GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum For

Post Graduate

M. E. Computer Science and Engineering

(Full Time)

2023

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
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VISION AND MISSION OF THE DEPARTMENT

VISION

To be in the frontier of Computer Science and Engineering and to produce globally competent graduates with moral values committed to build a vibrant nation.

MISSION

- To strengthen the core competence in Computer Science and Engineering through analytical learning.
- To produce successful graduates with personal and professional responsibilities and commitment to lifelong learning.
- To uplift innovative research in Computer Science and Engineering to serve the needs of Industry, Government and Society.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
M.E.COMPUTER SCIENCE AND ENGINEERING

FIRST SEMESTER

SI. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	23CSFCZ1	Research Methodology and IPR (Common to All Branches)	FC	40	60	100	3	0	0	3
2	23CSFC02	Mathematical Foundations of Computer Science	FC	40	60	100	3	1	0	4
3	23CSPC01	Formal Languages, Machines and Computations	PC	40	60	100	3	1	0	4
4	23CSPC02	High Performance Computer Architecture	PC	40	60	100	3	0	0	3
5	23CSPC03	Algorithms and Complexity Analysis	PC	40	60	100	3	0	0	3
6	23CSPEXX	Professional Elective I	PE	40	60	100	3	0	0	3
7	23CSACXX	Audit Course I	AC	40	60	100	2	0	0	0
PRACTICAL										
8	23CSPC04	Advanced Algorithms and Elective Laboratory	PC	60	40	100	0	0	3	1.5
Total				**340**	**460**	**800**	**20**	**2**	**3**	**21.5**

SECOND SEMESTER

SI. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	23CSPC05	Advanced Database Systems	PC	40	60	100	3	0	0	3
2	23CSPC06	Advanced Computer Networks	PC	40	60	100	3	0	0	3
3	23CSPC07	Advanced Operating System	PC	40	60	100	3	0	0	3
4	23CSPEXX	Professional Elective II	PE	40	60	100	3	0	0	3
5	23CSPEXX	Professional Elective III	PE	40	60	100	3	0	0	3
6	23CSACXX	Audit Course II	AC	40	60	100	2	0	0	0
PRACTICAL										
7	23CSPC08	Advanced Computer Networks and Electives Laboratory	PC	60	40	100	0	0	3	1.5
8	23CSEE01	Mini Project	EEC	40	60	100	0	0	4	2
Total				**340**	**460**	**800**	**17**	**0**	**7**	**18.5**

THIRD SEMESTER

SI. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	23CSPEXX	Professional Elective IV	PE	40	60	100	3	0	0	3
2	23$OEXX	Open Elective	OE	40	60	100	3	0	0	3
PRACTICAL										
3	23CSEE02	Internship/ Industrial Training	EEC	100	-	100	-	-	**	2
4	23CSEE03	Project Phase I	EEC	100	100	200	0	0	12	6
Total				**280**	**220**	**500**	**6**	**0**	**12**	**14**

** 4 Weeks Internship/Industrial training

FOURTH SEMESTER

SI. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
PRACTICAL										
1	23CSEE04	Project Phase II	EEC	200	200	400	0	0	24	12
Total				**200**	**200**	**400**	**0**	**0**	**24**	**12**

Total Credits : 66

PROFESSIONAL ELECTIVE (PE)

PROFESSIONAL ELECTIVES – I

SI.No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23CSPE01	Digital Image Processing	PE	40	60	100	3	0	0	3
2	23CSPE02	Embedded Systems	PE	40	60	100	3	0	0	3
3	23CSPE03	Fuzzy Logic and Neural Networks	PE	40	60	100	3	0	0	3
4	23CSPE04	Cloud Computing	PE	40	60	100	3	0	0	3
5	23CSPE05	Advanced Software Engineering	PE	40	60	100	3	0	0	3
6	23CSPE06	Pattern Recognition	PE	40	60	100	3	0	0	3

PROFESSIONAL ELECTIVES - II

SI.No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23CSPE07	Computer Vision Engineering	PE	40	60	100	3	0	0	3
2	23CSPE08	Internet of Things	PE	40	60	100	3	0	0	3
3	23CSPE09	Network Science	PE	40	60	100	3	0	0	3
4	23CSPE10	Machine Learning	PE	40	60	100	3	0	0	3
5	23CSPE11	Advanced Data Structures	PE	40	60	100	3	0	0	3
6	23CSPE12	Cryptography and Network Security	PE	40	60	100	3	0	0	3

PROFESSIONAL ELECTIVES - III

SI.No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23CSPE13	Data Science	PE	40	60	100	3	0	0	3
2	23CSPE14	Social Networks	PE	40	60	100	3	0	0	3
3	23CSPE15	Information Retrieval	PE	40	60	100	3	0	0	3
4	23CSPE16	Natural Language Processing	PE	40	60	100	3	0	0	3
5	23CSPE17	Virtual Reality	PE	40	60	100	3	0	0	3
6	23CSPE18	Theory of Modern Compilers	PE	40	60	100	3	0	0	3

PROFESSIONAL ELECTIVES - IV

SI.No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23CSPE19	Deep Learning	PE	40	60	100	3	0	0	3
2	23CSPE20	Cyber Forensics	PE	40	60	100	3	0	0	3
3	23CSPE21	Mining Massive Datasets	PE	40	60	100	3	0	0	3
4	23CSPE22	Data Center Networks	PE	40	60	100	3	0	0	3
5	23CSPE23	Data Visualization	PE	40	60	100	3	0	0	3
6	23CSPE24	Parallel Algorithms	PE	40	60	100	3	0	0	3

