Process – Terminating a Process – Waiting for Terminated Child Processes – Users and groups – Sessions and Process groups – Daemons. Advanced Process Management: Process scheduling – The Completely Fair Scheduler – Yielding the Processor - Process Priorities – Processor Affinity – Real-Time Systems – Resource Limits.

UNIT IV	THREADING & FILE AND DIRECTORY MANAGEMENT	9

Threading: Binaries, Processes and Threads – Multithreading – Threading Models – Threading Patterns – Concurrency, Parallelism and Races – Synchronization – Pthreads. File and Directory Management: Files and Their Metadata – Directories – Links – Copying and Moving Files – Device nodes – Out-of-Band Communication – Monitoring File Events.

UNIT V	MEMORY MANGEMENT, SIGNALS	9

Memory management: The Process address space - Allocating Dynamic Memory – Managing the Data Segment – Anonymous Memory Mappings – Advanced Memory Allocation – Debugging Memory Allocation – Stack-Based Allocations – Choosing a Memory Allocation Mechanism - Manipulating Memory - Locking Memory – Opportunistic Allocation. Signals: Signal Concepts –

Basic Signal Management – Sending a Signal – Reentrancy – Signal Sets – Blocking Signals – Advance Signal Management.	
	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand basics of System programming in Linux.
2.	Develop applications using Linux process , timing and signals.
3.	Understand basics of Threading in linux
4.	Understand memory management and signals
5.	Knowledge about files and directory.

REFERENCES:	
1.	*"Linux Systems programming", by Robert Love, 2nd Edition, 2013.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2	1		1	2			3		2	
CO2		2	3	1		2	2		2	1		1	2	3
CO3	1				2								2	
CO4			2					3		1		3		
CO5		1					2				3			

(1- Low, 2- Moderate, 3-High)

ELECTIVE LABORATORY – II

18CSPE13	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *To implement Map Reduce programs for processing big data*
- *To realize storage of big data using H base, Mongo DB*
- *To analyse big data using linear models*

LIST OF EXPERIMENTS

Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

R

4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R

LIST OF SOFTWARE REQUIRED:

1. Hadoop
2. YARN
3. R Package
4. Hbase
5. MongoDB

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Process big data using Hadoop framework
2.	Build and apply linear and logistic regression models
3.	Perform data analysis with machine learning methods
4.	Perform graphical data analysis
5.	Implement an application that stores big data in Hbase.

REFERENCES:	
1.	*Alan Gates and Daniel Dai, "Programming Pig – Dataflow scripting with Hadoop", O'Reilley, 2nd Edition, 2016.*
2.	*Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, ―An Introduction to Statistical Learning with Applications in R‖, Springer Publications, 2015(Corrected 6th Printing)*
3.	*Hadley Wickham,‖ggplot2 – Elegant Graphics for Data Analysis‖, Springer Publications,2nd Edition, 2016*
4.	*Kristina Chodorow, "MongoDB: The Definitive Guide – Powerful and Scalable Data Storage", O'Reilley, 2nd Edition, 2013.*
5.	*Lars George, "HBase: The Definitive Guide", O'Reilley, 2015.*
6.	*Tom White, ―Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale‖, O'Reilley, 4th Edition, 2015.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2			1		3				2	1
CO2		2			1	1	2			3	3		2	
CO3	2		2	2	1			2	1		1	3		3
CO4	3	2			2		1			1	3		1	
CO5			1			1							3	

(1- Low, 2- Moderate, 3-High)

18CSPE14	IMAGE PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *To implement Image processing In java*
- *To work in OpenCv in Python*
- *To implement OpenCv in C++*

LIST OF EXPERIMENTS

Image Processing in Java :

1. Read and Write
2. Get and set Pixels
3. Colored image to grayscale image conversion
4. Colored image to Negative image conversion
5. Colored to Red Green Blue Image Conversion
6. Colored image to Sepia image conversion
7. Creating a random pixel image
8. Creating mirror image
9. Face Detection
10. Watermarking an image)
11. Changing orientation of image

OpenCV in Python :

1. Working with Images in Python
2. Erosion and Dilation of images using OpenCV in python
3. Python Program to detect the edges of an image using OpenCV or Sobel edge detection method
4. Real-Time Edge Detection using OpenCV in Python or Canny edge detection method
5. Line detection in python with OpenCV or Houghline method
6. Template matching using OpenCV in Python
7. OpenCV Python Program to blur an image
8. Cartooning an Image using OpenCV in Python
9. OpenCV Python Program for face detection

OpenCV | C++ :

1. Gaussian Filter Generation in C++
2. OpenCV C++ Program to create a single colored blank image
3. OpenCV C++ Program to blur an image
4. OpenCV C++ Program for coin detection

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develop image processing tasks using Java and Open CV
2.	Knowing How to work with OpenCv using python
3.	Knowing How to work with OpenCv using C++
4.	Creating mirror images and face detection
5.	Creating programd for detections

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2		1			1			3	1	2	
CO2		3		1		1				2				
CO3		2			2				3				1	
CO4					2	1			3			2		
CO5		1		2			2				2			1

(1- Low, 2- Moderate, 3-High)

18CSPE15	LINUX SYSTEM PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Implementation of LINUX programs*
- *Knowledge of File concepts*
- *Implement signals and shared memory*

LIST OF EXPERIMENTS

1. Implement a C program that copies a source file to a destination file.
2. Implement a C program to reverse the contents of a given source file and put it into a new destination file.
3. Implement two C programs using write lock to the file.
4. Implement a C program in which multiple processes are contenting for a lock on a file to update that file automatically.
5. Implement a C program to create a Zombie state of the running program and verify using ps(l).
6. Implement a C program to create an orphan process.
7. Implement a C program to execute an executable program.
8. Implement a C program that writes a message every 5 seconds to filename supplied as an argument to the program.
9. Implement a C program for handling signal system call to catch different signals.
10. Implement a C program to ignore SIGINT signal then reset the default action of the SIGINT signal.
11. Implement a C program to set a interval timer for given milliseconds.
12. Implement a C program to print system resource limits.
13. Implement a C program for shared memory.

TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develop applications using Linux Systems programming for file operations
2.	Develop applications for shared memory access
3.	Develop applications for handling signals
4.	Knowledge of Threads

5.	Dvelopment of interactive environment

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2		1				1		3			2
CO2				2		1						3		
CO3	1						2			3			1	
CO4			1		3			1			2			3
CO5		1				3			2			2		

(1- Low, 2- Moderate, 3-High)

PROFESSIONAL ELECTIVES – IV

18CSPE16	COGNITIVE SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Computers in Cognitive Science, Interdisciplinary Nature of Cognitive Science*
- *Cognitive Psychology and Cognitive Neuroscience*
- *Architecture of Visual Computation and Connectionist Models*

UNIT I	INTRODUCTION TO COGNITIVE SCIENCE	9

The Cognitive view – Some Fundamental Concepts – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science. – Artificial Intelligence: Knowledge representation – Artificial Intelligence: Search, Control, and Learning.

UNIT II	COGNITIVE PSYCHOLOGY	9

Cognitive Psychology: The Architecture of the Mind – The Nature of Cognitive Psychology – The Notion of Cognitive Architecture – A Global View of the Cognitive Architecture – Propositional Representation – Schematic Representation – Cognitive Processes, Working Memory, and Attention – Mental Images – Automatic and Controlled Processes – The Acquisition of Skill – The Connectionist Approach to Cognitive Architecture.

