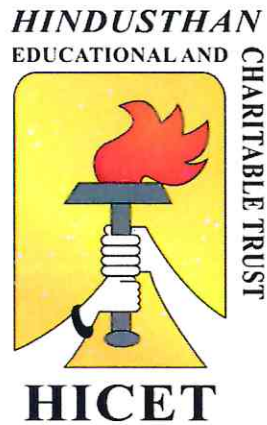


HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University, Chennai)
(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)
COIMBATORE 641 032.

M. E. COMPUTER SCIENCE AND ENGINEERING



(CHOICE BASED CREDIT SYSTEM)

Curriculum & Syllabus

2023 - 2024

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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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 2020

For the students admitted during the academic year 2021-2022 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 Structures Laboratory	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
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

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

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

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

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

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS	CIA	ESE	TOTAL
				L	T	P				
THEORY										
1.	20CP33XX	Program Elective III / NPTEL	PEC	3	0	0	3	40	60	100
2.	20CP33XX	Program Elective IV	PEC	3	0	0	3	40	60	100
3.	20CP33XX	Program Elective V	PEC	3	0	0	3	40	60	100
4.	20XX3401	Open Elective	OEC	3	0	0	3	40	60	100
PRACTICALS										
5.	20CP3901	Project Phase I	EEC	0	0	14	7	50	50	100
TOTAL				12	0	14	19	210	290	500

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS	CIA	ESE	TOTAL
				L	T	P				
PRACTICALS										
1.	20CP4901	Project Phase II	EEC	0	0	24	12	100	100	200
TOTAL				0	0	24	12	100	100	200



LIST OF PROFESSIONAL ELECTIVES

Professional Elective - III										
7.	20CP3301	Big Data Computing	PEC	3	0	0	3	40	60	100
8.	20CP3302	Image Processing and Analysis	PEC	3	0	0	3	40	60	100
9.	20CP3303	Data Mining Techniques	PEC	3	0	0	3	40	60	100
Professional Elective - IV										
9.	20CP3304	Deep Learning Techniques	PEC	3	0	0	3	40	60	100
10.	20CP3305	Soft Computing Techniques	PEC	3	0	0	3	40	60	100
Professional Elective - V										
11.	20CP3306	Linguistic Computing	PEC	3	0	0	3	40	60	100
12.	20CP3307	Advanced Cryptography Techniques	PEC	3	0	0	3	40	60	100

OPEN ELECTIVE COURSES (OEC)

*(out of 2 courses one course must be selected)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS	CIA	ESE	TOTAL
				L	T	P				
1.	20CP3401	Data Science for Engineers (NPTEL)	OEC	3	0	0	3	40	60	100
2.	20CP3402	Cyber Security	OEC	3	0	0	3	40	60	100

CREDIT DISTRIBUTION

R-2020

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


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SYLLABUS

Programme M.E.	Course Code 20MA1103	Name of the Course MATHEMATICAL FOUNDATION OF CSE	L 3	T 1	P 0	C 4
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- 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
	LINEAR PROGRAMMING	
I	Formulation – Graphical solution – Simplex method – Two phase method – Transportation and Assignment Problems	12
	SIMULATION	
II	Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems	12
	ESTIMATION THEORY	
III	Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments	12
	TESTING OF HYPOTHESIS	
IV	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
	MULTIVARIATE ANALYSIS	
V	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 for Engineers", Pearson Education, 9th Edition, New York, 2016.
- R3: Ross. S.M., "Probability Models for Computer Science", Academic Press, San Diego, 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 M.E.	Course Code 20CP1201	Name of the Course ADVANCE DATA STRUCTURES	L	T	P	C
			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 algorithms and techniques to solve problems

Unit	Description	Instructional Hours
FUNDAMENTALS		
I	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
SEARCH STRUCTURES		
II	Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees – B-Trees – Splay Trees – Tries.	12
HEAP STRUCTURES		
III	Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps	12
GEOMETRIC ALGORITHMS		
IV	Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram	12
ADDITIONAL TOPICS		
V	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 in C", 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 Geometry Algorithms 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 of Algorithms", Tata McGraw-Hill Edition, 2012.
- R5: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 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 Management System.
 - 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 deductive databases.
 - To develop applications based on NoSQL database

Unit	Description	Instructional Hours
	RELATIONAL MODEL	
I	Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language-Database Normalization – Transaction Management-Recovery	9
	PARALLEL AND DISTRIBUTED DATABASES	
II	Parallel Databases– I/O Parallelism– Inter-Query and Intra-Query Parallelism– 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 for DDB – DDB Security.	9
	XML AND WEB DATABASES	
III	XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity-Java Database Connectivity– Accessing Relational database using PHP – User Driven Querying – Writing to Web Databases – Session Management	9
	ACTIVE TEMPORAL AND DEDUCTIVE DATABASES	
IV	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
	NoSQL DATABASES	
V	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	<ul style="list-style-type: none"> To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation To learn the design principles and to apply for large scale systems To design architectures for distributed heterogeneous systems environment through brokerage interaction To build design knowledge on service oriented and model driven architectures and the aspect-oriented architecture. To develop appropriate architectures for various Case studies like semantic web 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. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product 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 various case 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
	RESEARCH PROBLEM FORMULATION	
I	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	TECHNICAL WRITING /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, Information Technology, 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.