LIST OF OPEN ELECTIVES

SI. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23SEOE01	Building Bye-Law and Codes of Practice	OE	40	60	100	3	0	0	3
2	23SEOE02	Planning of Smart Cities	OE	40	60	100	3	0	0	3
3	23SEOE03	Green Building	OE	40	60	100	3	0	0	3
4	23EEOE04	Environment Health and Safety Management	OE	40	60	100	3	0	0	3
5	23EEOE05	Climate Change and Adaptation	OE	40	60	100	3	0	0	3
6	23EEOE06	Waste to Energy	OE	40	60	100	3	0	0	3
7	23GEOE07	Energy in Built Environment	OE	40	60	100	3	0	0	3
8	23GEOE08	Earth and Its Environment	OE	40	60	100	3	0	0	3
9	23GEOE09	Natural Hazard and Mitigation	OE	40	60	100	3	0	0	3
10	23EDOE10	Business Analytics	OE	40	60	100	3	0	0	3
11	23EDOE11	Introduction to Industrial safety	OE	40	60	100	3	0	0	3
12	23EDOE12	Operations Research	OE	40	60	100	3	0	0	3
13	23MFOE13	Occupational Health and Safety	OE	40	60	100	3	0	0	3
14	23MFOE14	Cost Management of Engineering Projects	OE	40	60	100	3	0	0	3
15	23MFOE15	Composite Materials	OE	40	60	100	3	0	0	3
16	23TEOE16	Global Warming Science	OE	40	60	100	3	0	0	3
17	23TEOE17	Introduction to Nano Electronics	OE	40	60	100	3	0	0	3

18	23TEOE18	Green Supply Chain Management	OE	40	60	100	3	0	0	3
19	23PSOE19	Distribution Automation System	OE	40	60	100	3	0	0	3
20	23PSOE20	Electricity Trading & Electricity Acts	OE	40	60	100	3	0	0	3
21	23PSOE21	Modern Automotive Systems	OE	40	60	100	3	0	0	3
22	23PEOE22	Virtual Instrumentation	OE	40	60	100	3	0	0	3
23	23PEOE23	Energy Management Systems	OE	40	60	100	3	0	0	3
24	23PEOE24	Advanced Energy Storage Technology	OE	40	60	100	3	0	0	3
25	23AEOE25	Design of Digital Systems	OE	40	60	100	3	0	0	3
26	23AEOE26	Basics of Nano Electronics	OE	40	60	100	3	0	0	3
27	23AEOE27	Advanced Processor	OE	40	60	100	3	0	0	3
28	23VLOE28	HDL Programming Languages	OE	40	60	100	3	0	0	3
29	23VLOE29	CMOS VLSI Design	OE	40	60	100	3	0	0	3
30	23VLOE30	High Level Synthesis	OE	40	60	100	3	0	0	3
31	23CSOE31	Artificial Intelligence and Machine Learning	OE	40	60	100	3	0	0	3
32	23CSOE32	Computer Network Engineering	OE	40	60	100	3	0	0	3
33	23CSOE33	Big Data Analytics	OE	40	60	100	3	0	0	3

LIST OF AUDIT COURSES

(Common to All Branches)

SI. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23CSACZ1	English for Research Paper Writing	AC	40	60	100	2	0	0	0
2	23CSACZ2	Disaster Management	AC	40	60	100	2	0	0	0
3	23CSACZ3	Value Education	AC	40	60	100	2	0	0	0
4	23CSACZ4	Constitution of India	AC	40	60	100	2	0	0	0
5	23CSACZ5	Pedagogy Studies	AC	40	60	100	2	0	0	0
6	23CSACZ6	Stress Management by Yoga	AC	40	60	100	2	0	0	0
7	23CSACZ7	Personality Development Through Life Enlightenment Skills	AC	40	60	100	2	0	0	0
8	23CSACZ8	Sanskrit for Technical Knowledge	AC	40	60	100	2	0	0	0

SUMMARY OF CREDIT DISTRIBUTION

S.No	Course Work Subject Area	No of Credits					Percentage
		I	II	III	IV	Total	
1.	Foundation Course	7	0	0	0	07	10.61 %
2.	Professional Cores	11.5	10.5	0	0	22	33.33 %
3.	Professional Electives	3	6	3	0	12	18.18 %
4.	Employability Enhancement Courses	0	2	8	12	22	33.33 %
5.	Open Elective Courses	0	0	3	0	03	4.55 %
6.	Audit Courses	0	0	-	-	-	-
Total Credits		**21.5**	**18.5**	**14**	**12**	**66**	**100%**

23CSFCZ1	RESEARCH METHODOLOGY AND IPR *(Common to All Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	FC	3	0	0	3

Course Objectives	1. To impart knowledge on research methodology, Quantitative methods for problem solving, data interpretation and report writing 2. To know the importance of IPR and patent rights.

UNIT – I	**INTRODUCTION**	**L(9)**
Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.		
UNIT – II	**QUANTITATIVE METHODS FOR PROBLEM SOLVING**	**L(9)**
Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.		
UNIT – III	**DATA DESCRIPTION AND REPORT WRITING**	**L(9)**
Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.		
UNIT – IV	**INTELLECTUAL PROPERTY**	**L(9)**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.		
UNIT – V	**PATENT RIGHTS**	**L(9)**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

REFERENCES

1	*Stuart Melville and Wayne Goddard,* ***"Research methodology: an introduction",*** *Juta Academic, 2nd edition, 2014.*
2	*Donald H.McBurney and Theresa White,* ***"Research Methods",*** *9th Edition, CengageLearning, 2013*
3	*RanjitKumar,* ***"Research Methodology: A Step by Step Guide for Beginners"****, 5th Edition, 2019*
4	*Dr. C. R. Kothari and GauravGarg,* ***"Research Methodology: Methods and Trends",*** *New age international publishers, 4th Edition, 2018*

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Formulate research question for conducting research.	K3
CO2	Analyze qualitative and quantitative data.	K4
CO3	Interpret research findings and give appropriate conclusions.	K2
CO4	Develop a structured content to write technical report.	K3
CO5	Summarize the importance of IPR and protect their research work through intellectual property.	K2

COURSE ARTICULATION MATRIX :						
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	3	1	3
CO2	2	3	1	3	3	3
CO3	2	3	3	3	3	3
CO4	2	3	1	3	3	3
CO5	-	-	2	-	1	3
23CSFCZ1	**2**	**3**	**3**	**3**	**3**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	30	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	30	20	-	-	100
ESE	30	30	20	20	-	-	100