UNIT III	COGNITIVE NEUROSCIENCE	9

Cognitive Neuroscience: Brain and Cognition – Introduction to the Study of the Nervous System – Organization of the Central Nervous System – Neural Representation – Neuropsychology – Computational Neuroscience – Cognitive Philosophy: Foundations of Cognitive Science – Philosophy in Cognitive Science – Ontological Issues – Epistemological Issues – The State of Cognitive Science.

UNIT IV	LANGUAGE ACQUISITION AND SEMANTICS	9

Linguistics: The Representation of Language – The Study of Linguistic Knowledge – Phonology – Syntax – Universals. Language Acquisition: Milestones in Acquisition – Theoretical Perspectives. Semantics: Semantics and Cognitive Science – Meaning and Entailment – Reference – Sense – Problems in Possible-Worlds Semantics – Cognitive and Computational Models of Semantic Processing.

UNIT V	NATURAL LANGUAGE PROCESSING AND VISION	9

Natural Language Processing: Preliminaries – Role of Grammar in Language Processing – Connectionist Models – Role of Discourse – Production. Vision – The Problem of Vision – Low-Level Visual Processes – Intermediate Processes and Representations in Vision – High-Level Visual

Processes – The Architecture of Visual Computation.	
	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Analyze principles of cognitive science
2.	Apply empirical findings and acquisition of skills.
3.	Explore mind reading to critically evaluate the work of others in the same domain.
4.	Apply the symbolic paradigm
5.	Be proficient with basic cognitive science research methods, including both theory-driven and applied research design, data collection, data analysis, and data interpretation.

REFERENCES:	
1.	*Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, "Cognitive Science: An Introduction", Second Edition, MIT press ,1995*
2.	*José Luis Bermúdez, "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York, 2014.*
3.	*Robert L. Solso, Otto H. MacLin and M. Kimberly MacLin, "Cognitive Psychology, Pearson Education, 2007.*
4.	*J. Friedenberg and G. Silverman, "Cognitive Science: An Introduction to the Study of Mind", 2011*
5.	*Steven Pinker, "How the mind works", W. W. Norton & Company; Reissue edition, 2009*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1			3	3			1
CO2			2		1		2	3	1			1	2	
CO3		3		2	1					1	1	3	2	3
CO4	3	2		3		1		3			1		1	
CO5	3		2		1	2	1			2	3		2	1

(1- Low, 2- Moderate, 3-High)

18CSPE17	GPU COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Supercomputing, CUDA Hardware, Block Scheduling and Caches.*
- *Serial and Parallel Code , Shared Memory and Multi-CPU Systems.*
- *Memory Considerations , Operating Systems.*

UNIT I	INTRODUCTION	9

History of Supercomputing – Understanding Parallelism with GPUs: Traditional Serial Code – Serial/Parallel Problems – Concurrency – Types of Parallelism – Flynn's Taxonomoy – Common Parallel Patterns. CUDA Hardware: PC Architecture – GPU Hardware – CPUs and GPUs – Compute Levels. Grids, Blocks and Threads: Threads -Blocks – Grids – Warps – Block Scheduling – A Practical Example – Histograms.

UNIT II	MEMORY ORGANISATION	9

Memory Handling with CUDA: Introduction – Caches – Register Usage – Shared Memory – Constant Memory – Global Memory – Texture Memory.

UNIT III	CUDA IN PRACTICE	9

Using CUDA in Practice: Serial and Parallel Code – Processing Datasets – Profiling – An Example using AES. Multi-CPU and Multi-GPU Solutions: Locality – Multi-CPU Systems – Multi-GPU Systems – Algorithms on Multiple GPUs – Which GPU? – Single-Node Systems – Streams – Multiple-Node Systems.

UNIT IV	APPLICATIONS OPTIMIZATION	9

Parallel/Serial GPU/CPU Problem Breakdown – Memory Considerations – Transfers – Thread Usage, Calculations and Divergence – Algorithms – Resource Contentions – Self-Tuning Applications.

UNIT V	DESIGNING GPU-BASED SYSTEMS	9

Libraries and SDK: Libraries – CUDA Computing SDK – Directive-Based Programming – Writing Your Own Kernels. Designing GPU-Based Systems: CPU Processor – GPU Device – PCI-E Bus – GeForce Cards – CPU Memory – Air Cooling – Liquid Cooling – Desktop Cases and Motherboards – Mass Storage – Power Considerations – Operating Systems.

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Learn concepts in parallel programming.

2.	Implementation of programs on GPUs.
3.	Debugging and profiling parallel programs
4.	Learning Apllications optimization.
5.	Designing GPU based systems and their libraries.

REFERENCES:

1.	*Shane Cook , "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufman; 2012 (ISBN: 978-0124159334)*
2.	*David B. Kirk and Wen-mei W.Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", Morgan Kaufman; 2010 (ISBN: 978-0123814722)*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2			1			1		2		3
CO2			1		2				3				2	
CO3	2					2		2			1			1
CO4	1		2							1		1		
CO5		2		2			3				2		1	

(1- Low, 2- Moderate, 3-High)

18CSPE18	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Forensic Science, Digital Forensic.*
- *Types Of Computer Forensics Technology , Data Recovery*
- *Data Seizure And Computer Forensics Analysis*

UNIT I	INTRODUCTION	9

Introduction: Forensic Science – Digital Forensic – Uses of Digital Forensics – Locard's Exchange Principle – Scientific Method – Organizations of Note – Role of the Forensic Examiner in the Judicial System. Labs and Tools – Collecting Evidence – Windows System Artifacts – AntiForensics.

UNIT II	COMPUTER FORENSICS TECHNOLOGY	9

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types fo Computer Forensics Systems – Vendor and Computer Forensics Services.

UNIT III	COMPUTER FORENSICS EVIDENCE AND CAPTURE	9

Data Recovery – Evidence Collection and Data Seizure – Duplication and Preservation of Digital Evidence – Computer Image Verification and Authentication.

UNIT IV	COMPUTER FORENSICS ANALYSIS	9

Discovery of Electronic Evidence – Identification of Data – Reconstructing Past Events – Networks.

UNIT V	ADVANCED COMPUTER FORENCIS	9

Advanced Encryption: The Need to Conceal – Advanced Hacking – Advanced Tracker Hackers – The Problems of the Present – Computer Forensics Resources. Computer Forensics Case Studies: Lost Files – Corrupted Files – Disappearing Files – Forensic Accounting – Data Recovery.

TOTAL : 45 PERIODS

OUTCOMES: Upon completion of this course, the students will be able to:

1.	Understand relevant legislation and codes of ethics
2.	Computer forensics and digital detective and various processes, policies and procedures
3.	E-discovery, guidelines and standards, E-evidence, tools and environment.
4.	Email and web forensics and network forensics
5.	Understand Advanced computer Forencis

REFERENCES:	
1.	*John Sammons, The Basics of Digital Forensics, Elsevier,2012*
2.	*John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications, 2002*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1			3	3		1	
CO2	3				1		2	3				3		3
CO3		3	2		1	3			2		1		1	
CO4	3	2		1			1			1		2		1
CO5			1		2				3		1		2	

(1- Low, 2- Moderate, 3-High)

EMPLOYABILITY ENHANCEMENT COURSE

18CSEE10	MINI PROJECT WITH SEMINAR	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Usage of mathematical, computational and natural sciences gained by study, experience*
- *Practice with judgment to develop effective use of matter, energy and information to the benefit of mankind.*
- *Plan, execute, manage and document a project*

OUTCOMES:	Upon completion of this course, the students will be able to:
1. .	Identify research intensive feasible problems by considering societal/industrial Demands.
2.	Perform exhaustive literature survey on identified problem.
3.	Use design/simulation tools to implement critical methods/algorithms of the identified problem from the literature.
4.	Perform preliminary implementation to achieve encouraging results.
5.	Develop and deliver a good quality formal presentation.

