SEMESTER VII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	BA20151	Entrepreneurship Development	3	0	0	3
2	PC	CY20701	Machine Learning	3	0	0	3
3	PE	CY2035*	Professional Elective III	3	0	0	3
4	PE	CY2045*	Professional Elective IV	3	0	0	3
5	OE	CY2090*	Open Elective II	3	0	0	3
Practical							
7	PC	CY20702	Machine Learning Laboratory	0	0	2	1
8	EE	CY20703	Mini Project Work	0	0	6	3
			Total	**15**	**0**	**10**	**19**

SEMESTER VIII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	CY20801	Malware Analysis	3	0	0	3
2	PE	CY2055*	Professional Elective V	3	0	0	3
3	PE	CY2065*	Professional Elective VI	3	0	0	3
Practical							
4	EE	CY20802	Project Work	0	0	12	6
			Total	**9**	**0**	**12**	**15**
							Total Credits: 164

PROFESSIONAL ELECTIVE COURSES (PE III)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	PE	CY20351	Security Governance, Risk and Compliance	3	0	0	3
2.	PE	CY20352	Cloud Computing	3	0	0	3
3.	PE	CY20353	Big Data Analytics	3	0	0	3
4.	PE	CY20354	Software Testing	3	0	0	3
			TOTAL	**12**	**0**	**0**	**12**

PROFESSIONAL ELECTIVE COURSES (PE IV)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	PE	CY20451	Security Audit and Risk Assessment	3	0	0	3
2.	PE	CY20452	Secure Software Development Life Cycle	3	0	0	3
3.	PE	CY20453	Information Visualization	3	0	0	3
4.	PE	CY20454	Android Security	3	0	0	3
			TOTAL	**12**	**0**	**0**	**12**

PROFESSIONAL ELECTIVE COURSES (PE V)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	PE	CY20551	Secure Software Design	3	0	0	3
2.	PE	CY20552	Reverse Engineering	3	0	0	3
3.	PE	CY20553	Biometrics and Security	3	0	0	3
4.	PE	CY20554	Block chain Technology	3	0	0	3
			TOTAL	**12**	**0**	**0**	**12**

PROFESSIONAL ELECTIVE COURSES (PE VI)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	PE	CY20651	Criminal Psychology	3	0	0	3
2.	PE	CY20652	Software Project Management	3	0	0	3
3.	PE	CY20653	Social Network Analysis	3	0	0	3
4.	PE	CY20654	Cloud Security	3	0	0	3
			TOTAL	**12**	**0**	**0**	**12**

OPEN ELECTIVE COURSES (OE II)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	OE	CY20902	Free and Open Source Software	3	0	0	3
			TOTAL	**3**	**0**	**0**	**3**

BA20151 **ENTREPRENEURSHIP DEVELOPMENT** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand the Management principles.
- build the entrepreneurial competencies & analyse the support rendered by government and other agencies in entrepreneurship development.
- understand the business opportunities & to prepare a Feasibility Report.
- propose a business plan.
- appraise & comprehend the various factors to be considered for launching a small business.

UNIT I BASICS OF MANAGEMENT **9**

Management: Meaning, Definition, Nature and Importance; Roles of management - Functions of Management - Levels of Management - Functional areas of Management: Marketing, Finance, Production, HRM, IT, R & D.

The Evolution & Development of Management Thought : Classical, Neo -classical, System and Contingency Approaches - An Overview.

UNIT II ENTREPRENEURIAL COMPETENCE & ENVIRONMENT **9**

Entrepreneurial Competence: Entrepreneurship – Definition, Role and expectations – Entrepreneurial styles and types – Characteristics of the Entrepreneur - Entrepreneurial Competencies – Functions of an Entrepreneur.

Entrepreneurial Environment: Role of Socio-Cultural, Economic and Political Environment – Institutional Support for small entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework, Central and State Government Industrial Policies and Regulations.

UNIT III ENTREPRENEURIAL DEVELOPMENT **9**

Ownership Structures – Proprietorship, Partnership, Company, Co-operative, Franchise.

Identification of Business Opportunity – Preparation of Feasibility Report – Financial and Technical Evaluation – Project Formulation – Common Errors in Project Formulation – Specimen Project Report.

Entrepreneurial Development Programs — Role of SSI Sector in the Economy – IAS Units – Failure, Causes and Preventive Measures – Turnaround Strategies.

UNIT IV BUSINESS PLAN PREPARATION, FINANCING VENTURES **9**

Business Plan: Business opportunities-SWOT, Business plan process, Feasibility Study, Functional plan-Marketing plan, Operational plan, Organizational plan, financial plan, Evaluation Criteria.

Financing ventures: sources of raising capital, seed funding, venture capital funding, funding opportunities for startups in India.

UNIT V WOMEN ENTREPRENEURSHIP AND ENTREPRENEURSHIP IN VARIOUS SECTORS 9

Women Entrepreneurship: Growth of women Entrepreneurship – Problems faced by Women Entrepreneurs – Development of women Entrepreneurship.

Entrepreneurship in Informal Sector: Rural Entrepreneurship – Entrepreneurship in Sectors like Agriculture, Tourism, Health care, Transport and allied services.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- implement the necessary managerial skills to become an entrepreneur.
- take up self-employment having been exposed to entrepreneurial environment.
- select a best business idea by using appropriate methods to assess its viability.
- formulate a business plan & deploy the resources for sustainable growth.
- analyse channels and means of launching a small business in any sector.

TEXT BOOKS

1. Khanka S.S, "Entrepreneurial Development", S. Chand & Company Limited, New Delhi, 2016.
2. Saravanavel. P, "Entrepreneurial Development", Ess Pee Kay Publishing House, Chennai, 2013.

REFERENCES

1. Donald L. Sexton & Raymond W.Smilor, "The Art and Science of Entrepreneurship", Ballinger Publishing Company, 2008.
2. Clifford M.Baumback & Joseph R.Mancuso, "Entrepreneurship and Venture Management", Prentice Hall, 1975.
3. Gifford Pinchot, "Intrapreneuring" Harper & Row Publishers, New York, 2005.
4. Mathew Manimala, "Entrepreneurship Theory at the Crossroads", Paradigms & Praxis, Biztrantra, 2nd Edition, 2015.
5. Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation and Reviews", Tata McGraw-Hill, 2013.
6. P.C.Jain, "Handbook for New Entrepreneurs", EDII, Oxford University Press, New Delhi, 2012.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	3	1	-	2	2	2	-	2	3	2	3
CO2	-	2	2	-	2	1	-	-	-	-	1	1	1	3
CO3	-	1	1	-	1	1	1	-	1	1	1	3	-	3
CO4	1	1	-	-	-	-	1	-	3	1	1	3	1	2
CO5	1	1	1	-	1	1	2	-	2	1	-	3	-	1

CO PO MAPPING:

CY20701 MACHINE LEARNING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the concepts of machine learning and aspects of computational learning theory.
- gain supervised learning and their applications.
- gain unsupervised learning and their applications.
- study the theoretical and practical aspects of probabilistic graphical models.
- learn and analysis the advanced learning.