23CSFC02	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	FC	3	1	0	4

Course Objectives	To enhance the fundamental knowledge in probability concepts and its applications relevant to various streams of Engineering and Technology. This is a foundation course which mainly deals with topic such as probability, standard statistical distributions, correlation and regression analysis, testing of hypothesis, linear programming problems, transportation and assignment problems and plays an important role in the understanding of Science, Engineering and Computer Science among other disciplines.	
UNIT – I	**RANDOM VARIABLES& DISTRIBUTIONS**	**L(9)+T(3)**
Random variables: Discrete and continuous random variables- Moments, Moment generating functions- Binomial, Geometric, Poisson, Uniform, Exponential and Normal distributions.		
UNIT – II	**CORRELATION AND REGRESSION ANALYSIS**	**L(9)+T(3)**
Correlation coefficients- Equation of the lines of regression, Regression coefficients, Regression plane- Multiple and Partial correlation, Partial regression.		
UNIT –III	**TESTING OF HYPOTHESIS**	**L(9)+T(3)**
Large samples: Tests for Mean and proportions, Small samples: Tests for Mean, Variance andAttributesusingt,F,Chi–Square distributions.		
UNIT – IV	**LINEARPROGRAMMING PROBLEMS**	**L(9)+T(3)**
Formulation of Linear Programming problem: Graphical Method - Simplex Method – Big M method -dual method..		
UNIT – V	**MARKOVIAN QUEUEING MODELS**	**L(9)+T(3)**
Markovian models- Birth and Death Queuing models- steady state results: Single and multiple server queuing models-queues with finite waiting rooms- Finite source models-Little's formula.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

REFERENCES

1	*Veerarajan T,* ***"Probability, Statistics and Random Processes (with Queueing Theory and Queueing Networks)",*** *McGraw Hill Education(India)Pvt Ltd., New Delhi, Fourth Edition 2016.*
2	*Taha H.A.,* ***"Operations Research: An introduction", Ninth Edition, Pearson Education, Asia, New Delhi, 2012.***
3	*Gupta S.C and Kapoor V.K,* ***"Fundamentals of Mathematical Statistics",*** *Sultan Chand & Sons, New Delhi, 2015.*
4	*Gupta S.P,* ***"Statistical Methods",*** *Sultan Chand & Sons, New Delhi, 2015.*
5	*Veerarajan T,* ***"Higher Engineering Mathematics",*** *Yes Dee Publishing Pvt Ltd, Chennai,2016.*

6	*Kandasamy P, Thilagavathy K and Gunavathy K,* ***"Probability and Queueing Theory",*** *S. Chand & Co, Ramnagar, New Delhi, Reprint 2013.*

COURSE OUTCOMES:		**Bloom's Taxonomy Mapped**
CO1	Solve the engineering problems associated with random variables, moments and moment generating functions.	K4
CO2	Calculate the coefficient of correlation, regression coefficients, multiple and partial correlation.	K4
CO3	Test the significance of hypothesis connected to small and large samples using different parameters.	K4
CO4	Form the linear programming problems for a real time phenomena and find the solution for the same by using simplex, big M and dual methods.	K4
CO5	Analyse problems involving single and multi-server markovian models.	K4

COURSE ARTICULATION MATRIX :

COs/POs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO1	3	-	2	-	2	1
CO2	3	-	2	-	2	1
CO3	3	-	2	-	2	1
CO4	3	-	2	-	2	1
CO5	3	-	2	-	2	1
23CSFC02	**3**	**-**	**2**	**-**	**2**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	20	10	-	-	100
CAT2	30	40	20	10	-	-	100
	30	40	20	10	-	-	
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	30	40	20	10	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	30	40	20	10	-	-	100
ESE	30	40	20	10	-	-	100

23CSPC01	FORMAL LANGUAGES, MACHINES AND COMPUTATION	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objectives	The aims of this course are to understand basic theory of computation concepts that lies at the backbone of all state-of-the-art applications and program design. Students should understand the capabilities and limits of computation, particular applications and capabilities of deterministic and non-deterministic finite automata, context-free grammars, and finally Turing machines, as well as NP-completeness and complexity classes.	
UNIT – I	**REGULAR LANGUAGES AND APPLICATIONS**	**L(9)+T(3)**
Regular Expressions and applications – Regular languages, properties and applications – Finite Automata, variants and applications – Pumping lemma for RL.		
UNIT – II	**CONTEXT FREE LANGUAGES**	**L(9)+T(3)**
Grammars – Context Free Languages, properties and applications – Stack machines – Context free frontier – Stack machines applications – Pumping lemma for CFL.		
UNIT – III	**TURING MACHINES**	**L(9)+T(3)**
Turing machine basics – Simple TMs – Language define by TM – Variants of TMs and their equivalence – Universal TM – Recursive, Recursively Enumerable languages and properties		
UNIT – IV	**COMPUTABILITY AND UNCOMPUTABILITY**	**L(9)+T(3)**
Turing computable functions – Functions and languages – TM random access – Church-Turing thesis – Infinite models, finite machines – Halting problem – Reducibility – Rice's theorem – Grammars and Computability – Computable functions - Mathematical uncomputabilities		
UNIT – V	**COST MODELS AND ALTERNATE ALGORITHMS**	**L(9)+T(3)**
Asymptotic notations, properties and functions – TM cost model – Time complexity classes – Space complexity classes – Higher complexity classes – Verification methods – NP, NP hard and NP Complete problems – Approximation algorithms, probabilistic and parallel algorithms – Interactive proof system		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

REFERENCES :

1	*John E Hopcroft, Rajeev Motwani, Jeffrey D Ullman,* ***"Introduction to Automata Theory, Languages and Computation"****, Third Edition, Pearson, 2013*
2	*John C. Martin,* ***"Introduction to languages and the theory of computation"****, Third edition, McGrawHil, 2015*

3	*Michael Sipser,* ***"Introduction to Theory of Computation"****, Third Edition, Cengage learning, 2013.*
4	*H.R.Lewis and C.H.Papadimitriou,* ***"Elements of the theory of Computation****", Second Edition, Pearson, 2015*

COURSE OUTCOMES:		**Bloom's Taxonomy Mapped**
CO1	Identify, use and apply Formal Languages	K3
CO2	Solve given problem by constructing appropriate Automata/Machines	K4
CO3	Provide solution model for computable functions	K5
CO4	Classify the problems based on the cost analysis	K6
CO5	Use alternate models of computation such as Approximation algorithms, probabilistic and parallel algorithms and Interactive proof system	K3