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1	3	1	3	2	3	3	2	3	3	1	3
CO2	3	2	1	3	1	3	2	1	3	1	3	2	1	3
CO3	3	3	1	3	1	3	3	2	3	1	3	2	1	3
CO4	3	3	2	2	2	1	3	1	2	1	3	2	3	3
CO5	3	3	2	2	2	1	3	3	2	1	2	2	2	2

(1- Low, 2- Moderate, 3-High)

SEMESTER – III

PROFESSIONAL ELECTIVES – V

18CSPE19	MOBILE APPLICATION AND SERVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Fragments and Intents , Managing Changes to Screen Orientation.*
- *Designing Your User Interface with Views and Creating Your Own Content Providers.*
- *Networking ,Consuming Web Services Using HTTP , Sockets Programming*

UNIT I	INTRODUCTION	9

Getting Started with Android Programming: What is Android? – Obtaining the Required Tools – Creating Your First Android Application – Anatomy of an Android Application. Activities, Fragments and Intents: Understanding Activities – Linking Activities Using Intents – Fragments – Calling Built-In Applications Using Intents – Displaying Notifications.

UNIT II	ANDROID USER INTERFACE	9

Understanding the Components of a Screen – Adapting to Display Orientation – Managing Changes to Screen Orientation – Utilizing the Action Bar – Creating the User Interface Programmatically – Listening for UI Notifications.

UNIT III	DESIGNING USER INTERFACE	9

Designing Your User Interface with Views: Basic Views – Picker Views – List Views – Understanding Specialized Fragments – Displaying Pictures and Menus with Views – Using Image Views to Display Pictures – Using Menus with Views – Some Additional Views.

UNIT IV	DATA PERSISTENCE AND CONTENT PROVIDERS	9

Saving and Loading User Preferences – Persisting Data to Files – Creating and Using Databases – Sharing Data in Android – Using a Content Provider – Creating Your Own Content Providers – Using the Content Provider – Messaging.

UNIT V	DEVELOPING ANDROID SERVICES	9

Location-Based Services – Displaying Maps – Getting Location Data – Monitoring a Location – Project – Building a Location Tracker – Networking – Consuming Web Services Using HTTP – Consuming JSON Services – Sockets Programming – Developing Android Services – Publishing Android Applications.

	TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:

1.	Identify the target platform and users
2.	Understand the fundamentals, frameworks.
3.	Design and develop a mobile application prototype in one of the platform. (challengeproject)
4.	Be able to define and sketch a mobile application.
5.	Development lifecycle of mobileApplication platforms including ios, android, and phonegap.

REFERENCES:	
1.	*Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons.*
2.	*Reto Meier, Professional Android™ 4 Application Development, 2012 by John Wiley & Sons.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		3	1				3		2	
CO2			1		1		2	3	1			1		3
CO3	3		2	2	1					3			2	1
CO4		1				2		1			2			
CO5	1			3					3				3	

(1- Low, 2- Moderate, 3-High)

18CSPE20	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Contract Management, Stepwise Project Planning and Cash Flow Forecasting.*
- *Hazard Analysis , Risk Management and Sequencing and Scheduling Activities.*
- *Visualizing Progress and Organizational Behaviour.*

UNIT I	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT	9

Project Definition – Contract Management – Activities Covered By Software Project Management – Overview Of Project Planning – Stepwise Project Planning.

UNIT II	PROJECT EVALUATION	9

Strategic Assessment – Technical Assessment – Cost Benefit Analysis –Cash Flow Forecasting – Cost Benefit Evaluation Techniques – Risk Evaluation.

UNIT III	ACTIVITY PLANNING	9

Objectives – Project Schedule – Sequencing and Scheduling Activities –Network Planning Models – Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature Of Risk – Types Of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning And Control.

UNIT IV	MONITORING AND CONTROL	9

Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value – Priortizing Monitoring – Getting Project Back To Target – Change Control – Managing Contracts – Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management – Acceptance.

UNIT V	MANAGING PEOPLE AND ORGANIZING TEAMS	9

Introduction – Understanding Behavior – Organizational Behaviour: A Background – Selecting The Right Person For The Job – Instruction In The Best Methods – Motivation – The Oldman – Hackman Job Characteristics Model – Working In Groups – Becoming A Team –Decision Making – Leadership – Organizational Structures – Stress –Health And Safety – Case Studies.

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand the concepts of Software Project management.
2.	Evaluate a software project.

3.	Plan activities for the project.
4.	Manage team building for software development.
5.	Monitoring and controlling of projects.

REFERENCES:

1.	*Bob Hughes, Mikecotterell, "Software Project Management", Third Edition, Tata McGraw Hill, 2004.*
2.	*Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.*
3.	*Royce, "Software Project Management", Pearson Education, 1999.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2			1				3		2	
CO2		2			1		2			3		1		1
CO3	3		2		1				2			2		3
CO4	3			2		1		2		1	3		2	
CO5		1			2				1			2		

(1- Low, 2- Moderate, 3-High)

18CSPE21	BIOINFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Fundamentals of Genes and Genomes , Genetic Data and Genome Browsers*
- *Beginning of DNA replication ,Open Problems ,Multiple Replication.*
- *Breakpoints, Rearrangements in Tumor Genomes and Breakpoint Graphs*

UNIT I	INTRODUCTION AND FUNDAMENTALS	9

Fundamentals of Genes and Genomes – Fundamentals of Molecular Evolution – Genomic Technologies – The Beginning of Bioinformatics – Genetic Data, Databases, Data Format, Database Search, Data Retrieval Systems and Genome Browsers.

UNIT II	BIOINFORMATICS ALGORITHM AND ANALYSIS	9

Sequence Alignment and Similarity Searching in Genomic Databases: BLAST and FASTA – Additional Bioinformatics Analyses Involving Nucleic-Acid Sequences - Additional Bioinformatics Analyses Involving Protein Sequences – Phylogenetic Analysis.

UNIT III	DNA REPLICATION AND MOLECULAR CLOCKS	9

Beginning of DNA replication – Open Problems – Multiple Replication and Finding Replication – Computing Probabilities of patterns in a string - The frequency array – Converting patterns -Solving Problems – Finding frequent words – Big-O notation – Case Study – The Tower of Hanoi problem. Molecular Clocks – Brute Force Algorithm – Scoring Motifs – Greedy Motif Search – Randomized Motif Search – Gibbs Sampling.

UNIT IV	ASSEMBLE GENOMES AND SEQUENCES	9

Methods of Assemble Genomes – String Reconstruction – De Bruijn graph – The Seven Bridges of Konigsberg – Euler's Theorem – Assembling genomes – DNA sequencing technologies – Sequence Antibiotics – Brute Force Algorithm – Branch and Bound algorithm – Open Problems.

