VISION AND MISSION

VISION OF THE DEPARTMENT

The Department of Computer Science and Engineering strives to create computing professionals, researchers, and entrepreneurs, with high technical knowledge, communication skills, values and ethics. It collaborates with academia, industry and community to set high standards in academic excellence and in fulfilling societal responsibilities.

MISSION OF THE DEPARTMENT

The mission of the Department of Computer Science and Engineering is to

- Provide motivated faculty and state of the art facilities for education and research, both in foundational aspects and of relevance to emerging computing trends.
- Develop knowledgeable, industry-ready students with pertinent competencies.
- Inculcate responsibility through sharing of knowledge and innovative computing solutions that benefit the society-at-large.
- Engage in collaborative research with academia and industry for seamless transfer of knowledge resulting in patentable solutions.
- Generate adequate resources for research activities from sponsored projects and consultancy.

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PROGRAM EDUCATIONAL OBJECTIVES:

1. Demonstrate the ability to develop software systems of varying size and complexity using appropriate theory, principles and practices of Software Engineering.
2. Empower students to critically analyze current trends and future issues from a system perspective at multiple levels of detail and abstraction using appropriate tools, technologies and best practices.
3. Prepare students to critically analyze and identify gaps in the existing literature and propose innovative and appropriate solutions needed to the industry.
4. Ability to improve and expand skills through lifelong multidisciplinary learning as professional engineers, participation in professional activities and development of managerial and leadership skills.
5. Enable students to effectively communicate technically, function effectively on teams, and apply Software solutions within a global, societal, and environmental context by following ethical practices.

PROGRAM OUTCOMES (POs):

PO #	Graduate Attribute	Programme Outcomes
1.	Research Aptitude	An ability to independently carry out research / Investigations, identify problems and develop solutions to solve practical problems.
2.	Technical documentation	An ability to write and present a substantial technical report/ document.
3.	Technical competence	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4	Handle complex problems	Use research based knowledge, methods, appropriate techniques, resources and tools to solve complex engineering issues with an understanding of the limitations.
5	Environmental Sustainabilityand societal Ethics	Ensure development of socially relevant and eco friendly indigenous products by applying technical knowledge, ethical principles and, sound engineering practices
6	Life-long learning	Recognize the need for independent, life-long learning and engage in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO):

1. To acquire deep understanding of the concepts and practices for analyzing and synthesizing various Software Engineering Applications.
2. To ensure software quality and usage of standards.
3. Integrate ideas, design and develop applications using innovative approaches for real world complex problems.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme educational objective and the outcomes is given in the following table.

PROGRAMME EDUCATIONAL OBJECTIVES	PO1	PO2	PO3	PO4	PO5	PO6
1.	√	√	√	√	√	
2.	√	√	√	√	√	√
3.	√	√	√	√	√	
4.	√	√	√	√	√	√
5.		√	√	√	√	√

YEAR	SEMESTER	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
YEAR 1	SEM1	Advanced Mathematics for Scientific Computing	√	√	√	√		
		Data structures and Algorithms	√	√	√	√	√	
		Software Architecture	√	√	√		√	
		Software Requirements Engineering	√	√		√	√	
		Research Methodology and IPR	√	√		√		√
		Audit Course – I*						√
		Data structures and Algorithms Laboratory	√	√	√	√	√	
		Software Development Process Laboratory	√	√	√	√	√	
	SEM2	Advanced Databases	√	√	√	√	√	
		Advanced Operating Systems	√	√	√	√	√	
		Advanced Software Engineering	√	√	√	√	√	
		Program Elective I						
		Program Elective II						
		Audit Course –II						√
		Advanced Databases Laboratory	√	√	√	√	√	
		Advanced Software Engineering Laboratory	√	√	√	√	√ Attested	

YEAR	SEMESTER	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
		Professional Practices		√	√			√
YEAR 2	SEM3	Program Elective III						
		Program Elective IV						
		Program Elective V						
		Open Elective						
		Dissertation I	√	√	√	√	√	√
	SEM4	Dissertation II	√	√	√	√	√	√
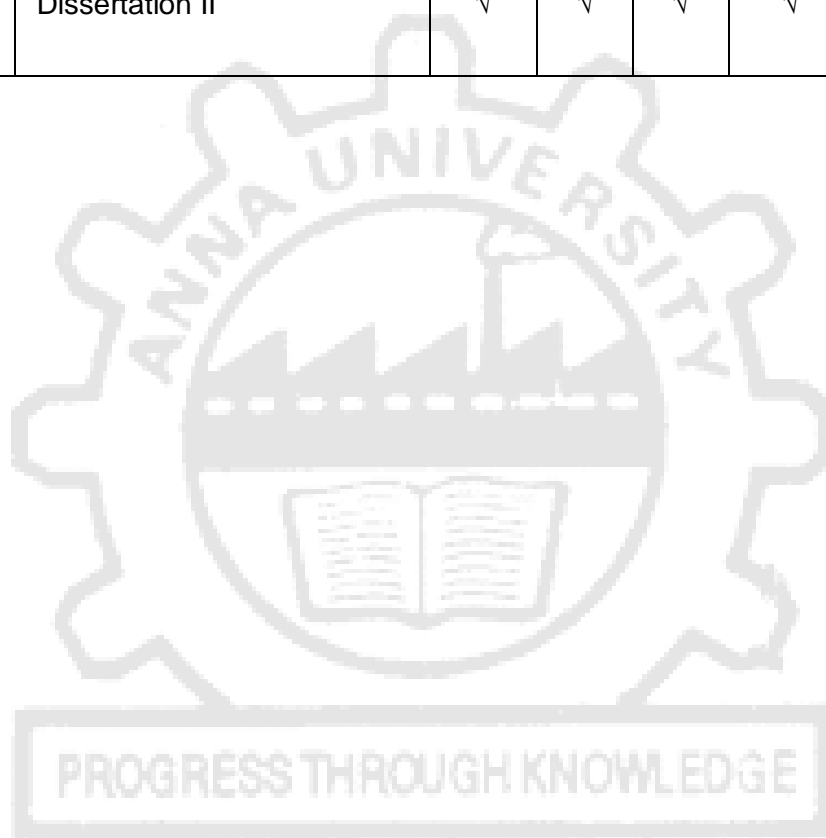
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UNIVERSITY DEPARTMENTS
M.E. SOFTWARE ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5153	Advanced Mathematics for Scientific Computing	FC	3	1	0	4	4
2.	CP5151	Data Structures and Algorithms	PCC	3	0	0	3	3
3.	SE5101	Software Architecture	PCC	3	0	0	3	3
4.	SE5102	Software Requirements Engineering	PCC	3	0	0	3	3
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
7.	CP5161	Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
8.	SE5111	Software Development Process Laboratory	PCC	0	0	4	4	2
			TOTAL	**16**	**1**	**8**	**25**	**19**

*Audit course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	OR5251	Advanced Databases	PCC	3	0	0	3	3
2.	CP5251	Advanced Operating Systems	PCC	3	0	0	3	3
3.	SE5201	Advanced Software Engineering	PCC	3	0	0	3	3
4.		Program Elective I	PEC	3	0	2	3	4
5.		Program Elective II	PEC	3	0	0	3	3
6.		Audit Course –II*	AC	2	0	0	2	0
PRACTICALS								
7.	OR5261	Advanced Databases Laboratory	PCC	0	0	4	4	2
8.	SE5211	Advanced Software Engineering Laboratory	PCC	0	0	4	4	2
9.	CP5262	Professional Practices	EEC	0	0	2	2	1
			TOTAL	**17**	**0**	**10**	**27**	**21**

*Audit course is optional

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective III	PEC	3	0	2	5	4
2.		Program Elective IV	PEC	3	0	0	3	3
3.		Program Elective V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	SE5311	Dissertation I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	SE5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 71

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.	MA5153	Advanced Mathematics for Scientific Computing	FC	3	1	0	4	4

PROGRAM CORE COURSES (PCC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	CP5151	Data structures and Algorithms	PCC	3	0	0	3	3
2.	SE5101	Software Architecture	PCC	3	0	0	3	3
3.	SE5102	Software Requirements Engineering	PCC	3	0	0	3	3
4.	CP5161	Data structures and Algorithms Laboratory	PCC	0	0	4	4	2
5.	SE5111	Software Development Process Laboratory	PCC	0	0	4	4	2
6.	OR5251	Advanced Databases	PCC	3	0	0	3	3
7.	CP5251	Advanced Operating Systems	PCC	3	0	0	3	3
8.	SE5201	Advanced Software Engineering	PCC	3	0	0	3	3
9.	OR5261	Advanced Databases Laboratory	PCC	0	0	4	4	2
10.	SE5211	Advanced Software Engineering Laboratory	PCC	0	0	4	4	2

PROGRAM ELECTIVE COURSES (PEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	SE5072	Fundamentals of Machine Learning	PEC	3	0	2	5	4
2.	CP5073	Cloud Computing Technologies	PEC	3	0	2	5	4
3.	CP5080	Ethical Hacking	PEC	3	0	2	5	4
4.	CP5085	Principles of Cryptography	PEC	3	0	2	5	4
5.	CP5083	Internet of Things	PEC	3	0	2	5	4
6.	CP5089	Web Content Design and Management	PEC	3	0	2	5	4
7.	SE5076	Software Testing and Quality Assurance	PEC	3	0	2	5	4
8.	IF5076	Deep Learning	PEC	3	0	2	5	4
9.	IF5090	Semantic Web	PEC	3	0	2	5	4
10.	IF5088	Mobile Application Development	PEC	3	0	2	5	4
11.	CP5075	Cryptocurrency and Blockchain Technologies	PEC	3	0	2	5	4
12	SE5071	Multimedia Systems and Applications	PEC	3	0	2	5	4

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
13.	CP5082	Information Retrieval Techniques	PEC	3	0	0	3	3
14.	CP5076	Cyber Security	PEC	3	0	0	3	3
15.	SE5075	Software Security	PEC	3	0	0	3	3
16.	CP5088	User Interface Design	PEC	3	0	0	3	3
17.	SE5001	Integrated Software Project Management	PEC	3	0	0	3	3
18.	SE5074	Software Reliability Metrics and Models	PEC	3	0	0	3	3
19.	SE5002	Software Test Automation	PEC	3	0	0	3	3
20.	SE5003	Software Verification and Validation	PEC	3	0	0	3	3
21.	SE5004	Enterprise Application Integration	PEC	3	0	0	3	3
22.	SE5005	Software Agents	PEC	3	0	0	3	3
23.	CP5086	Social Network Analysis	PEC	3	0	2	5	4
24.	SE5073	Sentiment Analysis	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES (OEC)
*(out of 6 courses one course must be selected)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	C
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	AX5091	English for Research Paper Writing	2	0	0	0
2.	AX5092	Disaster Management	2	0	0	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0
4.	AX5094	Value Education	2	0	0	0
5.	AX5095	Constitution of India	2	0	0	0
6.	AX5096	Pedagogy Studies	2	0	0	0
7.	AX5097	Stress Management by Yoga	2	0	0	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0
				TOTAL CREDITS		**0**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	C
				L	T	P		
1.	CP5262	Professional Practices	EEC	0	0	2	2	1
2.	SE5311	Dissertation I	EEC	0	0	12	12	6
3.	SE5411	Dissertation II	EEC	0	0	24	24	12

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MA5153   **ADVANCED MATHEMATICS FOR SCIENTIFIC COMPUTING**   **L T P C**
                                                                              3 1 0 4

OBJECTIVES:
- 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 multi-dimensional space.

UNIT I   LINEAR PROGRAMMING   12
Formulation – Graphical solution – Simplex method – Two phase method –Transportation and Assignment Problems.

UNIT II   SIMULATION   12
Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems.

UNIT III   ESTIMATION THEORY   12
Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments.

UNIT IV   TESTING OF HYPOTHESIS   12
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.

UNIT V   MULTIVARIATE ANALYSIS   12
Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, students will be able to
- Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.
- Simulate appropriate application/distribution problems.
- Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
- Apply the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
- Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:
1. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, 9th Edition, Boston, 2016.
2. Johnson, R.A, Irwin Miller and John Freund., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, 9th Edition, New York, 2016.
3. Johnson, R.A., and Wichern, D.W., "Applied Multivariate Statistical Analysis", Pearson Education, Sixth Edition, New Delhi, 2013.
4. Ross. S.M., "Probability Models for Computer Science", Academic Press, SanDiego, 2002.
5. Taha H.A.,, "Operations Research: An Introduction", Prentice Hall of India Pvt. Ltd. 10th Edition, New Delhi, 2017.
6. Winston, W.L., "Operations Research", Thomson – Brooks/Cole, Fourth Edition, Belmont, 2003.

CP5151   **DATA STRUCTURES AND ALGORITHMS**   **L T P C**
                                                                             3 0 0 3

OBJECTIVES:

- 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 I   FUNDAMENTALS   9
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.

UNIT II   SEARCH STRUCTURES   9
Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT III   HEAP STRUCTURES   9
Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps

UNIT IV   GEOMETRIC ALGORITHMS   9
Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram

UNIT V   ADDITIONAL TOPICS   9
Approximation Algorithms: Vertex Cover & Euclidean Travelling Salesperson Problem – Randomized Algorithms: Closest Pair Problem & Minimum Spanning Trees – Online Algorithm: Euclidean Spanning Tree.

                                                        TOTAL : 45 PERIODS

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

- Analyze algorithms.
- Determine algorithm correctness.
- Choose appropriate data structures for the problems to be solved.
- Design algorithms for problems from different domains.
- Identify various research strategies on algorithmic design.

REFERENCES:

1. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
2. Gilles Brassard, Paul Bratley, "Algorithmics: Theory and Practice", Prentice Hall, 1988.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, "Computational Geometry Algorithms and Applications", Third Edition, Springer, 2008.
4. 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.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 2009.

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CO	PO						PSO		
	1	**2**	**3**	**4**	**5**	**6**	1	2	3
1.			√	√			√	√	√
2.		√		√		√	√	√	√
3.	√		√	√	√		√		√
4.	√		√	√	√		√	√	√
5.	√		√	√	√		√	√	√

SE5101	SOFTWARE ARCHITECTURE	L T P C
		3 0 0 3

OBJECTIVES:

- Understand the fundamentals of software architecture.
- Study the various software development methodologies.
- Learn the importance of architectural documentation and evaluation.
- Learn the various software architecture design components.
- Relate software architecture and software quality.

UNIT I   INTRODUCTION   9

Basic concepts of software architecture – Context of Software Architecture – ABC cycle – What software architecture is and what it isn't – Architectural patterns – Good Architecture- Reference models – Architectural structures and views-Introduction to styles – Decentralized Architectures.

UNIT II   DESIGN METHODOLOGIES   9

Structured design- Design practices-Stepwise refinement – Incremental design- Structured system analysis and design –Jackson structured programming – Jackson system Development.

UNIT III   ARCHITECTURAL DESCRIPTION DOCUMENTATION AND EVALUATION   9

Early architecture description languages-Domain and style specific ADL's- Extensible ADL's – Documenting software architecture – Uses and Audiences for Architecture Documentation – Views – Choosing Views – Combining Views –Architecture evaluation – Evaluation Factors –Architecture Tradeoff Analysis Method – Lightweight Architecture Evaluation – ATAM.

UNIT IV   ARCHITECTURE DESIGN   9

Typical architectural design-Dataflow-Independent components-Call and return – Using styles in design – Architectural design space-Design space of architectural elements – Design space of architectural styles.

UNIT V   IMPLEMENTATION AND CONFORMANCE TO ARCHITECTURE   9

Understanding quality attributes- Implementation of Quality attributes in Architecture – Architecture and requirements conformance –Functionality– Quality attribute considerations – System quality attributes-Introduction to tactics – Achieving Quality Attributes through Tactics –Tactics types – Architectural patterns and styles – Architecture and Quality Attributes – Quality attribute scenarios in practice.

TOTAL: 45 PERIODS

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OUTCOMES:
Upon completion of the course, the student will be able to
- Develop Software applications starting from software architecture and design.
- Learn and evaluate existing software architectures.
- Realize importance of architectural documentation and document them.
- Employ various software architecture design components.
- Design methods for improving software quality from the perspective of software architecture.

REFERENCES:
1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Third Edition, Addison, Wesley, 2012.
2. David Budgen, "Software Design", Second Edition, Pearson Education, 2004.
3. Richard N.Taylor, Nenad Medvidovic and Eric M.Dashofy, "Software Architecture, Foundations, Theory and Practice", Wiley 2010.
4. Hong Zhu, "Software Design Methodology from Principles to Architectural Styles", Elsevier, 2005.
5. Mary Shaw and David Garlan, "Software Architecture –Perspectives on an emerging Discipline", Pearson Education, 2008.

CO	PO						PSO		
	1	**2**	**3**	**4**	**5**	**6**	1	2	3
1.	√	√	√	√	√	√	√	√	√
2.	√			√		√	√	√	
3.		√	√					√	
4.	√	√	√				√	√	√
5.	√	√	√	√			√	√	√

SE5102   **SOFTWARE REQUIREMENTS ENGINEERING**   **L T P C**
                                                                    3 0 0 3
OBJECTIVES:

- Understand the basics of requirements engineering.
- Learn different techniques used for requirements elicitation.
- Know the role played by requirements analysis in requirement integration.
- Appreciate the use of various methodologies for requirements development.
- Study the current trends in requirements prioritization and validation.

UNIT I   REQUIREMENTS ENGINEERING OVERVIEW   9
Software Requirement Overview – Software Development Roles –Software Development Process Kernels – Commercial Life Cycle Model – Vision Development – Stakeholders Needs & Analysis – Stakeholder needs –Stakeholder activities.

UNIT II   REQUIREMENTS ELICITATION   9

The Process of Requirements Elicitation – Requirements Elicitation Problems – Current Elicitation Techniques – Information Gathering – Requirements Expression and Analysis – Validation – An Elicitation Methodology Framework – A Requirements Elicitation Process Model – Methodology over Method – Integration of Techniques – Fact-Finding – Requirements Gathering – Evaluation and Rationalization – Prioritization– Integration and Validation – Risk Assessment and Risk Treatment (RART).

UNIT III   REQUIREMENTS ANALYSIS   9

Identification of Functional and Non Functional Requirements – Identification of Quality Requirements – Six Quality Attributes– Analysis – Feasibility and Internal Compatibility of System Requirements – Definition of Human Requirements Baseline.

UNIT IV   REQUIREMENTS DEVELOPMENT   9

Requirements analysis – Requirements Documentation – Requirements Development Workflow – Fundamentals of Requirements Development – Requirements Attributes Guidelines Document – Supplementary Specification Document – Use Case Specification Document – Methods for Software Prototyping – Evolutionary prototyping –Throwaway prototyping.

UNIT V   REQUIREMENTS VALIDATION   9

Validation objectives – Analysis of requirements validation – Activities – Properties – Requirement reviews – Requirements testing – ISO 31000 – Case tools for requirements engineering.

TOTAL : 45 PERIODS

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

- Prepare SRS including the details of requirements engineering.
- Describe the stages of requirement elicitation.
- Analyze software requirements gathering.
- Integrate the requirements well during requirements analysis.
- Use various methodologies for requirements development.

REFERENCES:

1. Ian Sommerville, Pete Sawyer," Requirements Engineering: A Good Practice Guide", Sixth Edition, Pearson Education, 2004.
2. Dean Leffingwe, DonWidrig, "Managing Software Requirements A UseCaseApproach", Second Edition, Addison Wesley,2003.
3. Karl Eugene Wiegers, "Software Requirements", Word Power Publishers, 2000.
4. Ian Graham, "Requirements Engineering and Rapid Development", AddisonWesley,1998.
5. Wiegers, Karl,JoyBeatty, "Software Requirements", Pearson Education,2013.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√		√	√	√	√
2.	√			√		√		√	√
3.			√			√			
4.			√	√		√			
5.			√			√			Attested

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RESEARCH METHODOLOGY AND IPR **LT P C**
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I   RESEARCH PROBLEM FORMULATION   6

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

UNIT II   LITERATURE REVIEW   6

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

UNIT III   TECHNICALWRITING /PRESENTATION   6

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

UNIT IV   INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)   6

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

UNIT V   INTELLECTUAL PROPERTY RIGHTS (IPR)   6

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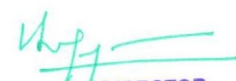Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
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CP5161   **DATA STRUCTURES AND ALGORITHMS LABORATORY**   **L T P C**

                                                                        0 0 4 2

OBJECTIVES:

- 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.

LIST OF EXPERIMENTS:
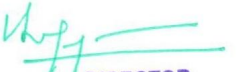
1. Binary Search Trees
2. Min/Max Heap
3. Leftist Heap
4. AVL Trees
5. Red-Black Trees
6. B-Trees
7. Segment Trees
8. Line segment intersection

                                                        TOTAL : 60 PERIODS

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

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

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√		√	√	√	√
2.	√		√			√		√	√
3.			√			√		√	
4.			√	√		√		√	
5.			√			√		√	

SE5111   **SOFTWARE DEVELOPMENT PROCESS LABORATORY**   **L T P C**
                                                                        0 0 4 2

OBJECTIVES:

- To learn the stages of software development process.
- To carry out Planning.
- To understand the importance of documentation.
- To equip in preparing software project documentation.
- To use models developed, code and test.

SUGGESTED LIST OF EXERCISES:

Choose any one application for performing the following phases.

1. Program Analysis and Project Planning.
   Thorough study of the problem – Identify project scope, Objectives, Infrastructure –PROJECT PLAN DOCUMENTATION

2. Software Requirement Analysis
   Describe the individual Phases / Modules of the project, Identify deliverables – SRS DOCUMENTATION

3. Data Modeling
   Use work products – Data dictionary, Use case diagrams and activity diagrams, build and test class diagrams, Sequence diagrams, add interface to class diagrams. – DESIGN DOCUMENTATION

4. Software Development and Debugging
   Use technology of your choice to develop and debug the application– CODE DOCUMENTATION

5. Software Testing
   Perform validation testing, Coverage analysis, memory leaks, develop test case hierarchy and Site monitor. – TEST CASE DOCUMENTATION

                                                                        TOTAL: 60 PERIODS

SUGGESTED LIST OF APPLICATIONS:
   1. Inventory System.
   2. Book Lending Application.
   3. Car Booking Application.
   4. Online Help Portal.
   5. Online Payment Portal.
   6. Student Marks Analyzing System.
   7. Quiz System.
   8. Online Ticket Reservation System.
   9. Payroll System.
   10. Course Registration System.

OUTCOMES:
Upon completion of the course, the student will be able to
- Prepare project plan.
- Prepare SRSas per standards.
- Prepare and use design document.
- Prepare and use code document.
- Prepare and use test case documentation at appropriate stages of software development process.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√	√		√			√		
2.		√						√	
3.		√							
4.		√							
5.		√						√	

OR5251   **ADVANCED DATABASES**   **L T P C**
                                                  3 0 0 3

OBJECTIVES:
- 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 I   RELATIONAL MODEL   9
Entity Relationship Model – Relational Data Model – Mapping Entity Relationship   Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization – Transaction Management-Recovery

UNIT II   PARALLEL AND DISTRIBUTED DATABASES   9

Parallel Databases – I/O Parallelism – Inter-Query and Intra-Query Parallelism – Inter-Operation and Intra-operation Parallelism – Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management.

UNIT III   XML AND WEB DATABASES   9
XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity – Java Database Connectivity – Accessing Relational database using PHP

UNIT IV   ACTIVE TEMPORAL AND DEDUCTIVE DATABASES   9

Event Condition Action Model – Design and Implementation Issues for Active Databases – Temporal Databases – Interpreting Time in Relational Databases – Deductive Databases – Data log Queries

UNIT V   NoSQL DATABASES   9
NoSQL database vs traditional RDBMS database – Migrating from RDBMS to NoSQL – MongoDB – Database creation and Querying – Web Application development using MongoDB   Attested

TOTAL : 45 PERIODS

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

- Design and implement relational databases.
- Design and implement parallel and distributed databases.
- Design and implement XML databases, Active, Temporal and Deductive databases.
- Implement the concept of database connectivity with the applications.
- Apply various data mining techniques.

REFERENCES:
1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Addison-Wesley, 2011.
2. Han, Jiawei, Jian Pei, and MichelineKamber. Data mining: concepts and Techniques. 2011.
3. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.
4. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Fifth Edition, McGraw Hill, 2006.
5. C.J.Date, A.Kannan andS.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
6. V.S.Subramanian, "Principles of Multimedia Database Systems", Harcourt India Pvt. Ltd.,2001.
7. ShashankTiwari, "Professional NoSQL", Wiley, 2011.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
1.	√	√	√			√
2.	√	√	√	√	√	
3.	√	√	√	√	√	
4.	√		√	√	√	√
5.		√	√	√	√	√

PROGRESS THROUGH KNOWLEDGE

CP5251   **ADVANCED OPERATING SYSTEMS**   **L T P C**
                                                          3 0 0 3

OBJECTIVES:

- 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.
- To understand cloud operating systems.

UNIT I   **INTRODUCTION**   **9**
Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages

Attested

UNIT II   DISTRIBUTED OPERATING SYSTEMS   9

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

UNIT III   DISTRIBUTED RESOURCE MANAGEMENT   9

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

UNIT IV   REAL TIME OPERATING SYSTEMS   9

Basic Model of Real Time Systems – Characteristics – Application of Real Time Systems – RealTime Task Scheduling – Handling Resource Sharing

UNIT V   MOBILE AND CLOUD OPERATING SYSTEMS   9

Android – Overall Architecture – Linux Kernel –Hardware Support – Native User-Space – Dalvik and Android's Java – System Services – Introduction to Cloud Operating Systems.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- Identify the features of distributed operating systems.
- Demonstrate the various protocols of distributed operating systems.
- Identify the different features of real time operating systems.
- Discuss the features of mobile operating systems.
- Discuss the features of cloud operating systems.

REFERENCES:
1. MukeshSinghal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems", Tata Mc Graw-Hill, 2001.
2. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.
3. KarimYaghmour, "Embedded Android", O'Reilly, First Edition, 2013.
4. NikolayElenkov, "Android Security Internals: An In-Depth Guide to Android's Security Architecture", No Starch Press, 2014.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√			√	√	
2.	√		√	√			√	√	
3.	√		√	√	√		√	√	√
4.	√		√	√			√	√	
5.	√		√	√			√	√	

SE5201	ADVANCED SOFTWARE ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES :
- Comprehend the different stages of Software Development Lifecycle.
- Comprehend the Process of developing Analysis models and map the Analysis models to Design Models.
- Comprehend the Design Issues related to Web applications and Mobile Apps.
- Comprehend the Quality Factors associated with Software Development.
- Comprehend the use of different Testing Strategies in Software Development.

UNIT I   PROCESS MODELS   9
Prescriptive process models–Specialized process models–The unified process–personal and team process models–Product and Process–Agile development–Extreme Programming–Other Agile process models–Human aspects of Software Engineering

UNIT II   REQUIREMENTS MODELING AND DESIGN CONCEPTS   9
Understanding Requirements–Scenario based methods–Class Based Methods–Behavior, Patterns and Web/Mobile Apps–The design process–Design concepts–The Design model

UNIT III   SOFTWARE DESIGN   9
Architectural design–Component level Design–User Interface Design–Pattern based design–Web App design– Mobile App design

UNIT IV   SOFTWARE QUALITY   9
Garvin's Quality dimensions–McCall's Quality factors–ISO9126 Quality factors–The software Quality Dilemma–Achieving Software Quality–Review Techniques–Elements of Software Quality Assurance–SQA Processes and Product Characteristics–SQA Tasks, Goals, and Metrics–Statistical Software Quality Assurance–Software Reliability–The ISO 9000 Quality Standards–The SQA Plan

UNIT V   SOFTWARE TESTING AND SOFTWARE CONFIGURATION   9
**   MANAGEMENT**
Software Testing Strategies–Testing Conventional Applications–Testing Object Oriented Applications–Testing Web applications–Testing Mobile Apps–Software Configuration management–The SCM process–Configuration Management for Web and Mobile App.

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the Course, the Student will be able to
- Select Appropriate Process Model for Software Development.
- Develop Analysis Models and Map the Analysis Models to Design Models.
- Address the Design Issues related To Web Applications and Mobile Apps.
- Incorporate Appropriate Quality Factors and Standards during Software Development.
- Select Appropriate Testing Strategies For Software Testing.

REFERENCES:
1. Roger S. Pressman, "Software Engineering – A Practioner's Approach", MC Graw Hill, 8th edition.
2. Ian Sommerville, "Software Engineering", Addison-Wesley, 9th Edition, 2010.
3. Bernd Bruegge, Allen H. Dutoit, "Object-Oriented Software Engineering", Prentice Hall, Third Edition, 2009.
4. Robert E. Filman, TzillaElrad, Siobhán Clarke, Mehmet Aksit, "Aspect-Oriented Software Development", Addison-Wesley Professional, 2004.

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5. RenuRajni, Pradeep Oak, "Software Testing: Effective Methods, Tools and Techniques", Tata McGraw Hill, 2004.
6. Jonathan Bowen, "Formal Specification and Documentation using Z – A Case Study Approach", Intl Thomson Computer Pr, 1996.
7. Antoni Diller, "Z: An Introduction to Formal Methods", Wiley, 1994.
8. James Shore, Shane Warden "The Art of Agile Development – Pragmatic guide to agile software development", O'Reilly Media, October 2007. . Ken Schwaber, "Agile Project Management with SCRUM", Microsoft Press, 2004.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√	√	√				√	√	
2.	√		√	√			√		√
3.		√	√	√		√	√	√	√
4.	√	√		√			√		√
5.	√		√	√		√		√	

OR5261	ADVANCED DATABASES LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:

- To learn the DDL and DML operations.
- To understand the use of various Joins.
- To acquire knowledge on creation of views and nested queries.
- To write and use functions, triggers, and stored procedures.
- To use distributed databases, heterogeneous databases and XML databases.

LIST OF EXPERIMENTS:

1. Data Definition Language–Create–Alter–Drop– Enforcing Primary Key and Foreign Key Constraints–Data Manipulation Language–Insert–Delete–Update–Transaction Control Language– Commit– Rollback– Save Points
2. Cartesian Product – Equijoin – Left Outer Join – Right Outer Join – Full Outer Join
3. Set Operations – Creating Views – Creating Sequence – Indexing–Aggregate Functions – Analytic Functions – Nested Queries
4. Creating Triggers and Stored Procedures
5. Implementation of Distributed Databases
6. Connecting Heterogeneous Databases
7. XML Databases
8. Accessing and Updating a Relational Database using PHP
9. Accessing and Updating a Relational Database using JDBC
10. Accessing and Updating MongoDB using PHP

TOTAL: 60 PERIODS

Attested

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OUTCOMES:
Upon completion of this course, the student should be able to

- Create and carry out all Data Manipulation operations.
- Create queries using various Joins appropriately.
- Create and use views and nested queries.
- Write and use functions, triggers, and stored procedures.
- Use distributed databases, heterogeneous databases and XML databases.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
1.	√	√	√			√
2.	√	√	√	√	√	
3.	√	√	√	√	√	
4.	√		√	√	√	√
5.		√	√		√	√

SE5211	**ADVANCED SOFTWARE ENGINEERING LABORATORY**	**L T P C**	
		0 0 4 2	

OBJECTIVES:

- To learn to prepare SRS for real time applications.
- To identify the entity relationship and data flow in the application.
- To learn modelling the requirements using various models.
- To use developed models for generating code from the model.
- To get equipped on various levels of testing the developed application.

LIST OF EXPERIMENTS:

1. Prepare SRS for a real time Application
2. Model Entity Relationship Diagram and Data Flow Diagram for the selected case study
3. Model the following UML Diagrams for the selected Case study
   - a) Class Diagram
   - b) Use Case Diagram
   - c) Sequence Diagram
   - d) Component diagram
   - e) State Transition Diagram
   - f) Activity Diagram
   - g) Deployment Diagram

4. Code Generation from UML Diagram
5. Testing
   - a) Unit Testing
   - b) Integration Testing

OUTCOMES:

Upon completion of the course, the student will be able to

- Prepare SRS for real time applications.
- Identify the entity relationship and data flow in the application.
- Model the requirements for analysis as well as for design.
- Generate code from the model developed.
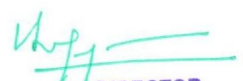- Perform various levels of testing on the developed application.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.		√					√		√
2.		√	√				√	√	√
3.		√		√					√
4.		√							
5.			√				√		√

CP5262   **PROFESSIONAL PRACTICES**   **L T P C**
                                                        0 0 2 1

OBJECTIVES:

- To facilitate analysis, design and problem solving skills.
- To have a thorough domain knowledge.
- To understand the best Industry practices by reading case studies.
- To kindle innovative and professional thinking.
- To explore possible alternative solutions.
- To estimate feasibility, cost, risk and ROI.

SESSIONS BASED ON:

Identify an Application/Projects (may be of social relevance) – Understand Customer Requirements – Analyze And Understand Customers And Stakeholders – Value Additions – Innovations and Research Component – Preparing Plan / SRS Document Indicating Feasibility, Cost, Risk, ROI and Related Design – Suggest Implementation Methodology – Perform Risk Assessment and Management

TOTAL: 30 PERIODS

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

- Identify and formulate the problem.
- Describe the background of the problem.
- Assess the needs of stakeholders.
- Make estimates like cost, risk, ROI etc., to justify the business opportunity.
- Describe the industry standards and procedures.
- Predict the business opportunity.
- Suggest system implications.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√						√		√
2.	√								√
3.			√		√			√	
4.			√	√			√		
5.			√	√			√		√
6.					√		√		
7.					√	√			√

SE5072   **FUNDAMENTALS OF MACHINE LEARNING**   **L T P C**
                                                                                                          3 0 2 4

OBJECTIVES:
- 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 I   INTRODUCTION   **8+6**
Machine Learning– Machine Learning Process- Preliminaries for Machine Learning algorithms –
Turning data into Probabilities and Statistics for Machine Learning- Probability theory –
Probability Distributions – Decision Theory.

Attested

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UNIT II   SUPERVISED LEARNING   10+6

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 – Deriving Back Propagation - Support Vector Machines.

UNIT III   UNSUPERVISED LEARNING   9+6

Clustering- K-means – EM Algorithm- Mixtures of Gaussians – Dimensionality Reduction – Linear Discriminant Analysis - Principal Components Analysis – Locally Linear Embedding – Isomap

UNIT IV   PROBABILISTIC GRAPHICAL MODELS   9+6

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).

UNIT V   ADVANCED LEARNING   9+6
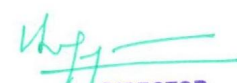
Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

TOTAL : 45+30 :75 PERIODS

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

- Design a learning model appropriate to the application.
- Design a Neural Network for an application of your choice.
- Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Design and implement an HMM for a Sequence Model type of application.
- Identify applications suitable for different types of Machine Learning with suitable justification.

REFERENCES:
1. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman and Hall, CRC Press, Second Edition, 2014.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
5. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.

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CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√	√	√	√	√	√
2.	√		√	√	√	√	√	√	√
3.	√		√	√		√	√	√	
4.	√		√	√					√
5.	√		√	√		√	√	√	√
6.	√		√	√		√	√	√	√

CP5073 **CLOUD COMPUTING TECHNOLOGIES** **LT P C**
3 0 2 4

OBJECTIVES:
- 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 I **INTRODUCTION** **9+6**

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.

UNIT II **VIRTUALIZATION** **9+6**

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

UNIT III **CLOUD COMPUTING MECHANISM** **9+6**

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

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UNIT IV HADOOP AND MAP REDUCE 9+6

Apache Hadoop – HadoopMapReduce –Hadoop Distributed File System- Hadoop I/O-Developing a MapReduce Application – MapReduce Types and Formats – MapReduce Features– Hadoop Cluster Setup –Administering Hadoop.

UNIT V SECURITY IN THE CLOUD 9+6

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.

TOTAL: 45 +30 :75 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Identify the architecture, infrastructure and delivery models of cloud computing.
- Explain the core issues of cloud computing such as security, privacy and interoperability.
- Choose the appropriate technologies, algorithms and approaches for the related issues.
- Facilitate Service Level Agreements (SLA).

REFERENCES:
1. Thomas Erl, ZaighamMahood, Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, 2013.
2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata McGraw-Hill,2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach",Tata McGraw-Hill Edition, 2010.
4. ArshdeepBahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press(India) Private Limited, 2014.
5. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
6. James E Smith and Ravi Nair, "Virtual Machines", Elsevier, 2005.
7. John Ritting house& James Ransome, Cloud Computing, Implementation,Management and Strategy, CRC Press, 2010.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√			√	√	
2.	√		√	√			√	√	
3.	√		√	√			√	√	
4.	√		√	√		√	√	√	
5.	√		√	√		√	√	√	√

CP5080   **ETHICAL HACKING**   **L T P C**
                                                                     3 0 2 4

OBJECTIVES:

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing.

UNIT I   INTRODUCTION TO HACKING   9+6

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

UNIT II   SCANNING AND ENUMERATION   9+6

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

UNIT III   SYSTEM HACKING   9+6

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing –
Password Cracking Tools – Password Cracking Countermeasures – Escalating Privileges –
Executing Applications – Keyloggers and Spyware

UNIT IV   PROGRAMMING FOR SECURITY PROFESSIONALS   9+6

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

UNIT V   PENETRATION TESTING   9+6

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

                                                    TOTAL: 45+30:75 PERIODS

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

- Identify threats to computers.
- Defend hacking attacks.
- Protect data assets.
- Defend a computer against a variety of security attacks using various tools.
- Practice and use safe techniques on the World Wide Web.

REFERENCES:
1. EC-Council, "Ethical Hacking and Countermeasures: Attack Phases", Cengage Learning, 2010.
2. Jon Erickson, "Hacking, 2nd Edition: The Art of Exploitation", No Starch Press Inc., 2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning, 2013.
4. Patrick Engebretson, "The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy", Second Edition, Elsevier, 2013.
5. RafayBoloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2014.

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CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√			√	√	
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CP5085   **PRINCIPLES OF CRYPTOGRAPHY**   **L T P C**
                                                          3 0 2 4

OBJECTIVES:

- To understand the mathematical foundations of security principles.
- To appreciate the different aspects of encryption techniques.
- To understand various attacks present over encryption and authentications techniques.
- To understand the role played by authentication in security.
- To appreciate the current trends of security practices.

UNIT I   CLASSICAL ENCRYPTION AND BLOCKCIPHERS   9+6
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.

UNIT II   PSEUDO- RANDOM FUNCTIONS AND SYMMETRIC ENCRYPTION   9+6
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.

UNIT III   HASH FUNCTIONS AND MESSAGE AUTHENTICATION   9+6
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.

UNIT IV   NUMBER THEORY AND ASYMMETRIC ENCRYPTION   9+6
Computational Number Theory – Number Theoretic Primitives – Diffie Hellman Problem – Asymmetric Encryption Schemes – Hybrid Encryption – ElGamal Scheme and its Variants – Homomorphic Encryption – Digital Signatures

UNIT V   SECURITY PRACTICES AND ADVANCED TOPICS   9+6
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

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TOTAL : 45 +30: 75 PERIODS

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

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

REFERENCES:
1. MihirBellare and Phillip Rogaway, "Introduction to Modern Cryptography", 2005.
2. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", Chapman and all/CRC Press Second Edition,2015.
3. Hans Delfts and Helmut Knebl, "Introduction to Cryptography – Principles and Applications", Springer, Third Edition by,2015.

CO	PO						PSO		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1.	√		√				√	√	
2.	√		√	√			√	√	
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5.	√		√	√			√	√	√

CP5083 **INTERNET OF THINGS** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the different architectures for IoT.
- To learn various protocols at the different layers for IoT.
- To develop prototype systems using Arduino / Rasberry Pi.
- To apply the use of data analytics in IoT.
- To develop applications of IoT in Industrial contexts.

UNIT I   ARCHITECTURES AND MODELS   9+6
Introduction to IoT – IoT Architectures – Core IoT Functional Stack, Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer – IoT Data Management and Compute Stack, Fog Computing, Edge Computing, Cloud Computing – Sensors, Actuators, Smart Objects, Sensor networks.

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UNIT II   CONNECTIVITY   9+6

Communications Criteria – Access Technologies – IP as IoT Network Layer – Business case – Optimization – Profiles and compliances – Application Protocols – Transport Layer – Application Transport Methods.

UNIT III   SYSTEM DEVELOPMENT   9+6

Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

UNIT IV   DATA ANALYTICS AND IoT SECURITY   9+6

Data Analytics for IoT – Big Data Analytics Tools and Technology – Edge Streaming Analytics – Network Analytics Applications. Security history, challenges, variations – Risk Analysis Structures – Application in Operational Environment.

UNIT V   IoT IN INDUSTRY   9+6

Manufacturing, Architecture, Protocols – Utilities, Grid Blocks - Smart Cities, Architecture, Use cases – Transportation, Architecture, Use cases.
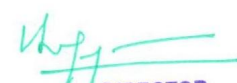
TOTAL: 45+30: 75 PERIODS

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

- Explain the underlying architectures and models in IoT.
- Analyse different connectivity technologies for IoT.
- Develop simple applications using Arduino / Raspberry Pi.
- Apply data analytics techniques to IoT.
- Study the needs and suggest appropriate solutions for Industrial applications.

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. Michael Miller, "The Internet of Things", Pearson Education, 2015.
4. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
5. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

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1.	√		√					√	
2.	√		√	√				√	√
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5.	√		√	√		√			√

CP5089 **WEB CONTENT DESIGN AND MANAGEMENT** **L T P C**
3 0 2 4

OBJECTIVES:

- Understand the design principles and interaction.
- To explore the detailed design practices, standards.
- To gain an insight into Content Management System for content design.
- To use any Content Management System tool for better content management.
- To get familiarized with Web Analytics for better management.

UNIT I   PRINCIPLES OF WEB DESIGN   9+6
User Centered Design, Web Medium, Information Architectures, Site Types and Architectures, Page Structure, Site Maps, Navigation, Search, Web Design Process, Designing for Multiple Screen Resolutions, Creating a Unified Site Design, Evaluating Web Sites.

UNIT II   ELEMENTS OF PAGE DESIGN   9+6
Elements of Page Design, Adding Styles With CSS, Pages and Layout, Typography, Color, Images, GUI Widgets And Forms, Responsive Web Designs, User Input Forms, Working With Data Tables, Web Standards and Styles.

UNIT III   WEB CONTENT DESIGN   9+6
Features – Automated Templates – Template Processor – Front Controller Pattern – Content Modeling – Content Aggregation – Plug-Ins – Search Engine Optimization – Recommended Usage of Tools – WORDPRESS

UNIT IV   WEB CONTENT MANAGEMENT   9+6
Work Flow Management – Document Management – Collaboration – Versioning – Recommended Usage of Tools – WORDPRESS

UNIT V   WEB ANALYTICS   9+6
Web Analytics Process – Data Collection – Qualitative Analysis – Log File Analysis – Page Tagging – Hybrid Methods – Click Analytics – Onsite and Offsite Analytics – Web Analytics Methods

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TOTAL : 45+60:75 PERIODS

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OUTCOMES:
Upon completion of the course, the student will be able to
- Design web pages that follow standards and are usable.
- Design web sites that are appealing.
- To be able to use Content management System for designing web Content.
- To take advantage of Content Management System tools for managing content for large web sites.
- To be able to use analytics tools for better management.

REFERENCES:
1. Patrich J. Lynch, Sarah Horton, "Web Style Guide-Foundations of User ExperienceDesign", Yale University Press, 4th Edition, 2016.
2. Thomas A. Powell, "The Complete Reference– Web Design", Tata McGraw Hill,Second Edition, 2003.
3. Joel Sklar, "Principles of Web Design, Cengage Learning", Web Warrior Series, 6th Edition,2015.
4. Deane Barker, "Web Content management-Systems, Features and Best Practices", O'reilly Media, 1st Edition, 2016.
5. Brian Clifton, "Advanced web Metrics with Google Analytics", Third Edition, Sybex Publishers, 2012.
6. AvinashKaushik, "Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity", 1st edition, Sybex publishers, 2009.

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1.	√	√	√	√			√	√	
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SE5076   **SOFTWARE TESTING AND QUALITY ASSURANCE**   **L T P C**
                                                                        3 0 2 4

OBJECTIVES:
The student should be able to
- Know what is software and the usage of different types of softwares.
- Know the Quality Metrics of various Softwares.
- Know the methodologies used in developing Software.
- Test the product finally to check the product Quality.

UNIT I   INTRODUCTION   9+6
Introduction to Software Quality – Challenges – Objectives – Quality Factors – Components of SQA – Contract Review – Development and Quality Plans – SQA Components in Project Life Cycle – SQA Defect Removal Policies – Reviews.

UNIT II   TESTING METHODOLOGIES   9+6
Basics of Software Testing – Test Generation from Requirements – Finite State Models – Combinatorial Designs – Test Selection, Minimization and Prioritization for Regression Testing – Test Adequacy, Assessment and Enhancement.

UNIT III   TEST STRATEGIES   9+6
Testing Strategies – White Box and Black Box Approach – Integration Testing – System and Acceptance Testing – Performance Testing – Regression Testing – Internationalization Testing – Ad-hoc Testing – Website Testing – Usability Testing – Accessibility Testing.

UNIT IV   TEST AUTOMATION AND MANAGEMENT   9+6
Test plan – Management – Execution and Reporting – Software Test Automation – Automated Testing tools – Hierarchical Models of Software Quality – Configuration Management – Documentation Control.

UNIT V   SQA IN PROJECT MANAGEMENT   9+6
Project progress control – costs – quality management standards – project process standards – management and its role in SQA – SQA unit.

TOTAL: 45+30:75 PERIODS

OUTCOMES
Upon completion of the course, the student will be able to
- Develop Quality plans and use SQA components in project life cycle.
- Analyze the product Quality.
- Judge the use of infrastructure components and use configuration items for Quality control.
- Use various testing methods and verify.
- Assess Quality standards of various software products.

REFERENCES
1. Daniel Galin, "Software Quality Assurance – from Theory to Implementation" Pearson Education, 2009
2. Yogesh Singh, "Software Testing", Cambridge University Press, 2012
3. AdityaMathur, "Foundations of Software Testing", Pearson Education, 2008
4. Ron Patton, "Software Testing" , Second Edition, Pearson Education, 2007
5. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006
6. Alan C Gillies, "Software Quality Theory and Management", Cengage Learning, Second Edition, 2003.
7. Robert Furtell, Donald Shafer, and Linda Shafer, "Quality Software Project Management", Pearson Education Asia, 2002.

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	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1.	√	√		√		√	√		√
2.	√		√			√			√
3.	√		√	√		√	√	√	
4.	√		√	√					√
5.	√		√	√				√	

IF5076   **DEEP LEARNING**   **L T P C**
                                                                     3 0 2 4

OBJECTIVES:

- To understand the basic ideas and principles of Neural Networks
- To understand the basic concepts of Big Data and Statistical Data Analysis
- To familiarize the student with The Image Processing facilities like Tensorflow and Keras
- To appreciate the use of Deep Learning Applications
- To understand and implement Deep Learning Architectures

UNIT I   BASICS OF NEURAL NETWORKS   9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

Suggested Activities:
- Discussion of role of Neural Networks.
- External learning – Boltzmann Machine and Perceptron.
- Practical – Installation of TensorFlow and Keras.

Suggested Evaluation Methods:
- Tutorial – Perceptron.
- Assignment problems on backpropagation networks.
- Quizzes on Neural Networks.

UNIT II   INTRODUCTION TO DEEP LEARNING   9

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.

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.

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Suggested Evaluation Methods
- Tutorial – Gradient descent in deep learning.
- Assignment problems in optimization.
- Quizzes on deep learning regularization and optimization.

UNIT III   CONVOLUTIONAL NEURAL NETWORKS   9
CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning

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.

UNIT IV   MORE DEEP LEARNING ARCHITECTURES   9
LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial 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.

UNIT V   APPLICATIONS OF DEEP LEARNING   9
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 Generation with LSTMs.

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.

PRACTICAL EXERCISES:
1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.
8. Implement a SimpleLSTM using TensorFlow/Keras.

9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN.
11. Mini Project

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:
1. Understand the role of Deep learning in Machine Learning Applications.
2. To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.
3. To design and implement Deep Learning Applications.
4. Critically Analyse Different Deep Learning Models in Image Related Projects.
5. To design and implement Convolutional Neural Networks.
6. To know about applications of Deep Learning in NLP and Image Processing.

REFERENCES:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.
3. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress , 2017.
4. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
5. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
6. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.

CO	PO						PSO		
	1	2	3	4	5	6	**1**	**2**	**3**
1.	√		√				√		√
2.	√		√	√			√		
3.	√		√	√		√	√		√
4.	√		√	√			√		√
5.		√	√	√			√		√
6.		√	√	√		√	√		√

IF5090   **SEMANTIC WEB**   **L T P C**
                                                            3 0 2 4

OBJECTIVES:

- To learn the fundamentals of semantic web and to conceptualize and depict Ontology for semantic web.
- To understand the languages for semantic web.
- To learn about the ontology learning algorithms and to utilize in the development of an application.
- To know the fundamental concepts of ontology management.
- To learn the applications related to semantic web.

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UNIT I THE QUEST FOR SEMANTICS 9

Building Models – Calculating with Knowledge – Exchanging Information – Semantic Web Technologies – Layers – Architecture – Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background – Sample Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation.

Suggested Activities:
- Flipped classroom on semantic web background and tutorial activity in class.
- Brainstorming session on various knowledge representation formats in class.

Suggested Evaluation Methods:
- Tutorial – Semantic web basics.
- Quizzes on knowledge representation formats.

UNIT II LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES 9

Web Documents in XML – RDF – Schema – Web Resource Description using RDF – RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics – Traditional Ontology Languages – LOOM – OKBC – OCML – Flogic Ontology Markup Languages – SHOE – OIL – DAML+OIL – OWL.

Suggested Activities:
- Flipped classroom on comparison of various semantic web related languages and tutorial activity in class.

Suggested Evaluation Methods:
- Quizzes on various ontology related languages.

UNIT III ONTOLOGY LEARNING FOR SEMANTIC WEB 9

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning –Importing and Processing Ontologies and Documents – Ontology Learning Algorithms –Methods for evaluating Ontologies.

Suggested Activities:
- Flipped classroom on natural language processing techniques like statistical text analysis, term extraction, Word sense disambiguation, concept extraction and tutorial activity in class.
- External reading – https://nlp.stanford.edu/fsnlp/

Suggested Evaluation Methods
- Tutorials – Language processing techniques.

UNIT IV ONTOLOGY MANAGEMENT AND TOOLS 9

Overview – Need for management – Development process – Target Ontology – Ontology mapping – Skills management system – Ontological class – Constraints – Issues – Evolution –Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.

Suggested Activities:
- Flipped classroom on study of various ontology related tools.

Suggested Evaluation Methods
- Tutorials – Ontology related tools like Protege, Ontolingua, Webonto.

UNIT V   APPLICATIONS   9

Web Services – Semantic Web Services – Case Study for specific domain – Security issues – Web Data Exchange and Syndication – Semantic Wikis – Semantic Portals – Semantic Metadata in Data Formats – Semantic Web in Life Sciences – Ontologies for Standardizations – Rule Interchange Format.

Suggested Activities:
- Flipped classroom on other applications of semantic web.

Suggested Evaluation Methods
- Quizzes on semantic web applications.

PRACTICAL EXERCISES: 30
1. Design of simple ontology on their domain of interest using Protege like tool.
2. Create RDF document using PHP library EasyRdf.
3. Use OWL language to represent relationships, properties and to provide inferences from created ontology.
4. Term extraction and Term disambiguation from corpus using Alchemy like API.
5. Use of any tool to apply SAPRQL queries and implement reasoning for avoiding inconsistencies.
6. Exercises on Merging two ontologies, Applying association rules and Applying clustering algorithms.
7. Development of Simple application like chat bot, semantic search engine creation using Topic map data models extracted from Ontopia/Mappa.
8. Creating intelligent expert systems using semantic Wikis like SMW+.

TOTAL: 75 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
1. Create ontology for a given domain.
2. Develop an application using ontology languages and tools.
3. Understand the concepts of semantic Web.
4. Use ontology related tools and technologies for application creation.
5. Design and develop applications using semantic web.
6. Understand the standards related to semantic web.

REFERENCES:
1. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, "Foundations of Semantic Web Technologies", Chapman & Hall/CRC, 2009.
2. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez, "Ontological Engineering: with Examples from the Areas of Knowledge Management, e-Commerce and the Semantic Web", Springer, 2004.
3. Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer (Cooperative Information Systems)", MIT Press, 2004.
4. Alexander Maedche, "Ontology Learning for the Semantic Web", First Edition, Springer. 2002.
5. John Davies, Dieter Fensel, Frank Van Harmelen, "Towards the Semantic Web: Ontology Driven Knowledge Management", John Wiley, 2003.
6. John Davies, Rudi Studer, Paul Warren, (Editor), "Semantic Web Technologies: Trends and Research in Ontology-Based Systems", Wiley, 2006.

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	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	1	1
CO2	3	1	2	3	3	1
CO3	2	2	2	3	1	1
CO4	3	1	2	3	3	2
CO5	3	1	2	3	3	2
CO6	2	2	1	2	2	3
Overall	3	1	2	3	3	2

IF5088   **MOBILE APPLICATION DEVELOPMENT**   **L T P C**
                                                                             3 0 2 4

OBJECTIVES:
- To understand the need and characteristics of mobile applications.
- To design the right user interface for mobile application.
- To understand the design issues in the development of mobile applications.
- To understand the development procedures for mobile application.
- To develop mobile applications using various tools and platforms.

UNIT I   INTRODUCTION   9
Mobile applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Device Profiles – Frameworks and Tools.

Suggested Activities:
- Flipped classroom on survey on mobile application models.
- External learning - mobile application design using frameworks and tools.

Suggested Evaluation Methods:
- Quiz - questionnaire related to mobile application models.
- Assignment - evaluate using learning content management system like Moodle.

UNIT II   USER INTERFACE   9
Generic UI development – Designing the right UI – Multimodal and Multichannel UI – Gesture based UI – Screen Elements and Layouts – Voice XML.

Suggested Activities:
- Flipped classroom on discussion on UI for mobile application like voice and gestures.
- External learning - survey on different view elements for mobile application.

Suggested Evaluation Methods:
- Quiz - questionnaire related to user interface design for mobile applications.
- Assignment - evaluate using learning content management system like Moodle.

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UNIT III   APPLICATION DESIGN   9
Memory Management – Design Patterns for Limited Memory – Work Flow for Application Development – Java API – Dynamic Linking – Plug-ins and Rule of Thumb for using DLLs – Concurrency and Resource Management.

Suggested Activities:
- Flipped classroom on discussion on memory constraints for mobile application design.
- External learning - survey on resource management and concurrent operations.

Suggested Evaluation Methods:
- Quiz - questionnaire related to memory constraints in design for mobile applications.
- Assignment - evaluate using learning content management system like Moodle.

UNIT IV   APPLICATION DEVELOPMENT I   9
Mobile OS: Android, iOS – Android Application Architecture – Android basic Components – Intents and Services – Storing and Retrieving data – Packaging and Deployment – Security and Hacking.

Suggested Activities:
- Simple Android application development like user account creation.
- Android application accessing the mobile database to view user data.

Suggested Evaluation Methods:
- Evaluation based on the demonstrated application functionality using emulators.

UNIT V   APPLICATION DEVELOPMENT II   9
Communication via the Web – Notification and Alarms – Graphics and Multimedia: Layer Animation, Event Handling and Graphics Services – Telephony – Location Based Services.

Suggested Activities:
- Application accessing Internet for communication like web application.
- Android application accessing GPS for location based service.

Suggested Evaluation Methods:
- Evaluation based on the demonstrated application functionality using emulators.

PRACTICAL EXERCISES: 30
1. Develop an application that uses GUI components, Font and Colours.
2. Develop an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Write an application that draws basic graphical primitives on the screen.
5. Develop an application that makes use of database.
6. Write an application that makes use of internet for communication (mobile web app).
7. Develop a native application that uses GPS location information.
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message.
10. Write a mobile application that creates alarm clock.

TOTAL: 75 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
1. Design the right user interface for mobile application.
2. Implement mobile application using UI toolkits and frameworks.
3. Design a mobile application that is aware of the resource constraints of mobile devices.
4. Develop web based mobile application that accesses internet and location data.
5. Implement android application to use telephony for SMS communication.
6. Implement android application with multimedia support.

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REFERENCES:
1. Reto Meier, "Professional Android 4 Application Development", Wiley, 2012.
2. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, "Programming Android", O'Reilly, 2011.
3. Alasdair Allan, "iPhone Programming", O'Reilly, 2010.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	1
CO2	3	3	3	3	3	3
CO3	3	3	3	1	3	1
CO4	3	3	3	3	1	1
CO5	3	3	3	1	3	3
CO6	3	3	3	3	3	3

CP5075   **CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES**   **L T P C**
                                                                  3 0 0 3

OBJECTIVES:
- To study the basic concepts of crytocurrencies and blockchains.
- To explain the details of Bitcoin and its different components.
- To study the basics Hyperledger and Web3.
- To analyse the position of Web 3 and Hyperledger with different aspects of blockchain technologies.
- To differentiate between alternate blockchains and their advantages in application areas.
- To understand the Ethereum development environment and the application development process.

UNIT I   INTRODUCTION   9
Cryptographic hash functions - hash pointers - digital signatures - public keys as identities - an example cryptocurrency. Bitcoin, history of blockchain and Bitcoin - Types of Blockchain - Consensus - Decentralization.

UNIT II   BITCOIN   9
Bitcoin – Digital Keys and Addresses – Transactions, life cycle, data structure, types – Structure of the blockchain - Mining – Bitcoin Networks and Payments - Wallets - Alternative coins - Smart Contracts - Definition - Recardian contracts.

UNIT III   WEB3 AND HYPERLEDGER   9
Web 3 Contract development - POST requests - Frontend - Development framework - Hyperledger Projects - Protocol - Reference architecture - Hyperledger Fabric - Corda.

UNIT IV   ALTERNATIVE BLOCKCHAINS AND APPLICATIONS   9
Alternative blockchains - Applications, Internet of Things, Government, Health, Finance - Scaleability - Privacy.

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UNIT V   ETHEREUM   9

Setting up Ethereum development tools - Solidity language. - Ethereum accounts, key pairs, working with Externally Owned Accounts (EOA), contract accounts - Smart contracts, structure, setting up and interaction, examples - Decentralised applications, implementation, case studies - Whisper protocol - Swarm architecture and concepts.

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

- Explain cryptocurrencies and their relationship with the blockchain technology.
- Explain the different steps in the use of Bitcoins.
- Relate Web 3 and Hyperledger to concepts in blockchain technologies.
- Apply blockchains to different real-life problems
- Implement a simple application using Ethereum.

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016.
3. Arshdeep Bahga and Vijay Madisetti, "Blockchain Applications : A Hands-On Approach", 2017
4. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly Publishing, 2014.
5. Roger Wattenhofer, "The Science of the Blockchain" Create Space Independent Publishing Platform, 2016.
6. Alex Leverington, "Ethereum Programming" Packt Publishing Limited, 2017.

CO	PO						PSO		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1.	√		√				√	√	
2.	√		√				√	√	
3.	√		√				√	√	
4.	√		√	√			√	√	√
5.	√		√	√			√	√	√

SE5071   MULTIMEDIA SYSTEMS AND APPLICATIONS   LT P C
3 0 2 4

OBJECTIVES:

- To enrich student learning in Multimedia systems basics
- To train the students to acquire knowledge in multimedia Tools and authoring
- To acquire knowledge about multimedia data compression techniques
- To acquire knowledge in the area of multimedia communication systems
- To know about popular multimedia application areas

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UNIT I MULTIMEDIA ELEMENTS   9+6

Principles – Cognition, Learning, Interaction, Medium of Consumption: Elements - Text – characteristics, standards, formats; Graphics – representation, file formats, Image / Graphics – file formats, standards; Digital Audio – Characteristics, formats, standards, Speech, Video – characteristics, formats; Animation – characteristics, formats; , Multidimensional Data Structures, k-d trees, Quad Trees, R-trees.

UNIT II MULTIMEDIA TOOLS and AUTHORING   9+6

Hardware – Display Devices, wearables, Graphics cards, I/O devices, software – Editing tools for Text, Image, Audio, Video and animation. Authoring tools, Authoring Multimedia presentations, Authoring Metaphors.

UNIT III MULTIMEDIA COMPRESSION   9+6

Symmetric and Asymmetric methods, Lossy and Lossless Compression, Text compression – RLE, Huffman, Arithmetic, Dictionary based; Document Image compression standards - CCITTand Color Image Compression - JPEG, Audio Compression – PCM, ADPCM, MPEG, AAC, AC3, speech compression; Video Compression-MPEG-4, H.265, DVI

UNIT IV MULTIMEDIA COMMUNICATION SYSTEMS   9+6

Multimedia Communication Standards, Transport Protocols, streaming protocols, Internet Protocols Wireless multimedia communications, synchronization and QOS, security, Entertainment networks, Collaborative multimedia support, Real-time distributed multimedia networks, Hypertext, Hypermedia.

UNIT V MULTIMEDIA APPLICATIONS   9+6

Applications for WWW.Multimedia databases – Indexing and Retrieval, Visualization, Virtual, Augmented and Mixed Reality, Interactive E-learning, HCI and UX design, Games and Animation, Real-Time video conferencing.
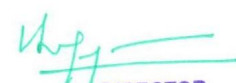
PRACTICAL EXERCISES:

1. Editing various images (Image restoration, Changing colour image to Grey scale and vice versa) and adding special effects to images using tools like Photoshop, Gimp and flash
2. Creating and Editing various video clippings and adding special effects using tools like Adobe Premier Pro
3. Creating and Editing various audio files and adding special effects using tools like SoundForge and Audacity
4. Creating three dimensional models and animations using tools like Blender, 3DS Max, Unity
5. Working on Text compression algorithms like Run length and Huffman
6. Implementation of transformations like DCT and FFT
    Designing User Interfaces and developing simple games using multimedia tools
7. Creating simple multimedia applications using any popular Authoring tools
8. Mini Project(4 Periods)

OUTCOMES:
On Completion of the course, the students should be able to:
- Handle the multimedia elements effectively
- Use Multimedia Hardware and Software for Editing and Authoring
- Implement Compression algorithms for various multimedia applications
- Develop effective strategies to deliver Quality-of-Experience in networked Multimedia applications
- Design and develop multimedia applications in various domains

TOTAL: 75 PERIODS

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TEXTBOOKS:

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, "Fundamentals of Multimedia", Second Edition, Springer Nature (Texts in Computer Science), 2014.
2. Prabhat K. Andleigh, KiranThakrar, "Multimedia Systems Design", Pearson Education India, Ist Edition, 2015
3. Ralf Steinmetz and KlaraNahrstedt, "Multimedia computing, communications, and applications", Pearson India, Pearson, 2002.

REFERENCES:

1. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education, 2002.
2. Khalid Sayood, "Introduction to Data Compression", 4th Edition, Morgan Kauffman, 2012.
3. K.R. Rao, Zoran S. Bojkovic, Bojan M. Bakmaz, " Wireless Multimedia Communication systems: Design, Analysis and Implementation", CRC press, 2017.
4. V.S. Subrahmanian, "Principles of Multimedia Database Systems", Elsevier / Morgan Kauffmann, 2008.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√				√	√	
2.	√	√	√	√			√	√	
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CP5082   **INFORMATION RETRIEVAL TECHNIQUES**   **L T P C**
                                                                              3 0 0 3
OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search.
- To learn measuring effectiveness and efficiency of information retrieval techniques.
- To get used to performing Parallel Information Retrieval.
- To understand the concepts of digital libraries.

UNIT I   INTRODUCTION   9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems – History of Web Search – Web Characteristics – The impact of the web on IR – IR Versus Web Search – Components of a Search engine

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UNIT II   RETRIEVAL MODELING   9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III   INDEXING   9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV   EVALUATION AND PARALLEL INFORMATION RETRIEVAL   9

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect - Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria – QueueingTheory – Query Scheduling – Parallel Information Retrieval - Parallel Query Processing – Map Reduce

UNIT V   SEARCHING THE WEB   9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Build an Information Retrieval system using the available tools.
- Identify and design the various components of an Information Retrieval system.
- Measure effectiveness and efficiency of information retrieval techniques.
- Use parallel Information Retrieval approaches in real world problems.
- Design an efficient search engine and analyze the Web content structure.

REFERENCES:

1. Ricardo Baeza – Yates, BerthierRibeiro – Neto, "Modern Information Retrieval: The Concepts and Technology behind Search" (ACM Press Books), Second Edition, 2011.
2. Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, "Introduction to Information Retrieval", Cambridge University Press, First South Asian Edition, 2008.
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval Implementing and Evaluating Search Engines", The MIT Press, Cambridge, Massachusetts London, England, 2010.

CO	PO						PSO		
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1.	√		√	√			√	√	
2.	√		√				√	√	
3.	√		√				√	√	
4.	√		√	√		√	√	√	√
5.	√		√	√			√	√	√

CP5076	CYBER SECURITY	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the nature of threats and cyber security management goals and technology
- To understand the landscape of hacking and perimeter defense mechanisms
- To develop strategies for cyber security and protecting critical infrastructure
- To understand policies to mitigate cyber risks
- To understand the IT Act, scheme, amendments and emerging cyber law and desired cyber ecosystem capabilities

UNIT I   OVERVIEW OF CYBER SECURITY   9
Introduction – Cyberspace – Cyber Crime – Nature of Threat – Cyber security – Policy, Mission and Vision of Cyber security Program. Cyber security management system – goals, technology categories – perimeter defense and encryption. Cyber security management framework.

UNIT II   ATTACKS AND COUNTERMEASURES   9
Malicious Attacks, Threats, and Vulnerabilities – Scope of cyber-attacks – Tools used to attack computer systems – security breach – Risks, vulnerabilities and threats. Malware – malicious software attack – social engineering attack – wireless network attack – web application attack – Countermeasures– Types of Network Security Devices –Firewalls, Intrusion Detection Systems, Content Filtering, Virtual Private Networks – Encryption

UNIT III   STRATEGIES FOR CYBER SECURITY   9
Creating a Secure Cyber, Types of Attacks, Comparison of Attacks, Creating an Assurance Framework, Encouraging Open Standards, Strengthening the Regulatory framework, Creating Mechanisms for IT Security, Securing E-Governance Services, and Protecting Critical Information Infrastructure. Areas for Intervention – Legal Responses – Harmonization of Legislation – Criminalization of Cyber Offences – National Security and issues related to Privacy and Freedom of Expression – Investigation Procedures – International Cooperation – Electronic Evidence – Liability of ISPs–Recommendations

UNIT IV   POLICIES TO MITIGATE CYBER RISK   8
Promotion of R&D in Cyber security – Reducing Supply Chain Risks – Mitigate Risks through Human Resource Development – Creating Cyber security Awareness– Information sharing – Implementing a Cyber security Framework. Signatures– Digital Signature, Electronic Signature

UNIT V   CRITICAL INFORMATION INFRASTRUCTURE PROTECTION   10
National Security – Information Sharing and Coordination – Innovation In Regulatory Approach – Innovation in Security Programs – Proactive Threat and Vulnerability Management – Promoting Best Practices in Critical Infrastructure Sectors – Assessing and Monitoring Security Preparedness of Sectors (Security Index) – Security in Information Technology Supply Chain – Taking Leadership and Participating in International Efforts – Capacity Building in Security Skills and training and Awareness. The Indian Cyberspace– Cyber Threats – Need for a Comprehensive Cyber Security Policy – Need for a Nodal Authority – Need for an International Convention on Cyberspace – Cyber War – Fifth Domain of Warfare – Meeting the Cyber Warfare Challenges.

TOTAL: 45 PERIODS

OUTCOMES:
- Gain knowledge on the nature of threats and cyber security management goals and framework
- Knowledge on the landscape of hacking and perimeter defense mechanisms
- Ability to differentiate and integrate strategies for cyber security and protecting critical infrastructure
- Able to understand policies to mitigate cyber risks
- Knowledge on IT Act, and amendments, copy rights, IPR and cyber law to deal with offenses.

REFERENCES:
1. David Kim and Michael G. Solomon, Fundamentals of Information Systems Security, Third Edition Transition Guide, Jones &Bartlett Learning, 2018.
2. Peter Trim and Yang - Im Lee, —Cyber Security Management- A Governance, Risk and Compliance Framework, Gower Publishing, England 2014.
3. Institute for Defence Studies and Analysis Report, India's Cyber Security Challenge, 2012 https://idsa.in/system/files/book/book_indiacybersecurity.pdf
4. John G. Voeller, Cyber Security, John Wiley & Sons, England, 2014.
5. Carol C. Woody, Nancy R. Mead, Cyber Security Engineering: A Practical Approach for Systems and Software Assurance, Addison-Wesley, 2016.
6. Edward Griffor, Handbook of System Safety and Security, Syngress an Elsevier Publications, 1st Edition, 2017.
7. Thomas A. Johnson Cyber Security- Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, CRC Press, 2015.
8. NIST Cyber security Framework, Version 1.0, 2014.
9. CGI, —Cyber security in Modern Critical Infrastructure Environments, 2014.
10. Stuart Broderick J, Cyber Security Program, Cisco Security Solutions, June 2016.

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	1	2	3	4	5	6	1	2	3
1.	√		√					√	
2.	√		√				√	√	
3.	√		√	√		√	√	√	√
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5.	√		√	√	√			√	√

SE5075	**SOFTWARE SECURITY**	**L T P C**
		3 0 0 3

OBJECTIVES:

- Know the importance and need of software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

UNIT I   LOW LEVEL ATTACKS   9
Need for Software Security – Memory Based Attacks – Low Level Attacks Against Heap And Stack - Stack Smashing – Format String Attacks – Stale Memory Access Attacks – ROP (Return Oriented Programming) – Malicious Computation Without Code Injection. Defense against Memory Based Attacks – Stack Canaries – Non-Executable Data - Address Space Layout Randomization (ASLR), Memory-Safety Enforcement, Control-Flow Integrity (CFI) – Randomization

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UNIT II   SECURE DESIGN   9

Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Generic Network Fault Injection – Local Fault Injection - SQL Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles - Good and Bad Software Design - Web Security- Browser Security: Cross-Site Scripting (XSS), Cross-Site Forgery (CSRF) – Database Security – File Security

UNIT III   SECURITY RISK MANAGEMENT   9

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation And Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

UNIT IV   SECURITY TESTING   9

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing with Threat Modeling – Shades of Analysis: White, Grey and Black Box Testing.

UNIT V   PENETRATION TESTING   9

Advanced Penetration Testing – Planning And Scoping – DNS Groper – DIG (Domain Information Graph) – Enumeration – Remote Exploitation – Web Application Exploitation - Exploits And Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Identify various vulnerabilities related to memory attack.
- Apply security principles in software development.
- Evaluate the extent of risks.
- Involve selection of testing techniques related to software security in testing phase of software development.
- Use tools for securing software.

REFERENCES:
1 Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2 Jon Erickson , "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3 Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4 Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5 Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
6 Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006
7 Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing, 2012

CO	PO						PSO		
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1.	√	√	√			√	√	√	
2.	√		√	√		√	√		√
3.	√		√	√		√	√	√	
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5.	√	√	√	√		√	√		√

CP5088   **USER INTERFACE DESIGN**   **L T P C**
                                                                              3 0 0 3

OBJECTIVES:

- To determine the necessity of user interaction by understanding usability engineering and user modeling.
- To learn the methodologies for designing interactive systems.
- To investigate the core and complex design issues for interaction.
- To examine the evaluation methodologies of design.
- To Understand design issues for web and mobile platforms.

UNIT I   INTRODUCTION   9
Context of Interaction –Ergonomics - Designing Interactive systems – Understanding Users-cognition and cognitive frame works, User Centred approaches - Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories

UNIT II   INTERACTION DESIGN   9
Universal design principles, guidelines, heuristics, HCI Patterns, Design Frame Works, Design Methods, Prototyping, Understanding Interaction Styles, Direct Manipulation and Immersive Environments, Fluid Navigation, Expressive Human and Command Languages, Communication and Collaboration.

UNIT III   DESIGN AND EVALUATION   9
Advancing the User Experience, Timely User Experience, Information Search, Data Visualization Evaluation Techniques- Assessing User Experience- Usability Testing – Heuristic Evaluation and Walkthroughs, Analytics Predictive Models.

UNIT IV   MODELS AND THEORIES   9
Cognitive Models, Socio-Organizational Issues And Stake Holder Requirements, Communication And Collaboration Modelstask Analysis, Dialog Notations and Design, Models of the System, Modeling Rich Interaction, Ubiquitous Computing

UNIT V   DESIGNING INTERACTIONS FOR WEB AND MOBILE PLATFORMS   9
Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions - Lookup patterns-Feedback Patterns, Mobile Apps, Mobile Navigation, Content and Control Idioms, Multi-Touch Gestures, Inter-App Integration, Mobile Web.

                                                              TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Understand the basics of human computer interactions via usability engineering and cognitive modeling.
- Understand the basic design paradigms, complex interaction styles.
- Understand the fundamental design issues.
- Examine the evaluate of interaction designs and implementations.
- Use models and theories for user interaction.
- Use above concepts for web and mobile applications.

REFERENCES:
1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Sixth Edition, Pearson Education, 2016.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, "Interaction Design: Beyond Human Computer Interaction", Wiley Student Edition, 4th Edition, Wiley, 2015.
3. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Pearson Education, 2004.
4. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4th Edition, Wiley, 2014.
5. Donald A. Norman, "Design of Everyday Things", MIT Press, 2013.
6. Cameron Banga, Josh Weinhold, "Essential Mobile Interaction Design: Perfecting Interface Design in Mobile Apps", Addison-Wesley Professional, 1 edition, 2014.
7. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009.
8. Steven Hoober, Eric Berkman, "Designing Mobile Interfaces Patterns for Interaction Design", O'Reilly, 2011.

CO	PO						PSO		
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1.	√		√				√	√	
2.	√		√				√	√	
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4.	√	√	√	√			√	√	
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6.	√	√	√	√		√	√	√	√

SE5001   **INTEGRATED SOFTWARE PROJECT MANAGEMENT**   **L T P C**
                                                                                                   3 0 0 3

OBJECTIVES:

- Understand the basic concept of project management.
- Learn the various costing and life cycle management.
- Understand the role played by risk in software project.
- Appreciate the use of metrics for software project management.
- Know the challenges in people management.

UNIT I   PROJECT MANAGEMENT & COSTING   9

Software Project Management approaches – Project Acquisition – Initiation – Planning – PERT-Execution and Control – CPM – Change Management – Project Closure – Agile SPM Problems in Software Estimation – Algorithmic Cost Estimation Process, Function Points, COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.

UNIT II   PROCESS MODELS & LIFECYCLE MANAGEMENT   9

Software Engineering Process Models - Adaptive Software Development (ASD) - DSDM – SCRUM– Crystal -Feature Driven Development (FDD)–SPICE – SIX SIGMA – CMMI, SLIM (Software Life cycle Management) – PLM (Product Lifecycle Management) – PDM (Product Data Management) - PLM, PDM Applications – Pre-PLM Environment – Change Management.

UNIT III   RISK MANAGEMENT   9

Perspectives of Risk Management - Risk Definition – Risk Categories – Risk Assessment: Approaches, techniques and good practices – Risk Identification / Analysis / Prioritization – Risk Control (Planning / Resolution / Monitoring) – Risk Retention – Risk Transfer - Failure Mode and Effects Analysis (FMEA) – Operational Risks – Supply Chain Risk Management.

UNITIV   METRICS   9

Need for Software Metrics – scope – basics – framework for software measurement - Classification of Software Metrics: Product Metrics (Size Metrics, Complexity Metrics, Halstead_s Product Metrics, Quality Metrics), and Process metrics (Empirical Models, Statistical Models, Theory-basedModels,CompositeModels,andReliabilityModels)–measuringinternalandexternal product attributes.

UNIT V   PEOPLE MANAGEMENT   9

Leadership styles – Developing Leadership skills – Leadership assessment – Motivating People – Organizational strategy – Management – Team building – Delegation – Art of Interviewing People - Team Management – Rewarding - Client Relationship Management.

                                                                                                   TOTAL: 45 PERIODS

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

- Identify the various elements of software management process framework.
- Use available open source estimation tools for cost estimation.
- Identify existing risk and perform risk assessment.
- Design a software metric for software project management.
- Modify the art of interviewing people for a given scenario.

REFERENCES:

1. BobHughes, Mike Cotterell, "Software Project Management", Fifth edition, The McGraw –Hill Companies,2009.
2. PankajJalote, "Software Project Management in Practice", Eight Impression, Pearson Publication, 2009.
3. Robert K.Wysocki, "Effective Software Project Management", John Wiley and sons Publications, 2010.
4. MuraliChemuturi,ThomasM.Cagley,"MasteringSoftwareProjectManagement:Best Practices, Tools and Techniques", J. Ross Publishing,2010.
5. Richard E.(DICK) Fairley ,"Managing and Leading Software Projects", John Wiley and Sons Publications, 2009.

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√	√	√				√	√	
CO2	√		√	√			√		√
CO3	√			√		√	√	√	√
CO4	√	√	√	√		√	√	√	√
CO5	√	√	√			√	√		

SE5074 **SOFTWARE RELIABILITY METRICS AND MODELS** **L T P C**
3 0 0 3

OBJECTIVES

The student should be able to
- Learn different definitions of software quality
- Know different notions of defects and classify them
- Understand the basic techniques of data collection and how to apply them
- Learn software metrics that define relevant metrics in a rigorous way.
- Gain confidence in ultra-high reliability

UNIT I INTRODUCTION TO SOFTWARE RELIABILITY 9

Basic concepts-Failure and faults – Environment – Software Reliability – Availability – Modelling - Requirement reliability metrics-Design and code reliability metrics-Testing reliability metrics -Model Selection – Execution Time component – calendar time component – calendar time to execution time relationship.

UNIT II SOFTWARE RELIABILITY MODELING 9

Reliability Concepts – Program – Environment and runs – Failure – Fault – General Model Characteristics – Historical development of Models –Model Classification scheme Markovian models-General poisson type models-Binomial type models-Poisson type models-Fault reduction factor for poisson type models.

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UNIT III   COMPARISON OF SOFTWARE RELIABILITY MODELS   9

Comparison of software reliability models - Comparison criteria – Failure data – comparison of predictive validity of model groups – Recommended models– Comparison of time domains - Calendar time modeling-Limiting resource concept-Resource usage model-Resource utilization-Calendar time estimation and confidence intervals.

UNIT IV   FUNDAMENTALS OF MEASUREMENT   9

Measurements in software engineering–Software metrics- Scope of software metrics–Cost and effort estimation-Productivity models and measures-Quality models and measures-Structural and complexity metrics- Measurements theory-Software measurement validation-Evaluation of methods and tools

UNIT V   MEASURING SOFTWARE PRODUCT   9

Classifying Software Measures – Product Metrics – Process Metrics – Project Metrics - Measurement of internal product attributes-External product attributes– Importance of internal attributes – Determining What to Measure– Goal-Question-Metric (GQM) paradigm - Measurement of quality – Software Reliabiltiy.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Perform some simple statistical analysis relevant to software measurement data.
- Use from practical examples both the benefits and limitations of software metrics for quality control and assurance

REFERENCES:
1. Norman Fenton, James Bieman, "Software Metrics: A Rigorous and Practical Approach", 3rd edition, CRC Press, 2015.

2. Michael R.Lyu, - Handbook of Software Reliability Engineering", IEEE Computer Society press & McGraw Hill, 1996.

3. John D. Musa, Anthony Iannino, KazuhiraOkumoto,"Software Reliability – Measurement,

4. Prediction, Application, Series in Software Engineering and Technology", McGraw Hill, 1987 John D. Musa, "Software Reliability Engineering", Tata McGraw Hill, 1999.

SE5002   SOFTWARE TEST AUTOMATION   L T P C
                                                        3 0 0 3
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OBJECTIVES:
- Understand the basics of test automation.

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- Appreciate the different aspects of test tool evaluation and test automation approach selection.
- Understand the role played by test planning and design in test execution.
- Appreciate the use of various testing tools for testing varied applications.
- Understand test automation using case studies.

UNIT I INTRODUCTION 9
Automated Testing – Background on software testing – Automated test life cycle methodology (ATLM) – Test Maturity Model – Test Automation Development – Overcoming false expectations of automated testing – benefits – Test tool proposal

UNIT II TEST FRAMEWORK AND AUTOMATION 9
Automated Test Tool Evaluation and selection – Organisation's system engineering environment – tools that support the testing life cycle – Test Tool Research – Hands-on Tool evaluation -Test process analysis – Test tool consideration – Selecting the test automation approach - Test team management – Organization Structure of a Test Team – Test Program Tasks – Test Effort Sizing

UNIT III TEST PLANNING AND DESIGN 9
Test planning – Test Program Scope – Test Requirements Management – Test Program Events, Activities and Documentation – Test Environment – Test Plan – Test Requirements Analysis – Test program design – Test Procedure Design – Test Development Architecture – Test Development Guidelines – Automation Infrastructure – Test Execution and Review – Executing and Evaluating Test Phases - Test Metrics -Test Bench Design and Evaluation

UNIT IV TESTING THE APPLICATIONS 9
Testing Web Applications – Functional Web testing with Twill – Selenium – Testing a simple Web Application – Testing Mobile Smartphone Applications – Running automated test scripts – Test tools for Browser based applications – Test Automation with Emulators – Test Results reporting – Test defect tracking and fixing.

UNIT V CASE STUDIES 9
Test Automation and Agile Project Management – Database Automation – Test Automation In Cloud – Mainframe and Framework Automation – Model Based Test Case Generation – Model Based Testing of Android Applications

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the student will be able to
- Identify the different test tools.
- Use available testing tools to test some software applications.
- Modify existing test metrics based on functionality or features used.
- Design test cases and execute them.
- Implement test scripts for automating test execution.

REFERENCES:
1. Elfriede Dustin, Jeff Rashka, " Automated software testing: Introduction, Management and Performance ", Pearson Education, 2008.
2. C. Titus Brown, Gheorghe Gheorghiu, Jason Huggins, " An Introduction to Testing Web Applications with twill and Selenium ", O'Reilly Media, Inc., 2007.
3. Dorothy Graham, Mark Fewster, "Experiences of Test Automation: Case Studies of Software Test Automation", illustrated Edition, Addison-Wesley Professional, 2012.
4. Julian Harty, "A Practical Guide to Testing Mobile Smartphone Applications", Vol. 6 of Synthesis Lectures on Mobile and Pervasive Computing Series‖, Morgan &Claypool Publishers, 2009.
5. Kanglin Li, Mengqi Wu, "Effective Software Test Automation: Developing an Automated Software Testing Tool", John Wiley & Sons, 2006.

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√			√		√	√		√
CO2	√	√		√	√	√	√	√	
CO3	√	√	√	√			√	√	√
CO4	√	√	√		√	√	√	√	√
CO5	√		√	√		√	√	√	√

SE5003   **SOFTWARE VERIFICATION AND VALIDATION**   **L T P C**
                                                                     3 0 0 3

OBJECTIVES:

- Understand the principles of verification and validation.
- Appreciate the different verification and validation techniques.
- Understand the various stages of testing.
- Appreciate the use of tools for verification and validation.
- Appreciate the benefits of using metrics for verification and validation.

UNIT I   INTRODUCTION   9
Principles Of Verification And Validation – Software Architecture Frameworks – Model Driven Architecture – UML – Systems Modeling Language – Verification, Validation And Accreditation.

UNIT II   METHODS OF SOFTWARE VERIFICATION   9
Verification and Validation Life Cycle – Traceability Analysis – Interface Analysis – Design and Code Verification – Test Analysis - Reviews – Inspections - Walkthroughs – Audits – Tracing – Formal Proofs – Model Based Verification and Validation - Program Verification Techniques – Formal Methods of Software Verification – Clean Room Methods.

UNIT III   TESTING   9
Stages of Testing: Test Planning – Test Design – Test Case Definition – Test Procedure – Test Reporting – Unit Testing: White Box , Black Box And Performance Testing – System Testing: Function, Performance, Interface, Operations, Resource, Security, Portability, Reliability, Maintainability, Safety, Regression and Stress Testing – Integration Testing – Acceptance Testing: Capability, Constraint Testing - Structured Testing – Structured Integration Testing

UNIT IV   TOOLS FOR SOFTWARE VERIFICATION   9
Tools For Verification and Validation: Static Analyser – Configuration Management Tools – Reverse Engineering Tools – Tracing Tools – Tools For Formal Analysis – Tools for Testing – Test Case Generators – Test Harnesses – Debuggers – Coverage Analysers – Performance Analysers – Test Management Tools

UNIT V   ADVANCED APPROACHES   9
Automatic Approach For Verification And Validation – Validating UML Behavioral Diagrams – Probabilistic Model Checking of Activity Diagrams in SysML – Metrics for Verification and Validation, Case Study, Introduction to Rational Rose.

TOTAL : 45 PERIODS

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OUTCOMES:
Upon completion of the course, the student will be able to
- Identify the different techniques for verification and validation.
- Use available traceability analysis tools on sample requirements.
- Modify existing coverage analysers in terms of functionality or features used.
- Design system test cases.
- Use test case generators and test management tools.

REFERENCES:
1. MouradDebbabi, Hassaine F, Jarrya Y., Soeanu A., Alawneh L., "Verification and Validation in Systems Engineering", Springer, 2010.
2. Marcus S. Fisher, "Software Verification and Validation: An Engineering and Scientific Approach‖, Springer, 2007.
3. ESA Board for Software Standardization and Control (BSSC), "Guide to softwareverification and Validation", European Space Agency ESA PSS05-10 Issue 1 Revision 1, 1995.
4. Avner Engel, "Verification, Validation & Testing of Engineered Systems", Wiley series in systems Engineering and Management, 2010.
5. AdityaMathur, "Foundations of Software Testing", Pearson Education, 2008.

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√				√	√	√		√
CO2		√	√						√
CO3	√			√	√	√	√	√	√
CO4				√					√
CO5	√			√	√		√		

SE5004   **ENTERPRISE APPLICATION INTEGRATION**   **L T P C**
                                                   3 0 0 3

OBJECTIVES:
- Create a Business Data Catalog Application Definition file.
- Discuss the most important topics and technologies related to enterprise application integration.
- Practice implementation strategies.
- Know the Integration facilities for an application.
- To appreciate the current trends in Enterprise Application Integration.

UNIT I   INTRODUCTION   9
Business Imperative for Enterprise Integration – Business agility – Business transactions – need of E-business - ROI of Enterprise Integration – Challenges – Business drivers – Defining Requirements – Enterprise Integration strategy.

UNIT II   ENTERPRISE INTEGRATION ARCHITECHTURE   9
Overview – Business case – Components of EIA – Organizational Structure – Architectural Governance - Understanding Integration Technology – Current Integration Architecture – Technical Integration Architecture specification.

UNIT III   SERVICE AND INFORMATION INTEGRATION ARCHITECTURE   9

Service Oriented Architecture – Benefits – Defining Services – Event driven service design – specification – Understanding Metadata – Metadata Architecture – standards – Information Integration Patterns – Architecture Specification.

UNIT IV   PROCESS AND APPLICATION INTEGRATION ARCHITECTURE   9

Process to Business – Process Integration Technology – Process Standards – Architecture Specification - Choosing Technology - Application Integration Technology – Implementation Specification – Composite Application – Composite integration specification.

UNIT V   PATTERNS OF ENTERPRISE APPLICATION INTEGRATION   9

Domain Logic Patterns – Data source architectural patterns – Object Relational Patterns – Web Presentation Patterns – Distribution Patterns – Concurrency Patterns – Session state patterns - base patterns.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Use object-oriented concepts for developing web applications.
- Demonstrate the enterprise application integration.
- Deploy the components of EIA with solutions.
- Apply pattern in Enterprise Application Integration.
- Identify appropriate technology for Process Integration.

REFERENCES:
1. David S.Linthicum, "Enterprise Application Integration", Addison-Wesley Professional, 2000.
2. Martin Fowler,"Patterns of Enterprise Application Architecture", Pearson Education, 17th edition, 2011.
3. GregorHohpe, Bobby Woolf, "Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions", Pearson Education, 15th edition, 2011.

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√				√	√	√		√
CO2		√	√						√
CO3	√			√	√	√	√	√	√
CO4				√					√
CO5	√		√	√			√		

SE5005   **SOFTWARE AGENTS**   **L T P C**
                                                                    3 0 0 3

OBJECTIVES:

- Have an overview of the agent systems and software agents.
- Understand the basic concepts of intelligent software agents.
- Design and build a multiagent system.

- Have a basic understanding about software agent technology and to be familiar with some of the communicating languages, standardization and applications.
- Learn the use of software agents to represent and share information to coordinate activities of the agents for the purpose of group problem solving.

UNIT I AGENTS – OVERVIEW 9
Agent Definition – Agent Programming Paradigms – Agent Vs Object – Aglet – Mobile Agents – Agent Frameworks – Agent Reasoning.

UNIT II JAVA AGENTS 9
Processes – Threads – Daemons – Components – Java Beans – ActiveX – Sockets – RPCs – Distributed Computing – Aglets Programming – Jini Architecture – Actors and Agents – Typed and proactive messages.

UNIT III MULTIAGENT SYSTEMS 9
Interaction between agents – Reactive Agents – Cognitive Agents – Interaction protocols – Agent Coordination – Agent negotiation – Agent Cooperation – Agent Organization – Self-Interested agents in Electronic Commerce Applications.

UNIT IV INTELLIGENT SOFTWARE AGENTS 9
Interface Agents – Agent Communication Languages – Agent Knowledge Representation – Agent Adaptability – Belief Desire Intension – Mobile Agent Applications. Introduction to Chat Bot

UNIT V AGENTS AND SECURITY 9
Agent Security Issues – Mobile Agents Security – Protecting Agents against Malicious Hosts – Untrusted Agent – Black Box Security – Authentication for agents – Security issues for Aglets.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Create / develop an agent based system for a particular task.
- Design an application that uses different security issues for intelligent agents.
- Effectively apply agent-based technologies in the development and application of distributed information systems that use software agents.
- Interface agents through Agent communication languages.
- Apply technologies for solving agent security issues.

REFERENCES:
1. Bigus & Bigus, "Constructing Intelligent agents with Java ", Wiley, 1997.
2. Bradshaw, "Software Agents ", MIT Press, 2010.
3. Russel, Norvig, "Artificial Intelligence: A Modern Approach", Second Edition, Pearson Education, 2003.
4. Richard Murch, Tony Johnson, "Intelligent Software Agents", Prentice Hall, 2000.
5. Gerhard Weiss, "Multi Agent Systems – A Modern Approach to Distributed Artificial Intelligence" , MIT Press, 2000.

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	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√		√	√	√		√		√
CO2			√	√	√	√	√	√	√
CO3				√	√	√		√	√
CO4	√			√		√	√		
CO5	√			√	√		√		√

CP5086 **SOCIAL NETWORK ANALYSIS** **L T P C**
3 0 2 4

OBJECTIVES:
- To gain knowledge about the current web development and emergence of social web.
- To study about the modeling, aggregating and knowledge representation of semantic web.
- To appreciate the use of machine learning approaches for web content mining.
- To learn about the extraction and mining tools for social networks.
- To gain knowledge on web personalization and web visualization of social networks.

UNIT I CLUSTERING AND CLASSIFICATION 9+6
Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers – Unsupervised Learning – K-means Clustering – Hierarchical Clustering –Partially Supervised Learning – Markov Models – Probability-Based Clustering – Vector Space Model

UNIT II SOCIAL MEDIA MINING 9+6
Data Mining Essentials –Data Mining Algorithms - Web Content Mining –Latent semantic Indexing – Automatic Topic Extraction – Opinion Mining and Sentiment Analysis – Document Sentiment Classification

UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS 9+6
Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks – Definition of Community – Evaluating Communities – Methods for Community Detection & Mining – Applications of Community Mining Algorithms – Tools for Detecting Communities – Social Network Infrastructure and Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities

UNIT IV HUMAN BEHAVIOR ANALYSIS AND PRIVACY ISSUES 9+6
Understanding and Predicting Human Behavior for Social Communities – Use Data Management, Inference and Distribution – Enabling New Human Experiences – Reality Mining – Context-Awareness – Privacy in Online Social Networks – Trust in Online Environment – Trust Models Based on Subjective Logic – Trust Network Analysis – Trust Transitivity Analysis – Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons – Attack Spectrum and Countermeasures.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9+6
Graph Theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing Online Social Networks – Visualizing Social Networks with Matrix-Based Representations – Node-Link Diagrams – Hybrid Representations – Applications – Covert

Networks – Community Welfare – Collaboration Networks – Co-Citation Networks – Recommendation in Social Media: Challenges – Classical Recommendation Algorithms – Recommendation Using Social Context – Evaluating Recommendations

TOTAL: 45+30:75 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Apply knowledge of current web development in the era of social web.
- Model, aggregate and represent knowledge for semantic web.
- Use machine learning approaches for web content mining.
- Design extraction and mining tools for social networks.
- Develop personalized web sites and visualization for social networks.

REFERENCES:
1. Peter Mika, "Social networks and the Semantic Web", Springer, 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 2010.
3. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer; Second Edition, 2011.
4. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining", Cambridge University Press, 2014.
5. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking Techniques and applications", Springer, 2011.
6. Dion Goh and Schubert Foo, "Social information retrieval systems: emerging technologies and Applications for searching the Web effectively", Idea Group, 2007.

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√		√	√	√		√	√	√
CO2	√		√	√			√	√	√
CO3	√		√	√			√	√	√
CO4	√		√	√	√		√	√	√
CO5	√		√	√	√		√		√

SE5073	**SENTIMENT ANALYSIS**	**L T P C**
		3 0 0 3

OBJECTIVES:
- To understand the need for sentiment analysis.
- To explore the various methodologies involved in text sentiment classification.
- To learn the fusion of Natural Language processing with sentiment analysis.
- To explore available sentiment summarization methods.
- To learn the various tools used for sentiment analysis.

UNIT I   INTRODUCTION   9
Need for Sentiment Analysis – Problem of Sentiment Analysis - Subjectivity – Stance – Words to Discourse – Pragmatics – Natural Language Processing issues – Opinion Definition – Sentiment

analysis Tasks – Opinion Summarization – Types of opinion – Subjectivity and emotion – Author and Reader Standpoint.

UNIT II DOCUMENT SENTIMENT CLASSIFICATION 9
Sentiment Classification Using Supervised Learning – Unsupervised Learning – Rating Prediction – Cross-Domain Sentiment Classification – Cross-Language Sentiment Classification – Sentence Subjectivity And Classification – Subjectivity Classification – Sentence Sentiment Classification – Conditional Sentences - Sarcastic Sentences – Cross-Language Subjectivity and Sentiment Classification – Discourse Information for Sentiment Classification.

UNIT III ASPECT BASED SENTIMENT ANALYSIS 9
Aspect Sentiment Classification – Rules Of Opinions And Compositional Semantics – Aspect Extraction – Identifying Resource Usage Aspect – Simultaneous Opinion Lexicon Expansion And Aspect Extraction – Grouping Aspects Into Categories – Entity, Opinion Hold And Timing Extraction – Coreference Resolution And Word Sense Disambiguation – Aspect And Entity Extraction - Sentiment Lexicon Generation – Corpus Based Approach – Dictionary Based Approach – Desirable And Undesirable Facts.

UNIT IV OPINION SUMMARIZATION 9
Aspect Based Opinion Summarization – Improvements to Aspect-Based Opinion Summarization – Contrastive View Summarization – Traditional Summarization – Analysis of Comparative Opinions – Identifying Comparative Sentences – Identifying Preferred Entities – Opinion Search And Retrieval – Opinion Spam Detection – Types of Spam Detection - Supervised and Un-Supervised Approach – Group Spam Detection.

UNIT V TOOLS FOR SENTIMENT ANALYSIS 9
Detecting Fake Or Deceptive Opinions - Quality of Review – Quality as Regression Model – Other Methods – Case Study – Sentiment Analysis Applications – Tools for Sentiment Analysis – Semantria – Meltwater – Google Analytics – Face Book Insights – Tweetstats.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- Apply the various algorithms to perform opinion mining and classification.
- Learn various supervised and unsupervised machine learning methods for sentiment analysis.
- Generate sentiment lexicons by applying NLP techniques.
- Solve problems on opinion summarization.
- Learn to use tools for sentiment analysis.

REFERENCES:
1. Bing Liu, "Sentiment Analysis and Opinion Mining", Morgan and Claypool publishers, 2012.
2. Bing Liu, "Sentiment Analysis – Mining opinion, Sentiments and Emotions", Cambridge University Press, 2015.
3. Bo Pang and Lillian Lee, "Opinion Mining and Sentiment Analysis", Now Publishers Inc,2008.
4. Roy De Groot, "Data mining for Tweet Sentiment Classification – Twitter Sentiment Analysis", LAP Lambert Academic Publishing, 2012.

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	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	√			√	√	√	√		
CO2	√	√		√		√	√		
CO3			√		√	√		√	
CO4	√		√	√	√				√
CO5		√		√		√		√	

OE5091   **BUSINESS DATA ANALYTICS**   **L T P C**
                                                                                 3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I   OVERVIEW OF BUSINESS ANALYTICS   9
Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and
Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and
Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle
for Business Analytics Process.

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II   ESSENTIALS OF BUSINESS ANALYTICS   9
Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean,
Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance,
Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble
Chart, Heat Map – Data Dashboards.

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

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- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:
1. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, "Business Analytics Using R – A Practical Approach", Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, "Essentials of Business Analytics", Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, 2017.
6. A. Ohri, "R for Business Analytics", Springer, 2012
7. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publication, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

PROGRESS THROUGH KNOWLEDGE

OE5092   **INDUSTRIAL SAFETY**   **LT P C**
                                                                       3 0 0 3

OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I   INTRODUCTION   9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II   FUNDAMENTALS OF MAINTENANCE ENGINEERING   9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III   WEAR AND CORROSION AND THEIR PREVENTION   9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV   FAULT TRACING   9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V   PERIODIC AND PREVENTIVE MAINTENANCE   9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

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OE5093   **OPERATIONS RESEARCH**   **L T P C**
                                                                        3 0 0 3

OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I   LINEAR PROGRAMMING   9
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II   ADVANCES IN LINEAR PROGRAMMING   9
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III   NETWORK ANALYSIS – I   9
Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV   NETWORK ANALYSIS – II   9
Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V   NETWORK ANALYSIS – III   9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:
1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

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OE5094   **COST MANAGEMENT OF ENGINEERING PROJECTS**   **L T P C**
                                                                                    3 0 0 3

OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I   INTRODUCTION TO COSTING CONCEPTS   9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II   INTRODUCTION TO PROJECT MANAGEMENT   9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III   PROJECT EXECUTION AND COSTING CONCEPTS   9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV   COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL   9
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V   QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT   9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.
                                                                        TOTAL: 45 PERIODS
OUTCOMES:
Students will be able to:
CO1: Understand the costing concepts and their role in decision making
CO2: Understand the project management concepts and their various aspects in selection
CO3: Interpret costing concepts with project execution
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5: Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:
1 .Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095   **COMPOSITE MATERIALS**   **L T P C**
                                                      3 0 0 3

OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I   **INTRODUCTION**   **9**
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II   **REINFORCEMENTS**   **9**
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III   **MANUFACTURING OF METAL MATRIX COMPOSITES**   **9**
Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV   **MANUFACTURING OF POLYMER MATRIX COMPOSITES**   **9**
Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V   **STRENGTH**   **9**
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

                                              TOTAL: 45 PERIODS

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OUTCOMES:
Students will be able to:
- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5			✓	✓	✓		✓					

REFERENCES:
1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096   **WASTE TO ENERGY**   **L T P C**
                                                                    3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I   INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE   9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II   BIOMASS PYROLYSIS   9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III   BIOMASS GASIFICATION   9
Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV   BIOMASS COMBUSTION   9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

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UNIT V   BIO ENERGY   9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:
1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

AX5091   **ENGLISH FOR RESEARCH PAPER WRITING**   **L T P C**
                                                                    2 0 0 0

OBJECTIVES
- 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 I   INTRODUCTION TO RESEARCH PAPER WRITING   6

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

UNIT II   PRESENTATION SKILLS   6

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

UNIT III TITLE WRITING SKILLS 6

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

UNIT IV RESULT WRITING SKILLS 6

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

UNIT V VERIFICATION SKILLS 6

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

TOTAL: 30 PERIODS

OUTCOMES

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.
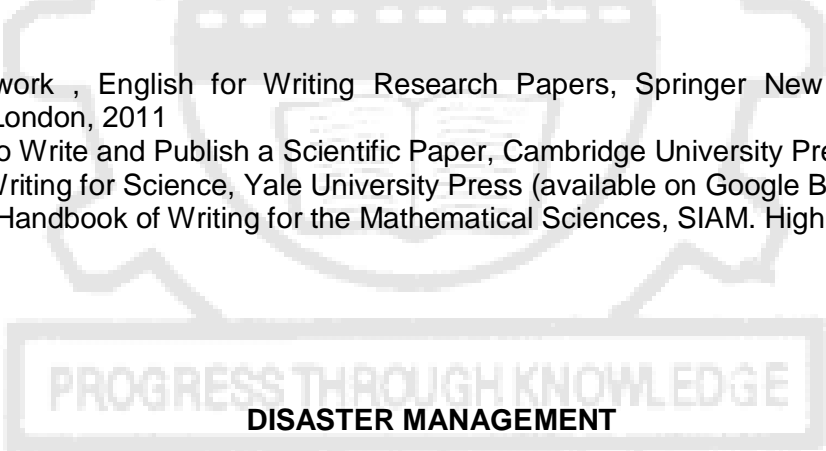
AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- 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 I INTRODUCTION 6

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

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UNIT II   REPERCUSSIONS OF DISASTERS AND HAZARDS   6

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

UNIT III   DISASTER PRONE AREAS IN INDIA   6

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

UNIT IV   DISASTER PREPAREDNESS AND MANAGEMENT   6

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

UNIT V   RISK ASSESSMENT   6

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

TOTAL : 30 PERIODS

OUTCOMES

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

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AX5093   **SANSKRIT FOR TECHNICAL KNOWLEDGE**   **L T P C**
                                                                               2 0 0 0

OBJECTIVES
- 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 I   ALPHABETS   6
Alphabets in Sanskrit

UNIT II   TENSES AND SENTENCES   6
Past/Present/Future Tense - Simple Sentences

UNIT III   ORDER AND ROOTS   6
Order - Introduction of roots

UNIT IV   SANSKRIT LITERATURE   6
Technical information about Sanskrit Literature

UNIT V   TECHNICAL CONCEPTS OF ENGINEERING   6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

                                                                    TOTAL: 30 PERIODS

OUTCOMES
- 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.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES
1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094   **VALUE EDUCATION**   **L T P C**
                                                                               2 0 0 0
OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

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UNIT 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

UNIT 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

UNIT 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

UNIT 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.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
* Knowledge of self-development.
* Learn the importance of Human values.
* Developing the overall personality.

Suggested reading
1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095   **CONSTITUTION OF INDIA**   **L T P C**
                                                    2 0 0 0
OBJECTIVES
Students will be able to:
* 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 Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I   HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II   PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III   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.

UNIT IV   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.

UNIT V   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.

UNIT VI   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.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

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

AX5096	PEDAGOGY STUDIES	L T P C
		2 0 0 0

OBJECTIVES
Students will be able to:
- Review existing evidence on there 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.

UNIT I   INTRODUCTION AND METHODOLOGY:

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

UNIT II   THEMATIC OVERVIEW

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

UNIT III   EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

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

UNIT IV   PROFESSIONAL DEVELOPMENT

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

UNIT V   RESEARCH GAPS AND FUTURE DIRECTIONS

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

* What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
* What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
* How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING:

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. 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.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097	STRESS MANAGEMENT BY YOGA	L T P C
		2 0 0 0

OBJECTIVES

* To achieve overall health of body and mind
* To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

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.

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UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

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

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- 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 I

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)

UNIT II

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.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.