COURSE ARTICULATION MATRIX :

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	-	3	3	3	-
CO2	3	-	2	3	3	-
CO3	3	-	3	3	3	-
CO4	2	-	3	3	2	1
CO5	1	-	1	1	1	2
23CSPC01	**3**	**-**	**3**	**3**	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	30	20	-	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	-	-	40	40	20	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	-	-	40	40	20	100
ESE	40	30	30	-	-	-	100

23CSPC02	HIGH PERFORMANCE COMPUTER ARCHITECTURE	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	After the completion of the course, the students will be able to understand fundamentals of Computer Organization, performance laws and memory organization. Concepts and issues in instruction level parallelism with different types of data Level Parallelism and different types of thread level parallelism. extract the performance from software that is oblivious to architecture.	
UNIT – I	**FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS AND MEMORY HIERARCHY DESIGN**	**L(9)**
RISC processors - Characteristics of RISC processors, RISC vs CISC, Classification of Instruction Set Architectures - Review of performance measurements - Trends in Technology , Power and Energy in Integrated Circuits and Cost - Dependability - Measuring, Reporting, and Summarizing Performance - Quantitative Principles of Computer Design - Memory Hierarchy Design – Introduction - Memory Technology and Optimizations - Ten Advanced Optimizations of Cache Performance - Virtual Memory and Virtual Machines - Cross-Cutting Issues: The Design of Memory Hierarchies.		
UNIT – II	**INSTRUCTION-LEVEL PARALLELISM AND ITS EXPLOITATION**	**L(9)**
Instruction-Level Parallelism: Concepts and Challenges - Basic Compiler Techniques for Exposing ILP - Reducing Branch Costs With Advanced Branch Prediction - Overcoming Data Hazards With Dynamic Scheduling - Dynamic Scheduling: Examples and the Algorithm - Hardware-Based Speculation - Exploiting ILP Using Multiple Issue and Static Scheduling - Exploiting ILP Using Dynamic Scheduling, Multiple Issue, and Speculation - Advanced Techniques for Instruction Delivery and Speculation.		
UNIT – III	**DATA-LEVEL PARALLELISM IN VECTOR, SIMD, GPU ARCHITECTURES ANDWAREHOUSE-SCALE COMPUTERS**	**L(9)**
Introduction - Vector Architecture - SIMD Instruction Set Extensions for Multimedia - Graphics Processing Units - Detecting and Enhancing Loop-Level Parallelism - Programming Models and Workloads for Warehouse-Scale Computers - Computer Architecture of Warehouse-Scale Computers - The Efficiency and Cost of Warehouse-Scale Computers - Cloud Computing: The Return of Utility Computing.		
UNIT – IV	**THREAD-LEVEL PARALLELISM**	**L(9)**
Introduction - Centralized Shared-Memory Architectures - Performance of Symmetric Shared-Memory Multiprocessors - Distributed Shared-Memory and Directory-Based Coherence - Synchronization: The Basics - Models of Memory Consistency: An Introduction - Cross-Cutting Issues - Multicore Processors and Their Performance - The Future of Multicore Scaling.		
UNIT – V	**DOMAIN-SPECIFIC ARCHITECTURES**	**L(9)**
Introduction- Guidelines for DSAs - Example Domain: Deep Neural Networks - Google's Tensor Processing Unit, an Inference Data Center Accelerator - Microsoft Catapult, a Flexible Data Center Accelerator - Intel Crest, a Data Center Accelerator for Training - Pixel Visual Core, a Personal Mobile Device Image Processing Unit -A Vision of Computer Architecture Research over the Next 15 Years.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

REFERENCES :

1	*John L. Hennessey and David A. Patterson,* ***"Computer Architecture – A Quantitative Approach",*** *Morgan Kaufmann / Elsevier, Six edition, 2019.*
2	*William Stallings,* ***"Computer Organization and Architecture*** *Designing for Performance****",*** *Pearson Education, Tenth Edition, 2016.*
3	D. A. Patterson and J. L. Hennessy, **"*Computer Organization and Design RISC-V Edition: The Hardware Software Interface*,"** 1st Edition, Morgan Kaufmann Publishing Co., Menlo Park, CA., April 2017.
4	*Luis Ceze, Mark D. Hill, Thomas F. Wenisch ,* ***"Arch2030: A Vision of Computer Architecture Research over the Next 15 Years",*** *The Arch2030 Workshop at ISCA 2016.*

COURSE OUTCOMES:		**Bloom's Taxonomy Mapped**
CO1	Understand the components and operation of a memory hierarchy and the range of performance issues influencing its design.	K2
CO2	Analyze and exploit instruction level parallelism.	K4
CO3	Evaluate performance of different architectures with respect to Data level Parallelism.	K5
CO4	Understand the organisation and operation of current generation multiprocessor and multicore systems.	K2
CO5	Describe and explain current and future trends in computer architecture	K4

COURSE ARTICULATION MATRIX :

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	2	3	3
CO2	3	2	3	2	3	3
CO3	3	2	3	2	3	3
CO4	3	2	3	2	3	3
CO5	3	2	3	2	3	3
23CSPC02	**3**	**2**	**3**	**2**	**3**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	40	30	20	-	-	100
CAT2	-	40	30	30	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	50	30	20	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	50	30	20	-	-	100
ESE	40	30	30	-	-	-	100