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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 and segment 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.	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
	ANALYSIS OF ALGORITHMIC PERFORMANCE	
I	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
	ALGORITHMIC DESIGN TECHNIQUES	
II	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
	EFFICIENT DATA PROCESSING	
III	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
	PROBABILISTIC & PARALLEL ALGORITHMS	
IV	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
	COMPUTATIONAL COMPLEXITY & APPROXIMATION ALGORITHMS	
V	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 M.E.	Course Code 20CP2202	Name of the Course CLOUD COMPUTING TECHNOLOGIES	L 3	T 0	P 0	C 3
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- 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 Madiseti, "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 Graphical Models.
 - To appreciate the concepts and algorithms of advanced learning.

Unit	Description	Instructional Hours
	INTRODUCTION	8
I	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. <i>Illustrative Programs: Simple Decision Tree.</i>	
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. <i>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.</i>	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. <i>Illustrative Programs: Data & Text Classification using Neural Networks, Data & Text Clustering using K-means algorithm, Data & Text Clustering using Gaussian Mixture Models.</i>	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). <i>Illustrative Programs: Application of CRFs in Natural Language Processing</i>	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. <i>Illustrative Programs: Dimensionality Reduction Algorithms in Image Processing applications, Using Weka tool for SVM classification for chosen domain application.</i>	15
Total Instructional Hours		60


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	CO1:	Design a learning model appropriate to the application.
	CO2:	Design a Neural Network for an application of your choice.
Course Outcome	CO3:	Implement Probabilistic Discriminative and Generative algorithms for an application 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.
Write Java programs that use recursive and non-recursive functions to traverse the given binary tree in Preorder
7. Inorder iii. Postorder.
8. Write Java programs for the implementation of bfs and dfs for a given graph.
Write Java programs for implementing the following sorting methods:
i. Heap sort
9. 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 spanning tree.
12. Write a Java program that implements KMP algorithm for pattern matching.

Total Instructional Hours 60

- 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 be 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 inferencing and artificial neural networks.
 - Determine which type of intelligent system methodology would be suitable for a given type of application problem.
 - Demonstrate, in the form of a major project work, the ability to design and develop an intelligent system for a selected application.
 - Demonstrate, in the form of a major project work, the ability to design and develop an intelligent system for a selected application. The learning mechanisms of agents
 - Demonstrate, in the form of a major project work, the ability to design and develop the communication and cooperation within agents

Unit	Description	Instructional Hours
INTRODUCTION		
I	Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching -Heuristics - Constraint Satisfaction Problems - Game playing.	9
KNOWLEDGE REPRESENTATION AND REASONING		
II	Logical Agents-First order logic-First Order Inference-Unification-Chaining-Resolution Strategies-Knowledge Representation-Objects-Actions-Events	9
PLANNING AGENTS		
III	Planning Problem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains-Conditional Planning-Continuous Planning-Multi Agent Planning.	9
AGENTS AND UNCERTAINTY		
IV	Acting under uncertainty – Probability Notation-Bayes Rule and use –Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.	9
HIGHER LEVEL AGENTS		
V	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 selected application.
- CO4: An ability to work individually or as a member with responsibility to function on multidisciplinary teams.
- CO5: Ability to understand and apply computational platforms and software tools for Information Technology applications

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 M.E.	Course Code 20CP2302	Name of the Course MULTICORE ARCHITECTURES	L 3	T 0	P 0	C 3
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- Course Objective**
- To introduce the students to the recent trends in the field of Computer Architecture 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	Instructional Hours
	FUNDAMENTALS OF COMPUTER DESIGN AND ILP	
I	Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges – Limitations of ILP – Multithreading – SMT and CMP Architectures – The Multicore era.	9
	MEMORY HIERARCHY DESIGN	
II	Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.	9
	MULTIPROCESSOR ISSUES	
III	Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization Issues – Models of Memory Consistency – Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.	9
	MULTICORE ARCHITECTURES	
IV	Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-Scale computers, Cloud Computing – Architectures and Issues – Case Studies.	9
	VECTOR, SIMD AND GPU ARCHITECTURES	
V	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

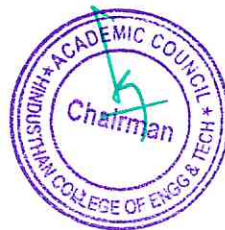
- Course Outcome**
- CO1: Identify the limitations of ILP and the need for multicore architectures.
- CO2: Discuss the issues related to multiprocessing and suggest solutions.
- CO3: Point out the salient features of different multicore architectures and how they exploit parallelism.
- CO4: Point out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

REFERENCE BOOKS:

- R1: John L. Hennessy 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 Catalog, 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

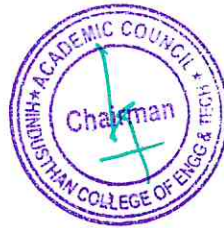
REFERENCE BOOKS:

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 analyzing programs.
 - 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
	INTERMEDIATE REPRESENTATION OF PROGRAMS AND ANALYSIS	
I	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
	LOCAL AND LOOP OPTIMIZATIONS	
II	Early Optimizations: Constant-Expression Evaluation – Scalar Replacement of 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
	PROCEDURE OPTIMIZATION AND SCHEDULING	
III	Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination – Procedure Integration – In-Line Expansion – Leaf-Routine Optimization 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
	INTER PROCEDURAL OPTIMIZATION	
IV	Symbol table Runtime Support – Interprocedural Analysis and Optimization: Interprocedural Control- Flow Analysis – The Call Graph – Interprocedural Data-Flow Analysis – Interprocedural Constant Propagation – Interprocedural Alias Analysis – Interprocedural Optimizations – Interprocedural Register Allocation – Aggregation of Global References. LLVM – Interprocedural Analyses.	9
	OPTIMIZING FOR MEMORY	
V	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 of code.
	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 Code Generation", CRC Press, Second Edition, 2008.
- R4: Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University 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 Dependence based 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 operating systems.
 - 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
INTRODUCTION		
I	Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport’s Logical Clocks – Vector Clocks – Causal Ordering of Messages	9
DISTRIBUTED OPERATING SYSTEMS		
II	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 Deadlock Detection Algorithms – Distributed Deadlock Detection Algorithms – Path Pushing Algorithm – Edge Chasing Algorithm – Hierarchical Deadlock Detection Algorithms – Agreement Protocols – Classification – Solutions to the Byzantine Agreement Problem – Lamport-Shostak-Pease Algorithm	9
DISTRIBUTED RESOURCE MANAGEMENT		
III	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
REAL TIME OPERATING SYSTEMS		
IV	Basic Model of Real - Time Systems – Characteristics – Application of Real -Time Systems – Real - Time Task Scheduling – Handling Resource Sharing	9
MOBILE AND CLOUD OPERATING SYSTEMS		
V	Android – Overall Architecture – Linux Kernel – Hardware Support – Native User-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 Niranjana 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 Security Architecture", No Starch Press, 2014.


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Programme M.E.	Course Code 20CP2306	Name of the Course SOFTWARE PROCESS AND PROJECT MANAGEMENT	L 3	T 0	P 0	C 3
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- Course Objective**
- To understand overall SDLC and adopt suitable processes
 - To elicit, 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
	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
I		
	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
II		
	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
III		
	CONFIGURATION AND QUALITY MANAGEMENT identifying artifacts to be configured – naming conventions and version control – configuration control – quality assurance techniques – peer reviews – Fagan 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
IV		
	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
V		
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. Perse, "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 20AC1091	Name of the Course ENGLISH FOR RESEARCH PAPER WRITING	L 2	T 0	P 0	C 0
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- 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
	INTRODUCTION TO RESEARCH PAPER WRITING	
I	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	06
	PRESENTATION SKILLS	
II	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	06
	TITLE WRITING SKILLS	
III	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	06
	RESULT WRITING SKILLS	
IV	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	06
	VERIFICATION SKILLS	
V	Useful phrases, checking Plagiarism, how to ensure paper is as good as it could 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 Heidelberg London, 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's book 1998.

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Programme M.E.	Course Code 20AC1092	Name of the Course DISASTER MANAGEMENT	L 2	T 0	P 0	C 0
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- 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
	INTRODUCTION	
I	Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	06
	REPERCUSSIONS OF DISASTERS AND HAZARDS	
II	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
	DISASTER PRONE AREAS IN INDIA	
III	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
	DISASTER PREPAREDNESS AND MANAGEMENT	
IV	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
	RISK ASSESSMENT	
V	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 practice from multiple perspectives.
	CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance 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 & Deep Publication Pvt. Ltd., New Delhi, 2009.
- R2: Nishitha Rai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” New Royal book Company, 2007.
- R3: Sahni, Pardeep Et. Al. ,” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi, 2001.


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Programme M.E.	Course Code 20AC1093	Name of the Course SANSKRIT FOR TECHNICAL KNOWLEDGE	L 2	T 0	P 0	C 0
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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 Decksha-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 M.E.	Course Code 20AC1094	Name of the Course PEDAGOGY STUDIES	L 2	T 0	P 0	C 0
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Course Objective	<ul style="list-style-type: none"> Review existing evidence on their view topic to inform programme design and policy Making under taken by the Dfid, other agencies and researchers. Identify critical evidence gaps to guide the development. Identify their Professional Development. Improve the Research and Future Direction.
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Unit	Description	Instructional Hours
	INTRODUCTION AND METHODOLOGY	
I	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
	THEMATIC OVERVIEW	
II	Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.	06
	EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES	
III	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
	PROFESSIONAL DEVELOPMENT	
IV	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
	RESEARCH GAPS AND FUTURE DIRECTIONS	
V	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 what conditions, and with what population of learners?
	CO3: How can teacher education (curriculum and practicum) and the school curriculum and 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, Hardman F (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 Curriculum Studies*, 36(3):361-379.
- R3: Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (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 Educational Development*, 33(3): 272-282.
- R5: Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
- R6: Chavan M (2003) *Read India: A mass 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	<ul style="list-style-type: none"> Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and 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, Right to 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, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and 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	<p>CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.</p> <p>CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.</p> <p>CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru</p> <p>CO4: The eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.</p> <p>CO5: Discuss the passage of the Hindu Code Bill of 1956.</p>					

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 M.E.	Course Code 20AC2091	Name of the Course VALUE EDUCATION	L 2	T 0	P 0	C 0
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- 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
VALUES AND SELF-DEVELOPMENT		
I	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
IMPORTANCE OF CULTIVATION OF VALUES		
II	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
PERSONALITY AND BEHAVIOR DEVELOPMENT		
III	Personality and Behavior Development–Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	8
CHARACTER AND COMPETENCE		
IV	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 and ethics 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 University Press, New Delhi

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Programme M.E.	Course Code 20AC2092	Name of the Course STRESS MANAGEMENT BY YOGA	L 2	T 0	P 0	C 0
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- 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 Training-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 LIFEENLIGHTENMENT 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 andprosperity
	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.	20CP3301	BIG DATA COMPUTING	3	0	0	3

- Course Objective**
1. Introduce Big Data and Hadoop
 2. Introduce Big Data Platform
 3. Introduce Big data streaming platform for fast Data
 4. To Learn about Machine learning
 5. To understand the Application of Big Data.

Unit	Description	Instructional Hours
	INTRODUCTION TO BIG DATA	
I	Introduction to Big Data-Big Data enabling Technologies- Hadoop Stack for Big Data-Hadoop Distributed File System-Hadoop Map Reduce 1.0- Hadoop MapReduce 2.0- Map Reduce examples.	9
	BIG DATA PLATFORM	
II	Parallel Programming with spark-Introduction to Spark- Spark Built-in Libraries- Design of Key Value stores-Data placement Strategies-CAP Theorem-Consistency Solutions-Design of Zookeeper-CQL(Cassandra Query Language)	9
	BIG DATA STREAMING PLATFORMS FOR FAST DATA	
III	Introduction to Big Data Streaming Platforms for Fast Data-Introduction to Big Data Streaming Systems-Big Data Pipelines for Real-Time computing -Design of HBase- Spark Streaming and Sliding Window Analytics- Sliding Window Analytics- Introduction to Kafka.	9
	MACHINE LEARNING	
IV	Big Data Machine Learning-Machine Learning Algorithm K-Means Using MapReduce for Big Data Analytics -Parallel K-Means Using Map Reduce On Big Data Cluster Analysis- Decision Trees for Big Data Analytics-Big Data Predictive Analytics .	9
	BIG DATA APPLICATIONS	
V	Introduction to Big Data Applications (Graph Processing-Introduction to Pregel- Parameter Servers-PageRank Algorithm in Big Data-Spark GraphX & Graph Analytics-Case Study: Flight Data Analysis Using Spark GraphX	9
Total Instructional Hours		45

Course Outcome	CO1:	Understand the Big Data and Hadoop
	CO2:	Understand the Big Data Platform
	CO3:	Understand the Big data streaming platform for fast Data
	CO4:	Explore the Machine learning
	CO5:	Illustrate Various Big Data applications

TEXT BOOK:

T1: Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014

REFERENCE BOOKS:

R1: <https://nptel.ac.in/courses/106/104/106104189/>

R2: Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.

R3: Chuck Lam, Hadoop in Action, December, 2010.


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Programme M.E.	Course Code 20CP3302	Name of the Course IMAGE PROCESSING AND ANALYSIS	L 3	T 0	P 0	C 3
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Course Objective	<ol style="list-style-type: none"> 1. Describe and explain basic principles of digital image processing. 2. Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement). 3. Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation). 4. Assess the performance of image processing algorithms and systems 5. Assess image processing algorithms in practical applications.
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Unit	Description	Instructional Hours
	IMAGE PROCESSING FUNDAMENTALS	
I	Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.	9
	IMAGE ENHANCEMENT AND RESTORATION	
II	Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.	9
	IMAGE SEGMENTATION AND MORPHOLOGY	
III	Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms-Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.	9
	IMAGE ANALYSIS AND CLASSIFICATION	
IV	Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification	9
	IMAGE REGISTRATION AND VISUALIZATION	
V	Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization	9
Total Instructional Hours		45

Course Outcome	CO1:	Analyze general terminology of digital image processing.
	CO2:	Examine various types of images, intensity transformations and spatial filtering.

- CO3: Develop Fourier transform for image processing in frequency domain.
- CO4: Evaluate the methodologies for image segmentation, restoration etc.
- CO5: Implement image process and analysis algorithms.

REFERENCE BOOKS:

- R1: Alasdair McAndrew, —Introduction to Digital Image Processing with Matlab, Cengage Learning 2011, India
- R2: Anil J Jain, —Fundamentals of Digital Image Processing, PHI, 2006
- R3: Kavyan Najarian and Robert Splerstor, Biomedical signals and Image processing, CRC – Taylor and Francis, New York, 2006
- R4: Rafael C. Gonzalez and Richard E. Woods, —Digital Image Processing, Third Edition, Pearson Education, 2008, New Delhi
- R5: S.Sridhar, —Digital Image Processing, Oxford University Press, 2011


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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP3303	DATA MINING TECHNIQUES	3	0	0	3

**Course
Objective**


1. To understand data mining principles and techniques and Introduce DM as a cutting edge business intelligence.
2. To expose the students to the concepts of data warehousing architecture and implementation.
3. To learn various Data Mining techniques such as classification, clustering & Association rule mining
4. To study the overview of developing areas – web mining, text mining and ethical aspects of data mining.
5. To identify business applications and trends of data mining.

Unit	Description	Instructional Hours
	INTRODUCTION TO DATA WAREHOUSING	
I	Evolution of Decision Support Systems- Data warehousing Components – Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact constellations	9
	DATA WAREHOUSE PROCESS AND ARCHITECTURE	
II	Types of OLAP servers, 3-Tier data warehouse architecture, distributed and virtual data warehouses. Data warehouse implementation, tuning and testing of data warehouse. Data Staging (ETL) Design and Development, data warehouse visualization, Data Warehouse Deployment, Maintenance, Growth, Business Intelligence Overview- Data Warehousing and Business Intelligence Trends - Business Applications- tools-SAS	9
	INTRODUCTION TO DATA MINING	
III	Data mining-KDD versus data mining, Stages of the Data Mining Process- task primitives, Data Mining Techniques -Data mining knowledge representation – Data mining query languages, Integration of a Data Mining System with a Data Warehouse – Issues, Data preprocessing – Data cleaning, Data transformation, Feature selection, Dimensionality reduction, Discretization and generating concept hierarchies-Mining frequent patterns-association-correlation	9
	CLASSIFICATION AND CLUSTERING	
IV	Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Clustering techniques – Partitioning methods- k-means- Hierarchical Methods – distance based agglomerative and divisible clustering, Density-Based Methods – expectation maximization -Grid Based Methods – Model-Based Clustering Methods – Constraint – Based Cluster Analysis – Outlier Analysis	9
	PREDICTIVE MODELING OF BIG DATA AND TRENDS IN DATA MINING	
V	Statistics and Data Analysis – EDA – Small and Big Data –Logistic Regression Model - Ordinary Regression Model-Mining complex data objects – Spatial databases – Temporal databases – Multimedia databases – Time series and sequence data – Text mining – Web mining – Applications in Data mining	9

Course	CO1:	Evolve multidimensional intelligent model from typical system.
Outcome	CO2:	Discover the knowledge imbibed in the high dimensional system and gain knowledge on dataware house process.
	CO3:	Acquire knowledge of data processing and data quality.
	CO4:	Design and deploy classification and clustering techniques.
	CO5:	Evaluate various mining techniques on complex data objects.

REFERENCE BOOKS:

- R1: Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann, Third edition, 2011.
- R2: Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw Hill, Tenth Reprint, 2007.
- R3: G. K. Gupta, "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India, Third Edition, 2014.
- R4: Ian.H.Witten, Eibe Frank and Mark.A.Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, Third edition, 2011
- R5: Bruce Ratner, "Statistical and Machine - Learning Data Mining: Techniques for Better Predictive Modeling and Analysis of Big Data", CRC Press, Second Edition, 2012
- R6: Mehmed kantardzic, "Data mining: Concepts, Models, Methods, and Algorithms", Wiley-Blackwell, Second Edition, 2011.
- R7: Ian Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Third Edition, Morgan Kaufmann, 2011.
- R8: George M Marakas, "Modern Data Warehousing, Mining and Visualization: Core Concepts", Prentice Hall, 2002.


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Programme M.E.	Course Code 20CP3304	Name of the Course DEEP LEARNING TECHNIQUES	L 3	T 0	P 0	C 3
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Course Objective	1. To understand the basic ideas and principles of Neural Networks
	2. To understand the basic concepts of Big Data and Statistical Data Analysis
	3. To familiarize the student with The Image Processing facilities like Tensorflow and Keras
	4. To appreciate the use of Deep Learning Applications
	5. To understand and implement Deep Learning Architectures

Unit	Description	Instructional Hours
	BASICS OF NEURAL NETWORKS Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.	
I	Suggested Activities: Discussion of role of Neural Networks, External learning – Boltzmann Machine and Perceptron, Practical – Installation of Tensor Flow and Keras. Suggested Evaluation Methods: Tutorial – Perceptron, Assignment problems on backpropagation networks, Quizzes on Neural Networks.	9
	INTRODUCTION TO DEEP LEARNING Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – ReLU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.	
II	Suggested Activities: Discussion of role of Gradient Descent in Deep Learning, External learning – Feature extraction and feature learning, Survey of Deep Learning Development Frameworks, Discussion of Gradient Descent Problem. Suggested Evaluation Methods Tutorial – Gradient descent in deep learning, Assignment problems in optimization. Quizzes on deep learning regularization and optimization.	9
	CONVOLUTIONAL NEURAL NETWORKS CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning	
III	Suggested Activities: Discussion of role of Convolutional Networks in Machine Learning, External learning – Concept of convolution and need for Pooling. Suggested Evaluation Methods: Tutorial – Image classification and recurrent nets, Assignment problems in image classification performances, Quizzes on Convolutional Neural Networks.	9
	MORE DEEP LEARNING ARCHITECTURES LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard-Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial	
IV		9

Generative Networks – Autoencoder and DBM

Suggested Activities: Discussion of role of Deep Learning architectures, External learning – Compression of features using Autoencoders.

Suggested Evaluation Methods: Tutorial – LSTM and Autoencoders, Assignment problems in deep generative models, Deep Belief Networks, Quizzes on deep learning architectures.

APPLICATIONS OF DEEP LEARNING

Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue

V Generation with LSTMs.

9

Suggested Activities:

Discussion of role of Deep Learning in Image and NLP applications, External learning – NLP concepts.

Suggested Evaluation Methods:

Tutorial – Image segmentation, Assignment problems in parsing and sentiment analysis, Quizzes on deep learning architectures.


Total Instructional Hours

45

Course Outcome	CO1:	Understand the role of Deep learning in Machine Learning Applications.
	CO2:	To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.
	CO3:	To design and implement Deep Learning Applications.
	CO4:	Critically Analyse Different Deep Learning Models in Image Related Projects.
	CO5:	To design and implement Convolutional Neural Networks, To know about applications of Deep Learning in NLP and Image Processing.

REFERENCE BOOKS:

- R1: Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017. R2: Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
- R3: Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
- R4: Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
- R5: Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018
- R6: Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.


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Programme M.E.	Course Code 20CP3305	Name of the Course SOFT COMPUTING TECHNIQUES	L 3	T 0	P 0	C 3
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Course Objective

1. To learn the key aspects of Soft computing and Neural networks.
2. To study the fuzzy logic components.
3. To gain insight onto neuro fuzzy modeling and control.
4. To know about the components and building block hypothesis of geneticalgorithm.
5. To gain knowledge in machine learning through neural networks

Unit	Description	Instructional Hours
	INTRODUCTION TO SOFT COMPUTING	
I	Evolution of Computing – Soft Computing Constituents – From Conventional AI to Computational Intelligence – Machine Learning Basics	9
	GENETIC ALGORITHMS	
II	Introduction to Genetic Algorithms (GA) – Applications of GA – Building Block Hypothesis- Representation– Fitness Measures – Genetic Operators-. GA based Machine Learning	9
	NEURAL NETWORKS	
III	Machine Learning using Neural Network, Adaptive Networks – Feed Forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks – Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance Architectures – Advances in NeuralNetworks	9
	FUZZY LOGIC	
IV	Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.	9
	NEURO-FUZZY MODELING	
V	Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule based Structure Identification – Neuro- Fuzzy Control – Case Studies.	9
Total Instructional Hours		45

Course Outcome	CO1:	Differentiate Conventional AI and Computational Intelligence.
	CO2:	Discuss on machine learning through neural networks.
	CO3:	Apply knowledge in developing a Fuzzy expert system.
	CO4:	Model Neuro Fuzzy system for clustering and classification.
	CO5:	Discover knowledge to develop Genetic Algorithm and Support vector machinebased machine learning system

REFERENCE BOOKS:

- R1: Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.
- R2: KwangH.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
- R3: George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1996.
- R4: James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.
- R5: David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 1989.
- R6: Mitchell Melanie, "An Introduction to Genetic Algorithm", MIT Press, 1996
- R7: S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", Springer, 2008edition

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Programme M.E.	Course Code 20CP3306	Name of the Course LINGUISTIC COMPUTING	L 3	T 0	P 0	C 3
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Course Objective

1. To learn the fundamentals of natural language processing
2. To appreciate the use of CFG and PCFG in NLP
3. To understand the role of semantics and pragmatics
4. To Understanding semantics and pragmatics of English language for processing
5. To Writing programs in Python to carry out natural Language processing

Unit	Description	Instructional Hours
INTRODUCTION		
I	Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of-Speech – Tagging - Hidden Markov and Maximum Entropy Models.	9
SPEECH		
II	Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition – Speech Recognition: - Advanced Topics - Computational Phonology	9
SYNTAX		
III	Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.	9
SEMANTICS AND PRAGMATICS		
IV	The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse	9
APPLICATIONS		
V	Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation	9
Total Instructional Hours		45

Course Outcome	CO1: To tag a given text with basic Language features
	CO2: To design an innovative application using NLP components
	CO3: To implement a rule based system to tackle morphology/syntax of a language
	CO4: To design a tag set to be used for statistical processing for real-time applications
	CO5: To compare and contrast use of different statistical approaches for different types of NLP applications

TEXT BOOKS

- T1: Daniel Jurafsky, —Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
- T2: Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, O'Reilly Media, 2009

REFERENCE BOOKS:

- R1: Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
- R2: Richard M Reese, —Natural Language Processing with Java, O'Reilly Media, 2015.
- R3: Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010

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Programme M.E.	Course Code 20CP3307	Name of the Course ADVANCED CRYPTOGRAPHY TECHNIQUES	L 3	T 0	P 0	C 3
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Course Objective	<ol style="list-style-type: none"> 1.To understand the mathematical foundations of security principles. 2.To appreciate the different aspects of encryption techniques. 3. To understand various attacks present over encryption and authentications techniques. 4. To understand the role played by authentication insecurity. 5. To appreciate the current trends of security practices.
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Unit	Description	Instructional Hours
	CLASSICAL ENCRYPTION AND BLOCKCIPHERS	
I	Classical Encryption – Substitution Cipher – One-time-pad Encryption – Block Ciphers – DES – Key Recovery Attacks on Block Ciphers – Iterated-DES and DESX – AES – Limitations of Key-recovery based Security	9
	PSEUDO RANDOM FUNCTIONS AND SYMMETRIC ENCRYPTION	
II	Random Functions – Permutations – Pseudo Functions – Pseudo-random Permutations – Modelling Blockciphers – Security Against Key Recovery – The Birthday Attack – Symmetric Encryption Schemes – Chosen Plaintext Attacks – Semantic Security – Security of CTR and CBC-Chosen Ciphertext Attack.	9
	HASH FUNCTIONS AND MESSAGE AUTHENTICATION	
III	Hash Function SHA1 – Collision resistant Hash Functions – Collision Finding Attacks – Onewayness of Collision resistant Hash Functions – MD Transform – Syntax for message Authentication – PRF as a MAC Paradigm – CBC MAC – Universal-hashing Approach – Authenticated Encryption.	9
	NUMBER THEORY AND ASYMMETRIC ENCRYPTION	
IV	Computational Number Theory – Number Theoretic Primitives – Diffie Hellman Problem – Asymmetric Encryption Schemes – Hybrid Encryption – ElGamal Scheme and its Variants – Homomorphic Encryption – Digital Signatures	9
	SECURITY PRACTICES AND ADVANCED TOPICS	
V	Electronic Mail Security – IP Security – Digital Cash – Schnorr’s Identification Protocol and Signature – Blind Signature – Distributed Ledger and Bitcoin – Secret Sharing – Shamir Threshold Scheme – Security in Routing – Mixnet	9
Total Instructional Hours		45

Course Outcome	CO1:	Demonstrate the various classical encryption techniques and the adversary capabilities.
	CO2:	Apply computational secrecy and semantic security to find out the probability of how strong are the security schemes.
	CO3:	Illustrate the various MAC and HASH functions and apply the Birthday attack over Hash.
	CO4:	Apply number theory in public key encryption techniques.
	CO5:	Analyze the application of cryptography for secure E-Commerce and other secret transactions.

REFERENCE BOOKS:

- R1: MihirBellare and Phillip Rogaway, "Introduction to Modern Cryptography", 2005.
- R2: Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography ",Chapman and Hall/CRC Press Second Edition,2015.
- R3: Hans Delfts and Helmut Knebl, "Introduction to Cryptography – Principles and Applications", Springer, Third Edition by,2015.


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Programme M.E.	Course Code 20CP3401	Name of the Course DATA SCIENCE FOR ENGINEERS	L 3	T 0	P 0	C 3
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- Course Objective**
1. Introduce R as a programming language
 2. Introduce the mathematical foundations required for data science
 3. Introduce the first level data science algorithms
 4. Introduce a data analytics problem solving framework
 5. Introduce a practical capstone case study

Unit	Description	Instructional Hours
	INTRODUCTION TO R	
I	Introduction to R– Variables and Data types in R-Data Frames-Recasting and joining of data frames-Arithmetic, Logical and Matrix operations in R-advanced programming in R:Functions-Control structures-Data visualization in R basic graphics.	9
	LINEAR ALGEBRA AND STATISTICS	
II	Solving Linear Equations-Linear Algebra-Distances ,Hyper planes and Half space,Eigen values, Eigen vectors-Statistical Modeling-Random variables and probability Mass/Density functions-Sample Statistics-hypotheses Testing	9
	OPTIMIZATION	
III	Optimization for Data science-Unconstrained Multivariate Optimization-Gradient Descent (Learning Rule)- Multivariate Optimization with Equality constraints- Multivariate Optimization with Inequality constraints-Introduction to Data science- Solving Data Analysis problems –A Guided Thought process-	9
	REGRESSION	
IV	Module: Predictive Modeling-Linear Regression-Model Assessment-Diagnostics to Improve linear model Fit-Simple Linear Regression Model building- Simple Linear Regression Model Assessment -Multiple Linear Regression- assessing importance of different variables-subset selection	9
	CLASSIFICATION AND CLUSTERING	
V	Cross Validation- Multiple Linear Regression modeling Building and selection- Classification- Logistic Regression –Performance Measures- Logistic Regression implementation in R- K-Nearest Neighbors- K-Nearest Neighbors implementation in R-K-means Clustering-K-Means implementation in R	9
Total Instructional Hours		45

Course Outcome	CO1:	Describe a flow process for data science problems
	CO2:	Classify data science problems into standard typology
	CO3:	Develop R codes for data science solutions
	CO4:	Correlate results to the solution approach followed
	CO5:	Assess the solution approach

REFERENCE BOOKS:

R1: <https://Nptel.Ac.In/Courses/106/106/106106179/>

R2: Introduction To Linear Algebra - By Gilbert Strang.

R3: Applied Statistics And Probability For Engineers – By Douglas Montgomery


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Programme	Course Code	Name of the Course	L	T	P	C
M.E.	20CP3402	CYBER SECURITY	3	0	0	3

OBJECTIVES:

1. Students should be able to understand.
2. The difference between threat, risk, attack and vulnerability.
3. How threats materialize into attacks.
4. Where to find information about threats, vulnerabilities and attacks.
5. Typical threats, attacks and exploits and the motivations behind them.

UNIT I INTRODUCTION TO CYBER SECURITY

9

Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web— User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data - Email Attacks.

UNIT II SECURITY IN OPERATING SYSTEM & NETWORKS

9

Security in Operating Systems - Security in the Design of Operating Systems - Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.

UNIT III DEFENCES: SECURITY COUNTERMEASURES

9

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases

- Reliability and Integrity - Database Disclosure - Data Mining and Big Data.

UNIT IV PRIVACY IN CYBERSPACE

9

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies - Where the Field Is Headed.

UNIT V MANAGEMENT AND INCIDENTS

9

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things

- Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law -International Laws - Cyber crime - Cyber Warfare and Homeland Security.

TOTAL : 45 PERIODS

OUTCOMES:

1. Analytical skills
2. Group / team working
3. Innovation / creativity
4. Problem solving skills
5. Research

REFERENCES:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education , 2015.
2. George K.Kostopoulos, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
4. Nelson Phillips and Enfinger Steuart, —Computer Forensics and Investigationsl, Cengage Learning, New Delhi, 2009.


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