UNIT I BASICS OF MACHINE LEARNING 9

Machine Learning – Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine learning – Applications Mathematical foundations of Machine Learning –Random Variables and Probabilities – Probability Theory – Probability Distributions – Decision Theory – Bayes Decision Theory – Information Theory.

UNIT II SUPERVISED LEARNING 9

Linear Models for Regression – Linear Models for Classification – Naive Bayes – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Bayesian Logistic Regression – Decision Trees – Classification Trees – Regression Trees – Pruning – Neural Networks – Feed Forward Network Functions – Back-Propagation – Support vector machines – Ensemble methods – Bagging – Boosting.

UNIT III UNSUPERVISED LEARNING 9

Clustering – K means – EM Algorithm – Mixtures of Gaussians–Curse of Dimensionality – Dimensionality Reduction – Factor Analysis – Principal Component Analysis – Probabilistic PCA.

UNIT IV PROBABILISTIC GRAPHICAL MODELS 9

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed GraphicalModels – Bayesian Networks – Conditional Independence Properties – Inference – Generalization – Hidden Markov Models.

UNIT V ADVANCED LEARNING 9

Sampling – Basic Sampling methods – Monte Carlo. Reinforcement Learning – K - Armed Bandit – Elements – Model - Based Learning – Value Iteration – Policy Iteration –Temporal Difference Learning – Exploration Strategies.

TOTAL PERIODS 45

TEXTBOOKS

1. Stephen Marsland, "Machine Learning of an Algorithmic Perspective", Second Edition, 2015.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.

REFERENCE BOOKS

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning", Springer, Second Edition, 2011.
3. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**												**Programme Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	1	2	-	2	1	1	2	3	2
CO2	2	2	1	1	1	1	-	-	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	1	1	1	-	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	1	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1

CY20702 **MACHINE LEARNING LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- implementation procedures for the machine learning algorithms.
- learn the Java/Python programs for various Learning algorithms
- appropriate data sets to the Machine Learning algorithms.
- apply Machine Learning algorithms to solve real world problems.

1. Implement and demonstrate the FIND-S-algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

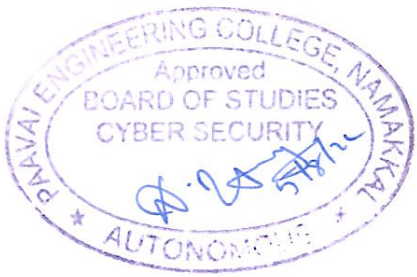
TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- understand the implementation procedures for the machine learning algorithms.
- design Java/Python programs for various Learning algorithms.
- apply appropriate data sets to the Machine Learning algorithms.
- identify and apply Machine Learning algorithms to solve real world problems.

CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	3	-	-	-	-	-	-	-
CO2	3	3	2	1	1	2	3	2	1	2	2	1	1	1
CO3	3	3	2	2	1	2	3	3	1	-	1	2	1	2
CO4	3	3	3	3	2	1	3	3	1	-	1	2	1	3



CY20703 **MINI PROJECT WORK** 0 0 6 3

COURSE OBJECTIVES

To enable students to

- recognize the significance of proper scope and the problems
- understand the strategic plans, project prioritization methods and projects
- understand the importance of scheduling / allocating resources to a project
- understand the importance of project management as it effects strategy and business success

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than 3 members on a project.
2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide has to be completed within the first two weeks from the day of beginning of7th semester
3. The group has to identify and select the problem to be addressed as their project work. make through literature survey and finalize a comprehensive aim and scope of their work to be done.
4. A project report has to be submitted by each student group for their project work.
5. Three reviews have to be conducted by a team of faculty (minimum of 3 and maximum of 5) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

COURSE OUTCOMES

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

- formulate a real world problem, identify the requirement and develop the design solutions.
- identify technical ideas, strategies and methodologies.
- utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- test and validate through conformance of the developed prototype and analysis the cost effectiveness.

TOTAL PERIODS 60

CO/PO Mapping

Mapping of Course Outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO	Programme Outcomes(POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	3	-	-	-	-	-	-	-
CO2	3	3	2	1	1	2	3	2	1	2	2	1	1	1
CO3	3	3	2	2	1	2	3	3	1	-	1	2	1	2
CO4	3	3	3	3	2	1	3	3	1	-	1	2	1	3

SEMSTER VIII

CY20801 **MALWARE ANALYSIS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- analyze the malware and its functionalities
- Assess the threat associated with malicious documents
- explore the techniques for detecting, analyzing, reverse engineering
- analyze the code for malware
- perform malware forensics

UNIT I MALWARE ANALYSIS 9

Basic Static Techniques - Malware Analysis in Virtual Machines - Basic Dynamic Analysis - Analyzing Malicious Windows Programs.

UNIT II MALWARE FUNCTIONALITY 9

Malware Behavior - Covert Malware Launching - Data Encoding - Malware - Focused Network Signatures.

UNIT III ANTI-REVERSE-ENGINEERING 9

Anti-Disassembly; Anti-Debugging; Anti-Virtual Machine Techniques; Packers and Unpacking

UNIT IV CODE ANALYSIS 9

Shell code Analysis - C++; Analysis - 64-Bit Malware; Tools for Malware Analysis.

UNIT V MALWARE FORENSICS 9

Using TSK for Network and Host Discoveries - Using Microsoft Offline API to Registry Discoverie Identifying Packers using PEiD; Registry Forensics with Reg Ripper Plugins - Bypassing Poison Ivy's Locke Files, Bypassing Conficker's File System ACL Restrictions , Detecting Rogue PKI Certificates.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- identify various malwares and understand the behavior of malwares in real world applications.
- implement different malware analysis techniques.
- analyze the malware behavior in windows and android.
- understand the purpose of malware analysis.
- identify the various tools for malware analysis.

COURSE OUTCOMES

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

- configure the shell commands and programming
- demonstrate the working with MYSQL.
- demonstrate the simple application in PHP.
- create strong application in PHP
- develop a simple problem & application in Perl programming

TEXT BOOKS

1. Richard Petersen,"The complete Reference Linux", Tata McGraw Hill Edition, Sixth edition 2010
2. Steve Suchring, MySQL Bible, John Wiley, 2002.
3. Steven Holzner, "PHP: The Complete Reference", 2nd Edition, Tata McGraw - Hill Publishing Company Limited, Indian Reprint 2009.

REFERENCES

1. Mark G. Sobell. "Practical Guide to Fedora and Red HatEnterpriseLinux", 6 th Edition, Prentice Hall, 2011.
2. RasmusLerdorf and Levin Tatroe, "Programming PHP", O'Reilly 3rd Edition, 2011.
3. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", Wiley Publications, 2007.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes(POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	2	-	2	1	1	2	3	2
CO2	2	2	1	1	1	1	-	-	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	1	1	1	-	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	1	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1

CY20802 **PROJECT WORK** 0 0 12 6

COURSE OBJECTIVES

To enable students to

- recognize the significance of proper scope and the problems.
- understand the strategic plans, project prioritization methods and projects.
- understand the importance of scheduling / allocating resources to a project.
- develop strategies for developing and reinforcing high performance teams.

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than 3 members son a project.
2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide has to be completed within the first two weeks from the day of beginning of 8th semester.
3. The group has to identify and select the problem to be addressed as their project work make through literature survey and finalize a comprehensive aim and scope of their work to be done.
4. A project report has to be submitted by each student group for their project work.
5. Three reviews have to be conducted by a team of faculty (minimum of 3 and maximum of5) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

TOTAL PERIODS 180

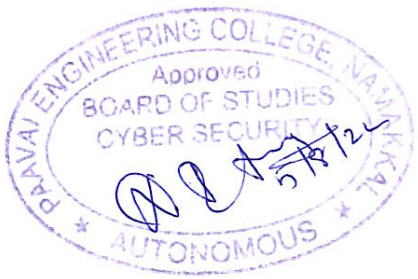
COURSE OUTCOMES

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

- prepare a literature survey in a specific domain as a team / individual tomotivate lifelong learning.
- identify the problem by applying acquired knowledge.
- choose efficient tools for designing project modules.
- design engineering solutions to complex problems utilizing a systemsapproach and combine all the modules for efficient testing.

CO/PO MAPPING:

(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**												**Programme Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2	1	1	1	1	-	-	-	1	1	2	3	2
CO2	2	2	1	1	1	1	-	-	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	-	1	1	-	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	-	1	2	3



PROGRAM ELECTIVE - 1

CY20151 FORMAL LANGUAGES AND AUTOMATA 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide introduction to some of the central ideas of theoretical computer science from the Perspective of formal languages and understand deterministic and non-deterministic machines
- introduce the fundamental concepts of regular expression and finite automata.
- introduce the fundamental concepts of context free grammar.
- employ push down automata to solve problems in computing.
- understand Turing machines and the differences between decidability and undecidability.

UNIT I INTRODUCTION TO FINITE AUTOMATA 9

Introduction to finite automata structural representations - the central concepts of automata theory, alphabets, strings, languages, problems; Nondeterministic finite automata - formal definition, finite automata with epsilon, transitions; Deterministic finite automata - definition of DFA, DFA process strings, language of DFA, conversion of NFA with ε-transitions to NFA without ε transitions; conversionof NFA to DFA.

UNIT II REGULAR EXPRESSIONS 9

Regular expressions - finite automata and regular expressions - applications of regular expressions algebraic laws for regular expressions - properties of regular languages pumping lemma for regular languages - applications of the pumping lemma - closure properties of regular languages - decision properties of regular languages; equivalence and minimization of automata.

UNIT III CONTEXT FREE GRAMMAR 9

Context-Free Grammars - definition of context - free grammars; Derivations using a grammar - leftmost and right most derivations, the language of a grammar, sentential forms, parse trees; Applications of context - free grammars, ambiguity in grammars and languages; Normal forms for context free grammars - eliminating useless symbols; Eliminating - productions; Chomsky normal form griebach normal form; Pumping lemma for context - free languages, statement of pumping lemma, applications Closure properties of CFL's, decision Properties of CFL's.

UNIT IV PUSH DOWN AUTOMATA 9

Push Down Automata - definition of the pushdown automaton, languages of a PDA, equivalence of PDA's and CFG's, acceptance by final state, acceptance by empty stack; deterministic pushdown automata;CFG to PDA, PDA to CFG.

UNIT V TURING MACHINE 9

Introduction to turning machine - Formal Description, Instantaneous description, the language of Turing machine and halting Undecidability, A language that is Not Recursively Enumerable, An Undecidable Problem that is RE, undecidable Problems about Turing machines, Recursive Languages, Properties of recursive languages, Post's Correspondence Problem.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- understand the concept of finite automata and to recognize the languages.
- convert regular expression to finite automata and minimize the DFA
- design context free grammars for formal language
- know the concept of PDA and its conversions.
- gain proficiency with Turing machine and distinguish between decidability and undecidability.

TEXTBOOKS

1. "Introduction to Automata Theory, Languages and Computations", Third Edition, J.E.Hopcroft, R.Motwani and J.D Ullman, Pearson Education.

2. "Introduction to the Theory of Computation", Micheal Sipser, 3rd edition, Cengage Learning.

REFERENCES

1. "Introduction to Languages and the Theory of Computation", John C.Martin, Fourth Edition, Tata McGraw Hill.
2. "Introduction to Computer Theory, Daniel I.A.Cohen, John Wiley.
3. Hopcroft J.E., Ullman J.D Introduction to Automata Theory, Languages, and Computation (3rd Edn). Reading, MA: Addison-Wesley. (2006).
4. Eitan G An Introduction to the "Theory of Computation". Computer Science Press. (1989).

CO/PO MAPPING

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	1	-	1	1	2	3	2
CO2	2	2	1	1	1	1	-	1	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	1	1	1	-	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	-	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	-	2	1	1

CY20152 **CYBER PHYSICAL SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the basics of cyber physical systems.
- design synchronous models for Real Time applications.
- design Asynchronous models for Real Time applications.
- develop Deep Understanding on selection of hardware and software's for designing dynamical systems.
- design and implement cyber physical system and address the problems and limitations for real world problems.

UNIT I INTRODUCTION TO CYBER PHYSICAL SYSTEMS **9**

Introduction To Cyber - Physical Systems, Cyber-Physical Systems Design Recommendations, Cyber-Physical System Requirements ; Requirements Engineering, Interoperability, Real Time System - GPU Computing, Internet Of Things (IOT) , Radio Frequency Identification Technology; Wireless Sensor Networks Technology, Powerline Communication, Smart Cities And Internet of Everything; Ubiquitous Computing Fundamentals - Core Properties Of Ubiquitous Computing, Smart Devices Components And Services, Autonomous Systems In Ubiquitous Computing; CASE STUDY: Cyber Physical Vehicle Tracking System.

UNIT II SYNCHRONOUS MODEL **9**

Reactive Components - Variables, Valuations, And Expression, Execution, Extended, State Machines; Properties of Components, Finite State Components, Combinational Components, Event, Triggered Components, Nondeterministic Components, Input Enabled Components, Task Graphs and Await Dependencies; Composing Components - Block Diagrams Input / Output Variable Renaming, Parallel Composition, Output Hiding, Synchronous Designs - Synchronous Circuits, Cruise Control Systems, Synchronous Networks.

UNIT III ASYNCHRONOUS MODEL **9**

Asynchronous Process - States, Internal Actions, Executions, Extended State Machines, Operation on Process; Asynchronous Design Primitives - Blocking Vs Non-Blocking Synchronization, Deadlocks, Shared Memory, Fairness Assumptions; Asynchronous Coordination Protocols, LeaderElection, Reliable Transmission - Wait Fee Consensus, Safety Specifications, Invariants of Transition Systems, Safety Monitors.

UNIT IV DYNAMICAL SYSTEM **9**

Continuous Time Model - Continuously Evolving Inputs and Outputs, Models with Disturbance, Composing Components Stability; Linear Systems Linearity, Solutions of Linear Differential Equations Stability; Designing Controllers - Open Loop Vs Feedback Controller, Stabilizing Controller, PID Controllers; Analysis Techniques - Numerical Solutions; Barrier Certificates.

UNIT V HYBRID SYSTEMS 9

Hybrid Dynamical Model - Hybrid Process, Process Composition, Zeno Behavior, Stability; Designing Hybrid Systems - Automated Guided Vehicle, Obstacle Avoidance with Multi Robot Coordination, Multi Hop Control Networks, Linear Hybrid Automata, Example Pursuit Game - Formal Model; Symbolic Reachability Analysis; Timed Automata Model of Timed Automata.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- understand the basics of cyber physical systems.
- design synchronous models for Real Time applications.
- design Asynchronous models for Real Time applications.
- develop Deep Understanding on selection of hardware and software's for designing dynamical systems
- come up with cost effective, reliable, robust and feasible designs for real world problems.

TEXTBOOKS

1. Rajeev Alur, Principles of Cyber Physical Systems, 1st Edition, MIT Press 2015.
2. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems – A Cyber-Physical Systems Approach, Lulu.com, First Edition, Jan 2013.

REFERENCES

1. Raj Rajkumar, "Cyber Physical Systems," 2nd Edition, Elsevier 2015.
2. Edward D Lamie, "Computing Fundamentals Of Cyber Physical Systems " , 2nd Edition,Newnes Elsevier Publication.
3. Sang C.Suh , U.JohnTanik and John N.Carbone , Applied Cyber-Physical systems, Springer,2014.
4. Hespanha, Joao P. Linear systems theory. Princeton university press, 2009.

CO/PO MAPPING

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	3	3	3	3	-	3	3	3	3	3	3	3
CO2	3	3	3	2	3	3	2	3	2	2	2	3	3	2
CO3	2	3	3	3	3	3	-	3	3	3	3	3	3	3
CO4	2	3	2	3	2	2	1	2	3	2	3	2	2	3
CO5	3	3	3	3	3	3	-	3	2	3	2	3	3	3

CY20153 **DATA WAREHOUSING AND DATA MINING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the design and implementation of a data store
- acquire knowledge on data and various preprocessing techniques
- analyze the various correlation based frequent patterns mining in large data sets
- learn various classifiers in data mining
- understand the data mining techniques and methods to be applied on large data sets.

UNIT I DATA WAREHOUSING 9

Data warehouse - Basic Concepts, Modeling, Design, and usage; Implementation - Data cube Computation Methods; Data Generalization by Attribute Oriented Induction approach.

UNIT II DATA MINING 9

Introduction - Kinds of Data and Patterns, Major Issues in Data Mining, Statistical Description of Data, Measuring Data Similarity and Dissimilarity; Data preprocessing - Data Cleaning, Data Integration, Data Transformation, Data Reduction - Data Discretization Concept Hierarchy Generation.

UNIT III ASSOCIATION RULE MINING 9

Basic concepts - Frequent Item set Mining Methods - Apriori algorithm, A Pattern Growth Approach for Mining Frequent Item sets, Mining Various Kinds of Association Rules, Correlation Analysis; Constraint Based Association Mining.

UNIT IV CLASSIFICATION 9

Basic Concepts - Decision Tree Induction - Bayes Classification Methods - Rule Based Classification- Classification by Back propagation - Support vector machines - Associative Classification - Lazy Learners - Other Classification Methods - Prediction.

UNIT V CLUSTERING AND DATA MINING APPLICATIONS 9

Cluster analysis - Partitioning Methods - Hierarchical Methods - Density Based Methods - Grid Based Methods - Model Based Clustering Methods - Clustering High Dimensional Data - Constraint Based Clustering Analysis - Outlier Analysis - Data Mining Applications - Financial Data Analysis, Science and Engineering, Intrusion Detection and Prevention.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- understand the design of a data warehouse
- apply preprocessing techniques
- identify frequent patterns in large data sets
- compare and contrast the various classifiers
- apply clustering techniques and methods to large data sets

TEXTBOOKS

1. Jiawei Han and Micheline Kamber, —Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP‖, Tata McGraw – Hill Edition, 35th Reprint 2016.

REFERENCES

1. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP‖, Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, Shyam Diwakar and V. Ajay, —Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.
4. Agile Data Warehouse Design: Collaborative Dimensional Modeling, from Whiteboard to Star Schema.

CO/PO MAPPING

Mapping of Course Outcomes with Programme Outcome
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	-	1	1	2	3	2
CO2	2	2	1	1	1	1	-	1	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	3	1	1	3	1	2	1
CO4	2	2	3	2	1	1	1	3	1	1	3	1	2	3
CO5	3	2	2	1	1	1	1	2	1	1	2	2	1	1

CY20154 **MOBILE AND WIRELESS SECURITY** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study salient features of various wireless and mobile technology.
- understand the need of security at mobile device, network, server levels
- explain the security issues in cellular networks.
- know about various types of threats for MANET applications.
- learn security challenges and attacks over mobile commerce services

UNIT I SECURITY ISSUES IN MOBILE COMMUNICATION 9

Mobile Communication History - Security – Wired Vs Wireless, Security Issues in Wireless and Mobile Communications, Security Requirements in Wireless and Mobile Communications, Security for Mobile Applications, Advantages and Disadvantages of Application-level Security.

UNIT II SECURITY OF DEVICE, NETWORK, AND SERVER LEVELS 9

Mobile Devices Security Requirements - Mobile Wireless network level Security, Server Level Security; Application - Level Security in Wireless Networks - Application of WLANs, Wireless Threats, Some Vulnerabilities and Attach Methods over WLANs, Security for 1G Wi-Fi Applications, Security for 2GWi-Fi Applications, Recent Security Schemes for Wi-Fi Applications.

UNIT III APPLICATION-LEVEL SECURITY IN CELLULAR NETWORKS 9

Generations of Cellular Networks - Security Issues and attacks in cellular networks - GSM Security for applications - GPRS Security for applications - UMTS security for applications - 3G security for applications - Some of Security and authentication Solutions.

UNIT IV APPLICATION-LEVEL SECURITY IN MANETS 9

MANETs-Applications of MANETs, MANET Features, Security Challenges in MANETs; Security Attacks on MANETs - External Threats for MANET applications, Internal threats for MANET Applications, Some of the Security Solutions; Ubiquitous Computing - Need for Novel Security Schemes for UC Security Challenges for UC, Security Attacks on UC networks, Some of the security solutions for UC.

UNIT V SECURITY FOR MOBILE COMMERCE APPLICATION 9

M-commerce Applications - M-commerce Initiatives - Security Challenges in Mobile E-commerce - Types of Attacks on Mobile E-commerce - A Secure M-commerce Model Based on Wireless LocalArea Network - Some of M-Commerce Security Solutions.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- describe salient features of various wireless and mobile technology.
- explain the need of security at mobile device, network, server levels
- summarize the security issues in cellular networks.
- list the various types of threats for MANET applications.
- discuss security challenges and attacks over mobile commerce services

TEXTBOOKS

1. Pallapa Venkataram, Satish Babu,"Wireless and Mobile Network Security", 1st Edition, TataMcGraw Hill,2010.
2. Man Ho Au, Raymond Choo,"Mobile Security and Privacy",1st Edition , Syngress Publisher,2016

EFERENCES

1. Frank Adelstein, K.S.Gupta , "Fundamentals of Mobile and Pervasive Computing", 1st Edition, Tata McGraw Hill 2005.
2. Randall k. Nichols, Panos C. Lekkas , "Wireless Security Models, Threats and Solutions", 1st Edition, Tata McGraw Hill, 2006.
3. Bruce Potter and Bob Fleck , "802.11 Security" , 1st Edition, SPD O'REILLY 2005.
4. James Kempf, "Guide to Wireless Network Security, Springer. Wireless Internet Security – Architecture and Protocols", 1st Edition, Cambridge University Press, 2008.

CO-PO MAPPING

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
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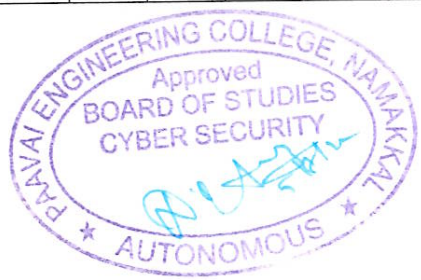
CO3	3	2	3	2	3	2	3	2	2	2	2	2	2	2
CO4	2	2	3	2	2	3	2	3	2	2	2	2	2	3
CO5	3	2	2	2	3	2	3	2	2	2	2	2	2	2



PROFESSIONAL ELECTIVE COURSES (PE-II)

CY20251 **COMPILER DESIGN** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the design principles of a compiler
- understand the various parsing techniques
- learn different levels of translation
- learn to optimize machine codes
- learn to generate machine codes.

UNIT I INTRODUCTION TO COMPILERS **9**

Translators - Compilation and Interpretation - Language processors - The Phases of Compiler-Errors encountered in Different Phases - The Grouping of Phases - Compiler Construction Tools - ProgrammingLanguage basics.

UNIT II LEXICAL ANALYSIS **9**

Need and Role of Lexical Analyzer - Lexical Errors-Expressing Tokens by Regular Expressions - Converting Regular Expression to DFA - Minimization of DFA - Language for Specifying Lexical Analyzers - LEX-Design of Lexical Analyzer for a sample Language.

UNIT III SYNTAX ANALYSIS **9**

Need and Role of the Parser-Context Free Grammars - Top Down Parsing - General Strategies - Recursive Descent Parser Predictive Parser - LL (1) Parser-Shift Reduce Parser-LR Parser - LR (0)Item-Construction of SLR Parsing Table - Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer - YACC-Design of a syntax Analyzer for a Sample Language.

UNIT IV SYNTAX DIRECTED TRANSLATION & RUN TIME ENVIRONMENT **9**

Syntax directed Definitions- Construction of Syntax Tree - Bottom-up Evaluation of S-Attribute Definitions - Design of predictive translator – Type Systems - Specification of a simple type of checker-Equivalence of Type Expressions-Type Conversions. RUN - TIME ENVIRONMENT - Source Language Issues - Storage Organization- Storage Allocation - Parameter Passing-Symbol Tables - Dynamic Storage Allocation - Storage Allocation in FORTAN.

UNIT V CODE OPTIMIZATION AND CODE GENERATION **9**

Principal Sources of Optimization – DAG - Optimization of Basic Blocks - Global Data Flow Analysis - Efficient Data Flow Algorithms - Issues in Design of a Code Generator - A Simple Code Generator Algorithm. Case Study - Single pass and two pass compilers.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- design and implement a prototype compiler.
- use the knowledge of patterns, tokens & regular expressions for solving a problem in the field of datamining.
- apply the various optimization techniques
- develop the runtime structures used to represent constructs in typical programming languages
- use the different compiler construction tools.

TEXTBOOKS

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers – Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation, "Morgan Kaufmann Publishers -Elsevier Science, India, Indian Reprint 2003.

REFERENCES

1. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: Dependence- based Approach", Morgan Kaufmann Publishers, 2002.
2. Keith D Cooper and Linda Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers Elsevier Science, 2004.
3. Charles N. Fischer, Richard. J. LeBlanc, "Craftinga Compiler with C", Pearson Education, 2008.
4. A.V. Aho, Monica, R.Sethi, J.D.Ullman, "Compilers, Principles, Techniques and Tools", Second Edition, Pearson Education/Addison Wesley, 2009.

CO-PO MAPPING

Mapping of Course Outcomes with Programme Outcome
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	1	-	1	1	2	3	2
CO2	2	2	1	1	1	1	-	1	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	1	1	1	1	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	1	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1

CY20252 SECURE CODING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the various security attacks.
- know the secure software development cycle
- identify the concept of threats modeling process and security techniques.
- learn the different types of attacks and its security issues.
- apply the security tester and its applications.

UNIT I INTRODUCTION 9

Security - CIA Triad, Viruses, Trojans, and Worms in a Nutshell; Security Concepts - exploit, threat, vulnerability, risk, attack; Malware Terminology - Rootkits, Trapdoors, Botnets, Key loggers, Honeypots. Active and Passive Security Attacks; IP Spoofing - Tear drop, DoS, DDoS, XSS, SQL injection, Smurf, Man in middle, Format String attack.

UNIT II NEED FOR SECURE SYSTEMS 9

Proactive Security development process - Secure Software Development Cycle (S-SDLC) - Security issues while writing SRS, Design phase security; Development Phase - Test Phase, Maintenance Phase, Writing Secure Code.

UNIT III THREAT MODELLING PROCESS 9

Identifying the Threats by Using Attack Trees and rating threats using DREAD - Risk Mitigation Techniques and Security Best Practices - Security Techniques, Authentication, authorization, Defense in Depth and Principle of Least Privilege.

UNIT IV SECURE CODING TECHNIQUES 9

Protection against DoS attacks - Application Failure Attacks, CPU Starvation Attacks, Insecure Coding Practices in Java Technology; ARP Spoofing and its countermeasures - Buffer Overrun - Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs.

UNIT V TESTING SECURE APPLICATIONS 9

Security code overview - Secure software installation, The Role of the Security Tester, Building the Security Test Plan; Testing HTTP - Based Applications, Testing File-Based Applications, Testing Clients with Rogue Servers.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- implement security as a culture and show mistakes that make applications vulnerable to attacks.
- understand various attacks like DoS, buffer overflow, web specific, database specific, web-spoofing attacks.
- demonstrate skills needed to deal with common programming errors.
- identify the nature of the threats to software and incorporate secure coding practices.
- properly handle application faults, implement secure authentication, authorization and data validation controls used to prevent common vulnerabilities.

TEXTBOOKS

1. Writing Secure Code, Michael Howard and David LeBlanc, Microsoft Press, 2nd Edition, 2004.
2. Buffer Overflow Attacks: "Detect, Exploit, Prevent by Jason Deckar", Syngress,1st Edition, 2005.

REFERENCES

1.Threat Modeling, "Frank Swiderski and Window Snyder", Microsoft Professional, 1st Edition, 2004.

2. Gertz, M., & Jajodia, S. (Eds.). "Handbook of database security: applications and trends". Springer Science & Business Media, 2007.

3. Bishop, M. "Computer Security: Art and Science". Pearson Education, Boston, US, 2003.

4. Randall k. Nichols, Panos C. Lekkas , "Wireless Security Models, Threats and Solutions", 1stEdition, Tata McGraw Hill, 2006.

CO-PO MAPPING

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**												**Programme Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2	1	1	1	1	-	-	-	1	1	2	3	2
CO2	2	2	1	1	1	1	-	-	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	-	1	1	-	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	-	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	-	2	1	1

CY20253 **INFORMATION ASSURANCE AND SECURITY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- explore system security related incidents and gain insight on potential defenses and counter measures against common threat/vulnerabilities
- install, configure and troubleshoot information security devices
- study and practice fundamental techniques in developing secure applications
- understand the concept of Security Analyst
- describe the Security Architecture and database audit.

UNIT I INFORMATION SECURITY FUNDAMENTALS **9**

Definitions & challenges of security - Attacks & services, Security policies, Security Controls, Access control structures: Cryptography – Deception - Ethical Hacking – Firewalls - Identify and Access Management.

UNIT II SYSTEM SECURITY AND INFORMATION SECURITY MANAGEMENT **9**

System Vulnerabilities - Network Security Systems, System Security, System Security Tools, Web Security, Application Security, Intrusion Detection Systems; Monitor systems and apply controls - security assessment using automated tools, backups of security devices; Performance Analysis – Root cause analysis and Resolution, Information Security Policies, Procedures, Standards and Guidelines.

UNIT III SECURITY PARAMETERS AND ACCESS CONTROL MODELS **9**

Confidentiality - integrity, and availability; Security violation and threats - Security policy and procedure - Assumptions and Trust - Security Assurance, Implementation and Operational Issues, Security Life Cycle. Discretionary - mandatory, role-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.

UNIT IV SECURITY POLICIES AND SYSTEM DESIGN **9**

Confidentiality policies - Integrity policies, hybrid policies, non-interference and policy composition, international standards; Design principles - representing identity, control of access and information flow, confinement problem. Assurance; Building systems with assurance - formal methods, evaluating systems.

UNIT V OPERATING SYSTEMS SECURITY AND DATABASE SECURITY **9**

Security Architecture - Analysis of Security in Linux/Windows; Enterprise security - Database auditing, Applications; Network security - operating system security - user security - program security; Special Topics - Data privacy, introduction to digital forensics, enterprise security specification.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- implement security as a culture and show mistakes that make applications vulnerable to attacks.
- understand various attacks like DoS, buffer overflow, web specific, database specific, web-spoofing attacks.
- demonstrate skills needed to deal with common programming errors.
- identify the nature of the threats to software and incorporate secure coding practices.
- properly handle application faults, implement secure authentication, authorization and datavalidation controls used to prevent common vulnerabilities.

REFERENCES

1. Pfleeger, C. P., Pfleeger, S. L., and Margulies, J. Security in Computing, ProQuest Safari TechBooks Online, 2017
2. Wheeler, D. A. Secure programming HOWTO, 2017.
3. Bishop, M. Computer Security: Art and Science. Pearson Education, Boston, US, 2003.
4. Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Wiley, 2017

CO/PO MAPPING

Mapping of Course Outcomes with Programme Outcome
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	1	-	1	1	2	3	2
CO2	2	2	1	1	1	1	-	1	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	1	1	1	1	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	1	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1

CY20254 **OPERATING SYSTEM SECURITY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the principles of securing a computer system
- have knowledge of security policies and mechanisms in operating systems
- understand vulnerabilities in operating system and software
- have insight into methods for development and test of security in software
- develop familiarity with and understanding of hot issues in computer and network security

UNIT I INTRODUCTION **9**

Secure Operating Systems definition, Security Goals, Trust Model, Threat Model, Access Control Fundamentals - Protection System, Reference Monitor, Assessment Criteria, Multics - Multics Fundamentals, Multics Security Fundamentals, Multics Protection System Models.

UNIT II SECURITY IN ORDINARY OPERATING SYSTEMS **9**

UNIX Security - UNIX Protection System, UNIX Authorization, UNIX Security Analysis, UNIX Vulnerabilities, Windows Security - Windows Protection System, Windows Authorization, Windows Security Analysis, Windows Vulnerabilities.

UNIT III VERIFIABLE SECURITY GOALS **9**

Information Flow, Information Flow Secrecy Models - Denning's Lattice Model, Bell-LaPadula Model, Information Flow Integrity Models, Biba Integrity Model, Low-Water Mark Integrity, Clark-Wilson Integrity.

UNIT IV SECURITY KERNELS **9**

The Security Kernel, Secure Communications Processor, Scomp Architecture, Scomp Hardware, Scomp Trusted Operating Program, Scomp Kernel Interface Package, Scomp Applications, Scomp Evaluation, Gemini Secure Operating System.

UNIT V SECURING COMMERCIAL OPERATING SYSTEMS **9**

Retrofitting Security into a Commercial OS, Commercial Era, Microkernel Era, UNIX Era, IX, Domain and Type Enforcement, Recent UNIX Systems, Case Study: Solaris Trusted Extensions- Building a secure operating system for Linux.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the various security concepts such as confidentiality, privacy etc
- understand various security models
- understand the notion of security policy enforcement and classes of policies
- identify and assess current and anticipated security risks and vulnerabilities
- conceptualize design issues, principles, and good practices in securing systems

TEXTBOOKS

1. Trent Jaeger, "Operating System Security", First Edition, Morgan & Claypool Publishers, 2008.
2. Michael J. Palmer, "Guide to Operating Systems Security", First Edition, Thomson/Course Technology, 2004.

REFERENCE

1. Gerardus Blokdyk, "Mobile Operating System Security A Complete Guide", First Edition, 5 STAR Cooks, 2021.
2. David A. Wheeler, "Secure Programming for Linux and Unix HOWTO"Free Software Foundation, 2003.
3. Ronald L. Krutz, Russell Dean Vines, "Cloud Security" [ISBN: 0470589876],2010.
4. Randall k. Nichols, Panos C. Lekkas , "Wireless Security Models, Threats and Solutions", 1st Edition, Tata McGraw Hill, 2006.

CO-PO MAPPING

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO4	2	2	3	2	1	1	1	-	1	1	-	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	-	2	1	1

PROFESSIONAL ELECTIVE COURSES (PE-III)

CY20351 SECURITY GOVERNANCE, RISK AND COMPLIANCE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of Cyber security, IT Service Management, and Business Continuity.
- learn the International Standards Management Systems such as the ISO 27001.
- be assess cyber security risks and recommend risk treatment options in line with organizational risk appetite
- learn the risk the ethical hacking steps and requisite counter measure while considering risk assessment.
- gain knowledge about the People, Process and Technology elements that underpin the various management systems.

UNIT I INTRODUCTION **9**

Introduction to Cyber Security - Conceptual Description of Governance, Risk and Compliance; IT Governance Frameworks and Strategic Planning; Governance Models; MIT Sloan School of Management and ISO 38500.

UNIT II INFORMATION SECURITY **9**

Understanding of IT Governance - 3 Waves; Information Security; Cyber Security Context, Cyber Security Components; Introduction to ISO 27001.

UNIT III ETHICAL HACKING AND RISK MANAGEMENT **9**

Ethical Hacking and Risk Management - Security Policy Management; Security Architecture Design; Security Awareness Program Design; Security Technologies.

UNIT IV SERVICE MANAGEMENT **9**

Introduction to Service Management - Service Management Frameworks; ITIL and ISO 20000 ; Build of IT Service Management System.

UNIT V BUSINESS CONTINUITY MANAGEMENT **9**

Introduction to Business Continuity Management - Building a Business Continuity Management system using ISO 22301; Case Study Discussion and Careers in Cyber Security.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end this course, students will be able to

- describe the cybersecurity goals to strategic business goals
- determine the high-level cybersecurity policy objectives
- interpret the cybersecurity risks and recommend risk treatment options in line with organizational risk appetite
- demonstrate the appropriate risk mitigation techniques and control measures
- analyze organizational compliance to cybersecurity standards and related frameworks

TEXTBOOKS

1. Douglas W. Hubbard and Richard Series ," How to Measure Anything in Cybersecurity Risk", John Wiley & Sons,2016.
2. Antony Tarantino, Governance, Risk, and Compliance Handbook: Technology, Finance,2015 Environmental, and International Guidance and Best Practices,2009

REFERENCES

1. Antony Tarantino, Governance, Risk, and Compliance Handbook: Technology, Finance, Environmental, and International Guidance and Best Practices,2009
2. Scott Donaldson and Stanley Siegel," Enterprise Cybersecurity",2018
3. CSX Cybersecurity Fundamentals Study Guide by ISACA,2018
4. Richard Steinberg,"Governance,Risk ,Management & Compliance",2nd edition,2017.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	2	2	1	1	1	1	-	-	-	1	1	1	3	2
CO3	3	2	3	1	1	1	1	1	1	1	-	1	2	1
CO4	2	2	3	2	1	1	1	-	1	1	1	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1

CY20352 **CLOUD COMPUTING** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the concept of cloud computing
- appreciate the evolution of cloud from the existing technologies
- grasp knowledge on the various issues in cloud computing.
- be familiar with the lead players in cloud
- appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODCUTION 9

Introduction to Cloud Computing–defining a cloud, the cloud computing reference model, characteristics and benefits of cloud computing, historical developments, building cloud computing environments, computing platforms and technologies, principles of parallel and distributed computing.

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Basics of Virtualization – characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and computing - pros and cons of virtualization – technology examples: para virtualization, full virtualization.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Cloud Reference Model: Infrastructure / Hardware as a Service – Case Study, Platform as a Service – Case Study, Software as a Service – Case Study, Service provider, cloud storage -Types of Clouds: PublicClouds, Private Clouds, Hybrid Clouds, Community Clouds-Case Study- Economics of the Cloud, Open Challenges.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management -Resource Provisioning and Resource Provisioning Methods - Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine —Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- learn the key and enabling technologies that help in the development of cloud.
- develop the ability to understand the architecture of compute and storage cloud, service and delivery models.
- learn the core issues of cloud computing such as resource management and security.
- evaluate and choose the appropriate technologies, and approaches for implementation and use of cloud.

TEXTBOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

REFERENCES

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, TataMcgraw Hill, 2009

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes(POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	2	-	2	1	1	2	3	2
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CO3	3	2	3	1	1	1	1	1	1	1	-	1	2	1
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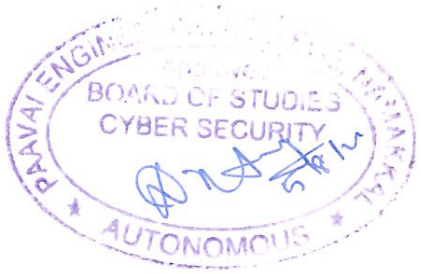
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1



CY20353 **BIG DATA ANALYTICS** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the fundamental concepts of big data and analytics.
- explore tools and practices for working with big data.
- learn about stream computing.
- know about the research that requires the integration of large amounts of data.
- learn NoSQL databases and management.

UNIT I INTRODUCTION TO BIG DATA 9

Evolution of Big data; Best Practices for Big data Analytics; Big data characteristics; Validating; The Promotion of the Value of Big Data; Big Data Use Cases; Characteristics of Big Data Applications - Perceptionand Quantification of Value; Understanding Big Data Storage ; HDFS; MapReduce and YARN– Map Reduce Programming Model.

UNIT II CLUSTERING AND CLASSIFICATION 9

Advanced Analytical Theory and Methods- Overview of Clustering , K-means , Use Cases; Overview of the Method - Determining the Number of Clusters, Diagnostics, Reasons to Choose and Cautions; Classification-Decision Trees, Overview of a Decision Tree, The General Algorithm, Decision Tree Algorithms, Evaluating a Decision Tree, Decision Trees in R; Naïve Bayes – Bayes' Theorem, Naïve Bayes Classifier.

UNIT III ASSOCIATION AND RECOMMENDATION SYSTEM 9

Advanced Analytical Theory and Methods- Association Rules, Overview, Apriori Algorithm, Evaluation of Candidate Rules; Finding Association& finding similarity; Recommendation System- Collaborative Recommendation, Content Based Recommendation, Knowledge Based Recommendation, Hybrid Recommendation Approaches.

UNIT IV STREAM MEMORY 9

Introduction to Streams Concepts; Stream Data Model and Architecture - Stream Computing, Sampling Data ina Stream, Filtering Streams, Counting Distinct Elements in a Stream; Estimating moments; Counting onenessin a Window – Decaying Window; Real time Analytics Platform (RTAP) applications; Case Studies; Real Time Sentiment Analysis.

UNIT V NO SQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION 9

NoSQL Databases- Schema-less Models; Increasing Flexibility for Data Manipulation; Key Value Stores-Document Stores, Tabular Stores, Object Data Stores; Graph Databases Hive;

Sharding; HBase – Analyzing big data with twitter; Big data for E-Commerce; Big data for blogs; Review of Basic Data Analytic Methods using .R

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- work with big data tools and its analysis techniques.
- analyze data by utilizing clustering and classification algorithms.
- learn and apply different mining algorithms and recommendation systems for large volumes of data.
- perform analytics on data streams.
- learn NoSQL databases and management.

TEXTBOOKS

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

2. David Loshin," Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL and Graph", Morgan Kauffmann/Elsevier Publishers, 2013

REFERENCES

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.

2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.

3. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010

4. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers" CRC Press, 2015.

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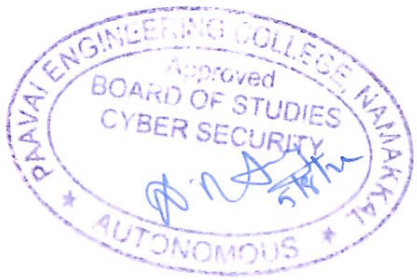

CY20354 **SOFTWARE TESTING** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand standard principles to check the occurrence of defects and its removal.
- learn the various design analysis methods.
- know the behaviour of the testing techniques to detect the errors in the software.
- be familiar with the concepts of test and defect controlling.
- learn the functionality of automated testing tools.

UNIT I INTRODUCTION 9

Testing as an Engineering Activity - Role of Process in Software Quality - Testing as a Process-asic. Definitions: Software Testing Principles, tester's role in software development organization. Origins of defects - defect classes, defect repository and test design, analysis of defect for a project.

UNIT II TESTING DESIGN STRATEGIES 9

Introduction to Testing Design Strategies - Black Box testing, Random Testing, Equivalence Class artitioning, Boundary Value Analysis. White-Box testing, Test Adequacy Criteria, Coverage and Control Flow Graphs, Covering Code Logic Paths - Case study: Additional White box testing approaches.

UNIT III LEVELS OF TESTING 9

Need for Levels of Testing- Unit Test, designing unit tests - Integration tests, designing integration Tests - System Testing, types of system testing – Acceptance Testing – Performance Testing - Regression Testing. Alpha -Beta and Acceptance Test- Usability and Accessibility test – Website testing.

UNIT IV TEST AND DEFECT MANAGEMENT 9

Test Management- Documenting test plan and test case, effort estimation, configuration management, project progress management. Use of testopia for test case documentation and test management –Test Planning - Test Plan Components, test plan attachments, locating test items reporting test results.

UNIT V TEST AUTOMATION 9

Introduction to automation testing, why automation, what to automate, skills needed for automation, design and architecture for automation, tools and result modules - Introduction to Selenium, Basics of Automation testing using selenium, using selenium IDE for automation testing.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply software testing fundamentals and testing design strategies to enhance software quality.
- implement the different analysing techniques in software design.
- impart knowledge in identifying suitable tests to be carried out.
- understand, plan and document the defect control procedures.
- explore the test automation concepts and tools.

TEXT BOOKS

1. Srinivasan Desikan and Gopalaswamy Ramesh, " Software Testing - Principles and Practices",Pearson education, 2006.
2. Rex Black (2001), Managing the Testing Process (2nd edition), John Wiley & Sons.

REFERENCES

1. AdityaP.Mathur, "Foundations of Software Testing", Pearson Education, 2008.
2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.
3. Foundations of software testing ,Dorothy Graham, Erik van Veenendaal, Isabel Evans, RexBlack,2008.

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PROFESSIONAL ELECTIVE COURSES (PE-IV)

CY20451 SECURITY AUDIT AND RISK ASSESSMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- Understand the security audit planning strategies
- Gain knowledge about information risk
- Discover knowledge in collecting data about organization
- Acquire knowledge in various analysis on Information Risk Assessment
- Introduce the System Risk analysis

UNIT I SECURITY AUDIT PLANNING 9

Need for Audit Planning - Steps in Audit Planning- Audit Risk Assessment- Performing Audit- Internal Controls- Audit Evidence- Audit Testing- Follow up activities- Security Monitoring and Auditing- Assurance and Trust- Need for Assurance- Role of Requirements in Assurance- Audit Assurance in SoftwareDevelopment Phases- Building Secure and Trusted Systems- Designing an Auditing System- Auditing to detect Violations of a Security Policy- Auditing Mechanisms- Audit Browsing.

UNIT II INFORMATION RISK 9

What is Risk- Going Deeper with Risk- Components of Risk- Putting it Altogether- Information Security Risk- Information Security Risk Assessment Overview- Assess Information Security Risk- Risk assessment and security Program- Information Security Management in a Nutshell- Drivers, Laws and Regulations- Federal Information Security Management- Gramm-Leach-Blile (GLBA)- Health Insurance Portability and Accountability Act(HIPAA)- State Governments- ISO 27001- Drivers, Laws and Regulations- Risk Assessment Framework- Practical Approach.

UNIT III DATA COLLECTION AND RISK SCHEDULING 9

Data Collection-Introduction- The Sponsor- The Project Team- The size and Breadth of the Risk Assessment- Scheduling and Deadlines- Assessor and Organization Experience- Work load- Data Collection Mechanisms- Collectors- Containers- Executive Interview- Document Requests- IT Asset Inventories- Asset Scoping- Business Impact Analysis and Other Assessments Critical Success Factor Analysis- Profile & Control Survey- Consolidation.

UNIT IV INFORMATION RISK ASSESSMENT 9

Compiling Observations from Organizational- Risk Documents- Preparation of Threat and Vulnerability Catalogs- Threat Catalog- Vulnerability Catalogs- Threat Vulnerability Pairs- Overview of the System Risk Computation- Designing the Impact Analysis Scheme- Confidentiality, Integrity- Availability- Preparing the Impact Score- Designing the Control analysis Scheme- Designing the Likelihood Analysis Scheme- Exposure- Frequency- Controls- Likelihood- Final Risk Score.

UNIT V TEST AUTOMATION 9

Introduction to automation testing, why automation, what to automate, skills needed for automation, design and architecture for automation, tools and result modules - Introduction to Selenium, Basics of Automation testing using selenium, using selenium IDE for automation testing.

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CO4	2	2	3	2	1	1	1	-	1	1	1	1	2	3
CO5	3	2	2	1	1	1	1	-	1	1	1	2	1	1