23CSPC03	ALGORITHMS AND COMPLEXITY ANALYSIS	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	The objective of the course is to enable students with the ability to analyze the asymptotic performance of algorithms along the capability to understand and design algorithms using advanced design and analysis techniques.	
UNIT – I	**INTRODUCTION**	**L(9)**
Role of Algorithms in Computing – Characterizing Running Times - Divide and Conquer – Probabilistic analysis – Randomized algorithms – Sorting and Order Statistics		
UNIT – II	**ADVANCED DESIGN AND ANALYSIS TECHNIQUES**	**L(9)**
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 -offline caching – Amortized Analysis.		
UNIT – III	**GRAPH ALGORITHMS**	**L(9)**
Single source shortest paths – All pairs shortest paths : Floyd-Warshall algorithm - Johnson's algorithms for sparse graphs – Maximum Flow: Flow networks - The Ford-Fulkerson method-Maximum bipartite matching – Matching in Bipartite Graphs: The stable-marriage problem - The Hungarian algorithm for the assignment problem		
UNIT – IV	**ADVANCED ALGORITHMS I**	**L(9)**
Parallel Algorithms: Basics of fork-join parallelism – Parallel Matrix multiplication – Parallel merge sort – Online Algorithms – Waiting for a elevator – Maintaining a search List –Online Caching- Matrix Operation: Solving system & Linear equation -Matrix Inversion - Symmetric Positive definite Matrices and least Square Approximation- Linear Programming		
UNIT – V	**ADVANCED ALGORITHMS II**	**L(9)**
Polynomials and FFT – Number theoretic Algorithms-String matching – machine learning algorithms - NP Completeness – Approximation Algorithms		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

REFERENCES

1	*Thomas H. Cormen, Charles E. Leiseron, Ronald L.Rivest, Clifford Stein,* ***"Introduction to Algorithms"****, Fourth Edition, PH1 learning Pvt. Ltd., 2022.*
2	*Anany Levitin,* ***"The Design and analysis & algorithms"****, III Edition, Pearson, 2011.*
3	*Jeff Erickson,* ***"Algorithms"****, 1st edition, 2019.*
4	*Aho. A.V., Hopcroft. J.E. and Ullman .J.D.,* ***"The Design and Analysis of Algorithms"****, Addison-Wesley, 1974.*

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Design and analyze algorithms using divide and conquer, dynamic programming, greedy approaches.	**K6**
CO2	Perform probabilistic analysis and amortized analysis of algorithms.	**K1**
CO3	Use appropriate graph and matrix manipulation algorithms	**K3**
CO4	Solve problems using parallel algorithms and linear programming approach.	**K2**
CO5	Use algorithms on polynomials	**K2**
CO6	Identify problems that are NP Complete and generate near optimal solution	**K4**

COURSE ARTICULATION MATRIX :						
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	2	-	-	2
CO2	3	-	2	-	-	2
CO3	2	-	2	-	3	2
CO4	2	-	2	-	3	2
CO5	2	-	2	-	1	2
CO6	2	-	2	-	-	2
23CSPC03	**2**	**-**	**2**	**-**	**1**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	30	-	20	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	30	30	30	-	10	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	30	40	30	-	-	-	100
ESE	30	30	20	-	20	-	100

23CSPE01	DIGITAL IMAGE PROCESSING	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Understand the basic concepts of image processing like pixel relations, transforms and Enhancement techniques, restoration and compression techniques, Segmentation methods, and Recognition. 2. Apply image processing concepts in real time applications	
UNIT – I	**FUNDAMENTALS**	**L(9)**
Digital Image Processing – Fundamental steps, Components – Elements of Visual Perception – Image Sensing and Acquisition– Sampling and Quantization – Relationship between Pixels – Color Image Fundamentals		
UNIT – II	**IMAGE TRANSFORMS AND ENHANCEMENT**	**L(9)**
Image Transforms and its properties: Unitary transform, Discrete Fourier Transform, Discrete Cosine Transform, Hadamard-Walsh transform, Haar Transform, Hoteling Transform – Image Enhancement in spatial Domain: Gray level transformations, Histogram processing, Spatial Filtering - Image Enhancement in spatial Domain: Sharpening and smoothing filters, Homomorphic filtering		
UNIT – III	**IMAGE RESTORATION AND COMPRESSION**	**L(9)**
Image Restoration: Degradation model – Noise models – Estimating Degradation - Algebraic approach to restoration – Inverse Filtering – Wiener Filtering – Blind deconvolution –Image reconstruction from projections. Image Compression: redundancy and compression models - Loss less compression: variable-length, Huffman, Arithmetic coding, bit-plane coding, Lossless predictive coding. Lossy compression: Transform based coding (DCT), JPEG standard		
UNIT – IV	**IMAGE SEGMENTATION, UNDERSTANDING AND RECOGNITION**	**L(9)**
Image Segmentation: Line, Edge Detection – Edge Linking and Boundary detection – Region based segmentation – Boundary representation – Region Descriptors. Image understanding and recognition: Pattern classes - Matching by templates, classifiers-statistical and neural network based model		
UNIT – V	**APPLICATIONS**	**L(9)**
Applications: Automatic fruit grading system in Precision agriculture – Automatic visual system – forensic and security system – Medical Investigation – Entertainment: Multimedia		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

REFERENCES

1	*Rafael C. Gonzalez and Richard E. Woods,* ***"Digital Image Processing",*** *Fourth Edition, Pearson Education, 2018*
2	*Anil K. Jain,* ***"Fundamental of Digital Image Processing",*** *Prentice Hall, 2015*
3	*Annadurai S, Shanmugalakshmi R,* ***"Fundamentals of Digital Image Processing",*** *Pearson Education Pvt. Ltd., 2007*
4	*S. Jayaraman, S.Esakkirajan, T.Veerakumar,* ***"Digital Image Processing",*** *Second Edition, Tata McGraw Hill Education Pvt. Ltd., 2020.*
5	*S. Sridhar,* ***"Digital Image Processing"****, Second Edition, OXFORD University press, 2016*

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Describe the image processing steps and relationship between the pixels.	K2
CO2	Apply the image transforms and enhancement techniques on images.	K3
CO3	Analyze the different kinds of restoration and compression techniques of image processing.	K4
CO4	Perform edge detection and segmentation and Recognize image using matching by templates, statistical and neuralnetwork models.	K5
CO5	Apply suitable image processing techniques for various real time applications like medical and network security applications	K3

COURSE ARTICULATION MATRIX :

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	-	1	1
CO2	3	-	3	-	2	2
CO3	3	-	3	-	2	2
CO4	3	-	3	-	3	3
CO5	3	-	3	-	3	3
23CSPE01	**3**	**-**	**3**	**-**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	20	20	-	-	100
CAT2	20	30	20	30	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	30	20	20	30	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	30	20	-	20	30	100
ESE	10	30	20	20	10	10	100