UNIT V	HUMAN GENOME	9

Comparing Biological Sequences – Case Study – Manhattan tourist Problem. Human and mouse Genomes – Random Breakage Model of Chromosome Evolution – Sorting by Reversals – A Greedy Heuristic approach – Breakpoints – Rearrangements in Tumor Genomes – From Unichromosomal to Multichromosomal Genomes - Breakpoint Graphs – Computing the 2-Break Distance – Rearrangement Hotspots – Synteny Block Construction - Open Problems and Technologies.

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Deploy the genomics technologies in Bioinformatics.
2.	Able to distinct efficient algorithm and issues.
3.	Deploy the replication and molecular clocks in bioinformatics.
4.	Work on assemble genomes and sequences
5.	Use the Microarray technologies for genome expression.

REFERENCES:	
1.	*Supratim Choudhuri, —Bioinformatics For Beginners‖, Elsevier, 2014.*
2.	*Philip Compeau and Pavel pevzner, —Bioinformatics Algorithms: An Active Learning Approach‖ Second edition volume I , Cousera, 2015.*
3.	*Ion Mandoiu and Alexander Zelikovsky , "Computational Methods for Next Generation Sequencing Data Analysis — Wiley series 2016.*
4.	*Istvan Miklos,Renyi Institutue, —Introduction to algorithms in bioinformatics‖,Springer 2016*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		3	1		2		3			3
CO2	2				1		2			3			3	
CO3			2		1			3		2		1		
CO4		2		2			2		3		1		2	1
CO5	3				1	2		1			1		3	

(1- Low, 2- Moderate, 3-High)

EMPLOYABILITY ENHANCEMENT COURSE

18CSEE11	PROJECT PHASE - I	L	T	P	C
		0	0	20	6

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Usage of mathematical, computational and natural sciences gained by study, experience and practice with judgment*
- *Develop effective use of matter, energy and information to the benefit of mankind.*
  Plan, execute, manage and document a project

OUTCOMES:	Upon completion of this course, the students will be able to:
1. .	Identify research intensive feasible problems by considering societal/industrial Demands.
2.	Perform exhaustive literature survey on identified problem.
3.	Use design/simulation tools to implement critical methods/algorithms of the identified problem from the literature.
4.	Develop and deliver a good quality formal presentation.
5.	Write clear, concise, and accurate technical document for journal publication.

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	3	1	3	2	3	3	2	3	3	1	1
CO2	3	2	1	3	1	3	2	1	3	2	3	3	1	3
CO3	2	2	1	3	1	3	3	1	3	2	3	3	1	3
CO4	2	2	1	2	2	2	3	1	2	2	1	2	3	3
CO5	3	2	2	2	2	2	3	3	2	2	1	2	2	3

(1- Low, 2- Moderate, 3-High)

SEMESTER – IV

EMPLOYABILITY ENHANCEMENT COURSE

18CSEE12	PROJECT PHASE - II	L	T	P	C
		0	0	32	12

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Usage of mathematical, computational and natural sciences gained by study, experience and practice with judgment to develop effective use of matter, energy and information to the benefit of mankind.*
- *Plan, execute, manage and document a project*
- *Construct logical and physical models to demonstrate the skills at assimilating, synthesizing and critically appraising all materials relevant to the project.*

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Perform detailed implementation of the identified problem using advanced tools or by developing new tools
2.	Exhaustive testing of the proposed methods and algorithms to validate new findings.
3.	Performance analysis with existing methods and algorithms to establish applicability.
4.	Develop and deliver a good quality formal presentation.
5.	Write clear, concise, and accurate technical document for journal publication.

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1	3	1	3	2	3	3	2	3	3	1	2
CO2	3	2	1	3	2	3	2	3	3	1	3	1	1	2
CO3	3	3	1	3	2	3	3	3	3	2	3	1	1	2
CO4	3	3	2	2	2	3	3	3	2	2	3	2	3	3
CO5	3	3	2	2	2	3	3	3	2	2	3	2	2	2

(1- Low, 2- Moderate, 3-High)

AUDIT COURSES

(FOR SEMESTER - I, II AND III)

18ZAC001	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humani multiple perspectives tarian response.*
- *Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*
- *Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*

UNIT I	INTRODUCTION TO DISASTER	6

Concepts of Hazard, Vulnerability, Risks, Natural Disasters (earthquake, Cyclone, Floods, Volcanoes), and Man Made Disaster (Armed conflicts and civil strip, Technological disasters, Human Settlement, Slow Disasters (famine, draught, epidemics) and Rapid Onset Disasters(Air Crash, tidal waves, Tsunami) Risks, Difference between Accidents and Disasters, Simple and Complex Disasters, Refugee problems, Political, Social, Economic impacts of Disasters, Gender and Social issues during disasters, principles of psychosocial issues and recovery during emergency situations, Equity issues in disasters, Relationship between Disasters and Development and vulnerabilities, different stake holders in Disaster Relief. Refugee operations during disasters, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters, Models in Disasters.

UNIT II	APPROACHES TO DISASTER RISK REDUCTION	6

Disaster Risk Reduction Strategies, Disaster Cycle, Phases of Disaster, Preparedness Plans, Action Plans and Procedures, Early warning Systems Models in disaster preparedness, Components of Disaster Relief-(Water, food, sanitation, shelter, Health and Waste Management), Community based DRR, Structural non structural measures in DRR, Factors affecting Vulnerabilities, Mainstreaming disaster risk reduction in development, Undertaking risk and vulnerability assessments

UNIT III	DISASTER PREPAREDNESS	6

Policies for Disaster Preparedness Programs, Preparedness Planning, Roles and Responsibilities, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis, Sustainable Management, Survey of Activities Before Disasters Strike, Survey of Activities During Disasters, DRR Master Planning for the Future, Capacity Building, Sphere Standards. Rehabilitation measures and long term reconstruction. Psychosocial care provision during the different phases of disaster.

UNIT IV	DISASTER RISK MANAGEMENT IN INDIA	6
Hazard and Vulnerability Profile India,, Disaster Management Indian scenario, India's vulnerability profile, Disaster Management Act 2005 and Policy guidelines,National Institute of Disaster Management,National Disaster Response Force (NDRF)National Disaster Management Authority, States Disaster Management Authority, District Disaster Management Authority Cases Studies : Bhopal Gas Disaster, Gujarat Earth Quake, Orissa Super-cyclone, south India Tsunami, Bihar floods, Plague-Surat, Landslide in North East, Heat waves of AP& Orissa, 278 Cold waves in UP. Bengal famine		
UNIT V	**BEST PRACTICES IN DISASTER MANAGEMENT**	**6**
Local Knowledge Appropriate Technology and local Responses, Indigenous Knowledge, Development projects in India (dams, SEZ) and their impacts, Logistics management in specific emergency situation. Rajiv Gandhi Rehabilitation package, Integrated Coastal Zone Management, National Flood Risk Mitigation Project (NFRMP), Mines Safety in India, Indian Meteorological Department, National Crisis Management Committee, Indian NATIONAL Centre for Oceanic Information System (INCOIS)		
		TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Application of Disaster Concepts to Management.
2.	Analyze Relationship between Development and Disasters.
3.	Ability to Categories Disasters and Preparedness plans for disaster response.
4.	Monitoring and evaluation plan for disaster response and Setting up of early warning systems for risk reductions
5.	Acquainting with Disaster Response command system in respective states and Application of Best Practices from Case scenario Studies in India

REFERENCES:

1.	*Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-2012.*
2.	*Watts S Humphrey, " Managing the Software Process", Pearson Education Inc*
3.	*Gordon G Schulmeyer, "Handbook of Software Quality Assurance", Third Edition, Artech House Publishers 2007*
4.	*Aim and Scope of Disaster Management. Study Guide prepared by Sharman and Hansen. UW-DMC, University of Washington*
5.	*Geneva: Sphere Project. http://www.sphereproject.org/ handbook/*

6.	*Sphere Project (2011). Humanitarian Charter and Minimum Standards in Disaster Response.*
7.	*Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.*
8.	*Alexander David, 2000 Introduction in 'Confronting Catastrophe', Oxford University Press.*
9.	*Satapathy S. (2009) Psychosocial care in Disaster management, A training of trainers manual (ToT), NIDM publication.*
10.	*Sekar, K (2006). Psychosocial Support in Tsunami Disaster: NIMHANS responses Disaster and Development, 1.1, pgs 141-154.*
11.	*Prewitt Diaz, J.O (2004). The cycle of disasters: from Disaster Mental Health to Psychosocial Care. Disaster Mental Health in India, Eds: Prewitt Diaz, Murthy, Lakshmi Narayanan, Indian Red Cross Society Publication.*
12.	*Andharia J. 2008 Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Sciences Working Paper no. 8*
13.	*Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.*
14.	*Coppola P Damon, 2007. Introduction to International Disaster Management, Carter, Nick 1991. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manil*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		2	2		1		3		3		3	3	3	
CO2	3		1	1	2	1			2	2				1
CO3		2					3	1					3	
CO4		2			2					1	2	2		1
CO5	2		3	2		1		2						2

(1- Low, 2- Moderate, 3-High)

18ZAC002	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Understand that how to improve your writing skills and level of readability*
- *Learn about what to write in each section*
- *Understand the skills needed when writing a Title*

UNIT I	PLANNING AND PREPARATION	6

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

UNIT II	HIGHLIGHTING	6

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

UNIT III	LITERAURE REVIEW	6

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check

UNIT IV	KEY SKILLS	6

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

UNIT V	WRITING SKILLS	6

Writing Skills, Results skills , Writing skills during discussion, when writing the Conclusions useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Write technical papers on their own.
2.	Planning preparation of content for papers.
3.	Knowledge of what to be highlighted.
4.	Review of a literatures
5.	Key skills needed for writing papers.

REFERENCES:

1. *Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)*

2.	*Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.*
3.	*Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		1		1			3			2
CO2			1				2				2			
CO3					1				3			2	3	
CO4		2		2			3				1			1
CO5	2					2				2			2	

(1- Low, 2- Moderate, 3-High)

18ZAC003	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Definition and objectives of Research*
- *Quantitative methods for problem solving*
- *Data description and report writing*

UNIT I	RESEARCH METHODOLOGY AND DATA COLLECTION	6

Research methodology - definition, mathematical tools for analysis. Types of research exploratory research, conclusive research, modelling research, algorithmic research, Research process - steps. Data collection methods - primary data - observation method personal interview, telephonic interview, mail survey, questionnaire design. Secondary data - internal sources of data, external sources of data.

UNIT II	SCALES AND SAMPLING	6

Scales - Measurement, Types of scale - Turnstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale. Q-sort scale. Sampling methods - Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, Stratified sampling, cluster sampling. Non-probability sampling method - convenience sampling, judgment sampling quota sampling.

UNIT III	HYPOTHESES	6

Hypotheses testing- Testing of hypotheses concerning means (one mean and difference between two means- one tailed and two tailed tests) , Concerning variance one tailed Chi-square test.

UNIT IV	NONPARAMETRIC TESTS	6

Nonparametric tests- One sample tests - one sample tests- on sample sign test, Kolmogorov-Smirnov test, run test for randomness, Two sample test - Two sample sign test, Mann- Whitney U test, K-sample test - Kruskal Wallis test (H-Test)

UNIT V	DISCRIMINANT ANALYSIS	6

Introduction to Discriminant analysis, Factor analysis, cluster analysis, multi-dimensional scaling, conjoint analysis. Report writing- Types of report, guidelines to review report, typing instructions, oral presentation.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Aware of basic research process, research methodology.
2.	Apply Knowledge of hypotheses, Non-parametric Tests
3.	Develop research question
4.	Perform exhaustive literature survey
5.	Apply right problem solving methods

REFERENCES:	
1.	*Kothari. C.R., "Research Methodology - Methods and techniques", New Age Publications, New Delhi, 2009*
2.	*Panneerselvam, R., "Research Methodology", Prentice-Hall of India. New Delhi, 2004.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		3	1		2		3		2	1
CO2	3		2		1		2	1		2	1	3		
CO3		1					1			1				
CO4				3				3				2		1
CO5		2				1				1				

(1- Low, 2- Moderate, 3-High)

18SAC004	STRESS MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *To achieve overall health of body and mind*
- *To overcome stress*
- *Developing a sense of Humour.*

UNIT I	UNDERSTANDING STRESS	6

Meaning – Symptoms – Works Related Stress – Individual Stress – Reducing Stress – Burnout.

UNIT II	COMMON STRESS FACTORS TIME & CAREER PLATEAUING	6

Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area – Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'.

UNIT III	CRISIS MANAGEMENT	6

Implications – People issues – Environmental issues – Psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment.

UNIT IV	WORK PLACE HUMOUR	6

Developing a sense of Humour – Learning to laugh – Role of group cohesion and team spirit – Using humour at work – Reducing conflicts with humour.

UNIT V	SELF DEVELOPMENT	6

Improving Personality – Leading with Integrity – Enhancing Creativity – Effective decision Making – Sensible Communication – The Listening Game – Managing Self – Meditation for peace – Yoga for Life.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand the management of work related stress at an individual and organisational level.
2.	Develop and implement effective strategies to prevent and manage stress at work.

3.	Develop and implement effective strategies to manage stress at work.
4.	Understand the management of work related stress at organisational level
5.	Improving personality and integrity.

REFERENCES:

1.	*Cooper, Managing Stress, Sage, 2011.*
2.	*Waltschafer, Stress Management ,Cengage Learning, 4th Edition 2009.*
3.	*Jeff Davidson, Managing Stress, Prentice Hall of India, New Delhi, 2012.*
4.	*Juan R. Alascal, Brucata, Laurel Brucata, Daisy Chauhan. Stress Mastery- The art of coping gracefully. Pearson, 2012.*
5.	*Argyle. The Psychology of Happiness. Tata McGraw Hill, Oct 2013.*
6.	*Bartlet. Stress – Perspectives & Process. Tata McGraw Hill. 2012.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1		1		3		2	
CO2	3		2		1		2	2		1		1	2	1
CO3		1		2			1		1					
CO4					3						1		2	
CO5	1					1		2		2	3	3		

(1- Low, 2- Moderate, 3-High)

18SAC005	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Review existing evidence on the review topic to inform programme design*
- *Policy making undertaken by the DfID, other agencies and researchers*
- *Identify Critical evidence gaps to guide the development*

UNIT I	INTRODUCTION AND METHODOLOGY	6

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II	THEMATIC OVERVIEW	6

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III	PEDAGOGICAL PRACTICES EFFECTIVENESS	6

Evidence on the effectiveness of pedagogical practices - Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV	PROFESSIONAL DEVELOPMENT	6

Professional development: alignment with classroom practices and follow-up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V	RESEARCH GAPS AND FUTURE DIRECTIONS	6

Research design - Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2.	Understand What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

3.	Understand How can teacher education and the school curriculum and guidance materials best support effective pedagogy?
4.	Understand how can the curriculum best support effective pedagogy.
5.	Understand how can the practicum best support effective pedagogy.

REFERENCES:

1.	*Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.*
2.	*Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.*
3.	*Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1			1	3		2	2
CO2		2			1		2		3			3		
CO3	3		3	2	1			2			3			1
CO4						1							1	
CO5	1			2						3		2		

(1- Low, 2- Moderate, 3-High)

18SAC006	PRINCIPLES OF MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Organization management and role of managers.*
- *Planning and Policies and decision making.*
- *Organising , controlling and directing.*

UNIT I	OVERVIEW OF MANAGEMENT	6

Organization - Management - Role of managers - Evolution of Management thought - Organization and the environmental factors - Managing globally - Strategies for International Business.

UNIT II	PLANNING	6

Nature and purpose of planning - Planning process - Types of plans – Objectives - Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.

UNIT III	ORGANIZING	6

Nature and purpose of organizing - Organization structure - Formal and informal groups organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

UNIT IV	DIRECTING	6

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories Leadership - Leadership theories - Communication - Hurdles to effective communication - Organization Culture - Elements and types of culture - Managing cultural diversity.

UNIT V	CONTROLLING	6

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand the insight of management.

2.	Plan various activities of departmentation.
3.	Organize various activities of departmentation.
4.	Direct various activities of departmentation.
5.	Control various activities of departmentation.

REFERENCES:

1.	*Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th editioN, 2005*
2.	*Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.*
3.	*Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.*
4.	*Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management – A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.*
5.	*Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3			2			1			2	1		2	3
CO2		2			1		2	3			3		2	
CO3			1			3				3		2		
CO4		1		2					2					2
CO5	1					2		3			1			

(1- Low, 2- Moderate, 3-High)

18SAC007	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *To enable the students to create an awareness on Engineering Ethics and Human Values*
- *To instill Moral and Social Values and Loyalty*
- *To appreciate the rights of others.*

UNIT I	ENGINEERING ETHICS	6

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II	ENGINEERING AS SOCIAL EXPERIMENTATION	6

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

UNIT III	ENGINEER'S RESPONSIBILITY FOR SAFETY	6

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

UNIT IV	RESPONSIBILITIES AND RIGHTS	6

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V	GLOBAL ISSUES	6

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Recognize the values of Engineering Ethics.
2.	Practice engineering as experimentation
3.	Explore various responsibility of engineers and safety measures

4.	Explore rights of engineers
5.	Understand global issues.

REFERENCES:	
1.	*Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.*
2.	*Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.*
3.	*Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 2012.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		2	1			1	3		2	
CO2					1		2		2					3
CO3			3	2		1		3		2		1		
CO4	3	2									3		1	
CO5			2		2		1		3	1		3		2

(1- Low, 2- Moderate, 3-High)

18SAC008	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Demand ,Supply and Analysis.*
- *Knowledge about Production and cost analysis.*
- *Knowledge of price and Financial accounting.*

UNIT I	INTRODUCTION	6

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis.

UNIT II	DEMAND & SUPPLY ANALYSIS	6

Demand - Types of demand - Determinants of demand - Demand function - Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function - Supply elasticity.

UNIT III	PRODUCTION AND COST ANALYSIS	6

Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT IV	PRICING	6

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT V	FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)	6

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand the concepts of economics in engineering.
2.	Analyse demand and cost function.
3.	Determine pricing and financial accounting.

4.	Analyse managerial economics.
5.	Determine supply function and supply elasticity.

REFERENCES:

1.	*Samuelson. Paul A and Nordhaus W.D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, July 2016.*
2.	*McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.*
3.	*Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press,New Delhi, 2007.*
4.	*Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson South Western, 4th Edition, 2001.*
5.	*Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3		1		2			3		3		1		2
CO2		2		3		1	2		1		3		2	
CO3	1				3				3			2		1
CO4			3			3					2		2	
CO5		2		2			1		2	1				3

(1- Low, 2- Moderate, 3-High)

18SAC009	INDUSTRIAL AUTOMATION AND ROBOTICS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Read and write data from/to files in Python Programs.*
- *Robotics in Science Fiction and future trends.*
- *Industrial robots and nano robots.*

UNIT I	EVOLUTION OF ROBOTICS AND AUTOMATION	6

Robotics in science fiction- industrial revolution-history and need of robotics-– definition of a robot –robot terminology- types and applications of robot – overview of present status and future trends – robotics market and future prospects

UNIT II	INDUSTRIAL AUTOMATION	6

Reasons for automation – arguments for and against automation – type of Industries and components of automation

UNIT III	ROBOTIC KITS	6

Introduction–Classification of robots–robot component–Industrial Robots–Mobile Robots–Nao Robot

UNIT IV	ROBOT ASSEMBLING	6

Assembly of robots using Lego, Vex and Tetrix Kits - Five minute bot, Line follower, Obstacle avoidance robot, Wall following robot and other simple applications.

UNIT V	FIREBIRD KIT	6

Introduction, Architecture, programming using Atmel studio, Programming: Buzzer, Line following, LCD display and other simple applications.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Understand basic concepts of industrial automation.
2.	Explore concepts of robotics and kits.
3.	Explore concepts of robotic assembling.

4.	Expertise in firebird kit.
5.	Evolution of robotics and automation.

REFERENCES:	
1.	*Mikell P Groover, ―Automation, Production Systems, and computer integrated Manufacturing, Prentice Hall, 2001.*
2.	*Deb S R.and DebS., ―Robotics Technology and Flexible Automation, Tata McGraw Hill Education Pvt. Ltd, 2010*
3.	*Manual Prepared by the Department of Robotics and Automation Engineering, 2015*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2			1		1		3		2	
CO2			2		1			3		1		3		
CO3		1				3			3					3
CO4	3		2		2		1	1		2	1		2	
CO5		2				2						2		

(1- Low, 2- Moderate, 3-High)

OPEN ELECTIVES

(OFFERED BY CSE)

18CSOE01	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Read and write data from/to files in Python Programs.*
- *Problem solving in python*
- *Knowledge of file ,Tuples, and Packages*

UNIT I	ALGORITHMIC PROBLEM SOLVING	6

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT II	DATA, EXPRESSIONS, STATEMENTS	6

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III	CONTROL FLOW, FUNCTIONS	6

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV	LISTS, TUPLES, DICTIONARIES	6

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V	FILES, MODULES, PACKAGES	6

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Develop algorithmic solutions to simple computational problems.
2.	Read, write, execute by hand simple Python programs.

3.	Structure simple Python programs for solving problems.
4.	Decompose a Python program into functions.
5.	Represent compound data using Python lists, tuples, and dictionaries.

REFERENCES:	
1.	*Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016*
2.	*Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2", Network Theory Ltd., 2011.*
3.	*Dr.A.Kannan, Dr.L.Sairamesh, "Problem Solving and Python programming", United Global Publishers Pvt. Ltd., 2017.*
4.	*Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd.,*
5.	*Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.*
6.	*Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		2	3		2		1		2		3		2	1
CO2	2			1		3		3		1				
CO3			1				3					2		3
CO4	2				2				3	3				
CO5		1		3		1		2				1		2

(1- Low, 2- Moderate, 3-High)

18CSOE02	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Verify and validate the software applications using different types of testing
- Maintain the quality of software.
- Application of Scrum Development Process to develop software.

UNIT I	INTRODUCTION AND REQUIREMENTS MODELING	6

Software Engineering - Process models-Agile development - Software engineering Knowledge - Core Principles - Principles that guide each framework Activity - Requirements Engineering - Developing use cases - Building the requirements model - Negotiating, validating Requirements - Requirements Analysis - Requirements Modeling.

UNIT II	SOFTWARE DESIGN AND ESTIMATION	6

Design Process - Design Concepts – Design Model - Architectural Design - Component level design – User interface design - pattern based design – Web App design – Case Study.
Software Project Estimation – Process and Project Metrics- Empirical Estimation model – Specialized Estimation Technique for Agile Development - Project Scheduling - Risk Management.

UNIT III	SOFTWARE QUALITY AND TESTING	6

Software Quality - Software - Quality Dilemma - Achieving Software Quality - Testing: Strategic Approach to software Testing - Strategic IssuesTesting: Strategies for Conventional Software, Object oriented software, Web Apps - Validating Testing - System Testing - Art of Debugging.

UNIT IV	SOFTWARE MAINTENANCE AND IMPROVEMENT	6

Software Maintenance - Software Supportability - Reengineering - Business Process Reengineering - Software Reengineering - Reverse Engineering - Restructuring - Forward Engineering.

UNIT V	INTRODUCTION TO SCRUM DEVELOPMENT PROCESS	6

Basics of Scrum – Running a Scum project – Steps for transition to scrum – Metrics for scrum – Case Study.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Apply different process models for different projects levels.
2.	Perform requirement gathering and model the requirements.
3.	Perform architectural design, component level design, UI design and Web design for a given project.
4.	Identify risks and construct RMMM plan for a software project.

5.	Apply effort and schedule estimation models.
REFERENCES:	
1.	*Roger Pressman.S "Software Engineering: A Practitioner's Approach" Eighth Edition, McGraw Hill, 2010*
2.	*Ian Sommerville "Software Engineering" Nineth Edition, Pearson Education Asia, 2011*
3.	*Shari Lawrence Pfleeger, Joanne M. Atlee, "Software Engineering: Theory and Practice", Fourth Edition, Pearson Education, 2011.*
4.	*Alistair Cockburn, "Agile Software Development", First Edition, Pearson Education, 2001.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										PROGRAM SPECIFIC OUTCOMES			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2			1			2			3	3		1	
CO2		3				3		1	3			2		1
CO3			3		1									
CO4		2		2			1		2		2		3	
CO5	2					2				1		1	1	

(1- Low, 2- Moderate, 3-High)

18CSOE03	ANDROID APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *An Open Platform for Mobile Development and Native Android Applications.*
- *Creating Applications and building user interfaces.*
- *Working with files and databases.*

UNIT I	INTRODUCTION TO ANDROID	6

Hello Android - A Little Background - Android: An Open Platform for Mobile Development - Native Android Applications - Android SDK Features - Introducing the Open Handset Alliance - Introducing the Development Framework. Getting Started: Developing for Android - Developing for Mobile and Embedded devices - Android Development Tools.

UNIT II	CREATING APPLICATIONS AND BUILDING USER INTERFACES	6

Android Application - Introducing the Application Manifest File - Using the Manifest Editor - Externalizing Resources - The Android Application Lifecycle - Understanding an Application's Priority and its Process States - Introducing the Android Application Class - Fundamental Android UI Design - Android User Interface Fundamentals - Introducing Layouts - To-Do List Example - Introducing Fragments - The Android Widget Toolbox - Creating New Views - Introducing Adapters.

UNIT III	BROADCAST RECEIVERS AND INTERNET	6

Introducing Intents - Creating Intent Filters and Broadcast Receivers - Using Internet Resources - Downloading and Parsing Internet Resources - Using the Download Manager - Using Internet Services - Connecting to Google App Engine - Best Practices for Downloading Data Without Draining the Battery.

UNIT IV	FILES AND DATABASES	6

Saving Simple Application Data - Creating and Saving Shared Preferences - Retrieving Shared Preferences - Creating a Setting Activity for the Earthquake Viewer - Introducing the Preference Framework and the Preference Activity - Creating a Standard Preference Activity for the Earthquake Viewer Persisting the Application Instance State - Including Static Files as Resources - Working with the File System - Introducing Android Databases - Introducing SQLite - Contents Values and Cursors - Working with SQLite Databases - Creating Content Providers - Using Content Providers - Adding Search to Your Application - Creating a Searchable Earthquake Content Provider - Native Android Content Providers.

UNIT V	ADVANCED USER EXPERIENCE	6

Designing for Every Screen Size and Density - Ensuring Accessibility - Introducing Android Text-to-Speech - Using Speech Recognition - Controlling Device Vibration - Working with Animations - Enhancing Your Views - Advanced Drawable Resources - Copy, Paste and the Clipboard - Hardware Sensors - Using Sensors and the Sensor Manager - Monitoring a Device's Movement and Orientation - Introducing the Environmental Sensors - Using Location-Based Services - Using the Emulator with

Location-Based Services - Selecting a Location Provider - Finding Your Current Location - Best Practice for Location Updates - Using Proximity Alerts - Using the Geocoder - Creating Map-Based Activities - Mapping Earthquakes Example.	
	TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Identify the target platform and users and be able to define and sketch an Android application.
2.	Understand the fundamentals, frameworks, and development lifecycle of Android Application platforms.
3.	Design and develop an Android application prototype in one of the platform. (challenge project)
4.	Be able to define and sketch an Android application.
5.	Development lifecycle of Android Application platforms.

REFERENCES:	
1.	*Reto Meier, "Professional Android™ 4 Application Development", 2012 by John Wiley & Sons.*
2.	*Wei-Meng Lee," Beginning Android™ 4 Application Development", 2012 by John Wiley & Sons.*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2			1		1		3		2	1
CO2					1			3				1		
CO3	3		2			2				3				1
CO4				2			1		2		2			
CO5		3			3					2			2	

(1- Low, 2- Moderate, 3-High)

18CSOE04	ESSENTIALS OF CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Fundamentals of computing and cloud computing.*
- *Cloud computing applications and their implementation platforms.*
- *Cloud security infrasctructures.*

UNIT I	INTRODUCTION TO CLOUD COMPUTING	6

Overview of Computing Paradigm:Recent trends in Computing - Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing - Introduction to Cloud Computing - Cloud issues and challenges- Cloud Computing (NIST Model) - History of Cloud Computing, - Cloud service providers Properties, Characteristics & Disadvantages - Pros and Cons of Cloud Computing, Benefits of Cloud Computing - Role of Open Standards .

UNIT II	CLOUD COMPUTING ARCHITECTURE AND VIRTUALIZATION	6

Cloud computing stack - Comparison with traditional computing architecture (client/server), Services provided at various levels - Role of Networks in Cloud computing, protocols used, Role of Web services- Service Models (XaaS)- Infrastructure as a Service(IaaS) -Platform as a Service(PaaS) - Cloud Platform and Management – Software as a Service(SaaS)- Web services - Web 2.0 - Deployment Models -Public cloud -Private cloud -Hybrid cloud -Community cloud - Virtualization concepts - Introduction to virtualization - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs

UNIT III	CLOUD APPLICATION PROGRAMMING AND THE ANEKA PLATFORM	6

Aneka - Framework overview - anatomy of the Aneka container - Building Aneka clouds - Cloud programming and management - Programming applications with threads - Multithreading with Aneka - Programming applications with Aneka threads - Task computing - Task-based application models - Aneka task-based programming - Data-Intensive Computing - Aneka MapReduce programming

UNIT IV	CLOUD SECURITY	6

Infrastructure Security - Network level security, Host level security, Application level security - Data security and Storage - Data privacy and security Issues, Jurisdictional issues raised by Data location - Identity & Access Management -Access Control -Trust, Reputation, Risk , Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.- Cloud Reliability and fault-tolerance -privacy - policy and compliance -Cloud federation, interoperability and standards.

UNIT V	CLOUD APPLICATIONS AND CASE STUDY	6

Scientific applications : Healthcare – Biology – Geoscience - Business and consumer applications: CRM and ERP – Productivity - Social networking - Media applications - Multiplayer online gaming - Case Study on Open Source & Commercial Clouds – Eucalyptus - Microsoft Azure - Amazon EC2 -

Google AppEngine.	
	TOTAL : 30 PERIODS
OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Explain and discuss basic concepts, fundamental issues and challenges of Cloud Computing and paradigms of computing
2.	Explain the basic architecture of cloud computing and virtualization techniques.
3.	Design and implement basic cloud application using Aneka framework.
4.	Explain the core issues of cloud computing such as security, privacy, and interoperability.
5.	Provide cloud computing solutions and recommendations and for applications.
REFERENCES:	
1.	*Barrie Sosinsky, "Cloud Computing Bible" , Wiley-India, 2010*
2.	*Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, 2012.*
3.	*RajkumarBuyya, Christian Vecchiolaand S. ThamaraiSelvi ," Mastering Cloud Computing Foundations andApplications Programming", Morgan Kaufmann, 2013*
4.	*RajkumarBuyya, James Broberg, Andrzej M. Goscinski, " Cloud Computing: Principles and Paradigms", Wiley,2011*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2			3		3		3		2	2			1
CO2			2		3				2			3		
CO3	2			1		1	2			3	3			2
CO4		1							2				2	
CO5	2			3				3		2		3		3

(1- Low, 2- Moderate, 3-High)

18CSOE05	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Fundamentals of image processing techniques for computer vision.*
- *Shape and pattern analysis.*
- *Hough Transform and its applications to detect lines, circles, ellipses.*

UNIT I	LOW LEVEL VISION	6

Images and Imaging Operations – Image Filtering and Morphology – The Role of Thresholding – Edge detection – Corner,Interest Point and Invariant Feature Detection – Texture Analysis.

UNIT II	INTERMEDIATE LEVEL VISION	6

Binary Shape Analysis – Boundary Pattern Analysis – Line, Circle and Ellipse Detection – The generalized Hough Transform – Object Segmentation and Shape Models.

UNIT III	MACHINE LEARNING AND DEEP LEARNING NETWORKS	6

Basic Classification Concepts – Machine Learning: Probabilistic Methods – Deep Learning Networks.

UNIT IV	3D VISION AND MOTION	6

Three Dimensional World – Tackling the Perspective n-point Problem – Invariants and Perspective – Image Transformations and Camera Calibration – Motion.

UNIT V	APPLICATIONS	6

Face Detection and Recognition: the Impact of Deep Learning – Surveillance – The Basic Geometry – Foreground-Background Separation – Particle Filters – Chamfer Matching, Tracking, and Occlusion – Combining Views from Multiple Cameras – Human Gait analysis – Application: In-Vehicle Vision System: Locating the Roadway – Location of Road Markings – Location of Road signs – Location of Vehicles – Locating Pedestrians.

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Developed the practical skills necessary to build computer vision applications.
2.	To have gained exposure to object and scene recognition and categorization from images
3.	Implement fundamental image processing techniques required for computer vision.

4.	Perform shape analysis and apply chain codes and other region descriptors
5.	Implement Machine Learning Algorithms.

REFERENCES:	
1.	*E. R. Davies, "Computer Vision Principles,Algorithms,Applications,Learning", Fifth Edition, Academic Press, 2018.*
2.	*Computer Vision: Algorithms and Applications by Richard Szeliski,2010*
3.	*Deep Learning, by Goodfellow, Bengio, and Courville,2016*
4.	*Dictionary of Computer Vision and Image Processing, by Fisher et al, 2013*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2		1		1		1	3		2	3
CO2	3		1		1		2		2			2		
CO3		1		3						2				13
CO4			2			2		2			2			
CO5	1				2				3				3	

(1- Low, 2- Moderate, 3-High)

18CSOE06	HIGH PERFORMANCE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Performance evaluation of systems and networks.*
- *Performance issues and cache coherence issues.*
- *Multicore architectures and social computing.*

UNIT I	PERFORMANCE EVALUATION OF SYSTEMS AND NETWORKS	6

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 II	MULTIPROCESSORS	6

Symmetric and distributed shared memory architectures – Cache coherence issues - Performance Issues – Synchronization issues – Models of Memory Consistency - Interconnection networks – Buses, crossbar and multi-stage switches.

UNIT III	MULTI-CORE ARCHITECTURES	6

Software and hardware multithreading – SMT and CMP architectures – Design issues – Case studies – Intel Multi-core architecture – SUN CMP architecture – IBM cell architecture.- hp architecture.

UNIT IV	QUANTUM COMPUTATION	6

Quantum Computing History, Postulates of Quantum Theory, Dirac Notation, the Quantum Circuit Model, Simple Quantum Protocols: Teleportation, Superdense Coding, Foundation Algorithms

UNIT V	SOCIAL COMPUTING AND EVOLUTIONARY COMPUTING	6

Social Computing Online communities, Online discussions, Twitter, Social Networking Systems, Web 2.0, social media, Crowdsourcing, Facebook, blogs, wikis, social recommendations, Collective intelligence. Evolutionary Computing: Introduction to Genetic Algorithms, Genetic Operators and Parameters, Genetic Algorithms in Problem Solving, Theoretical Foundations of Genetic Algorithms, Implementation Issues

TOTAL : 30 PERIODS

OUTCOMES:	Upon completion of this course, the students will be able to:
1.	Evaluate the performance of Systems and Networks.
2.	Understand the basic concepts and performance issues of Multi-processors and Multi-Core architectures.

3.	Predict the major results in computability and complexity theory.
4.	Understand the basic concepts and performance issues of Multi-Core architectures.
5.	Understand the basic concepts of Quantum computations.

REFERENCES:	
1.	*James D.McCabe , Network Analysis , Architecture and Design , 2nd Edition,Elsevier,2003*
2.	*John L. Hennessey and David A. Patterson, " Computer Architecture – A quantitative approach", Morgan Kaufmann / Elsevier, 4th. edition, 2007.*
3.	*William Stallings, " Computer Organization and Architecture – Designing for Performance", Pearson Education, Seventh Edition, 2006*
4.	*Danah Boyd, "It's Complicated: The Social Lives of Networked Teens", Yale University Press, 2015*
5.	*M. Mitchell, "An Introduction to Genetic Algorithms", Prentice-Hall, 1996*

COURSE ARTICULATION MATRIX:

	PROGRAM OUTCOMES										**PROGRAM SPECIFIC OUTCOMES**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3		2					3		2	1			3
CO2		1			2		1					3		
CO3	1			3		2				2			1	
CO4			1						2		3			
CO5	2				2		1						1	

(1- Low, 2- Moderate, 3-High)