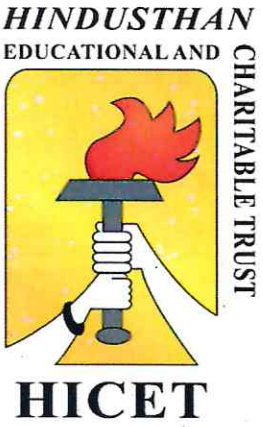
HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)

COIMBATORE 641 032.

M. E. COMPUTER SCIENCE AND ENGINEERING



(CHOICE BASED CREDIT SYSTEM)

Curriculum & Syllabus

2020-2021

VISION AND MISSION OF THE INSTITUTION

VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION

IM1: To provide academic excellence in technical education through novel teaching methods.

IM2: To empower students with creative skills and leadership qualities.

IM3: To produce dedicated professionals with social responsibility.

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CSE - HiCET

Dean (Academics)
HiCET

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VISION AND MISSION OF THE DEPARTMENT

VISION

To provide an excellence for individuals to develop technologically superior, socially conscious and nationally responsible citizens.

MISSION

DM1: To develop competent Computer Science and Engineering professionals with knowledge in current technology.

DM2: To mould them to attain excellent leadership qualities there by making them excel in their careers.

DM3: To inspire and nurture students to come out with innovation and creativity solutions meeting the societal needs.

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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering Knowledge - Ability to apply knowledge of mathematics, science, mechanical engineering fundamentals and specialization to the solutions of complex engineering problems;

2. Problem Analysis - Ability to identify, formulate, conduct research literature and analyze complex engineering problems using principles of mathematics, natural sciences and mechanical engineering sciences;

3. Design/Development of Solutions - Ability to design mechanical solutions for complex engineering problems and systems, components or processes that meet specified needs;

4. Investigation - Ability to conduct investigation of complex problems using research based knowledge and research methods to provide valid conclusions;

5. Modern Tool Usage - Ability to develop and apply appropriate techniques, resources, and innovative engineering tools to complex mechanical engineering activities;

6. The Engineer and Society - Ability to apply contextual knowledge to assess societal, health, safety, legal and cultural issues with the awareness of the consequent responsibilities to professional mechanical engineering practice for the betterment of society;

7. Environment and Sustainability - Ability to understand the impact of professional mechanical engineering solutions in societal, economic and environmental contexts and demonstrate knowledge of and need for sustainable development;

8. Ethics - Ability to apply ethical principles and demonstrate commitment to professional ethics, responsibilities and norms of mechanical engineering

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practice;

9. Communication - Ability to communicate effectively on complex engineering activities with the engineering community and with society at large;

10. Individual and Team Work - Ability to demonstrate knowledge and understanding of mechanical engineering and management principles and apply these effectively as an individual, a member or a leader in diverse teams and in multidisciplinary settings;

11. Life Long Learning - Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change in mechanical engineering practice;

12. Project Management and Finance - Ability to demonstrate knowledge and understanding of project management, finance principles, business development within the scope of mechanical engineering practices.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Evolve and apply innovative, state-of-the-art practices and technologies and provide relevant solutions to Computer Science and Engineering problems.
PSO2	Ability to unveil computing, research and development skill to identify research gaps and to exhibit the outcomes as technical report.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To acquire knowledge in the latest technologies and innovations and an ability to identify, analyze and solve problems in computer engineering.

PEO2: To be capable of modeling, designing, implementing and verifying a computing system to meet specified requirements for the benefit of society.

PEO3: To possess critical thinking, communication skills, teamwork, leadership skills and ethical behavior necessary to function productively and professionally.

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CURRICULUM

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

POST GRADUATE PROGRAMMES

M.E. COMPUTER SCIENCE AND ENGINEERING (PG)

REGULATION 2016 & 2020

REGULATION 2020

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS	CIA	ESE	TOTAL
				L	T	P				
THEORY										
1.	20MA1103	Mathematical foundation of CSE	FC	3	1	0	4	40	60	100
2.	20CP1201	Advance Data Structures	PCC	3	1	0	4	40	60	100
3.	20CP1202	Advanced Database Management System	PCC	3	0	0	3	40	60	100
4.	20CP1203	Software Architecture	PCC	3	0	0	3	40	60	100
5.	20RM1161	Research Methodology and IPR	RMC	2	0	0	2	40	60	100
6.	20AC10XX	Audit Course I	AC	2	0	0	0	100	0	100
PRACTICALS										
7.	20CP1001	Advance Data StructuresLaboratory	PCC	0	0	4	2	50	50	100
8.	20CP1002	Advanced Database Management System Laboratory	PCC	0	0	4	2	50	50	100
TOTAL				**16**	**2**	**8**	**20**	**400**	**400**	**800**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS	CIA	ESE	TOTAL
				L	T	P				
THEORY										
1.	20CP2201	Advanced algorithms	PCC	3	0	0	3	40	60	100
2.	20CP2202	Cloud Computing Technologies	PCC	3	0	0	3	40	60	100

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3.	20CP23XX	Program Elective I	PEC	3	0	0	3	40	60	100
4.	20CP23XX	Program Elective II	PEC	3	0	0	3	40	60	100
5.	20AC20XX	Audit Course II	AC	2	0	0	0	100	0	100
THEORY WITH LAB COMPONENT										
6.	20CP2251	Machine learning Techniques	PCC	3	0	2	4	50	50	100
PRACTICALS										
7.	20CP2001	Advanced Algorithms Laboratory	PCC	0	0	4	2	50	50	100
8.	20CP2002	Internship / Mini Project	EEC	0	0	2	1	50	50	100
TOTAL				**17**	**0**	**8**	**19**	**410**	**390**	**800**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I										
S.No.	**Course Code**	**Course Title**		**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1.	20CP2301	Agent Based Intelligent Systems	PEC	3	0	0	3	40	60	100
2.	20CP2302	Multicore Architecture	PEC	3	0	0	3	40	60	100
3.	20CP2303	Software Design Patterns	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE - II										
4.	20CP2304	Compiler Optimization Techniques	PEC	3	0	0	3	40	60	100
5.	20CP2305	Distributed Operating Systems	PEC	3	0	0	3	40	60	100
6.	20CP2306	Software Process and Project Management	PEC	3	0	0	3	40	60	100

AUDIT COURSES SEMESTER – I

S. No	Course Code	Course Name	L	T	P	C
1	20AC1091	English for Research Paper writing	2	0	0	0
2	20AC1092	Disaster Management	2	0	0	0
3	20AC1093	Sanskrit for Technical knowledge	2	0	0	0
4	20AC1094	Pedagogy Studies	2	0	0	0
5	20AC1095	Constitution of India	2	0	0	0

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AUDIT COURSES SEMESTER - II

S. No	Course Code	Course Name	L	T	P	C
1	20AC2091	Value Education	2	0	0	0
2	20AC2092	Stress Management by Yoga	2	0	0	0
3	20AC2093	Personality Development Through Life Enlightenment Skills	2	0	0	0
4	20AC2094	Unnat Bharat Abhiyan	2	0	0	0

REGULATION 2016

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER III

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16CP3201	Software Process and Project Management	3	1	0	4	40	60	100
2	16CP3202	Internet of Things	3	0	0	3	40	60	100
3	16CP33XX	**Professional Elective V**	3	0	0	3	40	60	100
4	16CP33XX	**Professional Elective VI (OR)**	3	0	0	3	40	60	100
	16XX34XX	**Open Elective (Optional)**							
PRACTICAL									
5	16CP3901	Project Phase – I	0	0	12	6	50	50	100
		Total:	**12**	**1**	**12**	**19**	**210**	**290**	**500**

SEMESTER IV

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
PRACTICAL									
1	16CP3902	Project Phase – II	0	0	24	12	100	100	200
		Total:	**0**	**0**	**24**	**12**	**100**	**100**	**200**

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE V									
1	16CP3301	Social Network Analysis	3	0	0	3	40	60	100
2	16CP3302	Managing Big Data	3	0	0	3	40	60	100
3	16CP3303	Model Checking and Program Verification	3	0	0	3	40	60	100
4	16CP3304	Medical Image Processing	3	0	0	3	40	60	100
5	16CP3305	Software Design	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE VI									
1	16CP3306	Multi Objective Optimization Techniques	3	0	0	3	40	60	100
2	16CP3307	Information Storage Management	3	0	0	3	40	60	100
3	16CP3308	Software Quality Assurance	3	0	0	3	40	60	100
4	16CP3309	Green Computing	3	0	0	3	40	60	100
5	16CP3310	Reconfigurable Computing	3	0	0	3	40	60	100

OPEN ELECTIVE									
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1	16CPX401	Mobile Application Development	3	0	0	3	40	60	100
2	16CPX402	Data Mining Techniques	3	0	0	3	40	60	100

CREDIT DISTRIBUTION

R-2016

Semester	I	II	III	IV	TOTAL
CREDITS	24	23	19	12	**78**

R-2020

Semester	I	II	III	IV	TOTAL
CREDITS	20	19	19	12	**70**

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20MA1103	MATHEMATICAL FOUNDATION OF CSE	3	1	0	4

Course Objective

- To apply mathematical linear programming techniques to solve constrained problems.
- To appreciate the use of simulation techniques.
- To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives.
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions.
- To impart knowledge of handling random vectors which represent random variables in multidimensional space.

Unit	Description	Instructional Hours
I	**LINEAR PROGRAMMING** Formulation – Graphical solution – Simplex method – Two phase method –Transportation and Assignment Problems	12
II	**SIMULATION** Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems	12
III	**ESTIMATION THEORY** Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments	12
IV	**TESTING OF HYPOTHESIS** Sampling distributions – Estimation of parameters – Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion, Tests for independence of attributes and goodness of fit.	12
V	**MULTIVARIATE ANALYSIS** 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	12
	Total Instructional Hours	**60**

Course Outcome

CO1:	Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.
CO2:	Simulate appropriate application/distribution problems.
CO3:	Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
CO4:	Apply the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
CO5:	Get exposure to the principal component analysis of random vectors and matrices.