23CSPE02	EMBEDDED SYSTEMS	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	After the completion of the course, the students will be able to understand embedded concepts and embedded system architecture with programming of ARM Cortex Microcontroller. Selection of a proper Microcontroller for an application. The usage of the development and debugging tools. Memory systems and Peripherals.	
UNIT – I	**INTRODUCTION TO EMBEDDED CONCEPTS**	**L(9)**
Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software.		
UNIT – II	**OVERVIEW OF ARM AND CORTEX-M3**	**L(9)**
Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. CortexM3Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions.Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D Code Bus, System Bus, External PPB and DAP Bus		
UNIT – III	**CORTEX EXCEPTION HANDLING AND INTERRUPTS**	**L(9)**
Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency		
UNIT – IV	**CORTEX-M3/M4 PROGRAMMING**	**L(9)**
Cortex-M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.		
UNIT – V	**CORTEX-M3/M4 DEVELOPMENT AND DEBUGGING TOOLS**	**L(9)**
STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

REFERENCES :

1	*Joseph Yiu,* ***" The Definitive Guide to the ARM Cortex-M3"****, Second Edition, Elsevier Inc. 2010.*
2	*Andrew N Sloss, Dominic Symes, Chris Wright,* ***"ARM System Developer'sGuide Designing and Optimizing System Software"****, Elsevier Publications,2006*
3	*Steve Furber,* ***"ARM System-on-Chip Architecture"****, 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403 , 2015*

4	***STM32L152xx ARM Cortex M3 Microcontroller*** *Reference Manual 5/97*
5	*ARM Company Ltd.* ***"ARM Architecture Reference Manual– ARM DDI 0100E"***

COURSE OUTCOMES:		**Bloom's Taxonomy Mapped**
CO1	Understand the Embedded Concepts and Architecture of Embedded Systems.	K2
CO2	Describe the architectural features and instructions of ARM Cortex M3 Microcontroller.	K2
CO3	Use Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation.	K2
CO4	Use ARM Cortex M3/M4 with Embedded C Programming for Application Development.	K5
CO5	Design and implement software systems to provide an interface to ARM Cortex M3 based hardware systems.	K6

COURSE ARTICULATION MATRIX :

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	-	3	2	2	3
CO2	2	-	3	2	2	3
CO3	2	-	3	2	2	3
CO4	3	-	3	3	2	3
CO5	3	-	3	3	2	3
23CSPE02	**2**	**-**	**3**	**2**	**2**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	30	10	10	-	-	100
CAT2	40	25	20	10	-	5	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	50	30	10	10	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	5	5	20	20	15	35	100
ESE	50	25	15	10	-	-	100

23CSPE03	FUZZY LOGIC AND NEURAL NETWORKS	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Explain the basics of Fuzzy set, Fuzzy relations, and methods for Fuzzificationand Fuzzy Logic Systems. 2. Understand the architecture and learning rules of simple neural networks, BPN, BAM and competitive resonance neural networks	
UNIT – I	**FUNDAMENTALS OF FUZZY LOGIC**	**L(9)**
Classical And Fuzzy Sets: Operations and Properties – Classical Relations and Fuzzy Relations: Properties and Operations, Composition, Tolerance and Equivalence Relations – Membership Functions: Features and Standard Forms – Fuzzification– Λ Cuts For Fuzzy Sets and Relations - Defuzzification		
UNIT – II	**FUZZY LOGIC SYSTEMS AND APPLICATIONS**	**L(9)**
Logic and Fuzzy Systems – Membership Value Assignments – Automated Methods for Fuzzy Systems: Least Squares Algorithm, Gradient and Clustering Method – Decision Making with Fuzzy Information – Applications: Fuzzy Classification, Fuzzy Pattern Recognition – Fuzzy Control Systems: Design Problems, Examples, Industrial Applications– Fuzzy Information Retrieval		
UNIT – III	**ARCHITECTURE OF NEURAL NETWORKS**	**L(9)**
Artificial Neural Networks - Biological Neural Networks - Typical Architecture - Setting Weights - Common Activations Functions- Basic Learning Rules - Mcculloch-Pitts Neuron - Simple Neural Nets For Pattern Classification: Architecture, Biases and Thresholds, Linear Separability, Hebb Net-Perceptron-Adaline.		
UNIT – IV	**BASIC NEURAL NETWORK TECHNIQUES**	**L(9)**
Back Propagation Neural Net: Standard Back Propagation – Architecture, Algorithm- Training Algorithm for Pattern Association-Hebb Rule and Delta Rule - Associative and other Neural Networks: Hetro Associative Memory Neural Net, Auto Associative Net- Bidirectional Associative Memory-Applications-Hopfield Nets-Boltzman Machine		
UNIT – V	**COMPETITIVE NEURAL NETWORKS**	**L(9)**
Neural Network Based on Competition: Fixed Weight Competitive Nets- KohonenselfOrganizing Maps and Applications-Learning Vector Quantization-Counter Propagation Nets and Applications - Adaptive Resonance Theory: Basic Architecture and Operation-Architecture, Algorithm, Application and Analysis of ART1 & ART2 - Cognitron and Neocognitron - Architecture, Training Algorithm and application		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

REFERENCES

1	*LaureneFausett,* ***"Fundamentals of Neural Networks",*** *Pearson Education India, 2008.*
2	*Timothy J.Ross,* ***"Fuzzy Logic with Engineering Applications",*** *John Wiley and sons Pvt.Ltd, Fourth Edition, 2016*
3	*J.A.Freeman and B.M.Skapura,* ***"Neural Networks, Algorithms applications and Programming Techniques",*** *Pearson, 2002*

4	*Zimmermann.H.J,* ***"Fuzzy Set Theory and its Applications"****, Kluwer Academic Publishers, Dordrecht, Germany, Fourth Edition,2013.*
5	*Zurada J.M.* ***"Introduction to Artificial Neural Systems",*** *Jaico Publishing House,1994*

COURSE OUTCOMES:		**Bloom's Taxonomy Mapped**
CO1	Perform simple arithmetic, logical and geometric operations on classical and fuzzy sets.	K3
CO2	Apply Fuzzy Logic techniques for real time applications.	K3
CO3	Apply activation functions suitable for different neural networks and Solve linearly separable problems	K3
CO4	Choose and apply the suitable BPN algorithm for pattern classification, character recognization	K4
CO5	Describe the features, operations and applications of Competitive Networks and Adaptive resonance neural networks, and Neocognitron.	K2

COURSE ARTICULATION MATRIX :

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	2	2	2
CO2	3	1	3	3	2	2
CO3	2	1	3	2	2	2
CO4	3	1	3	3	2	2
CO5	2	1	3	2	1	2
23CSPE03	**2**	**1**	**3**	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	20	20	-	-	100
CAT2	20	30	20	30	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	30	20	20	30	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	30	20	-	20	30	100
ESE	10	20	30	20	10	10	100

23CSPE04	CLOUD COMPUTING	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. The objective of the course is to enable students to understand the basic underlying concepts, Characteristics, issues and challenges of cloud computing, architecture and virtualization. 2. Students will be familiar with Cloud application program and the ANEKA latform, security issues of cloud computing.	
UNIT – I	**INTRODUCTION TO CLOUD COMPUTING**	**L(9)**
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**	**L(9)**
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**	**L(9)**
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**	**L(9)**
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**	**L(9)**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

REFERENCES

1	*Sosinsky, Barrie.* ***"Cloud computing bible"****, Vol. 762. John Wiley & Sons, 2010.*
2	*Kai Hwang, Geoffrey C. Fox, Jack, J. Dongarra* ***"Distributed and Cloud Computing from Parallel Processing to the Internet of Things",*** *Elsevier 2012.*
3	*RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi* ***"Mastering Cloud Computing Foundations and Applications Programming",*** *2013.*
4	*RajkumarBuyya, James Broberg, Andrzej M. Goscinski,* ***"Cloud Computing: Principles and Paradigms",*** *Wiley,2011*
5	*Nikos Antonopoulos, Lee Gillam ,* ***"Cloud Computing: Principles, Systems and Applications"*** *Springer, 2012.*
6	*Ronald L. Krutz, Russell Dean Vines****, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing",*** *Wiley-India, 2010.*
7	*John Ritting house & James Ransome,* ***"Cloud Computing, Implementation, Management and Strategy",*** *CRC Press, 2016.*

COURSE OUTCOMES:		**Bloom's Taxonomy Mapped**
CO1	Explain and discuss basic concepts, fundamental issues and challenges of Cloud Computing and paradigms of computing.	K1
CO2	Explain the basic architecture of cloud computing and virtualization techniques.	K2
CO3	Design and implement basic cloud application using Aneka framework.	K3
CO4	Explain the core issues of cloud computing such as security, privacy, and interoperability.	K4
CO5	Provide cloud computing solutions and recommendations and for applications.	K5

COURSE ARTICULATION MATRIX :

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	3	2	-	3	2
CO4	3	2	2	2	-	-
CO5	3	3	2	2	3	-
23CSPE04	**3**	**2**	**2**	**2**	**3**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	-	30	30	20	20	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	40	40	20	-	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	30	30	20	20	-	100
ESE	40	20	10	10	10	10	100

23CSPE05	ADVANCED SOFTWARE ENGINEERING	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	The objective of the course is to familiarize students with software Design and estimation techniques, software quality, testing and maintenance strategies along with scrum development process	
UNIT – I	**INTRODUCTION AND REQUIREMENTS MODELING**	**L(9)**
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**	**L(9)**
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**	**L(9)**
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**	**L(9)**
Software Maintenance-Software Supportability- Reengineering- Business Process Reengineering-Software Reengineering- Reverse Engineering-Restructuring- Forward Engineering.Software Process improvement: Process – CMMI – The people CMM – SPI return on investment – SPI Trends.		
UNIT – V	**INTRODUCTION TO SCRUM DEVELOPMENT PROCESS**	**L(9)**
Basics of Scrum – Running a Scum project – Steps for transition to scrum – Metrics for scrum –CaseStudy.		
Contact Periods: **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods**		

REFERENCES

1	*Roger Pressman.S* ***"Software Engineering: A Practitioner's Approach"*** *Eighth Edition, McGraw Hill, 2014*
2	*Ian Sommerville* ***"Software Engineering"*** *Tenth Edition, Pearson Education Asia, 2017.*
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, 2002.*

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Apply different process models for different projects and Perform requirement gathering and model the requirements.	*K3*
CO2	Design the project and identify risks, construct RMMM plan and develop estimation models.	*K4*
CO3	Verify and validate the software applications using different types of testing and maintain the quality of software.	*K4*
CO4	Perform reverse and forward engineering process for maintenance and improvement required in the project	*K5*
CO5	Apply Scrum Development Process to develop software.	*K6*

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	2	3
CO2	3	3	3	1	2	3
CO3	3	3	3	1	2	3
CO4	3	3	3	1	2	3
CO5	3	3	3	1	2	3
23CSPE05	**3**	**3**	**3**	**1**	**2**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	-	20	30	30	-	20	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	-	50	50	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	-	50	50	-	-	100
ESE	20	20	20	20	-	20	100

23CSPE06	PATTERN RECOGNITION	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Explain and compare a variety of pattern classification, structural pattern recognition and pattern classifier combination techniques	
UNIT – I	**INTRODUCTION TO PATTERN RECOGNITION**	**L(9)**
Introduction to Pattern Recognition- Data structures for pattern recognition –Review of Random Vectors, Expectation, Correlation, Covariance - Review of Linear Algebra- Linear Transformations -Feature Extraction– Training and Learning– Discriminant Functions.		
UNIT – II	**LINEAR CLASSIFIERS**	**L(9)**
Bayes Decision Theory - The Gaussian Probability Density Function - Minimum Distance classifiers – Mixture Models - Perceptron Algorithm – The Sum of Error Squares Classifier - Support Vector Machines: K-Nearest-Neighbor Classification		
UNIT – III	**UNSUPERVISED LEARNING AND CLUSTERING**	**L(9)**
Terminologies–Maximum likelihood estimation –Applications - Clustering - Sequential algorithms –Data descriptions - Criterion functions -Spectral Clustering - Hierarchical Clustering		
UNIT – IV	**SYNTACTICAL PATTERN RECOGNITION**	**L(9)**
Elements of formal grammars – String generation as pattern description – Case Studies - Recognition of syntactic description – Parsing – Stochastic grammars and applications – Graph based structural representation		
UNIT – V	**FEATURE SELECTION TECHNIQUES**	**L(9)**
Outlier Removal – Normalization – ROC Curve - Fishers Discriminant Ratio - Class Separability - Feature Subset Selection - Unsupervised learning in neural Pattern Recognition – Self-organizing networks		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods**		