REFERENCE BOOKS:

R1: Jay L.Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, 9th Edition, Boston, 2016

R2: Johnson, R.A, Irwin Miller and John Freund., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, 9th Edition, New York, 2016.

R3: Ross. S.M., "Probability Models for Computer Science", Academic Press, SanDiego, 2002.

R4: Taha H.A.,, "Operations Research: An Introduction", Prentice Hall of India Pvt. Ltd. 10th Edition, New Delhi, 2017

R5: Winston, W.L., "Operations Research", Thomson – Brooks/Cole, Fourth Edition, Belmont, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP1201	ADVANCE DATA STRUCTURES	3	1	0	4

Course Objective

- To extend the students' knowledge of algorithms and data structures.
- To enhance their expertise in algorithmic analysis and algorithm design techniques.
- To understand various types of search and heap structures.
- To study various types of geometric, randomized and approximation algorithms.
- To extrapolate from them in order to apply those algorithmsand techniques to solve problems

Unit	Description	Instructional Hours
I	**FUNDAMENTALS** Properties of Big-oh Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Introduction to NP-Completeness/NP-Hard –Recurrence Equations – Solving Recurrence Equations – Time-Space Tradeoff	12
II	**SEARCH STRUCTURES** Binary Search Trees – AVL Trees – Red-Black trees – Multi-way SearchTrees –B-Trees – Splay Trees – Tries.	12
III	**HEAP STRUCTURES** Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – FibonacciHeaps – Skew Heaps – Lazy Binomial Heaps	12
IV	**GEOMETRIC ALGORITHMS** Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Computing the Overlay of Two Subdivisions – Range Trees –Voronoi Diagram	12
V	**ADDITIONAL TOPICS** Approximation Algorithms: Vertex Cover & Euclidean Travelling Salesperson Problem – Randomized Algorithms: Closest Pair Problem & Minimum Spanning Trees – Online Algorithm: Euclidean Spanning Tree	12
	Total Instructional Hours	**60**

Course Outcome

CO1:	Analyze algorithms.
CO2:	Determine algorithm correctness.
CO3:	Choose appropriate data structures for the problems to be solved.
CO4:	Design algorithms for problems from different domains.
CO5:	Identify various research strategies on algorithmic design

REFERENCE BOOKS:

R1: Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures inC",Second Edition, University Press, 2008

R2: Gilles Brassard, Paul Bratley, "Algorithmics: Theory and Practice", Prentice Hall, 1988.

R3: Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, "Computational GeometryAlgorithms and Applications", Third Edition, Springer, 2008.

R4: R.C.T Lee, S.S Tseng, R.C Chang and Y.T Tsai, "Introduction to the Design and Analysis ofAlgorithms", Tata McGraw-Hill Edition, 2012.

R5: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction toAlgorithms", MIT Press, 2009

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP1202	ADVANCED DATABASE MANAGEMENT SYSTEM	3	0	0	3

Course Objective

- To comprehend the underlying principles of Relational Database ManagementSystem.
- To develop database models using parallel and distributed databases.
- To understand the concepts of XML and Web databases.
- To apprehend the design and implementation of active temporal and deductivedatabases.
- To develop applications based on NoSQL database

Unit	Description	Instructional Hours
I	**RELATIONAL MODEL** Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language-Database Normalization – Transaction Management-Recovery	9
II	**PARALLEL AND DISTRIBUTED DATABASES** Parallel Databases– I/O Parallelism– Inter-Query and Intra-QueryParallelism– Inter-Operation and Intra-operation Parallelism – Performance evaluation for Parallel DB Systems – Distributed Database Architecture- Distributed Data Storage – Distributed Transactions – Distributed Query Processing –Distributed Transaction Management – Load balancing tools forDDB – DDB Security.	9
III	**XML AND WEB DATABASES** XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity-Java Database Connectivity– Accessing Relational database using PHP – User Driven Querying – Writingto Web Databases – Session Management	9
IV	**ACTIVE TEMPORAL AND DEDUCTIVE DATABASES** Event Condition Action Model – Design and Implementation Issues for Active Databases – Termination, Confluence, Determination and Modularization – Temporal Databases –Interpreting Time in Relational Databases – Deductive Databases – Datalog Queries	9
V	**NoSQL DATABASES** NoSQL database vs traditional RDBMS database – Migrating from RDBMS to NoSQL– CRUD operations – Querying NoSQL stores – Indexing and Ordering Datasets – MongoDB-Database creation and Querying– Web Application development using MongoDB	9
	Total Instructional Hours	**45**

Course Outcomes

CO1:	Design and implement relational databases
CO2:	Design and implement parallel and distributed databases.
CO3:	Design and implement XML databases, Active, Temporal and Deductive databases.
CO4:	Implement the concept of database connectivity with the applications.
CO5:	Design and implement NoSQL database.

REFERENCE BOOKS:

R1: R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Addison-Wesley, 2011.

R2: Han, Jiawei, Jian Pei, and MichelineKamber. Data mining: Concepts and Techniques. 2011.

R3: Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007

R4: Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Fifth Edition,McGraw Hill, 2006

R5: C. J. Date, A.Kannan and S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP1203	SOFTWARE ARCHITECTURE	3	0	0	3

Course Objective

- To understand the need, design approaches for software architecture tobridge the dynamic requirements and implementation
- To learn the design principles and to apply for large scalesystems
- To design architectures for distributed heterogeneous systemsenvironment through brokerage interaction
- To build design knowledge on service oriented and model driven architecturesand the aspect-oriented architecture.
- To develop appropriate architectures for various Case studies like semanticweb services, supply chain cloud services.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SOFTWARE ARCHITECTURE** Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).	9
II	**OBJECT-ORIENTED PARADIGM** Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC),Presentation-Abstraction-Control (PAC).	9
III	**DISTRIBUTED ARCHITECTURE** Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM, CORBA Message Broker Architecture- Service- Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture-Methodology of Architecture Decision, Quality Attributes	9
IV	**ARCHITECTURE OF USER INTERFACES** Architecture of User Interfaces containers, case study-web service. ProductLine Architectures - methodologies, processes and tools. Software Reuse andProduct Lines - Product Line Analysis, Design and implementation,configuration Models. Model Driven Architectures (MDA) –why MDA- Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.	9
V	**ASPECT ORIENTED ARCHITECTURES** Aspect Oriented Architectures- AOP in UML, AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping – inventory, supply chain cloud service Management, semantic web services	9
	Total Instructional Hours	45

Course Outcome

CO1: Understand the need of software architecture for sustainable dynamic systems
CO2: Have a sound knowledge on design principles and to apply for large scale systems
CO3: Design architectures for distributed heterogeneous systems
CO4: Have good knowledge on service oriented and model driven architectures and the aspect-oriented architecture
CO5: Have a working knowledge to develop appropriate architectures through variouscase studies.

REFERENCE BOOKS:

R1: Essentials of software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011
R2: Software Architecture Design Illuminated, Kai Qian, Jones and Bartlett Publishers Canada, 2010

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20RM1161	RESEARCH METHODOLOGY AND IPR	2	0	0	2

Course Objective

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues Understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Unit	Description	Instructional Hours
I	**RESEARCH PROBLEM FORMULATION** Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis,interpretation, necessary instrumentations	06
II	**LITERATURE REVIEW** Effective literature studies approaches, analysis, plagiarism, and research ethics.	06
III	**TECHNICALWRITING /PRESENTATION** Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee	06
IV	**INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)** 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.	06
V	**INTELLECTUAL PROPERTY RIGHTS (IPR)** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	06
	Total Instructional Hours	30

Course Outcome

CO1: Ability to formulate research problem.
CO2: Ability to carry out research analysis.
CO3: Ability to follow research ethics.
CO4: Ability to understand that today's world is controlled by Computer, InformationTechnology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO5: Ability to understand about IPR and filing patents in R & D.

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REFERENCE BOOKS:

R1: Asimov, "Introduction to Design", Prentice Hall, 1962

R2: Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007

R3: Mayall, "Industrial Design", McGraw Hill, 1992.

R4: Niebel, "Product Design", McGraw Hill, 1974.

R5: Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP1001	ADVANCED DATA STRUCTURES LABORATORY	0	0	4	2

Course Objective

- To familiarize various data structure implementations.
- To implement heap and various tree structures like AVL, Red-black, B-Tree and segment trees.
- To understand efficient implementation of line segment intersection.
- To understand various search structures.
- To get understanding of problem to program mapping.

S.No	Description of the Experiments
1.	Binary Search Trees
2.	Min/Max Heaps
3.	Leftist Heaps
4.	AVL Trees
5.	Red-Black Trees
6.	B-Trees
7.	Segment Trees
8.	Line segment intersection
	Total Practical Hours 60

Course Outcome	CO1:	Achieve programming skill to convert a problem to a programming logic.
	CO2:	Apply suitable data structure for the problem in hand.
	CO3:	Implement heap and various tree structures like AVL, Red-black, B-Tree andsegment trees.
	CO4:	Understand the usage of data structures for geometric problems.
	CO5:	Understand the importance of height balancing in search structures.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP1002	ADVANCED DATABASE MANAGEMENT SYSTEM LABORATORY	0	0	4	2

Course Objective

- To explore the features of a Database Management Systems
- To interface a database with front end tools
- To understand the internals of a database system

S. No	Description of the Experiments
1.	Basic SQL
2.	Intermediate SQL
3.	Advanced SQL
4.	ER Modeling
5.	Database Design and Normalization
6.	Accessing Databases from Programs using JDBC
7.	Building Web Applications using PHP & MySQL
8.	Indexing and Query Processing
9.	Query Evaluation Plans
10.	Concurrency and Transactions
11.	Big Data Analytics using Hadoop

Total Instructional Hours **60**

Course Outcome

CO1: Ability to use databases for building web applications

CO2: Gaining knowledge about the internals of a database system

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2201	ADVANCED ALGORITHMS	3	0	0	3

COURSE OUTCOMES:

Upon completion of this course, the students will be able to
CO 1: analyze the algorithm's efficiency of any given problem. (K4)
CO 2: apply different algorithmic design techniques to solve the problem. (S2, K3)
CO 3: use various efficient optimization techniques and parallel algorithms to reduce space complexity. (S5, K2)
CO 4: develop different approximation algorithm for P and NP class Problems. (S3, A2)

Unit	Description	Instructional hours
I	**ANALYSIS OF ALGORITHMIC PERFORMANCE** Introduction of Analysis of algorithm - Average and worst-case analysis- Probabilistic and Randomized algorithm - Computation Analysis - Algorithm Redesign and Adaptation - Asymptotic Notation - Amortized Efficiency.	9
II	**ALGORITHMIC DESIGN TECHNIQUES** Divide and Conquer: Binary Search – Analysis - Greedy Method: Prim's Algorithm – Analysis - Dynamic Programming strategies: Computing Binomial Co-efficient – Analysis - Backtracking: Eight Queen's Problem- Analysis - Branch and Bound- 0 / 1 Knapsack Problem	9
III	**EFFICIENT DATA PROCESSING** Searching algorithms - Priority queues - Binary heaps - Binomial heaps - Dictionaries - Hash tables - String Matching - Introduction to string-matching problem- Naïve algorithm - Rabin Karp - Knuth Morris Pratt - Boyer-Moore algorithms and complexity analysis- Data compression algorithms - Huffman compression -Lempel-Ziv compression	9
IV	**PROBABILISTIC & PARALLEL ALGORITHMS** Probabilistic Algorithm - Numerical probabilistic algorithms - Monte Carlo algorithms-Las Vegas algorithms - Parallel algorithms: Introduction - Complexity measure for a parallel algorithm parallel searching algorithm - parallel sorting algorithm - parallel algorithm for matrix manipulation	9
V	**COMPUTATIONAL COMPLEXITY & APPROXIMATION ALGORITHMS** The class P and NP: NP- Completeness Problem, NP-Hard Problems - Approximation Algorithms: Introduction- approximation factor- Polynomial Time Approximation Scheme (PTAS) - Fully Polynomial Time Approximation Scheme (FPTAS) - Approximation algorithms: Travelling Salesman Problem – knapsack problem - Bin packing- subset sum problem	9
	Total Instructional Hours	**45**

REFERENCES

R1: Dave, Dave Parag Himanshu, "Design and Analysis of Algorithms", 2nd Edition, Pearson Education India, 2007.
R2: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction To Algorithms ", 3rdEdition, MIT Press, 2008.
R3: Sara Baase, "Computer Algorithms: Introduction to Design and Analysis, Second Edition", Addison-Wesley, 2008.
R4: Banachowski. L, Kreczmar. A, Wojciech. R, "Analysis of Algorithms and Data Structures", 2nd Edition, AddisonWesley, 2006.
R5: Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 2nd Edition, Pearson Education,2011.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2202	CLOUD COMPUTING TECHNOLOGIES	3	0	0	3

Course Objective

- To understand the concept of cloud and utility computing.
- To understand the various issues in cloud computing.
- To familiarize themselves with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.
- To be able to set up a private cloud.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction- Historical Development – Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds- Cloud Delivery Models: IaaS, PaaS, SaaS – Open-Source Private Cloud Software: Eucalyptus, Open Nebula,Open Stack.	09
II	**VIRTUALIZATION** Data Center Technology – Virtualization – Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing –Pros and Cons of Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V, KVM, Virtual Box	09
III	**CLOUD COMPUTING MECHANISM** Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System	09
IV	**HADOOP AND MAP REDUCE** Apache Hadoop – Hadoop Map Reduce –Hadoop Distributed File System- Hadoop I/O- Developing a Map Reduce Application – Map Reduce Types and Formats – Map Reduce Features– Hadoop Cluster Setup –AdministeringHadoop.	09
V	**SECURITY IN THE CLOUD** Basic Terms and Concepts – Threat Agents – Cloud Security Threats –Cloud Security Mechanism: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups, Hardened Virtual Server Images.	09
	Total Instructional Hours	**45**

Course Outcome

CO1:	Articulate the main concepts, key technologies, strengths and limitations of cloud computing
CO2:	Identify the architecture, infrastructure and delivery models of cloud computing.
CO3:	Explain the core issues of cloud computing such as security, privacy and interoperability.
CO4:	Choose the appropriate technologies, algorithms and approaches for the related issues.
CO5:	Facilitate Service Level Agreements (SLA).

REFERENCE BOOKS:

R1: Thomas Erl, Zaigham Mahood, Ricardo Puttini, "Cloud Computing, Concept, Technology &Architecture", Prentice Hall, 2013.

R2: Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", TataMcGraw-Hill,2013.

R3: Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach", TataMcGraw-Hill Edition, 2010.

R4: Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", UniversitiesPress(India) Private Limited, 2014.

R5: Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
James E Smith and Ravi Nair, "Virtual Machines", Elsevier, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2251	MACHINE LEARNING TECHNIQUES	3	0	2	4

Course Objective

- To understand the concepts of Machine Learning.
- To appreciate supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning.
- To understand the theoretical and practical aspects of Probabilistic GraphicalModels.
- To appreciate the concepts and algorithms of advanced learning.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory. *Illustrative Programs: Simple Decision Tree.*	8
II	**SUPERVISED LEARNING** Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines. *Illustrative Programs: Solving Regression & Classification using Decision Trees, Root Node Attribute Selection for Decision Trees using Information Gain, Bayesian Inference in Gene Expression Analysis, Pattern Recognition Application using Bayesian Inference, Bagging in Classification, Bagging, Boosting applications using Regression Trees.*	15
III	**UNSUPERVISED LEARNING** Clustering -K-means–EM Algorithm - Mixtures of Gaussians – Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis. *Illustrative Programs: Data & Text Classification using Neural Networks, Data & Text Clustering using K-means algorithm, Data & Text Clustering using Gaussian Mixture Models.*	13
IV	**PROBABILISTIC GRAPHICAL MODELS** Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields- Hidden Markov Models – Conditional Random Fields (CRFs). *Illustrative Programs: Application of CRFs in Natural Language Processing*	9
V	**ADVANCED LEARNING** Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration. *Illustrative Programs: Dimensionality Reduction Algorithms in Image Processing applications, Using Weka tool for SVM classification for chosen domain application.*	15
	Total Instructional Hours	**60**

Course Outcome	CO1:	Design a learning model appropriate to the application.
	CO2:	Design a Neural Network for an application of your choice.
	CO3:	Implement Probabilistic Discriminative and Generative algorithms for anapplication of your choice and analyze the results.
	CO4:	Use a tool to implement typical Clustering algorithms for different types of applications.
	CO5:	Design and implement an HMM for a Sequence Model type of application.

REFERENCE BOOKS:

R1: Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.

R2: Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman andHall, CRCPress, Second Edition, 2014

R3: Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

R4: Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.

R5: Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2001	ADVANCED ALGORITHMS LABORATORY	0	0	4	2

Course Objective

- To learn mathematical background for analysis of algorithm
- To learn various advanced data structures.
- To understand the concept of designing an algorithm
- To understand the concept of pattern matching
- To learn advanced tree and graph applications.

S.No	Description of the Experiments
1.	Singly linked list
2.	Doubly linked list.
3.	Write a Java program to implement priority queue ADT
4.	Write a Java program to perform the following operations:i.Construct a binary search tree of elements. ii.Search for a key element in the above binary search tree.iii.Delete an element from the above binary search tree.
5.	Write a Java program to implement all the functions of a dictionary (ADT) using Hashing.
6.	Write a Java program to implement Dijkstra's algorithm for Single source shortest path problem.
7.	Write Java programs that use recursive and non-recursive functions to traverse the givenbinary tree in Preorder Inorder iii.Postorder.
8.	Write Java programs for the implementation of bfs and dfs for a given graph.
9.	Write Java programs for implementing the following sorting methods:i.Heap sort Quick sort Radix sort
10.	Write a Java program to perform the following operations:i.Insertion into a B-tree ii.Searching in a B-tree
11.	Write a Java program that implements Kruskal's algorithm to generate minimum cost spanningtree.
12.	Write a Java program that implements KMP algorithm for pattern matching.

Total Instructional Hours60

Course Outcome

CO1: Students will be able to choose appropriate advanced data structure for given problem.
CO2: Students will be able to calculate complexity.
CO3: Students will be able to select appropriate design techniques to solve real world problems.
CO4: Students will able to apply the dynamic programming technique to solve the problems.
CO5: Students will be able to select a proper pattern matching algorithm for given problem

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2301	AGENT BASED INTELLIGENT SYSTEM	3	0	0	3

Course Objective

- Demonstrate good knowledge of basic theoretical foundations of the following common intelligent systems methodologies: Rule-based systems, Fuzzy inferencingand artificial neural networks.
- Determine which type of intelligent system methodology would be suitable for a giventype of application problem.
- Demonstrate, in the form of a major project work, the ability to design andDevelop an intelligent system for a selected application.
- Demonstrate, in the form of a major project work, the ability to design and develop anintelligent system for a selected application The learning mechanisms ofagents
- Demonstrate, in the form of a major project work, the ability to design and develop anthe communication and cooperation within agents

Unit	Description	Instructional Hours
I	**INTRODUCTION** Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching -Heuristics - Constraint Satisfaction Problems - Game playing.	9
II	**KNOWLEDGE REPRESENTATION AND REASONING** Logical Agents-First order logic-First Order Inference-Unification-Chaining-Resolution Strategies-Knowledge Representation-Objects-Actions-Events	9
III	**PLANNING AGENTS** PlanningProblem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains-Conditional Planning-Continuous Planning-MultiAgent Planning.	9
IV	**AGENTS AND UNCERTAINITY** Acting under uncertainty – Probability Notation-Bayes Rule and use –Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- UtilityTheory - Decision Network – Complex Decisions.	9
V	**HIGHER LEVEL AGENTS** Knowledge in Learning-Relevance Information-Statistical Learning Methods Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars Future of AI.	9
	Total Instructional Hours	45

Course Outcome

CO1: Students will gain deep understanding of the basic artificial intelligence techniques.

CO2: Students will apply their knowledge to design solutions to different problems.

CO3: Students will have the ability to design and develop an intelligent system for a selectedapplication.

CO4: An ability to work individually or as a member with responsibility to function onmultidisciplinary teams.

CO5: Ability to understand and apply computational platforms and software tools forInformation Technology applications

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TEXT BOOKS:

T1: Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach",2nd Edition, PrenticeHall, 2002

REFERENCE BOOKS:

R1: Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley, 2002.

R2: Patrick Henry Winston, Artificial Intelligence, 3rd Edition, AW, 1999.

R3: Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2302	MULTICORE ARCHITECTURES	3	0	0	3

Course Objective

- To introduce the students to the recent trends in the field ofComputerArchitecture and identify performance related parameters.
- To understand the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.
- To understand how the various forms of parallelism are exploited by the architecture.

Unit	Description	InstructionalHours
I	**FUNDAMENTALS OF COMPUTER DESIGN AND ILP** 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 – TheMulticore era.	9
II	**MEMORY HIERARCHY DESIGN** Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.	9
III	**MULTIPROCESSOR ISSUES** Symmetric and Distributed Shared Memory Architectures – Cache CoherenceIssues – Performance Issues – Synchronization Issues – Models of Memory Consistency – Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.	9
IV	**MULTICORE ARCHITECTURES** Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introductionto Warehouse-Scale computers, Cloud Computing – Architectures and Issues – Case Studies.	9
V	**VECTOR, SIMD AND GPU ARCHITECTURES** Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism – Introduction to Domain Specific Architectures.	9
	Total Instructional Hours	**45**

Course Outcome

CO1:	Identify the limitations of ILP and the need for multicore architectures.
CO2:	Discuss the issues related to multiprocessing and suggest solutions.
CO3:	Point out the salient features of different multicore architectures and how they exploitparallelism.
CO4:	Point out the various optimizations that can be performed to improve the memoryhierarchy design.
CO5:	Point out the salient features of vector, GPU and domain specific architectures.

REFERENCE BOOKS:

R1: John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier, 5th edition, 2012.

R2: Darryl Gove, "Multicore Application Programming: For Windows, Linux, and Oracle Solaris",Pearson, 2011.

R3: David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors", MorganKauffman, 2010.

R4: Wen–mei W.Hwu,"GPU Computing Gems", Morgan Kaufmann / Elsevier, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2303	SOFTWARE DESIGN PATTERNS	3	0	0	3

Course Objective

- Demonstration of patterns related to object-oriented design.
- Describe the design patterns that are common in software applications.

3.Analyze a software development problem and express it.

- Design a module structure to solve a problem, and evaluate alternatives.
- Implement a module so that it executes efficiently and correctly.

Unit	Description	InstructionalHours
I	**INTRODUCTION TO DESIGN PATTERN** What is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalogue of Design Patterns, Organizing The Cato log, How DesignPatterns solve Design Problems, How to Select a Design pattern, How to Use a Design Pattern.	9
II	**A CASE STUDY OF DESIGN PATTERN** A Case Study: Designing a Document Editor, Design Problems , DocumentStructure, Formatting , Embellishing the User Interface, Supporting MultipleLook-and-Feel Standards, Supporting Multiple Window Systems, UserOperations Spelling Checking and Hyphenation, Summary, Creational Patterns, Abstract Factory, Builder , Factory Method, Prototype, Singleton, Discussion of Creational Patterns	9
III	**STRUCTURAL PATTERN PART-I & II** Structural Pattern Part-I, Adapter, Bridge, Composite. Structural Pattern Part-II,Decorator, Facade, Flyweight, Proxy.	9
IV	**BEHAVIORAL PATTERN'S PART: I & II** Behavioral Patterns Part: I, Chain of Responsibility, Command, Interpreter, Iterator. Behavioral Patterns Part: II, Mediator, Memento, Observer, Discussion ofBehavioral Patterns.	9
V	**BEHAVIORAL PATTERN'S PART: III** Behavioral Patterns Part: III, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns, A Brief History, ThePattern Community, An Invitation, A Parting Thought	9
	Total Instructional Hours	45

Course Outcome

CO1: Construct a design consisting of a collection of modules.
CO2: Exploit well-known design patterns (such as Iterator, Observer, Factory and Visitor).
CO3: Distinguish between different categories of design patterns.
CO4: Ability to understand and apply common design patterns to incremental/iterativedevelopment.
CO5: Ability to identify appropriate patterns for design of given problem.
CO6: Design the software using Pattern Oriented Architectures.

TEXT BOOKS:

T1: Design Patterns By Erich Gamma, Pearson Education

REFERENCE BOOKS:

R1: Patterns in JAVA Vol-I (or) Vol-II By Mark Grand, Wiley Dream Tech.

R2: Java Enterprise Design Patterns Vol-III By Mark Grand Wiley Dream Tech

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2304	COMPILER OPTIMIZATION TECHNIQUES	3	0	0	3

Course Objective

- To understand different forms of intermediate languages and analyzingprograms.
- To understand optimizations techniques for single program blocks.
- To apply optimizations on procedures and low-level code.
- To explore and enhance inter procedural optimizations
- To enhance resource utilization.

Unit	Description	Instructional Hours
I	**INTERMEDIATE REPRESENTATION OF PROGRAMS AND ANALYSIS** Structure of an Optimizing Compiler – Compiler Construction tools – LIR, MIR, HIR, DAG, Syntax Tree and Postfix. Analysis: Control Flow Analysis, Iterative DataFlow Analysis, Static Single Assignment – A Linear Time Algorithm for Placing φ-Nodes, Basic Block Dependence, Alias Analysis. Introduction to LLVM – Compiling a language	9
II	**LOCAL AND LOOP OPTIMIZATIONS** Early Optimizations: Constant-Expression Evaluation – Scalar Replacementof Aggregates – Algebraic Simplifications and Re-association – Value Numbering – Copy Propagation – Sparse Conditional Constant Propagation.Redundancy Elimination: Common – Subexpression Elimination – Loop- Invariant Code Motion – Partial-Redundancy Elimination – Redundancy Elimination and Reassociation – Code Hoisting. Loop Optimizations: Induction Variable Optimizations – Unnecessary Bounds Checking Elimination. LLVM pass –LLVM Test Infrastructure.	9
III	**PROCEDURE OPTIMIZATION AND SCHEDULING** Procedure Optimizations: Tail-Call Optimization and Tail-RecursionElimination – Procedure Integration – In-Line Expansion – Leaf-RoutineOptimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling Speculative Loads and Boosting – Speculative Scheduling – Software Pipelining – Trace Scheduling – Percolation Scheduling. Control-Flow and Low-Level Optimizations: Unreachable-Code Elimination – Straightening – If Simplifications – Loop Simplifications – Loop Inversion Un-switching – Branch Optimizations – Tail Merging or Cross Jumping – Conditional Moves Dead-Code Elimination – Branch Prediction – Machine Idioms and Instruction Combining. LLVM API procedure optimization.	9
IV	**INTER PROCEDURAL OPTIMIZATION** Symbol table Runtime Support – Interprocedural Analysis and Optimization:Interprocedural Control- Flow Analysis – The Call Graph – InterproceduralData-Flow Analysis – Interprocedural Constant Propagation – InterproceduralAlias Analysis – Interprocedural Optimizations – Interprocedural RegisterAllocation – Aggregation of Global References. LLVM – Interprocedural Analyses.	9
V	**OPTIMIZING FOR MEMORY** Register Allocation: Register Allocation and Assignment – Local Methods – Graph Coloring Priority Based Graph Coloring. Computations on Iteration Spaces- Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches – Instruction-Cache Optimization – Scalar Replacement of Array Elements – Data- Cache Optimization – Scalar vs. Memory-Oriented Optimizations. Software	9

Prefetching – Parallelization – Instruction Level Parallelism – Automatic Parallelization

Total Instructional Hours 45

Course Outcome

CO1: Identify the different optimization techniques that are possible for a sequence ofcode.
CO2: Design performance enhancing optimization techniques.
CO3: Manage procedures with optimal overheads.
CO4: Understand modern programming language features and constructs.
CO5: Learn to work on a larger software project

REFERENCE BOOKS:

R1: Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufman Publishers,1997.

R2: Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques,and Tools", Addison Wesley, Second Edition, 2007.

R3: Y.N.Srikant, Priti Shankar, "The Compiler Design Handbook – Optimizations and Machine CodeGeneration", CRC Press, Second Edition, 2008.

R4: Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", CambridgeUniversity Press, Second Edition, 2002.

R5: Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011.

R6: Randy Allen and Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependencebased Approach, Morgan Kaufman, 2001.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2305	DISTRIBUTED OPERATING SYSTEMS	3	0	0	3

Course Objective

- To understand the concepts of distributed systems.
- To get an insight into the various issues and solutions in distributed operatingsystems.
- To learn about real-time operating systems.
- To gain knowledge on the design concepts of mobile operating systems.5.To understand cloud operating systems

Unit	Description	Instructional Hours
I	**INTRODUCTION** Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages	9
II	**DISTRIBUTED OPERATING SYSTEMS** Distributed Mutual Exclusion Algorithms – Classification – Preliminaries –Simple Solution – Lamport's Algorithm – Ricart-Agrawala Algorithm –Suzuki-Kasami's Broadcast Algorithm – Raymond's Tree-Based Algorithm –Distributed Deadlock Detection – Preliminaries – Centralized DeadlockDetection Algorithms – Distributed Deadlock Detection Algorithms – PathPushing Algorithm – Edge Chasing Algorithm – Hierarchical Deadlock Detection Algorithms – Agreement Protocols – Classification – Solutions to the Byzantine Agreement Problem – Lamport-Shostak- Pease Algorithm	9
III	**DISTRIBUTED RESOURCE MANAGEMENT** Distributed File Systems – Design Issues – Google File System – Hadoop Distributed File System-Distributed Shared Memory – Algorithms for Implementing Distributed Shared Memory – Load Distributing Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance –Two-Phase Commit Protocol – Nonblocking Commit Protocol	9
IV	**REAL TIME OPERATING SYSTEMS** Basic Model of Real - Time Systems – Characteristics – Application of Real -Time Systems – Real - Time Task Scheduling – Handling Resource Sharing	9
V	**MOBILE AND CLOUD OPERATING SYSTEMS** Android – Overall Architecture – Linux Kernel – Hardware Support – NativeUser-Space – Dalvik and Android's Java – System Services – Introduction to Cloud Operating Systems.	9
	Total Instructional Hours	**45**

Course Outcome

CO1:	Identify the features of distributed operating systems.
CO2:	Demonstrate the various protocols of distributed operating systems.
CO3:	Identify the different features of real time operating systems.
CO4:	Discuss the features of mobile operating systems.
CO5:	Discuss the features of cloud operating systems.

REFERENCE BOOKS:

R1: Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed,Database and Multiprocessor Operating Systems", Tata MC Graw-Hill, 2001

R2: Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.

R3: Karim Yaghmour, "Embedded Android", O'Reilly, First Edition, 2013.

R4: Nikolay Elenkov, "Android Security Internals: An In-Depth Guide to Android's SecurityArchitecture", No Starch Press, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP2306	SOFTWARE PROCESS AND PROJECT MANAGEMENT	3	0	0	3

Course Objective

- To understand overall SDLC and adopt suitable processes
- To elicite, analyze, prioritize, and manage both functional andqualityrequirements
- To estimate efforts required, plan, and track the plans
- To understand and apply configuration and quality managementtechniques
- To evaluate, manage, and design processes

Unit	Description	Instructional Hours
I	**DEVELOPMENT LIFE CYCLE PROCESSES** Overview of software development life cycle – introduction to processes – Personal Software Process (PSP) – Team software process (TSP) – Unified processes – agile processes – choosing the right process Tutorial: Software development using PSP	9
II	**REQUIREMENTS MANAGEMENT** Functional requirements and quality attributes – elicitation techniques – Quality Attribute Workshops (QAW) – analysis, prioritization, and trade-off – Architecture Centric Development Method (ACDM) – requirements documentation and specification – change management – traceability of requirements Tutorial: Conduct QAW, elicit, analyze, prioritize, and document requirements using ACDM	9
III	**ESTIMATION, PLANNING, AND TRACKING** Identifying and prioritizing risks – risk mitigation plans – estimation techniques –use case points – function points – COCOMO II – top-down estimation – bottom-up estimation – work breakdown structure – macro and micro plans – planningpoker – wideband delphi – documenting the plan – tracking the plan – earned value method (EVM) Tutorial: Estimation, planning, and tracking exercises	9
IV	**CONFIGURATION AND QUALITY MANAGEMENT** identifying artifacts to be configured – naming conventions and version control – configuration control – quality assurance techniques – peer reviews – Feganinspection – unit, integration, system, and acceptance testing – test data and test cases – bug tracking – causal analysis Tutorial: version control exercises, development of test cases, causal analysis of defects	9
V	**SOFTWARE PROCESS DEFINITION AND MANAGEMENT** Process elements – process architecture – relationship between elements – process modeling – process definition techniques – ETVX (entry-task-validation-exit) –process baselining – process assessment and improvement – CMMI – Six Sigma Tutorial: process measurement exercises, process definition using ETVX	9
	Total Instructional Hours	**45**

Course Outcome

CO1:	Explain software development life cycle
CO2:	Elicit functional and quality requirements
CO3:	Perform trade-off among conflicting requirements
CO4:	Estimate the efforts required for software development
CO5:	Control the artifacts during software development

REFERENCE BOOKS:

R1: Pankaj Jalote, "Software Project Management in Practice", Pearson, 2002.

R2: Chris F. Kemerer, "Software Project Management – Readings and Cases", McGraw Hill, 1997.

R3: Watts S. Humphrey, "PSP: A self-improvement process for software engineers", Addison- Wesley, 2005.

R4: Watts S. Humphrey, "Introduction to the Team Software Process", Addison-Wesley, 2000.

R5: Orit Hazzan and Yael Dubinsky, "Agile software engineering", Springer, 2008.

R6: James R. Persse, "Process Improvement Essentials", O'Reilly, 2006.

R7: Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, McGraw Hill,2010.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC1091	ENGLISH FOR RESEARCH PAPER WRITING	2	0	0	0

Course Objective

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

Unit	Description	Instructional Hours
I	**INTRODUCTION TO RESEARCH PAPER WRITING** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	06
II	**PRESENTATION SKILLS** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing,Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	06
III	**TITLE WRITING SKILLS** Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skillsneeded when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	06
IV	**RESULT WRITING SKILLS** Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed whenwriting the Conclusions	06
V	**VERIFICATION SKILLS** Useful phrases, checking Plagiarism, how to ensure paper is as good as itcould possibly be the first- time submission	06
	Total Instructional Hours	30

Course Outcome

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

REFERENCE BOOKS:

R1: Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht HeidelbergLondon, 2011

R2: Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006

R3: Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006

R4: Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC1092	DISASTER MANAGEMENT	2	0	0	0

Course Objective

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

Unit	Description	Instructional Hours
I	**INTRODUCTION** Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	06
II	**REPERCUSSIONS OF DISASTERS AND HAZARDS** Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	06
III	**DISASTER PRONE AREAS IN INDIA** Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics	06
IV	**DISASTER PREPAREDNESS AND MANAGEMENT** Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.	06
V	**RISK ASSESSMENT** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival	06
	Total Instructional Hours	30

Course Outcome

CO1:	Ability to summarize basics of disaster
CO2:	Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response
CO3:	Ability to illustrate disaster risk reduction and humanitarian response policy and practicefrom multiple perspectives.
CO4:	Ability to describe an understanding of standards of humanitarian response and practicalrelevance in specific types of disasters and conflict situations
CO5:	Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCE BOOKS:

R1: Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & DeepPublication Pvt. Ltd., New Delhi,2009.

R2: NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies"'NewRoyal book Company,2007.

R3: Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia,New Delhi,2001.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC1093	SANSKRIT FOR TECHNICAL KNOWLEDGE	2	0	0	0

Course Objective

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

Unit	Description	Instructional Hours
I	**ALPHABETS** Alphabets in Sanskrit	06
II	**TENSES AND SENTENCES** Past/Present/Future Tense - Simple Sentences	06
III	**ORDER AND ROOTS** Order - Introduction of roots	06
IV	**SANSKRIT LITERATURE** Technical information about Sanskrit Literature	06
V	**TECHNICAL CONCEPTS OF ENGINEERING** Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	06
	Total Instructional Hours	30

Course Outcome

CO1: Understanding basic Sanskrit language
CO2: Write sentences.
CO3: Know the order and roots of Sanskrit.
CO4: Know about technical information about Sanskrit literature.
CO5: Understand the technical concepts of Engineering.

REFERENCE BOOKS:

R1: "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi

R2: "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication

R3: "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC1094	PEDAGOGY STUDIES	2	0	0	0

Course Objective

- Review existing evidence on there view topic to inform programme design andpolicy
- Making under taken by the DfID, other agencies andresearchers.
- Identify critical evidence gaps to guide the development.
- Identify their Professional Development.
- Improve the Research and Future Direction.

Unit	Description	Instructional Hours
I	**INTRODUCTION AND METHODOLOGY** Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.	06
II	**THEMATIC OVERVIEW** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.	06
III	**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.	06
IV	**PROFESSIONAL DEVELOPMENT** 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	06
V	**RESEARCH GAPS AND FUTURE DIRECTIONS** Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.	06
	Total Instructional Hours	30

Course Outcome

CO1: What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2: What is the evidence on the effectiveness of these pedagogical practices, in whatconditions, and with what population of learners?

CO3: How can teacher education (curriculum and practicum) and the school curriculumand guidance materials best support effective pedagogy?

CO4: How can teacher to develop their Professional development support effective pedagogy?

CO5: How can improve the Research and Future Direction using effective pedagogy.

REFERENCE BOOKS:

R1: Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.

R2: Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of CurriculumStudies, 36(3):361-379.

R3: Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education researchproject (MUSTER) country report 1.London:DFID

R4: Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal EducationalDevelopment, 33(3): 272–282.

R5: Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxfordand Boston: Blackwell.

R6: Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC1095	CONSTITUTION OF INDIA	2	0	0	0

Course Objective

- Understand the premises informing the twin themes of liberty andfreedomfrom a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indianintellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution
- To understand the central and state relation, financial and administrative.

Unit	Description	Instructional Hours
I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION** History, Drafting Committee, (Composition & Working), Preamble, Salient Features	06
II	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES** Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Rightto Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	06
III	**ORGANS OF GOVERNANCE** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	06
IV	**LOCAL ADMINISTRATION** District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, MunicipalCorporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officialsand their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy	06
V	**ELECTION COMMISSION** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	06
	Total Instructional Hours	30

Course Outcome

CO1:	Discuss the growth of the demand for civil rights in India for the bulk of Indiansbefore the arrival of Gandhi in Indian politics.
CO2:	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3:	Discuss the circumstances surrounding the foundation of the Congress SocialistParty[CSP] under the leadership of Jawaharlal Nehru
CO4:	The eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO5:	Discuss the passage of the Hindu Code Bill of 1956.

REFERENCE BOOKS:

R1: The Constitution of India,1950(Bare Act),Government Publication.

R2: Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.

R3: M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.

R4: D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC2091	VALUE EDUCATION	2	0	0	0

Course Objective

- Understand value of education and self-development
- Imbibe good values in students
- Let they should know about the importance of character
- To teach and inculcate the importance of value based living
- To give students a deeper understanding about the purpose of life.

Unit	Description	Instructional Hours
I	**VALUES AND SELF-DEVELOPMENT** Values and self-development–Social values and individual attitudes. Work ethics,Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements	7
II	**IMPORTANCE OF CULTIVATION OF VALUES** Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline	7
III	**PERSONALITY AND BEHAVIOR DEVELOPMENT** Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoidfault Thinking. Free from anger, Dignity of labour. Universal brother hoodand religious tolerance. True friendship. Happiness Vs suffering, love fortruth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	8
IV	**CHARACTER AND COMPETENCE** Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.	8
	Total Instructional Hours	**30**

Course Outcome

CO1: Students will understand the importance of value based living.
CO2: Students will gain deeper understanding about the purpose of their life.
CO3: Students will understand and start applying the essential steps to become good leaders.
CO4: Students will emerge as responsible citizens with clear conviction to practice values andethics in life.
CO5: Students will become value based professionals and building a healthy nation

REFERENCE BOOKS:

R1: Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford UniversityPress, New Delhi

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC2092	STRESS MANAGEMENT BY YOGA	2	0	0	0

Course Objective

- To achieve overall health of body and mind
- To overcome stress
- To possess emotional stability.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO YOGA** Definitions of Eight parts of yoga.(Ashtanga)	10
II	**DO`S AND DON'T'S IN LIFE** Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.	10
III	**ASAN AND PRANAYAM** Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam	10
	Total Instructional Hours	30

Course Outcome

CO1: Develop healthy mind in a healthy body thus improving social health also
CO2: Improve efficiency
CO3: The student will apply forces and exert themselves using rarely used muscle groups

REFERENCE BOOKS:

R1: Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal
R2: "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20AC2093	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	2	0	0	0

Course Objective

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Unit	Description	Instructional Hours
I	**NEETISATAKAM-HOLISTIC DEVELOPMENT** Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)	10
II	**DAY TO DAY WORK AND DUTIES** Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2- Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.	10
III	**STATEMENTS OF BASIC KNOWLEDGE** Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2- Verses56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 -Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	10
	Total Instructional Hours	**30**

Course Outcome

CO1: Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

CO2: The person who has studied Geeta will lead the nation and mankind to peace and prosperity

CO3: Study of Neet is hatakam will help in developing versatile personality of students.

REFERENCE BOOKS:

R1: Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya,New Delhi,2010

R2: Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata,2016.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3201	SOFTWARE PROCESS AND PROJECT MANAGEMENT	3	1	0	4

Course Objective

- To understand overall SDLC and adopt suitable processes
- To elicite, analyze, prioritize, and manage both functional and quality requirements
- To estimate efforts required, plan, and track the plans
- To understand and apply configuration and quality management techniques
- To evaluate, manage, and design processes

Unit	Description	Instructional Hours
I	**DEVELOPMENT LIFE CYCLE PROCESSES** Overview of software development life cycle – introduction to processes – Personal Software Process (PSP) – Team software process (TSP) – Unified processes – agile processes – choosing the right process **Tutorial:** Software development using PSP	9+3
II	**REQUIREMENTS MANAGEMENT** Functional requirements and quality attributes – elicitation techniques – Quality Attribute Workshops (QAW) – analysis, prioritization, and trade-off – Architecture Centric Development Method (ACDM) – requirements documentation and specification – change management – traceability of requirements **Tutorial:** Conduct QAW, elicit, analyze, prioritize, and document requirements using ACDM	9+3
III	**ESTIMATION, PLANNING, AND TRACKING** Identifying and prioritizing risks – risk mitigation plans – estimation techniques – use case points – function points – COCOMO II – top-down estimation – bottom-up estimation – work breakdown structure – macro and micro plans – planning poker – wideband delphi – documenting the plan – tracking the plan – earned value method (EVM) **Tutorial:** Estimation, planning, and tracking exercises	9+3
IV	**CONFIGURATION AND QUALITY MANAGEMENT** identifying artifacts to be configured – naming conventions and version control – configuration control – quality assurance techniques – peer reviews – Fegan inspection – unit, integration, system, and acceptance testing – test data and test cases – bug tracking – causal analysis **Tutorial:** version control exercises, development of test cases, causal analysis of defects	9+3
V	**SOFTWARE PROCESS DEFINITION AND MANAGEMENT** Process elements – process architecture – relationship between elements – process modeling – process definition techniques – ETVX (entry-task-validation-exit) – process baselining – process assessment and improvement – CMMI – Six Sigma **Tutorial:** process measurement exercises, process definition using ETVX	9+3
	Total Instructional Hours	**60**

Course Outcome

CO1: Explain software development life cycle and adopt a suitable process for software development
CO2: Elicit functional and quality requirements, analyze, prioritize, and manage requirements and perform trade-off among conflicting requirements
CO3: Identify and prioritize risks and create mitigation plans, estimate the efforts required for software development and perform planning and tracking activities
CO4: Control the artifacts during software development and perform various tests to ensure quality
CO5: Define new processes based on the needs and adopt best practices for process improvement

REFERENCE BOOKS :

R1 - Pankaj Jalote, "Software Project Management in Practice", Pearson, 2002.
R2 - Chris F. Kemerer, "Software Project Management – Readings and Cases", McGraw Hill, 1997.
R3 - Watts S. Humphrey, "PSP: A self-improvement process for software engineers", Addison- Wesley, 2005.
R4 - Watts S. Humphrey, "Introduction to the Team Software Process", Addison-Wesley, 2000.
R5 - Orit Hazzan and Yael Dubinsky, "Agile software engineering", Springer, 2008.
R6 - James R. Persse, "Process Improvement Essentials", O'Reilly, 2006.
R7 - Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, McGraw Hill, 2010.

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Programme M.E.	Course Code	Name of the Course	L	T	P	C
	16CP3202	INTERNET OF THINGS	3	0	0	3

Course Objective

- To understand the basics of Internet of Things and to understand the middleware for Internet of Things
- To understand the IOT protocols
- To understand the concepts of Web of Things
- To understand the concepts of different models for network dynamics
- To understand the concepts of IoT applications

Unit	Description	Instructional Hours
I	**INTRODUCTION** Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security	9
II	**IOT PROTOCOLS** Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security	9
III	**WEB OF THINGS** Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture	9
IV	**INTEGRATED** Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small-World Phenomenon	9
V	**APPLICATIONS** The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify and design the new models for market strategic interaction and Design a middleware for IoT
CO2: Analyze various protocols for IoT
CO3: Design business intelligence and information security for WoB
CO4: Analyze and design different models for network dynamics
CO5: Design IoT applications – Smart Grid – Electrical Vehicle Charging

REFERENCE BOOKS :

R1 - The Internet of Things in the Cloud: A Middleware Perspective - Honbo Zhou – CRC Press – 2012
R2 - Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles- (Eds.) – Springer – 2011
R3 - Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, Cambridge University Press - 2010
R4 - The Internet of Things: Applications to the Smart Grid and Building Automation by - Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley -2012
R5 - Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3301	SOCIAL NETWORK ANALYSIS	3	0	0	3

Course Objective

- To understand the components of the social network
- To model and visualize the social network
- To mine the users in the social network
- To understand the evolution of the social network
- To mine the interest of the user

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks	9
II	**MODELING AND VISUALIZATION** Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.	9
III	**MINING COMMUNITIES** Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.	9
IV	**EVOLUTION** Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models	9
V	**TEXT AND OPINION MINING** Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time	9
	Total Instructional Hours	45

Course Outcome

CO1: Work on the internals components of the social network
CO2: Model and visualize the social network
CO3: Mine the behaviour of the users in the social network
CO4: Predict the possible next outcome of the social network
CO5: Mine the opinion of the user

REFERENCE BOOKS :

R1 - Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011
R2 - Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
R3 - Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1st edition, 2010.
R4 - Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2011.
R5 - Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
R6 - Ajith Abraham, Aboul Ella Hassanien, Vaclav Snašel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
R7 - Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3302	MANAGING BIG DATA	3	0	0	3

Course Objective

- Learn business case studies for big data analytics
- Understand nosql big data management
- Perform map-reduce analytics using Hadoop
- Understand the mapreduce functionalities
- Apply Hadoop using tools for various applications

Unit	Description	Instructional Hours
I	**UNDERSTANDING BIG DATA** What is big data – why big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics	9
II	**NOSQL DATA MANAGEMENT** Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – map-reduce – partitioning and combining – composing map-reduce calculations	9
III	**BASICS OF HADOOP** Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures	9
IV	**MAPREDUCE APPLICATIONS** MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output Formats	9
V	**HADOOP RELATED TOOLS** Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.Cassandra – cassandra data model – cassandra examples – cassandra clients – Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.	9
		45
	Total Instructional Hours	

Course Outcome

CO1: Describe big data and use cases from selected business domains
CO2: Explain NoSQL big data management
CO3: Install, configure, and run Hadoop and HDFS
CO4: Perform map-reduce analytics using Hadoop
CO5: Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

REFERENCE BOOKS:

R1 - Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
R2 - P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
R3 - Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
R4 - Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
R5 - E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
R6 - Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
R7 - Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
R8 - Alan Gates, "Programming Pig", O'Reilley, 2011.

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Programme M.E.	Course Code	Name of the Course	L	T	P	C
	16CP3303	MODEL CHECKING AND PROGRAM VERIFICATION	3	0	0	3

Course Objective

- To understand automata for model checking
- To understand LTL, CTL, and CTL*
- To understand timed automata, TCTL, and PCTL
- To understand verification of deterministic and recursive programs
- To understand verification of object-oriented programs and to understand verification of parallel, distributed, and non-deterministic programs

Unit	Description	Instructional Hours
I	**AUTOMATA AND TEMPORAL LOGICS** Automata on finite words – model checking regular properties – automata on infinite words – Buchi automata – Linear Temporal Logic (LTL) – automata based LTL model checking – Computational Tree Logic (CTL) – CTL model checking – CTL* model checking	9
II	**TIMED AND PROBABILISTIC TREE LOGICS** Timed automata – timed computational tree logic (TCTL) – TCTL model checking – probabilistic systems – probabilistic computational tree logic (PCTL) – PCTL model checking – PCTL* - Markov decision processes	9
III	**VERIFYING DETERMINISTIC AND RECURSIVE PROGRAMS** Introduction to program verification – verification of "while" programs – partial and total correctness – verification of recursive programs – case study: binary search – verifying recursive programs with parameters	9
IV	**VERIFYING OBJECT-ORIENTED AND PARALLEL PROGRAMS** Partial and total correctness of object-oriented programs – case study: Insertion in linked lists – verification of disjoint parallel programs – verifying programs with shared variables – case study: parallel zero search – verification of synchronization – case study: the mutual exclusion problem	9
V	**VERIFYING NON-DETERMINISTIC AND DISTRIBUTED PROGRAMS** Introduction to non-deterministic programs – partial and total correctness of non-deterministic programs – case study: The Welfare Crook Problem – syntax and semantics of distributed programs – verification of distributed programs – case study: A Transmission Problem – introduction to fairness	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Perform model checking using LTL and Perform model checking using CTL
CO2: Perform model checking using CTL*
CO3: Perform model checking using TCTL and PCTL
CO4: Verify deterministic and recursive programs
CO5: Verify object-oriented programs and Verify parallel, distributed, and non-deterministic programs

REFERENCE BOOKS :

R1 - C. Baier, J.-P. Katoen, and K. G. Larsen, "Principles of Model Checking", MIT Press, 2008.
R2 - E. M. Clarke, O. Grumberg, and D. A. Peled, "Model Checking", MIT Press, 1999.
R3 - M. Ben-Ari, "Principles of the SPIN Model Checker", Springer, 2008.
R4 - K. R. Apt, F. S. de Boer, E.-R. Olderog, and A. Pnueli, "Verification of Sequential and Concurrent Programs", Third Edition, Springer, 2010.
R5 - M. Huth and M. Ryan, "Logic in Computer Science --- Modeling and Reasoning about Systems", Second Edition, Cambridge University Press, 2004.
R6 - B. Berard et al., "Systems and Software Verification: Model-checking techniques and tools", Springer, 2010.
R7 - J. B. Almeida, M. J. Frade, J. S. Pinto, and S. M. de Sousa, "Rigorous Software Development: An Introduction to Program Verification", Springer, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3304	MEDICAL IMAGE PROCESSING	3	0	0	3

Course Objective

- To Understand the basics of medical image processing
- To Understand the Storage Methods.
- Discuss about the visualization
- To understand the classification
- To study about resolution

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction to medical imaging technology, systems, and modalities. Brief history; importance; applications; trends; challenges. Medical Image Formation Principles: X-Ray physics; X-Ray generation, attenuation, scattering; dose Basic principles of CT; reconstruction methods; artifacts; CT hardware.	9
II	**STORAGE AND PROCESSING** Medical Image Storage, Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding; contrast enhancement; SNR characteristics; filtering; histogram modeling.	9
III	**VISUALIZATION** Medical Image Visualization Fundamentals of visualization; surface and volume rendering/visualization; animation; interaction. Magnetic Resonance Imaging (MRI) Mathematics of MR; spin physics; NMR spectroscopy; imaging principles and hardware; image artifacts.	9
IV	**SEGMENTATION AND CLASSIFICATION** Medical Image Segmentation - Histogram-based methods; Region growing and watersheds; Markov Random Field models; active contours; model-based segmentation. Multi-scale segmentation; semi-automated methods; clustering-based methods; classification-based methods; atlas-guided approaches; multi-model segmentation. Medical Image Registration Intensity-based methods; cost functions; optimization techniques.	9
V	**NUCLEAR IMAGING** PET and SPECT Ultrasound Imaging methods; mathematical principles; resolution; noise effect; 3D imaging; positron emission tomography; single photon emission tomography; ultrasound imaging; applications. Medical Image Search and Retrieval Current technology in medical image search, content-based image retrieval, new trends: ontologies. Applications. Other Applications of Medical Imaging Validation, Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.	9
	Total Instructional Hours	45

Course Outcome

CO1: Apply Medical Image Formation Principles
CO2: Apply medical image storage and hospital information system
CO3: Develop visualization for medical images
CO4: Design segmentation and classification techniques
CO5: Apply nuclear imagimg for PET

REFERENCE BOOKS:

R1 - Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.
R2 - J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.
R3 - Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
R4 - Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
R5 - Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition, Prentice Hall, 2005.
R6 - John L. Semmlow, "Biosignal and Medical Image Processing", Second Edition, CRC Press, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3305	SOFTWARE DESIGN	3	0	0	3

Course Objective

- Analyze specifications
- Describe approaches to design
- Develop design documentation
- Evaluate the design
- Understand user centered design

Unit	Description	Instructional Hours
I	**SOFTWARE DESIGN PRINCIPLES** Introduction – Design process – Managing complexity – Software modeling and notations – Abstraction – Modularity – Hierarchy – Coupling - Cohesion – Design guidelines and checklists – Refactoring	9
II	**OO DESIGN** Object model – Classes and objects – Object oriented analysis – Key abstractions and mechanisms – Object oriented design – Identifying design elements – Detailed design – Case studies.	9
III	**DESIGN PATTERNS** Introduction to patterns – Design context – Reusable solutions – Documenting reusable solutions – Standard patterns from GOF book.	9
IV	**FUNCTION AND SERVICE ORIENTED DESIGNS** Structural decomposition – Detailed Design – Function oriented design Case study – Services – Service identification – Service design – Service composition – choreography and orchestration – Service oriented design Case study	9
V	**USER CENTERED DESIGN AND DESIGN REVIEW** Introduction to user centered design – Use in context – Interface and interaction – User centered design principles – Task analysis – Evaluation – Introduction to design review– Testing the design– Walk throughs – Review against check lists.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Describe different approaches to designing a software application
CO2: Analyze specifications and identify appropriate design strategies.
CO3: Develop an appropriate design for a given set of requirements
CO4: Identify applicable design patterns for the solution
CO5: Evaluate a given design against the specifications

REFERENCE BOOKS :

R1 - Grady Booch et al., "Object Oriented Analysis and Design with Applications", 3rd Edition, Pearson, 2010.
R2 - Carlos Otero, "Software Engineering Design: Theory and Practice", CRC Press, 2012
R3 - David Budgen, "Software Design", 2nd Edtion, Addison Wesley, 2003
R4 - Alan Shalloway and James R Trott, "Design Patterns Explained: A New Perspective on Object-Oriented Design", 2nd Edition, Addison-Wesley Professional, 2004
R5 - Hassan Gomaa, "Software Modeling and Design", Cambridge University Press, 2011
R6 - Eric Gamma et al., "Design Patterns: Elements of Reusable Object-Oriented Software",Addison-Wesley Professional, 1994
R7 - Ian Sommerville, "Software Engineering", 9th Edition, Addison-Wesley, 2010
R8 - M B Rosson and J M Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann, 2002

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3306	MULTI OBJECTIVE OPTIMIZATION TECHNIQUES	3	0	0	3

Course Objective

- Learn fundamental principles of Multiobjective Optimization (MOP)
- Survey different Multiobjective Optimization algorithms
- Introduce various design issues of MOP
- Develop and Evaluate MOP Algorithms
- Learn Parallel and hybrid MOP Algorithms and learn other Metaheuristics

Unit	Description	Instructional Hours
I	**INTRODUCTION AND CLASSICAL APPROACHES** Multiobjective optimization: Introduction - Multiobjective optimization problem-principles – Difference between single and multiobjective optimization – Dominance and Pareto Optimality, Classical Methods – Weighted Sum - □ Constraint method – Weighted Metric methods – Benson's method - Value Function - Goal Programming methods – Interactive Methods	9
II	**MOP EVOLUTIONARY ALGORITHMS** Generic MOEA - Various MOEAs: MOGA, NSGA-II, NPGA, PAES, SPEA2, MOMGA, micro GA - Constrained MOEAs: Penalty Function approach - Constrained Tournament – Ray – Tai –Seow's Method.	9
III	**THEORETICAL ISSUES** Fitness Landscapes - Fitness Functions - Pareto Ranking - Pareto Niching and Fitness Sharing - Recombination Operators - Mating Restriction - Solution Stability and Robustness – MOEA Complexity - MOEA Scalability - Running Time Analysis - MOEA Computational Cost - No Free Lunch Theorem.	9
IV	**MOEA TESTING, ANALYSIS, AND PARALLELIZATION** MOEA Experimental Measurements – MOEA Statistical Testing Approaches – MOEA Test Suites - MOEA Parallelization: Background – Paradigms – Issues - MOEA Local Search Techniques.	9
V	**APPLICATIONS AND ALTERNATIVE METAHEURISTICS** Scientific Applications: Computer Science and Computer Engineering - Alternative Metaheuristics: Simulated Annealing – Tabu Search and Scatter Search – Ant System – Distributed Reinforcement Learning – Particle Swarm Optimization – Differential Evolution – Artificial Immune Systems - Other Heuristics.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Explain MOP principles
CO2: Explain classical methods to solve MOP problems
CO3: Be familiar with and explain structures of different MOP algorithms
CO4: Solve constrained MOP problems
CO5: Perform a evaluation and analysis of MOP algorithm results

REFERENCE BOOKS:

R1 - Carlos A. Coello Coello, Gary B. Lamont, David A. Van Veldhuizen, "Evolutionary Algorithms for Solving Multi-objective Problems", Second Edition, Springer, 2007.
R2 - Kalyanmoy Deb, " Multi-Objective Optimization Using Evolutionary Algorithms", John Wiley, 2002.
R3 - Aimin Zhoua, Bo-Yang Qub, Hui Li c, Shi-Zheng Zhaob, Ponnuthurai Nagaratnam Suganthan b, Qingfu Zhangd, "Multiobjective evolutionary algorithms: A survey of the state of the art", Swarm and volutionary Computation (2011) 32–49.
R4 - E Alba, M Tomassini, "Parallel and evolutionary algorithms", Evolutionary Computation, IEEE transactions on 6 (5), 443-462.
R5 - Crina Grosan, Ajith Abraham, "Hybrid Evolutionary Algorithms: Methodologies, Architectures, and Reviews", Studies in Computational Intelligence, Vol. 75, Springer, 2007.
R6 - Christian Blum and Andrea Roli. 2003. Metaheuristics in combinatorial optimization:Overview and conceptual comparison. ACM Comput. Surv. 35, 3 (September 2003), 268-308.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3307	INFORMATION STORAGE MANAGEMENT	3	0	0	3

Course Objective

- Understand basics of storage technology
- Analyze storage system architecture for host environment
- Understand networked storage and its architectures
- Analyze monitoring and managing datacenter
- Evaluate information availability and storage virtualization

Unit	Description	Instructional Hours
I	**INTRODUCTION TO STORAGE TECHNOLOGY** Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities	9
II	**STORAGE SYSTEMS ARCHITECTURE** Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system	9
III	**INTRODUCTION TO NETWORKED STORAGE** Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments	9
IV	**INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTER** List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Differentiate between business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, Architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center	9
V	**SECURING STORAGE AND STORAGE VIRTUALIZATION** Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes	9
	Total Instructional Hours	45

Course Outcome

CO1:Explain data creation and its applications
CO2: Apply storage system architecture and key protocols for host environment
CO3: Apply FC-SAN and NAS
CO4: Identify information availability and monitoring and managing data center
CO5: Describe storage virtualization and security in storage

REFERENCE BOOKS :

R1 - EMC Corporation, Information Storage and Management, Wiley, India.
R2 - Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill , Osborne, 2003.
R3 - Marc Farley, "Building Storage Networks", Tata McGraw Hill ,Osborne, 2001.
R4 - Additional resource material on www.emc.com/resource-library/resource-library.esp

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3308	SOFTWARE QUALITY ASSURANCE	3	0	0	3

Course Objective

- Describe approaches to quality assurance
- Understand quality models
- Analyze the system based on the chosen quality model
- Understand structural testing and its adequacy criteria
- Understand functional testing and design test cases

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction – Views on quality – Cost of quality - Quality models – Quality frameworks – Verification and Validation – Defect taxonomy – Defect management – Statistics and measurements – IEEE standards – Quality assurance and control processes	9
II	**VERIFICATION** Introduction – Verification techniques – Inspections, reviews, walk-throughs – Case studies	9
III	**TEST GENERATION** Software testing- Validation – Test plan – Test cases - Test Generation – Equivalence partitioning – Boundary value analysis – Category partition method – Combinatorial generation – Decision tables – Examples and Case studies	9
IV	**STRUCTURAL TESTING** Introduction – Test adequacy criteria – Control flow graph – Coverages: block, conditions, multiple conditions, MC/DC, path – Data flow graph – Definition and use coverages – C-use, P-use, Defclear, Def-use – Finite state machines – Transition coverage – Fault based testing – Mutation analysis – Case studies	9
V	**FUNCTIONAL TESTING** Introduction – Test adequacy criteria - Test cases from use cases – Exploratory testing - Integration, system, acceptance, regression testing – Testing for specific attributes: Performance, load and stress testing – Usability testing – Security testing - Test automation – Test oracles	9
	Total Instructional Hours	45

Course Outcome

CO1: Describe different approaches to testing software applications
CO2: Analyze specifications and identify appropriate test generation strategies
CO3: Develop an appropriate test design for a given test object
CO4: Identify applicable measurements for the verification and validation effort
CO5: Execute the test design and Evaluate the testing effort based on adequate measures

REFERENCE BOOKS :

R1 - Boriz Beizer, "Software Testing Techniques", 2nd Edition, DreamTech, 2009.
R2 - Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2008
R3 - Mauro Pezze and Michal Young, "Software Testing and Analysis. Process, Principles, and Techniques", John Wiley 2008
R4 - Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Edition, Pearson, 2003
R5 - Kshirasagar Naik and Priyadarshi Tripathy (Eds), "Software Testing and Quality Assurance: Theory and Practice", John Wiley, 2008
R6 - "Combinatorial Methods in Software Testing", http://csrc.nist.gov/groups/SNS/acts/index.html

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3309	GREEN COMPUTING	3	0	0	3

Course Objective

- To introduce the concept of green computing.
- To create awareness of energy efficient computing.
- To understand the power management in computing devices
- To analyze the consumption of power in data centers
- Analyze IBM green tectnology and its applications

Unit	Description	Instructional Hours
I	**INTRODUCTION** Energy- efficient – power efficient and thermal aware computing and communication - Newton"s cooling model and basic thermodynamics and sustainability.	9
II	**POWER MANAGEMENT** Operating system Directed power management – Power management history and motivation – key power management concepts – power management scenarios – ACPI desktop motherboard design	9
III	**DEVELOPMENT OF EFFICIENT POWER MANAGEMENT SYSTEM** Dual mode desktop power delivery – system BIOS – Designing mobile systems - Communication with peripheral devices – Drivers – Developing robust power managed applications	9
IV	**ENERGY EFFICIENT DATA CENTER** Data center power consumption – Power metrics – Energy efficient data center tuning - energy efficient server management – Industry vision and recommendations	9
V	**CASE STUDIES AND APPLICATION** Google green datacenter - IBM green technology - Microsoft – Case Studies – Applying Green IT Strategies and Applications to a Home – Hospital - Packaging Industry and Telecom Sector	9
	Total Instructional Hours	45

Course Outcome

CO1: Identify the benefits and challenges of energy efficient computing.
CO2 : Develop energy efficient computing applications.
CO3 : Apply the strategies of going Green
CO4: Develop energy efficient data center
CO5: Design home applications using green IT strategies

REFERENCE BOOKS :

R1 - Jerzy Kolinski, Ram Chary, Andrew Henroid, and Barry Press, "Building the Power-Efficient PC A Developer's Guide to ACPI Power Management", Intel Press August 2001.
R2 - Lauri Minas, Brad Ellison, "Energy Efficiency for Information Technology: How to Reduce Power Consumption in Servers and Data Centers", Intel Press, 2009.
R3 - Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2011.
R4 - Wu Chun Feng, "Green Computing: Large-Scale Energy Efficiency", CRC Press INC, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CP3310	RECONFIGURABLE COMPUTING	3	0	0	3

Course Objective

- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose the students to HDL programming and familiarize with the development Environment

Unit	Description	Instructional Hours
I	**DEVICE ARCHITECTURE** General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.	9
II	**RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS** Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.	9
III	**PROGRAMMING RECONFIGURABLE SYSTEMS** Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.	9
IV	**MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS** The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.	9
V	**APPLICATION DEVELOPMENT WITH FPGAS** Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.	9
	Total Instructional Hours	**45**

Course Outcomes

CO1: Identify the need for reconfigurable architectures
CO2:Discuss the architecture of FPGAs
CO3:Point out the salient features of different reconfigurable architectures
CO4:Build basic modules using any HDL
CO5: Develop applications using any HDL and appropriate tools and design and build an SoPC for a particular application

REFERENCE BOOKS :

R1 - Maya B. Gokhale and Paul S. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.
R2 - Scott Hauck and Andre Dehon (Eds.), "Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation", Elsevier / Morgan Kaufmann, 2008.
R3 - Christophe Bobda, "Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications", Springer, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CPX401	MOBILE APPLICATION DEVELOPMENT	3	0	0	3

Course Objective

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications	9
II	**BASIC DESIGN** Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.	9
III	**ADVANCED DESIGN** Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.	9
IV	**TECHNOLOGY I – ANDROID** Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.	9
V	**TECHNOLOGY II – IOS** Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.	9
	Total Instructional Hours	45

Course Outcomes

CO1: Describe the requirements for mobile applications
CO2: Explain the challenges in mobile application design and development
CO3: Develop design for mobile applications for specific requirements
CO4: Implement the design using Android SDK
CO5: Implement the design using Objective C and iOS

REFERENCE BOOKS :

R1 - http://developer.android.com/develop/index.html
R2 - Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
R3 - Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech,2012
R4 - James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012
R5 - David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	16CPX402	DATA MINING TECHNIQUES	3	0	0	3

Course Objective

- Understand basics of data mining and its algorithms
- Analyze data mining algorithms for various applications
- Differentiate OnLine Transaction Processing and OnLine Analytical processing
- Learn Multidimensional schemas suitable for data warehousing
- Understand various data mining functionalities

Unit	Description	Instructional Hours
	INTRODUCTION TO DATA MINING	
I	Introduction to Data Mining – Data Mining Tasks – Components of Data Mining Algorithms – Data Mining supporting Techniques – Major Issues in Data Mining – Measurement and Data – Data Preprocessing – Data sets	9
	OVERVIEW OF DATA MINING ALGORITHMS	
II	Overview of Data Mining Algorithms – Models and Patterns – Introduction – The Reductionist viewpoint on Data Mining Algorithms – Score function for Data Mining Algorithms- Introduction – Fundamentals of Modeling – Model Structures for Prediction – Models for probability Distributions and Density functions – The Curve of Dimensionality – Models for Structured Data – Scoring Patterns – Predictive versus Descriptive score functions – Scoring Models with Different Complexities – Evaluation of Models and Patterns – Robust Methods.	9
	CLASSIFICATIONS	
III	Classifications – Basic Concepts – Decision Tree induction – Bayes Classification Methods – Rule Based Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy – Classification: Advanced concepts – Bayesian Belief Networks- Classification by Back Propagation – Support Vector Machine – Classification using frequent patterns.	9
	CLUSTER ANALYSIS	
IV	Cluster Analysis: Basic concepts and Methods – Cluster Analysis – Partitioning methods – Hierarchical methods – Density Based Methods – Grid Based Methods – Evaluation of Clustering – Advanced Cluster Analysis: Probabilistic model based clustering – Clustering High – Dimensional Data – Clustering Graph and Network Data – Clustering with Constraints.	9
	ASSOCIATION RULE MINING AND VISUALIZATION	
V	Association Rule Mining – Introduction – Large Item sets – Basic Algorithms – Parallel and Distributed Algorithms – Comparing Approaches – Incremental Rules – Advanced Association Rule Techniques – Measuring the Quality of Rules – Visualization of Multidimensional Data – Diagrams for Multidimensional visualization – Visual Data Mining – Data Mining Applications – Case Study: WEKA.	9
	Total Instructional Hours	**45**

Course Outcomes

1. Design a data mart or data warehouse for any organization
2. Develop skills to write queries using DMQL
3. Extract knowledge using data mining techniques
4. Adapt to new data mining tools.
5. Explore recent trends in data mining such as web mining, spatial-temporal mining

REFERENCE BOOKS:

R1 - Jiawei Han, Micheline Kamber , Jian Pei, "Data Mining: Concepts and Techniques", Third Edition (The Morgan Kaufmann Series in Data Management Systems), 2012.
R2 - David J. Hand, Heikki Mannila and Padhraic Smyth "Principles of Data Mining" (Adaptive Computation and Machine Learning), 2005
R3 - Margaret H Dunham, "Data Mining: Introductory and Advanced Topics", 2003
R4 - Soman, K.P., Diwakar Shyam and Ajay V. "Insight Into Data Mining: Theory And Practice", PHI, 2009.

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