REFERENCES

1	*M. Narasimha Murthy and V. Susheela Devi,* ***"Pattern Recognition. An Algorithmic approach",*** *Springer, 2011.*
2	*Robert J.Schalkoff,* ***"Pattern Recognition Statistical, Structural and Neural Approaches",*** *Wiley, India, 2009.*
3	*SergiosTheodoridis, Konstantinos Koutroumbas,* ***"Introduction to Pattern Recognition: A Matlab Approach"****, Elsevier Academic Press, 2010.*
4	*Andrew R. Webb, Keith D. Copsey,* ***"Statistical Pattern Recognition"****, Third Edition, Wiley, 2011.*
5	*Duda R.O., HarP.E.,and David G Stork,* ***"Pattern Classification",*** *Second edition, John Wiley & Sons, NewYork, 2012*

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Describe the significance of pattern recognition	K2
CO2	Analyze the given patterns and apply suitable pattern classifiers for pattern classification	K4
CO3	Apply appropriate clustering techniques for high dimensional datasets.	K3
CO4	Summarize various syntactical pattern recognition models.	K4
CO5	Identify appropriate feature selection techniques.	K4

COURSE ARTICULATION MATRIX :

COs/POs	PO 1	PO2	PO 3	PO 4	PO5	PO6
CO1	1	2	3	1	2	2
CO2	1	2	3	1	2	2
CO3	1	2	3	1	2	2
CO4	1	2	3	1	2	2
CO5	1	2	3	1	2	2
23CSPE06	**1**	**2**	**3**	**1**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	20	40	40	-	-	100
CAT2	-	20	40	40	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	-	-	100	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	-	-	100	-	-	100
ESE	-	30	40	30	-	-	100

23CSACZ1	ENGLISH FOR RESEARCH PAPER WRITING *(Common to All Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	The objective of the course is to make the learners understand the format and intricacies involved in writing a research paper.	
UNIT – I	**PLANNING AND PREPARATION**	**L(6)**
Need for publishing articles, Choosing the journal, Identifying a model journal paper, Creation of files for each section, Expectations of Referees, Online Resources		
UNIT – II	**SENTENCES AND PARAGRAPHS**	**L(6)**
Basic word in English, Word order in English and Vernacular, placing nouns, Verbs, Adjectives, and Adverb suitably in a sentence, Using Short Sentences, Discourse Markers and Punctuations- Structure of a Paragraph, Breaking up lengthy Paragraphs		
UNIT – III	**ACCURACY, BREVITY AND CLARITY (ABC) OF WRITING**	**L(6)**
Accuracy, Brevity and Clarity in Writing, Reducing the linking words, Avoiding redundancy, Appropriate use of Relative and Reflexive Pronouns, Monologophobia, verifying the journal style, Logical Connections between others author's findings and yours		
UNIT – IV	**HIGHLIGHTING FINDINGS, HEDGING AND PARAPHRASING**	**L(6)**
Making your findings stand out, Using bullet points headings, Tables and Graphs- Availing non-experts opinions, Hedging, Toning Down Verbs, Adjectives, Not over hedging, Limitations of your research.		
UNIT – V	**SECTIONS OF A PAPER**	**L(6)**
Titles, Abstracts, Introduction, Review of Literature, Methods, Results, Discussion, Conclusions, References		
Contact Periods: **Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods**		

REFERENCES

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

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Understand the need for writing good research paper.	K2
CO2	Practice the appropriate word order, sentence structure and paragraph writing	K4
CO3	Practice unambiguous writing	K3
CO4	Avoid wordiness in writing	K2
CO5	Exercise the elements involved in writing journal paper.	K3

COURSE ARTICULATION MATRIX :						
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	1	1	2
CO2	3	3	1	1	1	2
CO3	3	3	1	1	1	2
CO4	3	3	1	1	1	2
CO5	3	3	1	1	1	2
23CSACZ1	**3**	**3**	**1**	**1**	**1**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial						

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	50	50	-	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	50	50	-	-	-	100
ESE	30	30	40	-	-	-	100

23CSPC04	ADVANCED ALGORITHMS AND ELECTIVE LAB	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	Explain important algorithmic design paradigms and methods of analysisto design efficient algorithms in common engineering design solutions.
	PRACTICALS EXERCISESILLUSTRATINGTHEFOLLOWINGCONCEPTS:
1	Implement an algorithm that combines k sorted lists in time O(n log k)where n is the total number of elements.
2	Implement an algorithm to solve Matrix multiplication problem and Maximum value contiguous subsequence using dynamic programming approach.
3	Implement an algorithm based on greedy approach to solve knapsack problem and Activity selection problem.
4	Implement Merge sort algorithm using Divide and Conquer approach.
5	Implement stack operations and calculate the amortized cost.
6	Implement Graph Traversal algorithms.
7	Implement an algorithm to construct Minimum Spanning Trees.
8	Implement Shortest path and Maximum flow algorithms
9	Implement String matching algorithms
10	Implement Computational Geometry algorithms
Contact periods:	
Lecture: 0 Periods	**Tutorial: 0 Periods** / **Practical: 45 Periods** / **Total:45 Periods**

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
CO1	Design and analyze algorithms using divide and conquer, dynamic programming, greedy algorithms	K6
CO2	Perform probabilistic analysis and amortized analysis of algorithms	K4
CO3	Implement Minimum spanning trees,shortest path and Maximum flow algorithms in graphs to solve problems	K6
CO4	Solve problems using String matching algorithms	K6
CO5	Solve problems using Computational geometry algorithms	K6

COURSE ARTICULATION MATRIX :

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	3	3
CO2	3	3	3	1	3	3
CO3	3	3	3	1	3	3
CO4	3	3	3	1	3	3
CO5	3	3	3	1	3	3
23CSPC04	**3**	**3**	**3**	**1**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial