



Malad Kandivli Education Society's
NAGINDAS KHANDWALA COLLEGE
 OF COMMERCE, ARTS & MANAGEMENT STUDIES
 AND SHANTABEN NAGINDAS KHANDWALA COLLEGE OF SCIENCE

(Re-accredited (3rd cycle) by NAAC with 'A' Grade)
 ISO 9001 : 2015 Certified

Autonomous (2016-17)

Educational Excellence Award By Indus Foundation, U.S.A.
 IMC Ramkrishna Bajaj National Quality Commendation Certificate

Providing Syllabus copy of the courses highlighting the focus on employability/
 entrepreneurship/ skill development along with their course outcomes.

Sr. No.	Courses	2016-17	2017-18	2018-19	2019-20	2020-21	Total
1	Bachelor of Commerce (B.COM)	✓	✓	✓	✓	✓	5
2	Bachelor of Arts (B.A)	✓	✓	✓	✓	✓	5
3	Bachelor in Management Studies- (BMS)	✓	✓	✓	✓	✓	5
4	Bachelor of Commerce (Accounts and Finance)- BAF	✓	✓	✓	✓	✓	5
5	Bachelor of Commerce (Banking and Insurance)-BBI	✓	✓	✓	✓	✓	5
6	Bachelor of Commerce (Financial Markets)- BFM	✓	✓	✓	✓	✓	5
7	Bachelor of Science - Information Technology (B.Sc IT)	✓	✓	✓	✓	✓	5
8	Bachelor of Science- Computer Science(B.Sc CS)	✓	✓	✓	✓	✓	5
9	Bachelor of Arts- Multimedia and Mass Communication (B.A.MMC)	✓	✓	✓	✓	✓	5
10	Bachelor of Management Studies- Sports Management (BMS-SM)	X	X	✓	✓	✓	3
11	B. Com. Honours in Actuarial Studies	X	X	X	✓	✓	2
12	B.A. Honours in Apparel Design and Construction	X	X	X	✓	✓	2
13	B. Com. Honours in International Accounting	X	X	X	✓	✓	2
14	Bachelor of Management Studies- E commerce operations	X	X	X	X	✓	1
15	B.Sc. (Honours) in Integrative Nutrition & Dietetics	X	X	X	X	✓	1
16	BBA in Tourism and Travel Management	X	X	X	X	✓	1
17	B.Sc. in Interior Design	X	X	X	X	✓	1
18	Master Of Commerce-(M.COM)- Accountancy	✓	✓	✓	✓	✓	5
19	Master Of Commerce-(M.COM)- Management	✓	✓	✓	✓	✓	5
20	Master of Arts (Economics)	✓	✓	✓	✓	✓	5
21	Master of Arts (Geography)	✓	✓	✓	✓	✓	5
22	Master of Arts (Psychology)	X	X	X	✓	✓	2
23	Master of Science (Information Technology) (M.Sc IT)	✓	✓	✓	✓	✓	5
24	Master's Degree - Sports Management (MSM)	X	X	✓	✓	✓	3
25	Master of Science (Geo-informatics) (M.Sc GeoInformatics)	X	X	X	X	✓	1
							84

Moushumi Datta

Prof. (Dr.) Moushumi Datta
 I/c. Principal

Nagindas Khandwala College (Autonomous)



Syllabus Of Course of Master of Science Information Technology (MSC IT) Programme

Part I

Semester I

Under Academic Autonomy and Credit, Grading and Semester System

(To be implemented during Academic Year- 2020-21)

PRINCIPAL

**NAGINDAS KHANDWALA COLLEGE OF COMMERCE
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(AUTONOMOUS)
MALAD (W), MUMBAI - 400 084**

Elective-2 Analysis of Algorithms (2014PITAA)

Course Objectives:

1. To study fundamental concepts of algorithms and problem-solving strategies
2. To impart the basic concepts of data structures and algorithms.
3. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
4. To provide an insight into the intrinsic nature of the problem and to develop software systems of varying complexity

Learning Outcome:

At the end of this course learner will be able to:

CO1. Evaluating and providing suitable techniques for solving a problem using basic properties of Data Structures. (Level: Analyse and Apply)

CO2. Analyse the performance of algorithms using asymptotic notations. (Level: Analyse and Evaluate)

CO3. Demonstrate knowledge of basic data structures and legal operations on them. (Level: Understand)

CO4. Illustrate different types of algorithmic approaches to problem solving and assess the tradeoffs involved. (Level: Evaluate)

CO5. Analyse basic graph algorithms, operations and applications through a structured (well defined) algorithmic approach. (Level: Analyse)

CO6. Categorize the feasibility and limitations of solutions to real-world problems. (Level: Analyse)

CO7. Provide efficient algorithmic solution to real-world problems (Level: Create)

Sr. No.	Modules / Units
1	UNIT 1 Design strategies: The Role of Algorithms in Computing: Algorithms as a technology. Getting Started: Insertion sort, Analyzing algorithms, Designing algorithms. Growth of Functions: Asymptotic notation, Standard notations and common functions. Divide-and-Conquer: The maximum-subarray problem, Strassen's algorithm for matrix multiplication, The substitution method for solving recurrences.
2	UNIT 2 Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithms. Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Problem solvable and unsolvable using Greedy strategy. Name Services: Name services and the Domain Name System, Directory services, Case study: The Global Name Service, Case study: The X.500 Directory Service.

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3	UNIT 3
	Advanced Design and Analysis Techniques Dynamic Programming: Rod cutting, Elements of dynamic programming, longest common subsequence. Elementary Graph Algorithms: Representations of graphs, Breadth-first search, Depth-first search. Minimum Spanning Trees: Growing a minimum spanning tree, Algorithms of Kruskal and Prim. Single-Source Shortest Paths: The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm.
4	UNIT 4
	Number-Theoretic Algorithms and NP – Completeness Elementary number-theoretic notions, Greatest common divisor, Modular arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, The RSA public-key cryptosystem
5	UNIT 5
	NP-Completeness: Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-complete problems. Approximation Algorithms: The vertex-cover problem, The traveling-salesman problem, The set-covering problem, subset-sum problem.

Reference Books

Analysis of Algorithms

Text books:

1. Introduction to Algorithms, Third Edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI Learning Pvt. Ltd-New Delhi (2009).
2. Researching Information Systems and Computing, Brinoy J Oates, Sage Publications India Pvt Ltd (2006)

Reference books:

1. Algorithms, Sanjoy Dasgupta , Christos H. Papadimitriou, Umesh Vazirani, McGraw-Hill Higher Education (2006)
2. Grokking Algorithms: An illustrated guide for programmers and other curious people, MEAP, Aditya Bhargava, <http://www.manning.com/bhargava>



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Analysis of Algorithms Practical (2018PITAA)

(Employability and skill development)

1. Write a program to implement insertion sort and find the running time of the algorithm.
2. Write a program to implement merge sort algorithm. Compare the time and memory complexity.
3. Given an array of numbers of length l . Write a program to generate a random permutation of the array using (i) permute-by-sorting() and(ii) permute-by-cyclic().
4. Write a program to implement Longest Common Subsequence (LCS) algorithm
5. Write a program to implement Huffman's code algorithm
6. Write a program to implement Kruskal's algorithm.
7. Write a program to implement Dijkstra's algorithm
8. Write a program to implement Euclid's algorithm to implement gcd of two non negative integers a and b . Extend the algorithm to find x and y such that $\text{gcd}(a,b) = ax+by$. Compare the running time and recursive calls made in each case.
9. Write a program to verify (i) Euclid's theorem (ii) Fermat's theorem.
10. Write a program to implement greedy set cover algorithm to solve set covering problem.



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Syllabus Of Course of Master of Science Information Technology (MSC IT) Programme

Part I

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Elective – 2: Cyber and Information Security (2014PITCS)

Course Objectives:

1. Describe the principles and techniques associated with the cyber security Practices
2. Evaluate techniques used to break into an insecure web application and identify relevant Counter measures (K4)
3. Integrate approaches to secure networks, intrusion detection and prevention systems(K3)

Learning Outcome:

After successful completion of course, Learner will be able to understand and apply diverse security testing and suggest solutions to them.

CO1: Explain the basic information on cybercrime. (Level: Understand)

CO2: Describe cyber laws for various crime activities. (Level: Understand)

CO3: Identify the security policies for cyber issues. (Level: Understand)

CO4: Analyze the role of organization for securing cyberspace. (Level: Analyze)

CO5: Explain the need for security in organizations. (Level: Understand)

Sr. No.	Modules / Units
1	UNIT 1 Unit I: Computer Security: Principles of Security, Different Attacks: malicious and non-malicious program, Types of Computer Criminals. Operating System Security: Protected objects and methods of protection. Memory address protection: Fence, Relocation, Base/Bound Registers, Tagged Architecture, Segmentation, Paging, Directory, access control list. Database Security: Security requirements, Integrity, Confidentiality, Availability, Reliability of Database, Sensitive data, Multilevel database, Proposals for multilevel security.
2	UNIT 2 Unit II: Network Security: Different types of network layer attacks, Firewall (ACL, Packet Filtering, DMZ, Alerts and Audit Trails) – IDS, IPS and its types (Signature based, Anomaly based, Policy based, Honeypot based). Web Server Security: SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET), Kerberos.
3	UNIT 3 Unit III: Cloud Security: How concepts of Security apply in the cloud, User authentication in the cloud; How the cloud provider can provide this-Virtualization System Security Issues: e.g. ESX and ESXi Security, ESX file system security- storage considerations, backup and recovery-Virtualization System Vulnerabilities, security management standards-SaaS, PaaS, IaaS availability management- access control- Data security and storage in cloud.
4	UNIT 4



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	Unit IV: Mobile Security: Mobile system architectures, Overview of mobile cellular systems, GSM and UMTS
5	UNIT 5
	Security & Attacks, Vulnerabilities in Cellular Services, Cellular Jamming Attacks & Mitigation, Security in Cellular VoIP Services, Mobile application security. Securing Wireless Networks: Overview of Wireless Networks, Scanning and Enumerating 802.11 Networks, Attacking 802.11 Networks, Bluetooth Scanning and Reconnaissance, Bluetooth Eavesdropping, Attacking & Exploiting Bluetooth, Zigbee Security & Attacks.

Reference Books

Cyber and Information Security

Text books:

1. Security in Computing 4th edition, Charles P. Pfleeger, Charles P. Pfleeger, Shari Lawrence Pfleeger, Prentice Hall; 4th edition (2006)
2. Mobile and Wireless Security and Privacy, Kia Makki, Peter Reiher, Springer, (2007)
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory and practice), Tim Mather, Subra Kumaraswamy, Shahed Latif., O'Reilly Media; 1 edition (2009)

Reference books:

1. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley (2010)
2. Network Security, Charlie Kaufman, Radia Perlam, Mike Speciner, Prentice Hall, 2nd Edition (2002)
3. Cryptography and Network Security 3rd edition, Atul Kahate, Tata McGraw Hill Education Private Limited (2013)
4. Network Security, Charlie Kaufman, Radia Perlam, Mike Speciner, Prentice Hall, 2nd Edition (2002)
5. Cryptography and Network Security: Principles and practice 6th edition, William Stallings, Pearson Education (2013)


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Cyber and Information Security Practical (2018PITCS)
(Employability and skill development)

1. Implementation to gather information from any PC's connected to the LAN using whois, port scanners, network scanning, Angry IP scanners etc.
2. Implementation of MITM- attack using wireshark/ network sniffers
3. Implementation of Windows security using firewall and other tools
4. Implementation to identify web vulnerabilities, using OWASP project
5. Implementation of IT Audit, malware analysis and Vulnerability assessment and generate the report.
6. Implementation of OS hardening and RAM dump analysis to collect the Artifacts and other information's.
7. Implementation of Mobile Audit and generate the report of the existing Artifacts.
8. Implementation of Cyber Forensics tools for Disk Imaging, Data acquisition, Data extraction and Data Analysis and recovery
9. Implement ESX file system security in cloud.
10. Develop application to implement Zigbee security. Demonstrate and implement Bluetooth security.


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**Syllabus Of Course of
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Part I

Semester I

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Elective – 1 Distributed Systems (2013PITDS)

Course Objectives:

1. To introduce the fundamentals of distributed computing architectures and paradigms.
2. To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel and distributed computing systems.
3. To develop and execute basic parallel and distributed application using basic programming models and tools.

Learning Outcome:

Upon completion of this course, learner should be able to:

CO1: Understand foundations of Distributed Systems (Level: Understand)

CO2: Introduce the idea of peer-to-peer services and file system (Level: Understand)

CO3: Understand in detail the system level and support required for distributed system (level: Understand)

CO4: Understand the issues involved in studying process and resource management. (Level: Understand)

CO5: Design and develop distributed programs using sockets and RPC/RMI. (level: Create)

Sr. No.	Modules / Units
1	UNIT 1 Characterization Of Distributed Systems: Introduction, Examples of Distributed Systems, Trends In Distributed Systems, Focus On Resource Sharing, Challenges, Case Study: The World Wide Web. System Models: Physical Models, Architectural Models, Fundamental Models
2	UNIT 2 Networking And Internetworking: Types Of Network, Network Principles, Internet Protocols, Case Studies: Ethernet, Wifi And Bluetooth. Interprocess Communication: The Api For The Internet Protocols, External Data Representation And Marshalling, Multicast Communication, Network Virtualization: Overlay Networks, JAVA RMI: Creating Distributed Applications Using RMI and JDBC: Understanding Remote Method Invocation (RMI), Creating a Multitier Database Application Using RMI. Case Study: MPI Name Services: Name services and the Domain Name System, Directory services, Case study: The Global Name Service, Case study: The X.500 Directory Service. Time And Global States: Clocks, events and process states , Synchronizing physical clocks , Logical time and logical clocks, Global states, Distributed debugging Coordination And Agreement: Distributed mutual exclusion, Elections Coordination and agreement in group communication, Consensus and related problems
3	UNIT 3 Transactions and Concurrency Control: Introduction, Transactions

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	<p>Nested transactions, Locks Optimistic concurrency control. Timestamp ordering, Comparison of methods for concurrency control.</p> <p>Distributed Transactions: Introduction, Flat and nested distributed transactions, Atomic commit process, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.</p> <p>Replication: Introduction, System model and group communication, Fault-tolerant services.</p> <p>Case study: The gossip architecture, CODA</p>
4	UNIT 4
	<p>Peer-to-peer Systems: Introduction, Napster and its legacy, Peer-to-peer – Middleware, Routing overlays.</p> <p>Overlay case studies: Pastry, Tapestry- Distributed File Systems, Introduction, File service architecture, Andrew File system.</p> <p>File System: Features-File model, File accessing models, File sharing semantics Naming: Identifiers, Addresses, Name Resolution, Name Space Implementation, Name Caches, LDAP.</p>
5	UNIT 5
	<p>Distributed Transactions: Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks.</p> <p>Process Management: Process Migration: Features, Mechanism, Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach.</p> <p>People Skills and Team Composition Introduction, Individual Skills, Test Team Dynamics, Fitting Testing within an Organization, Motivation, Communication.</p>

Reference Books

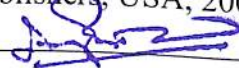
Distributed Systems

Text books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair , Distributed Systems - Concepts and Design (Unit I-Unit 5)
2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.(Unit 5)
3. Dynamic Web Programming : using Java, JavaScript, and Informix / Graham Harrison. 2000 ISBN: 0130861847.
<http://catalogue.pearsoned.co.uk/samplechapter/0130861847.pdf> (Unit 2)

Reference books:

1. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
2. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
3. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.



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Practical Distributed Systems (2017PITDS)
(Employability and skill development)

1. Write a program for implementing Client Server communication model.
2. Write a program to show the object communication using RMI.
3. Show the implementation of Remote Procedure Call.
4. Write a program to execute any one mutual exclusion algorithm.
5. Write a program to implement any one election algorithm.
6. Show the implementation of any one clock synchronization algorithm.
7. Write a program to implement two phase commit protocol.
8. Design and develop a distributed Hotel booking application using Java RMI.

A distributed hotel booking system consists of the hotel server and the client machines. The server manages hotel rooms booking information. A customer can invoke the following operations at his machine

- ☐ Book the room for the specific guest
- ☐ Cancel the booking of a guest
- ☐ Enquire the check in date for the specified customer/guest.

9. Design a distributed application using MapReduce which processes a log file of a system. List out the users who have logged for maximum period on the system. Use simple log file from the Internet and process it using a pseudo distribution mode on Hadoop platform.
10. Design and develop a distributed application to find the coolest/hottest year from the available weather data. Use weather data from the Internet and process it using MapReduce.
11. Show the distributed file system implementation with manets in NS2 simulator



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Elective – 1 Foundations of Data Science (2013PITFD)

Course Objectives:

1. The main goal of this course is to help students learn, understand, and practice different techniques used in data science.
2. Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics.
3. Practice problem analysis and decision-making.
4. Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.

Learning Outcome:

After successful completion of course, Learner will be able to understand and apply diverse data representations, visualization and analysis tools.

CO1: Apply principles of Data Science to the analysis of business problems. (Level: Apply)

CO2: Use data mining software to solve real-world problems. (Level: Apply)

CO3: Employ cutting edge tools and technologies to analyze Big Data. (Level: Apply)

CO4: Apply algorithms to build machine intelligence. (Level: Apply)

CO5: Demonstrate use of team work, leadership skills, decision making and organization theory. (Level: Apply)

Sr. No.	Modules / Units
1	UNIT 1 Data Science Technology Stack: Rapid Information Factory Ecosystem, Data Science Storage Tools, Data Lake, Data Vault, Data Warehouse Bus Matrix, Data Science Processing Tools ,Spark, Mesos, Akka , Cassandra, Kafka, Elastic Search, R ,Scala, Python, MQTT, The Future Layered Framework: Definition of Data Science Framework, Cross- Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering Business Layer: Business Layer, Engineering a Practical Business Layer Utility Layer: Basic Utility Design, Engineering a Practical Utility Layer
2	UNIT 2 Three Management Layers: Operational Management Layer, Processing-Stream Definition and Management, Audit, Balance, and Control Layer, Balance, Control, Yoke Solution, Cause-and-Effect, Analysis System, Functional Layer, Data Science Process Retrieve Superstep : Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources
3	UNIT 3

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	Assess Superstep: Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep
4	UNIT 4
	Process Superstep : Data Vault, Time-Person-Object-Location-Event, Data Science Process, Data Science Transform Superstep : Transform Superstep, Building a DataWarehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test
5	UNIT 5
	Transform Superstep: Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Networks, Clusters, and Grids, Data Mining, Pattern Recognition, Machine Learning, Bagging Data, Random Forests, Computer Vision (CV) , Natural Language Processing (NLP), Neural Networks, TensorFlow. Organize and Report Supersteps : Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference

Reference Books

Foundations of Data Science

Reference books:

1. Practical Data Science Andreas François Vermeulen APress 2018
2. Principles of Data Science Sinan Ozdemir PACKT 2016
3. Data Science from Scratch Joel Grus O'Reilly 2015
4. Data Science from Scratch first Principle in python Joel Grus Shroff Publishers 2017
5. Experimental Design in Data science with Least Resources N C Das Shroff Publishers 2018

Foundations of Data Science Practical (2017PITFD)

(Employability and skill development)

1. Setup and Use NumPy and Panda for Data Analysis.
2. Setup and Use Matplotlib for Data Visualisation.
3. Perform Linear Regression on the given Dataset.
4. Perform Logistic Regression on the given Dataset.
5. Perform K-means clustering on the given Dataset.
6. Perform Time Series Analysis on the given Dataset.
7. Perform Hypothesis Testing on the given Dataset.
8. Perform Decision Tree Classification on the given Dataset.
9. Create a handwritten digit classification model.
10. Create an image classifier in python.


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Core 2: Machine Learning (2012PITML)

Course Objectives:

1. Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics.
2. Practice problem analysis and decision-making.
3. Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.
4. To introduce students to the basic concepts and techniques of Machine Learning.
5. To develop skills of using recent machine learning software for solving practical problems.

Learning Outcome:

After successful completion of this course, Learners will be able to:

CO1: Demonstrate the fundamental issues and challenges of machine learning (Level: Understand)

CO2: Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions. (Level: Apply)

CO3: Demonstrate knowledge of statistical data analysis techniques utilized in business decision making. (Level: Understand)

CO4: Apply principles of Machine Learning to the analysis of business problems. (Level: Analyze)

CO5: Use appropriate software to model real-world problems and suggest solutions (Level: Create)

Sr. No.	Modules / Units
1	UNIT 1 Unit I: Learning-Standard Linear methods Statistical Learning: What Is Statistical Learning, Assessing Model Accuracy. Linear Regression: Simple Linear Regression, Multiple Linear Regressions, Other Considerations in the Regression Model, The Marketing Plan, Comparison of Linear Regression with K-Nearest Neighbors. Classification: An Overview of Classification, Why Not Linear Regression? , Logistic Regression, Linear Discriminant Analysis, a Comparison of Classification Methods.
2	UNIT 2 Unit II: Selection and improvements of linear learning methods Resampling Methods: Cross-Validation, The Bootstrap. Linear Model Selection and Regularization: Subset Selection, Shrinkage Methods, Dimension Reduction Methods, Considerations in High Dimensions.
3	UNIT 3 Unit III: Non-Linear Learning methods Polynomial Regression, Step Functions, Basis Functions, Regression Splines, Smoothing Splines, Local Regression, Generalized Additive

	Models, Tree-Based Methods: The Basics of Decision Trees. Bagging, Random Forests, Boosting.
4	UNIT 4
	Unit IV: Support Vector machines, Principle Component Analysis and Clustering Support Vector Machines: Maximal Margin Classifier. Support Vector Classifiers: Support Vector Machines, SVMs with More than Two Classes Relationship to Logistic Regression.
5	UNIT 5
	Unit V : Unsupervised Learning: The Challenge of Unsupervised Learning, Principal Components Analysis, Clustering Methods: K-Means Clustering, Hierarchical Clustering, Practical Issues in Clustering.

Reference Books

Machine Learning

Text book:

1. An Introduction to Statistical Learning with Applications in R: Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer 2013.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction (Second Edition): Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer (2008).

References :

1. Introduction to Machine Learning (Second Edition): Ethem Alpaydin, The MIT Press (2010).
2. Pattern Recognition and Machine Learning: Christopher M. Bishop, Springer (2006)
3. Bayesian Reasoning and Machine Learning: David Barber, Cambridge University Press (2012)
4. Machine Learning: The Art and Science of Algorithms that Make Sense of Data: Peter Flach, Cambridge University Press (2012) Machine Learning for Hackers: Drew Conway and John Myles White, O'Reilly (2012)
5. Machine Learning in Action: Peter Harrington, Manning Publications (2012).
6. Machine Learning with R: Brett Lantz, Packt Publishing (2013)
7. <https://class.coursera.org/ml-005/lecture/preview>
8. <https://github.com/josephmisiti/awesome-machine-learning>.



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Machine Learning Practical (2016PITML)
(Employability and skill development)

Note: Use R software to do the following

1. Implement simple linear regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Boston, Auto etc]
2. Implement multiple regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Carseats, Boston etc].
3. Fit a classification model using following: (i) logistic regression (ii) Linear Discriminant Analysis (LDA) and (iii) Quadratic Discriminant Analysis (QDA) on a standard data set and compares the results. [Inbuilt datasets like Smarket, Weekly, Auto, Boston etc may be used for the purpose].
4. Fit a classification model using K Nearest Neighbour (KNN) Algorithm on a given data set. [One may use data sets like Caravan, Smarket, Weekly, Auto and 34 Boston].
5. Use bootstrap to give an estimate of a given statistic. [Datasets like Auto, Portfolio and Boston etc may be used for the purpose].
6. For a given data set, split the data into two training and testing and fit the following on the training set: (i) Linear model using least squares (ii) Ridge regression model (iii) Lasso model (iv) PCR model (v) PLS model Report test errors obtained in each case and compare the results. [Data sets like College, Boston etc may be used for the purpose].
7. For a given data set, perform the following: (i) Perform the polynomial regression and make a plot of the resulting polynomial fit to the data. (ii) Fit a step function and perform cross validation to choose the optimal number of cuts. Make a plot of the fit to the data. [Use data set like Wage for the purpose].
8. For a given data set, do the following: (i) Fit a classification tree (ii) Fit a regression tree [One may choose data sets like Carseats, Boston etc for the purpose].
9. For a given data set, split the dataset into training and testing. Fit the following models on the training set and evaluate the performance on the test set: (i) Boosting (ii) Bagging (iii) Random Forest [Data sets like Boston may be used for the purpose].
10. Fit a support vector classifier for a given data set. [Data sets like Car, Khan, Boston etc may be used for the purpose].
11. Perform the following on a given data set: (i) Principal Component Analysis (ii) Hierarchical clustering. [Data set like NC160, USArrests etc may be used for the purpose].

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**Syllabus Of Course of
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(MSC IT) Programme**

Part I

Semester I

Under Academic Autonomy and Credit, Grading and Semester System

(To be implemented during Academic Year- 2020-21)

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Core 1: Research in Computing (2011PITRC)

Course Objectives:

1. To inculcate research aptitude by providing basic understanding in the research methodology
2. To be able to conduct business research with an understanding of all the latest theories.
3. To develop the ability to explore research techniques used for solving any real world or innovate problem
4. To develop analytical skills by applying scientific methods.

Learning Outcome:

Upon completion of this course, learner should be able to:

CO1: Solve real world problems with scientific approach. (Level: Apply)

CO2: Recognize, understand and apply the language, theory and models of the field of business analytics (Level: Apply)

CO3: Critically analyze, synthesize and solve complex unstructured business problems (Level: Analysis and Apply)

CO4: Apply the concepts and methods of business analytics identify, model and solve decision problems in different settings (Level: Create)

CO5: Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity. (Level: Analyse and Evaluate)

CO6: Create viable solutions to decision making problems (Level: Create)

Sr. No.	Modules / Units
1	UNIT 1 Introduction: Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and issues
2	UNIT 2 Beginning Stages of Research Process: Problem definition, Qualitative research tools, Secondary data research
3	UNIT 3 Research Methods and Data Collection: Survey research, communicating with respondents, Observation methods, Experimental research
4	UNIT 4 Measurement Concepts, Sampling and Field work: Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size
5	UNIT 5 Data Analysis and Presentation: Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis



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and differences between two variables. Multivariate Statistical Analysis

Reference Books

Research in Computing

Reference books:

1. Business Research Methods, William G.Zikmund, B.J Babin, J.C. Carr Atanu Adhikari, Cen gage 8e, 2016.
2. Business Analytics AlbrightWinston, Cengage 5e, 2015
3. Research Methods for Business Students Fifth Edition Mark Saunders 2011
4. Multivariate Data Analysis Hair Pearson 7e, 2014

Research in Computing Practical (2015PITRC)

(Employability and skill development)

1. (a) Write a program for obtaining descriptive statistics of data. (b) Import data from different data sources (from Excel, csv, mysql, sql server, oracle to R/Python/Excel)
2. (a) Design a survey form for a given case study, collect the primary data and analyze it (b) Perform suitable analysis of given secondary data.
3. (a) Perform testing of hypothesis using one sample t-test. (b) Perform testing of hypothesis using two sample t-test. (c) Perform testing of hypothesis using paired t-test.
4. (a) Perform testing of hypothesis using chi-squared goodness-of-fit test. (b) Perform testing of hypothesis using chi-squared Test of Independence
5. Perform testing of hypothesis using Z-test.
6. (a) Perform testing of hypothesis using one-way ANOVA. (b) Perform testing of hypothesis using two-way ANOVA. (c) Perform testing of hypothesis using multivariate ANOVA (MANOVA).
7. (a) Perform the Random sampling for the given data and analyse it. (b) Perform the Stratified sampling for the given data and analyse it.
8. Compute different types of correlation.
9. (a) Perform linear regression for prediction. (b) Perform polynomial regression for prediction.
10. (a) Perform multiple linear regression. (b) Perform Logistic regression.

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Semester II

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Elective – 3 Foundations of Big Data (2013PITBD)

Objectives:

1. To learn, understand, and practice different techniques used in big data analysis.
2. To understand the concept of big data
3. To Formulate big data analysis
4. To implement Hadoop and map reduce

Learning Outcome:

After successful completion of course, Learner will be able to:

CO1: Describe the significance of privacy and ethics in big data environment (Level: Understand)

CO2: Analyze the steps to secure big data. (Level: Analyze)

CO3: Build security in Hadoop environment and its ecosystem. (Level: Create)

CO4: Analyze data security and event logging in Hadoop environment (Level: Analyze)

CO5: Compare various application business models of different domains. (Level: Analyze and Apply)

Sr. No.	Modules / Units
1	UNIT 1
	Introduction to Big Data, Characteristics of Data, and Big Data, Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Data Warehouse environment, Traditional Business Intelligence versus Big Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Examples of big Data Analytics. Big Data Analytics, Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics Life Cycle
2	UNIT 2
	Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models.
3	UNIT 3
	Analytical Theory and Methods: Classification, Decision Trees, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods, Time Series Analysis, Box Jenkins methodology, ARIMA Model, Additional methods. Text Analysis, Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing Documents by Topics.

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	Determining Sentiments
4	UNIT 4
	Data Product, Building Data Products at Scale with Hadoop, Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, Working with Distributed file system, Working with Distributed Computation, Framework for Python and Hadoop Streaming, Hadoop Streaming, MapReduce with Python
5	UNIT 5
	Advanced MapReduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications, Distributed Analysis and Patterns, Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data Ingestion, Importing Relational data with Sqoop, Ingesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher level APIs.

Reference Books

Foundations of Big Data

Reference books:

1. Big Data and Analytics Subhashini Chellappan, Seema Acharya, Wiley First Ed.
2. Data Analytics with Hadoop An Introduction for Data Scientists, Benjamin Bengfort and Jenny Kim, O'Reilly 2016
3. Big Data and Hadoop , V.K Jain Khanna Publishing, First Ed. 2018

Foundations of Big Data Practical (2027PITBD)

(Employability and skill development)

1. Install and Setup MongoDB. Also, perform CRUD operations on the given dataset.
2. Implement Apriori algorithm to find the underlying patterns in the given dataset.
3. Create a model to classify the underlying dataset into different groups.
4. Implement Naive Bayes classifier.
5. Create a model to cluster the underlying dataset.
6. Setup and install Hadoop.
7. Implement the Map Reduce framework to solve a given problem.
8. Explore and execute different commands on the Hadoop Distributed File System.
9. Explore and execute different commands on Hive.



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Elective-4 Optimization Techniques (2024PITOT)

Course Objectives:

1. To develop a knowledge in the field of optimization techniques their basic concepts, principles, linear programming and queuing theory
2. Understand importance of optimization of industrial process management
3. Apply basic concepts of mathematics to formulate an optimization problem
4. Analyse and appreciate variety of performance measures for various optimization problems

Learning Outcome:

At the end of this course learner will be able to:

CO1: Demonstrate the concept of optimization and classification of optimization problems (Level: Understand)

CO2: Formulate simplex method variable with upper bounds (Level: Create)

CO3: explain the Queuing Model, poisson and exponential distributions (Level: Understand)

CO4: implement the maximization and minimization of convex functions (Level: Apply)

CO5: demonstrate equality constraints, inequality constraints (Level: Understand)

Sr. No.	Modules / Units
1	UNIT 1 Introduction to Linear programming Problems: Concept of optimization – classification of optimization – problems. Examples of linear programming problems – formulation simplex methods variable with upper bounds
2	UNIT 2 Linear Programming: Principle duality -dual simplex method - sensitivity analysis – revised simplex procedure – solution of the transportation problem – assignment – network minimization – shortest route problem – maximal two problem – L.P. representation of networks.
3	UNIT 3 Queuing Theory: Queuing Model, poisson and exponential distributions - Queues with combined arrivals and departures-random and series queues.
4	UNIT 4 Unconstrained Optimization: Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convergence – univariate search – steepest and descent methods- Fletcher reeves method -conjugate gradient method.
5	UNIT 5 Constrained Optimization: Necessary and sufficient condition – equality constraints, inequality constraints -kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of

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sibel directions.

Reference Books

Optimization Techniques

Text books:

1. Rao S. S, "Optimization – Theory and applications", Wiley Easter Ltd., 1979.

Reference books:

1. David G.Luerbeggan, "Introduction to Linear and Non Linear Programming", Addison Wesley Publishing Co. 1973.
2. Hadley G. "Nonlinear and – dynamic programming" Addison Wesley Publishing Co. 1964.
3. Cordan C.C. Beveridge and Robert S. Schedther, "Optimization, Theory and Practice" McGraw Hill Co.1970.
4. HarndyA.Tahh. "operations Research, An Introduction", Macmillan Publishers Co.NewYork,1982.
5. Beightferand S. others, "Foundations of Optimization Pill", New Delhi, 1979.

Optimization Techniques Practical (2028PITOT) (Employability and skill development)

1. To solve Linear Programming Problem using Graphical Method with (i) multiple constraints (ii) Unbounded solution (iii) Infeasible solution (iv) Alternative or multiple solution
2. Solution of LPP with simplex method.
3. Solution of LPP with unrestricted variables through Simplex method.
4. Problem solving using M-Charnes method.
5. Problem solving using Two Phase method.
6. Illustration of following special cases in LPP using Simplex method (i) Unrestricted variables (ii)Unbounded solution (iii)Infeasible solution (iv)Alternative or multiple solution
7. Problems based on Dual simplex method.
8. Problems based on sensitivity analysis.
9. Implement a queuing model.
10. Implement constraint and unconstrained optimization.



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Core 3: Internship/ Research paper/ mini-project (2021PITRP)

Course Objectives:

1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.
2. To evaluate complex arguments and to articulate their own positions on a range of technical and general topics.

Learning Outcome:

Upon completion of this course, learner should be able to:

CO1: Have an exposure to industrial practices and to work in teams (Level: Apply)

CO2. Communicate effectively (Level: Apply)

CO3. Explain the impact of engineering solutions in a global, economic, environmental and societal context (Level: Understand)

CO4. Develop the ability to engage in research and to involve in life-long learning (Level: Apply and Analyse)

CO5. Formulate solution to contemporary issues (Level: Create)

CO6. Engage in establishing his/her digital footprint (Level: Apply)

Paper Presentation/ Paper Publication (2025PITRP)

(Employability and skill development)

1. Students are required to present a paper in any national/international conference
2. Publish a paper in any national or international peer reviewed journal

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Core 4: Soft Computing

Course Objectives:

1. To introduce students to the basic concepts and techniques of soft computing.
2. Identify and describe soft computing techniques
3. Understand soft computing approaches in problem solving
4. Formulate real-world methodologies to data mining using soft computing tools

Learning Outcome:

After successful completion of course, Learners will be able to:

CO1: Differentiate between soft and hard computing (Level: Understand)

CO2: Implement artificial neural networks and fuzzy logic (Level: Apply)

CO3: Implement supervised and unsupervised learning networks (Level: Apply)

CO4: Demonstrate the suitable soft computing strategy to solve a given problem (Level: Analyse and Apply)

CO5: Demonstrate the advantages and drawbacks of soft computing strategies in problem solving (Level: Analyse and Evaluate)

CO6: Model complex problems using evolutionary algorithms and other soft computing models and compare the performance (Level: Create and Evaluate)

Sr. No.	Modules / Units
1	UNIT 1 Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.
2	UNIT 2 Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloch-Pitts Neuron, Linear Separability, Hebb Network. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Back propagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network. Associative Memory Networks: Autoassociative memory network, heteroassociative memory network
3	UNIT 3 UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propagation networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine, Gaussian

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	Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network
4	UNIT 4
	<p>Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets.</p> <p>Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.</p> <p>Membership Function: features of the membership functions, fuzzification, methods of membership value assignments.</p> <p>Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods.</p> <p>Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.</p>
5	UNIT 5
	<p>Genetic Algorithm: Biological Background, Traditional optimization and search techniques, genetic algorithm and search space, genetic algorithm vs. traditional algorithms, basic terminologies, simple genetic algorithm, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm, Holland classifier systems, genetic programming, advantages and limitations and applications of genetic algorithm.</p>

Reference Books

Soft Computing

References :

1. Artificial Intelligence and Soft Computing, Anandita Battacharya Das, SPD 3rd 2018
2. Principles of Soft computing S.N.Sivanandam , S.N.Deepa, Wiley 3rd 2019
3. Neuro-Fuzzy Computing and Soft J.S.R.Jang, C.T.Sun and E.Mizutani, Prentice Hall of India 2004
4. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S. Rajasekaran, G. A. Vijayalakshami Prentice Hall of India 2004
5. Fuzzy Logic with Engineering Applications Timothy J.Ross McGraw-Hill 1997



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Soft Computing Practical (2026PITSC)
(Employability and skill development)

1. Implement clustering algorithms
2. Write a program of Perceptron Training Algorithm.
3. Write a program to implement Hebb's rule
4. Write a program for Back Propagation Algorithm
5. Generate ANDNOT function using McCulloch-Pitts neural net
6. Generate XOR function using McCulloch-Pitts neural net
7. Write a program for Perceptron net for an AND function with bipolar inputs and targets.
8. Write a program to calculate the weights for the following patterns using hetero-associative neural net for mapping four input vectors to two output vectors
9. Write program to store vector $[-1 \ -1 \ -1 \ -1]$ and $[-1 \ -1 \ 1 \ 1]$ in an auto-associative net. Find weight matrix. Test the net with $[1 \ 1 \ 1 \ 1]$ as input.
10. Implement an unsupervised learning net
11. Write a program to plot various membership functions.
12. Use Fuzzy toolbox to model tip value that is given after a dinner which can be-not good, satisfying, good and delightful and service which is poor, average or good and the tip value will range from Rs. 10 to 100.
13. Implement genetic algorithm functions.
14. Implement Travelling sales person using genetic Algorithm.


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Elective – 3 Cloud Computing (2013PITCC)

Objectives:

1. To study the cloud computing fundamentals and cloud architectures.
2. Understand fundamentals of cloud computing
3. Understand the industrial platforms and cloud architectures
4. Understand the security aspects of cloud computing
5. Implement applications on cloud platforms

Learning Outcome:

At the end of this course learner will be able to:

CO1: Describe the fundamentals of cloud computing and its security. (Level: Understand)

CO2: Analyze risk issues and legal aspects in cloud computing. (Level: Analyse)

CO3: Illustrate various data security methods in cloud computing. (Level: Apply)

CO4: Explore security controls and monitoring in cloud computing. (Level: Analyse)

CO5: Investigate security and evaluation criteria in internal and external cloud. (Level: Analyse)

Sr. No.	Modules / Units
1	UNIT 1 Introduction to Cloud Computing: Introduction, Historical developments, Building Cloud Computing Environments, Principles of Parallel and Distributed Computing: Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples.
2	UNIT 2 Cloud Computing Architecture: Introduction, Fundamental concepts and models, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. Industrial Platforms and New Developments: Amazon Web Services, Google App Engine, Microsoft Azure. Fundamental Cloud Security: Basics, Threat agents, Cloud security threats, additional considerations
3	UNIT 3 Specialized Cloud Mechanisms: Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multi-device broker, State Management Database. Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images

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4	UNIT 4
	Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture.
5	UNIT 5
	Cloud Delivery Model Considerations: Cloud Delivery Models: The Cloud Provider Perspective, The Cloud Consumer Perspective, Cost Metrics and Pricing Models: Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations, Service Quality Metrics and SLAs: Service Quality Metrics, SLA Guidelines

Reference Books

Cloud Computing

Reference books:

1. Mastering Cloud Computing Foundations and Applications Programming, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Elsevier (2013).
2. Cloud Computing Concepts, Technology & Architecture, Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Prentice Hall (2013).
3. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley (2010).
4. Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Kai Hwang, Jack Dongarra, Geoffrey Fox, MK Publishers (2012).

Cloud Computing Practical (2027PITCC) (Employability and skill development)

1. Implement Client Server Communication Model
2. Implement Object Communication using RMI
3. Implement Remote Procedural Call.
4. Implement Xen virtualization and manage with Xen Center
5. Implement virtualization using VMWare ESXi Server and managing with vCenter
6. Implement Windows Hyper V virtualization
7. Develop application for Microsoft Azure
8. Develop application for Google App Engine


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Nagindas Khandwala College (Autonomous)



Syllabus Of Course of Master of Science Information Technology (MSC IT) Programme

Part I

Semester II

Under Academic Autonomy and Credit, Grading and Semester System

(To be implemented during Academic Year- 2020-21)


PRINCIPAL

**NAGINDAS KHANDWALA COLLEGE OF COMMERCE
ARTS & MANAGEMENT STUDIES AND SHANTABEN
NAGINDAS KHANDWALA COLLEGE OF SCIENCE
(PUNE CAMPUS)
MALAD (W), MUMBAI - 400 054**

Elective – 4 Computer Forensic (2013PITCF)

Course Objectives:

1. To learn, understand, and practice different cyber forensic and investigation techniques.
2. Summarize the activities of initial and incident responses.
3. Investigate web server attacks, DNS attacks and router attacks.
4. Describe the techniques related to system investigation.

Learning Outcome:

After successful completion of course, learners will be able to:

CO1: Understand and apply diverse security issues and investigation methods. (Level: Understand)

CO2: Explain the role of digital forensics in the business and private world. (Level: Understand)

CO3: Identify potential sources of electronic evidence and explain the importance. (Level: Understand)

CO4: Recognize current techniques and tools for forensic investigations. (Level: Understand)

CO5: Explain and perform forensic analysis in various fields. (Level: Understand)

CO6: Describe the procedures for virtual, network and mobile device forensics. (Level: Understand)

Sr. No.	Modules / Units
1	UNIT 1 Digital forensics : Locard's exchange principle, code of ethics, digital forensic process models of Lee, Carrier, Casey and Cohen. Framework for digital forensic evidence collection with Chain of Custody (CoC), standard evidence collection procedures (SOP). IPR and cyber laws in India , setting up a forensic laboratory, NIST tools (CFReDS, CFTT and NSLR), debate on exceptional cyber crime case reports and hands-on with open-source tools
2	UNIT 2 Fundamentals of host forensics for unix derivatives - linux operating system forensics, epoch formats and audit mechanisms. Network Sniffing-wireshark and Password Cracking-John the Ripper; Encrypting and Signing Emails: PGP- GPG/openPGP, DKIM and SPF; Single Sign On (SSO)-OAUTH and OPENID; Network packet creation and Manipulation using scapy and dpkt libraries.
3	UNIT 3 Forensic analysis of database systems and identifying database tampering. Slack space forensics, swap space forensics, network device forensics, investigating logs, network traffic and web attacks, mobile device forensics, wireless forensics, anti-forensics, steganography, email

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	investigation, social media forensics, investigating copiers, IVR, DVR and SIM cards.
4	UNIT 4
	Web application security: Security Development Lifecycle - Security Requirements Engineering, Use/Misuse case - Design – Secure Software Development Principles, Threat Modelling – STRIDE. Risk Assessment - DREAD, Common Vulnerabilities and Exploits, CVSS scoring. Web Application Development and Security - OWASP Top10 flaws - Core Defense Mechanisms - Web Application Technologies - Vulnerabilities - OS command injection - Directory traversal - SQL injection - Cross site Scripting (XSS) - Cross site Request Forgery(CSRF) – Click jacking - Web Cache Poisoning - DOM based vulnerabilities - Access Control Vulnerabilities and Privilege Escalation - Cross-origin resource sharing (CORS) -- XML external entity(XXE) injection - - Server-side request forgery (SSRF) - HTTP request smuggling - Web sockets security.
5	UNIT 5
	Machine learning in cyber security: Machine learning for anomaly detection using Probabilistic Learning, Unsupervised learning, Combination learners, Evaluation methods, Hybrid detection. Machine learning for scan detection and Network traffic profiling, Privacy-Preserving Data Mining, Applications in malware analysis and anomaly detection.

Reference Books

Computer Forensic

Reference books:

1. E. Casey, Handbook of Digital Forensics and Investigation, Academic Press, 2010.
2. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, 2012.
3. David Cowen, Computer Forensics: A Beginners Guide, Mc Graw Hill Education, 2013.
4. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, 4th Edition, 2014.
5. C. Kaufman, R. Perlman and M. Speciner, Network Security: Private Communication in a Public World, 2nd Edition, Prentice Hall PTR, 2002.
6. Vincent J. Nestler et. al, Principles of computer security Lab Manual, 4th Edition, McGraw-Hill, 2014
7. Shostack, Adam. Threat modeling: Designing for security. John Wiley & Sons, 2014.
8. Dafydd Stuttard, and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2nd Edition, John Wiley & Sons, 2011.
9. Wenliang Du, Computer Security – A hands-on Approach, First Edition, Createspace Independent Pub, 2017
10. <https://www.owasp.org>
11. D. K. Bhattacharyya and J. K. Kalita, Network Anomaly Detection: A Machine Learning Perspective, 1st Edition, Chapman and Hall/CRC, 2013.

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Computer Forensic Practical (2028PITCF)
(Employability and skill development)

1. Creating a Forensic Image using FTK Imager/Encase Imager :
2. To Use 'nmap' tool to perform vertical and horizontal scanning for checking open and closed ports.
3. To implement cryptographic algorithm using Crypto Tools. for building a secure communication network
4. To exploit the vulnerabilities in a LAN environment to launch attacks : Ettercap/arp spoof tool to perform ARP Cache Poisoning based attacks
5. To analyze the network packet using WIRESHARK
6. To perform the web penetration testing using BURPSUITE
7. To perform vulnerability assessment of wireless devices and audit the same with penetration testing : Perform a VA/PT on your local Wi-Fi network and try automated attacks with NetStumbler and Kismet to gather information wireless network and try attacks like CowPatty and Aircrack-ng.
8. To perform the Log analysis using SPLUNK
9. Mobile & Smart Phone Security Lab Familiarize with Android application .apk files. By performing static and dynamic analysis on the app find the vulnerable application and document the inferences
10. Familiarization with Network testbeds Familiarization with advanced testbed technologies (e.g. Emulab, DETER and PlanetLab, etc.)


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Course Code	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1731PITES	Embedded Systems	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To have knowledge about the basic working of an embedded system, components, and its development life cycle.
2. To provide experience to integrate hardware and software for microcontroller applications systems.
3. To introduce Basics of Real time operating system
4. To understand in detail the design of memory systems and different families of microcontrollers.
5. To write programs in Embedded C language for development of embedded system

Course Outcome:

After successful completion of course, learner will be able to:

CO1: Explain the internal architecture of memory and interfacing of different peripheral devices with Microcontrollers. (Level: Evaluate)

CO2: Identify the need and role of embedded systems in industry. (Level: Analyze)

CO3: Write the programs for 8051 microcontroller using C/Assembly Programming language. (Level: Create)

CO4: Demonstrate the usage of Embedded Systems in real life applications such as traffic signals, elevators, and so on. (Level: Create)

CO5: Create Embedded Projects for industries. (Level: Create)

Sr. No.	Modules / Units
1	<p>UNIT 1</p> <p>Introduction What is an Embedded System, Embedded System Vs, General Computing System.</p> <p>The Typical Embedded System Core of Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware. Characteristic and quality attributes of Embedded System Characteristics of an Embedded System, Quality Attributes of Embedded System.</p> <p>Embedded product development life cycle What is EDLC, Why EDLC? Objectives of EDLC, Different Phases of EDLC.</p>
2	<p>UNIT 2</p> <p>Hardware Software Co-design and Program Modelling Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modelling Language (UML), Hardware Software Trade-offs.</p> <p>Embedded Hardware design and development Analog Electronic Components, Digital Electronic Components, Electronic design</p>


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	Automation (EDA) Tools, The PCB Layout design.
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	<p>Embedded Firmware design and development Embedded Firmware Design Approaches, Embedded Firmware Development Languages</p> <p>Real Time Operating System(RTOS) Operating System Basics, Types of Operating Systems, Device Drivers, How to choose an RTOS</p>
3	UNIT 3
	<p>Memories and Memory Subsystem Introduction, Classifying Memory, A general Memory Interface, ROM Overview, Static RAM Overview, Dynamic RAM Overview, Chip Organization, A SRAM Design, A DRAM Design, The DRAM Memory Interface, The Memory Map, Memory Subsystem Architecture, Basic Concepts of Caching, Design a cache system, Dynamic Memory Allocation, Testing Memories.</p>
4	UNIT 4
	<p>Programming Concept and Embedded Programming in C/C++ and Java Software programming in Assembly Language (ALP) and in High-level Language 'C', C program Elements: Header and Source Files and Pre-processor Directives, Program Elements: Macros and Functions, Program Elements: Types, Data Structures, Modifiers, Statements, Loops and Pointers, Object-Oriented Programming, Embedded Programming in C++, Embedded Programming in Java.</p>
5	UNIT 5
	<p>Trends in the Embedded Industry Processor trends in Embedded System, Embedded OS Trends, Development Language Trends, Introduction of PIC Family of Microcontrollers, Introduction of ARM Family of Microcontrollers, Introduction of AVR Family of Microcontrollers .</p>

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Reference Books

Embedded Systems

Text Books:

1. Introduction to embedded systems Shibu K. V 2nd Edition Tata McGraw-Hill
2. Embedded Systems Architecture, Programming and Design Raj Kamal 2nd Edition Tata McGraw-Hill
3. Embedded Systems: A Contemporary Design Tool. James K. Peckol 1st Edition Wiley Edition

Practical (1735PITES)

(Skill development & Employability)

1. Compulsory.

Study of hardware components

1. 8051 Microcontroller
2. Resistors (color code, types)
3. Capacitors
4. ADC, DAC
5. Operational Amplifiers
6. Transistors, Diode, Crystal Oscillator
7. Types of Relays
8. Sensors
9. Actuator
10. Types of connectors
2. WAP to blink an LED
3. WAP block transfer of data
4. WAP to serial data interface
5. WAP for the keypad and LCD interface
6. Implement mouse driver program using MSDOS interrupt
7. WAP to implement ADC0808 with 8051 microcontroller
8. WAP to simulate elevator functions
9. WAP to interface stepper motor controller
10. WAP to simulate traffic signals.



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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1732PITIS	Information Security Management	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To provide an understanding of principal concepts, major issues, technologies and basic approaches in information security.
2. To master information security governance, and related legal and regulatory issues.
3. To be familiar with how threats to an organization are discovered, analyzed, and dealt with.
4. To be familiar with network security threats and countermeasures
5. To use different tools used for network monitoring and security.

Course Outcomes:

On successful completion of the course, learner will be able to:

CO1: Explain advanced security issues and technologies (such as DDoS attack detection and containment, and anonymous communications,) (Level: Understand)

CO2: Gain familiarity with prevalent network and distributed system attacks, defences against them and forensics to investigate the aftermath. (Level: Apply)

CO3: Develop a basic understanding of cryptography, how it has evolved and some key encryption techniques used today. (Level: Evaluate)

CO4: Develop an understanding of security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges. (Level: Apply)

CO5: Use different tools used for network monitoring and security. (Level: Create)

Sr. No.	Modules / Units
1	UNIT 1
	Security Risk Assessment and Management: Introduction to Security Risk Management. Reactive and proactive approaches to risk management. Risk assessment, quantitative and qualitative approaches and asset
	classification - Security Assurance Approaches: Introduction to OCTAVE and COBIT approaches

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2	UNIT 2
	Security Management of IT Systems: Network security management. Firewalls, IDS and IPS configuration management. Web and wireless security management. General server configuration guidelines and maintenance. Information Security Management Information classification. Access control models, role-based and lattice models. Mandatory and discretionary access controls. Linux and Windows case studies. Technical controls, for authentication and confidentiality. Password management and key management for users. Case study: Kerberos
3	UNIT 3
	Key Management in Organizations: Public-key Infrastructure. PKI Applications, secure email case study(S/ MIME or PGP). Issues in public-key certificate issue and lifecycle management - Management of IT Security Infrastructure; Computer security log management, malware handling and vulnerability management programs. Specifying and enforcing security policies
4	UNIT 4
	Auditing and Business continuity Planning: Introduction to information security audit and principles of audit. Business continuity planning and disaster recovery. Case study: 9/11 tragedy. Backup and recovery techniques for applications and storage.
5	UNIT 5
	Computer forensics: techniques and tools. Audit Tools: NESSUS and NMAP. Information Security Standards and Compliance: Overview of ISO 17799 Standard. Legal and Ethical issues.



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Reference Books

Information Security Management

Text book:

1. IT Security and Risk Management (Main reference) Slay, J. and Koronios, A., 2006 Wiley
2. Incident Response and Computer Forensics. Chris Prosise and Kevin Mandia, 2003. McGraw-Hill
3. Information Systems Security-Security Management, Metrics, Frameworks and Best Practices, Nina Godbole Wiley, 2009
4. Information Security Policies, Procedures, and Standards: Guidelines for Effective Information Security Management (Paperback) 1st edition Auerbach, 2001

Practical (1736PITIS) (Skill development & Employability)

1. Working with Sniffers for monitoring network communication (Ethereal)
2. Using open SSL for web server - browser communication
3. Using GNU PGP
4. Performance evaluation of various cryptographic algorithms
5. Using IP TABLES on Linux and setting the filtering rules
6. Configuring S/MIME for e-mail communication
7. Understanding the buffer overflow and format string attacks
8. Using NMAP for ports monitoring
9. Implementation of proxy based security protocols in C or C++ with features like confidentiality, integrity and authentication Socket programming
10. Exposure to Client Server concept using TCP/IP, blowfish, Pretty Good Privacy.



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Course Code	Course	Hrs. of Instruction/Week	Exam Duration (Hours)	Maximum Marks			Credits
				C I E	SE E	Total	
1733PITNN	Elective 2 Artificial Neural Network	3	2 1/2 Hours	25	75	100	4

Course Objectives:


1. To introduce the neural networks for classification and regression.
2. To give design methodologies for artificial neural networks.
3. To offer neural network implementations in R Programming
4. To demonstrate neural network applications on real-world tasks.
5. To understand fuzzy systems

Course Outcomes:

After successful completion of the course, learner will be able to:

- CO1: Explain the differences between networks for supervised and unsupervised learning; (Level: Understand)
 CO2: Design single and multi-layer feed-forward neural networks. (Level: Apply)
 CO3: Analyze Program linear and nonlinear models for data mining; (Level: Analyze)
 CO4: Analyze the performance of neural networks. (Level: Analyze)
 CO5: Describe the fuzzy systems (Level: Create)

Sr. No.	Modules / Units
1	UNIT 1 The Brain Metaphor, Basics of Neuroscience, Artificial Neurons, Neural Networks and Architectures
2	UNIT 2 Geometry of Binary Threshold Neurons and Their Networks , Supervised Learning I: Perceptrons and LMS, Supervised Learning II: Backpropagation and Beyond
3	UNIT 3



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	Neural Networks: A Statistical Pattern Recognition Perspective , Statistical Learning Theory, Support Vector Machines and Radial Basis Function Networks
4	UNIT 4
	Dynamical Systems Review, Attractor Neural Networks, Adaptive Resonance Theory
5	UNIT 5
	Towards the Self-organizing Feature Map, Fuzzy Sets and Fuzzy Systems , Evolutionary Algorithms

Reference Books	
Artificial Neural Network	
Reference books:	
<ol style="list-style-type: none"> 1. Neural Networks, A Classroom Approach Satish Kumar 2nd Edition McGraw Hill 2. Artificial Neural Networks Robert Schalkoff McGraw Hill 3. Introduction to Neural Networks using MATLAB S Sivanandam,S Sumathi McGraw Hill 	

Comment [1]: Focusses on employability

Practical (1737PITNN) (Skill Development & Employability)	
<ol style="list-style-type: none"> 1. Show the Functioning of artificial neural network (Implement all hidden layer functions). 2. Demonstrate non-separable two input perceptron cannot be classified using: $P=[-0.8 \ -0.8 \ 0.3 \ 1.0 \ 0.7; \ -0.8 \ 0.8 \ -0.4 \ -1.0 \ -0.7]$; and Target $T=[1 \ 0 \ 1 \ 0 \ 1]$ 3. Use perceptron learning rule to find final weights of a neural network using fixed input vectors and a fixed target vector. 4. Prediction using neural network. 5. Implement Radial Basis Function. 6. Implement Least Mean Square Algorithm. 7. Implement Support Vector Machine Algorithm. 8. Create and train a feed forward back propagation network with a supplied Input P and Target T. 9. Design a Hopfield network consisting of two neurons with two stable equilibrium points. 10. Perform defuzzification using the following methods: <ul style="list-style-type: none"> Centroid Bisector Smallest of Maximum Largest of Maximum 	
All practicals can be done using R / Matlab	


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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1734PITIP	Elective 2: Digital Image Processing	3	2 ½ hrs	25	75	100	4

Course Objective:

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques
3. To study image restoration procedures.
4. To study the image compression procedures.
5. To introduce fundamentals of image processing

Course Outcomes:

After successful completion of course, learners will be able to:

CO1: Review the fundamental concepts of a digital image processing system. (Level: Understand)

CO2: Analyze images in the frequency domain using various transforms. (Level: Analyze)

CO3: Evaluate the techniques for image enhancement and image restoration. (Level: Evaluate)

CO4: Categorize various compression techniques. (Level: Create)

CO5: Able to apply geometrical transformation on 2D and 3D objects (Level: Create)

Sr. No.	Modules / Units
1	<p>UNIT 1</p> <p>Introduction to image processing, Example of fields that uses image processing, Steps of image processing, Components, Applications, Image sensors and image formats</p>
	<p>Visual Preliminaries Brightness adaptation and contrast, Acuity and contour, Texture and pattern discrimination, Shape detection and recognition, perception of colour, Computational model of perceptual processing, Image sampling and quantization, Basic relationships between pixels</p>
2	<p>UNIT 2</p>



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	<p>Intensity transformations Introduction, Some basic intensity transformation functions, Histogram equalization, local histogram processing, Using histogram statistics for image enhancement,</p> <p>Spatial filtering Fundamentals of spatial filtering, Smoothing and Sharpening spatial filters, Combining spatial enhancement methods, Using fuzzy techniques for intensity transformations and spatial filtering</p>
3	UNIT 3
	<p>Colour image processing Colour fundamentals, Colour models, Pseudocolour image processing, Basic of full-colour image processing, Colour transformations, Smoothing and Sharpening, Image segmentation bases on colour, Noise in colour images, Colour image compression</p> <p>Image Compression Fundamentals, Some basic methods, Digital image watermarking, Full motion video compression</p>
4	UNIT 4
	<p>Morphological Image Processing Introduction, Erosion and Dilation, Opening and Closing, The Hit-or-Miss transformation, Some basic morphological algorithms, Gray scale morphology</p> <p>Segmentation Fundamentals, Point, Line, and Edge detection, Thresholding, Region based segmentation, Segmentation using morphological watersheds, The use of motion in segmentation- Spatial techniques.</p>
5	UNIT 5
	<p>Representation and Description Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Relational Descriptors</p> <p>Object Recognition Patterns and pattern classes, Recognition based on decision theoretic methods, Structural methods</p>



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Reference Books

Digital Image Processing

Reference books:

1. Digital Image Processing Gonzalez and Woods 3rd Edition Pearson Education
2. Digital Image Processing and Analysis Bhabatosh Chanda, Dwijesh Dutta Majumder 2nd Edition PHI
3. Fundamentals of Digital Image Processing Anil K. Jain 1st Edition PHI

Practical (1738PITIP) (Skill development & Employability)

Note:

1. All the practical can be done in C, C++, Java or Matlab, R
 2. The use of built-in functions in image processing toolbox in Matlab except the following is not allowed.
Imshow, Imread, Imdilate, Imerode
 3. The use of all other built-in functions for matrix operations and mathematical operations are allowed.
 4. Use grey level and color images or image matrices as input to all the programs.
-
1. WAP to study the effects of reducing the quantization values and spatial resolution
 2. Image enhancement
 - A. Thresholding
 - B. Contrast Adjustment
 - C. Brightness adjustment
 - D. Grey level slicing
 3. Basic Transformation
 - A. Log Transformation
 - B. Power law transformation
 - C. Negation
 4. Different Filters (LPF, HPF, Laplacian, LOG etc.)

To generate mask for LOG use the following formula

 - A. Write a program to apply a mask on the image
 - a. Accept the size of mask from the user.
 - b. Check whether the mask is of odd size.
 - c. The program should work for any high pass and low pass mask.
 - d. Check the sum of all the elements of the mask. For low pass filter the sum should be one and zero for high pass filter.
 - e. Compare the output for different size of masks
 5. A. Write a program to plot a Histogram
 - B. Write a program to apply Histogram equalization.


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6. Write a program to apply Gaussian filter on an image.
 - a. Write a code to generate a Gaussian mask and then apply the mask on the image.
 - b. Accept the size of mask and the sigma value from the user to generate a mask.
7. Apply following morphological operations on the image:
 - Opening
 - Closing
 - Morphological gradient
 - Top-hat transformationWrite a program for boundary detection
8. WAP to show RGB planes
9. WAP to convert
 - RGB to NTSC
 - RGB to YCbCr
 - RGB to CMY
 - RGB to HIS
10. WAP to achieve Pseudo coloring



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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1734PITEH	Elective 2: Ethical Hacking	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To understand the technical foundation of cracking and ethical hacking, aspects of security, importance of data gathering, foot printing and system hacking.
2. To perform evaluation of computer security
3. To understand the meaning of different virus attacks.
4. To reinforce and apply theory to encourage an analytical and problem-based approach to ethical hacking
5. To perform Cryptography

Course Outcome:

After successful completion of course, learners will be able to do:

CO1: Identify and analyze the stages an ethical hacker requires to take in order to compromise a target system. (Level: Understand)

CO2: Identify tools and techniques to carry out penetration testing. (Level: Understand)

CO3: Critically evaluate security techniques used to protect system and user data. (Level: Apply)

CO4: Describe various virus attacks (Level: Evaluate)

CO5: Perform Cryptography on given data (Level: Evaluate)

Sr. No.	Modules / Units
1	UNIT 1 Introduction to Ethical Hacking, Footprinting and Reconnaissance, Scanning Networks, Enumeration
2	UNIT 2 System Hacking, Trojans and Backdoors, Viruses and Worms, Sniffing
3	UNIT 3 Social Engineering, Denial of Service, Session Hijacking, Hacking

	Webservers
4	UNIT 4
	Hacking Web Applications, SQL Injection, Hacking Wireless Networks, Hacking Mobile Platforms
5	UNIT 5
	Evading IDS, Firewalls and Honeypots, Buffer Overflows, Cryptography, Penetration Testing

Reference Books

Ethical Hacking

Reference books:

1. Ethical Hacking Review Guide Kimberly Graves **Wiley Publishing**
2. Ethical Hacking Ankit Fadia 2nd Edition Macmillan India Ltd, 2006
3. Insider Computer Fraud Kenneth C.Brancik 2008 Auerbach Publications Taylor & Francis Group

Practical (1738PITEH) (Skill development & Employability)

Using the tools for whois, traceroute, email tracking, google hacking.
Using the tools for scanning network, IP fragmentation, war dialing countermeasures, SSL Proxy, Censorship circumvention.
Using NETBIOS Enumeration tool, SNMP Enumeration tool, LINUX/ UNIX, enumeration tools, NTP Enumeration tool, DNS analyzing and enumeration tool.
Using System Hacking tools.
Study of backdoors and Trojan tools
Study of sniffing tools
Study of Denial of Service attack tools
Study of Hijacking tools
Study of webserver attack tools.
Study of SQL injection and Web server tools
Study of wireless hacking tools
Using cryptanalysis tool.
Study of different security tools.



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Part II

Semester III

Under Academic Autonomy and Credit, Grading and Semester System

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Course Code	Course	Hrs. of Instruction/Week	Exam Duration (Hours)	Maximum Marks			Credits
				C I E	SE E	Total	
1733PITVR	Elective 1 Virtualization	3	2 1/2 Hours	25	75	100	4

Course Objectives:


1. To understand the basics of virtualization, and types of virtualizations.
2. To understand and implement Server Virtualization
3. To understand and implement Network Virtualization
4. To understand and implement Storage Virtualization
5. To have knowledge about next generation techniques - blades virtualization.

Course Outcomes:

After successful completion of this course, learners will be able to:

- CO1: Explain the concepts of virtualization along with its types. (Level: Analyze)
CO2: Create different types of server virtualization like ESXi, Xen and so on. (Level: Create)
CO3: Explain and implement blade server with Cisco UCS/HP eva simulator (Level: Apply)
CO4: Describe the functionalities of Firewalls (Level: Understand)
CO5: Describe the Blade Virtualization Technique and its architecture. (Level: Understand)

Sr. No.	Modules / Units
1	<p>UNIT 1</p> <p>OVERVIEW OF VIRTUALIZATION</p> <p>Basics of Virtualization - Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-level or Operating Virtualization – Application Virtualization-Virtualization Advantages – Virtual Machine Basics – Taxonomy of Virtual machines - Process Virtual Machines – System Virtual Machines – Hypervisor - Key Concepts</p>
2	<p>UNIT 2</p>


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	<p>SERVER CONSOLIDATION</p> <p>Hardware Virtualization – Virtual Hardware Overview - Server Virtualization – Physical and Logical Partitioning - Types of Server Virtualization – Business cases for Server Virtualization – Uses of Virtual server Consolidation – Planning for Development – Selecting server Virtualization Platform</p>
3	<p>UNIT 3</p>
	<p>NETWORK VIRTUALIZATION</p> <p>Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design – WAN Architecture - WAN Virtualization - Virtual Enterprise Transport Virtualization–VLANs and Scalability - Theory Network Device Virtualization Layer 2 - VLANs Layer 3 VRF</p> <p>Instances Layer 2 - VFIs Virtual Firewall Contexts Network Device Virtualization - Data-Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation - IPsecL2TPv3 Label Switched Paths - Control-Plane Virtualization–Routing Protocols- VRF - Aware Routing Multi-Topology Routing.</p>
4	<p>UNIT 4</p>
	<p>VIRTUALIZING STORAGE</p> <p>SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables –Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual tape libraries</p>
5	<p>UNIT 5</p>
	<p>Blades and Virtualization — Building Blocks for Next-Generation Data Centers,Evolution of Computing Technology — Setting the Stage,Evolution of Blade and Virtualization Technologies,Blade Architecture,Assessing Needs — Blade System Hardware Considerations</p>


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Reference Books

ELECTIVE 1:- Virtualization

Reference books:

1. Mastering_VMware_vSphere_5.5 Sybex Publication
2. Configuring Windows Server Virtualization Microsoft Press
3. Citrix.XenServer.6.0.Administration.Essential.Guide Feb.2007 Packtpub.
4. Blade.Servers.and.Virtualization. Wiley.
5. Virtualization:A Beginner's Guide
6. Professional Xen Virtualization William von Hagen January, 2008. Wrox Publications
7. Virtualization: From the Desktop to the Enterprise Chris Wolf , Erick M. Halter 2005. APress
8. VMware and Microsoft Platform in the Virtual Data Center 2006 Auerbach
9. Network virtualization . Kumar Reddy, Victor Moreno July, 2006 Cisco Press

Practical (1737PITVR)

(Skill development & Employability)

1. Implement vmware ESXi for server virtualization
2. Implement XEN for server virtualization
3. Implement Hyper-V server virtualization
4. Manage vmware ESXi with vCentre server
5. Manage xen server Xen center
6. Understanding blade server with cisco UCS/HP eva simulator
7. Implement vlan concept with L2/L3 switches/nexus virtual switching
8. Simulating SAN with navisphere/netapps



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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				C I E	SE E	Total	
1744PITIP	Elective 2: Advanced Image Processing	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To study the image fundamentals and mathematical transforms necessary for image processing based on frequencies.
2. To study the image enhancement techniques
3. To study medical images.
4. To study the feature extraction procedures.

Course Outcome:

After successful completion of course, learners will be able to:

CO1: Explain the fundamental concepts of a digital image processing system in the frequency domain. (Level: Understand)

CO2: Analyze images in the frequency domain using various transforms. (Level: Analyse)

CO3: Implement image enhancement techniques on medical images. (Level: Analyse and Apply)

CO4: Implement feature extractions from an image. (Level: Analyse and Apply)

Sr. No.	Modules / Units
1	<p>UNIT 1</p> <p>Enhancement in Frequency domain Introduction, 2-D Discrete Fourier Transform, Properties of Fourier transform, Basic filtering in the frequency domain, Smoothing and Sharpening filters, FFT algorithm. Discrete cosine transform (DCT), KL (PCT) transform, HAAR, Basics of wavelets.</p> <p>Remote Sensing Introduction (Passive and Active sensing), Electromagnetic remote sensing process, Physics of radiant energy, Energy source and its characteristics, Atmospheric interactions with electromagnetic radiation, Energy interaction with Earth's surface materials.</p>


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2	UNIT 2
	<p>Microwave Remote Sensing Introduction, The Radar principle, Factors affecting microwave measurements, Radar wavebands, Side looking airborne (SLAR) systems, Synthetic Aperture Radar (SAR), Polarimetric SAR (PolSAR), Interaction between microwaves and Earth's surface, Interpreting SAR images, Geometric characteristics.</p> <p>Remotes Sensing Platforms and Sensors Introduction, Satellite system parameters, Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal resolution, Imaging sensor systems (thermal, multispectral and microwave imaging), Earth resources satellites, Meteorological satellites, Satellites carrying microwave sensors, OCEASAT-1, IKONOS, Latest trends in remote sensing platforms and sensors (weather, land observation and marine satellites).</p>
3	UNIT 3
	<p>Image Analysis Introduction, Visual interpretation, Elements of visual interpretation, Digital processing, Pre-processing, Enhancement, Transformations, Classification, Integration, Classification accuracy assessment.</p> <p>Applications Introduction, Agriculture, Forestry, Geology, Hydrology, Sea Ice, Land cover, Mapping, Oceans and Coastal.</p>
4	UNIT 4
	<p>Medical Image Processing Various modalities of medical imaging, Breast cancer imaging, Mammographic imaging, Ultrasound imaging, Magnetic resonance imaging (MRI), Breast thermograph imaging, Problems with medical images. Image enhancement, Spatial domain methods, Frequency domain methods, Other modalities of medical imaging, Radiography, Positron emission tomography (PET), Computed tomography angiography (CTA), Echocardiogram.</p>
5	UNIT 5
	<p>Feature Extraction and Statistical Measurement Selection of features, Shape related features, Shape representation, Bounding box, Shape matrix, Moments of region and shape, Co-occurrence matrix, Principle feature analysis (PFA), Fourier descriptors, Snake boundary detection, Snake algorithm, Texture analysis, Texture features, Feature extraction using discrete Fourier transform, wavelet transform, Gabor filters for texture analysis, Breast tissue detection, Analysis of tissue structure.</p>



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Reference Books

Elective 2: Advanced Image Processing

Reference books:

1. Text Book of Remote Sensing and Geographical Information Systems M. Anji Reddy 4th Edition BS publication.
2. Remote Sensing and Image Interpretation Lillesand, T.M. and Kiefer, R.W. 6th edition. John Wiley and Sons Inc.
3. Medical Image Processing Concepts and Applications Sinha, G.R., Patel, Bhagwati Charan PHI
4. Digital Image Processing Gonzalez and Woods 3rd Edition Pearson
5. Digital Image Processing and Analysis Bhabatosh Chanda, Dwijesh Dutta Majumder 2nd Edition PHI

Practical (1746PITIP) (Skill development & Employability)

Comment [1]: Focuses on employability

Practicals (PSIT4P4b): Note:

1. All the practical can be done in C, C++, Java or Matlab, PolSARPro, Nest, ImageJ, R and ENVI
2. Satellite images can be downloaded from
3. <http://bhuvan3.nrsc.gov.in/bhuvan/bhuvannew/bhuvan2d.php>
4. http://landsat.usgs.gov/Landsat_Search_and_Download.php
5. <http://uavsar.jpl.nasa.gov/>
6. <http://airsar.jpl.nasa.gov/>
7. Medical images can be downloaded from
8. <http://www.barre.nom.fr/medical/samples/>
9. Apply DFT on Image
10. WAP for implementing LPF
 - a. Ideal LPF on square image
 - b. Butterworth filter
 - c. Gaussian filter
11. WAP for implementing HPF
 - a. Ideal HPF on square image
 - b. Butterworth filter
 - c. Gaussian filter
12. a. WAP for high boost filtering on square image
b. WAP for homomorphic filtering on square image
13. Acquire satellite/medical image and apply pre-processing techniques to improve the quality of image (use different low pass filters and compare the results).



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14. Apply different image enhancement techniques (to improve contrast, brightness, sharpness) on satellite image
15. Apply different supervised classification techniques to classify the satellite image (minimum distance, maximum likelihood, decision tree, ANN)
16. Apply different clustering algorithms (K-means, ISODATA)
17. Apply compression and decompression algorithm on image (Huffman coding, Arithmetic encoding, LZW encoding)
18. Apply DCT and PCA on image



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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1744PITCM	Elective 2: Cloud Management	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To understand the functioning of Virtualized Data Center Architecture.
2. To gain knowledge of Storage Network Design
3. To work with Cloud OS and System Centre 2012
4. To monitor the performance of Cloud
5. To manage and maintain the cloud

Course Outcome:

After completion of this course, learners will be able to:

CO1: Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures. (Level: Analyse)

CO2: Design different workflows according to requirements and apply map-reduce programming models. (Level: Create)

CO3: Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms. (Level: Apply)

CO4: Monitor the performance of the cloud using different tools. (Level: Analyse and Apply)

Sr. No.	Modules / Units
1	UNIT 1 Virtualized Data Center Architecture: Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures.
2	UNIT 2



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	Storage Network Design: Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations IP- SAN:Introduction, iSCSI—components of iSCSI, iSCSI host connectivity, topologies for iSCSI connectivity, iSCSI discovery, iSCSI names, iSCSI session, iSCSI PDU, ordering and numbering, iSCSI security and error handling, FCIP—FCIP topology, FCIP performance and security, iFCP—iFCP topology, iFCP addressing and routing, iFCP gateway architecture,FCOE architecture.
3	UNIT 3
	Cloud Management: System Center 2012 and Cloud OS, Provisioning Infrastructure: Provisioning Infrastructure with Virtual Machine Designing, Planning and Implementing. Managing Hyper-V Environment with VMM 2012. Provisioning self-service with AppController, AppController essentials, Managing Private, Public, Hybrid clouds. AppController cmdlets.
4	UNIT 4
	Managing and maintaining with Configuration Manager 2012, Design, Planning, Implementation, Administration, Distributing Applications, Updates, Deploying Operating Systems, Asset Management and reporting. Backup and recovery with Data Protection Manager. Design, Planning,

	Implementation and Administration.
5	UNIT 5
	Implementing Monitoring: Real-time monitoring with Operations Manager, Proactive monitoring with Advisor, Operations Design, Planning, Implementation, Administration, Monitoring, Alerting, Operations and Security reporting. Building private clouds: Standardisation with service manager, Service Manager 2012: Design, Planning, Implementing, Incident Tracking, Automation with orchestrator, System Orchestrator 2012: Design, Planning, Implementing. Windows Azure Pack.



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Reference Books

Elective 2: Cloud Management

Reference books:

1. Introducing Microsoft System Center 2012, Technical Overview Mitch Tulloch, Symon Perriman and Symon Perriman **Microsoft**
2. Microsoft System Center 2012 Unleashed Chris Amaris, Rand Morimoto, Pete Handley, David E. Ross, Technical Edit by Yardeni Pearson Education
3. The Official VCP5 Certification Guide Aug. 2012, VMware Press
4. VCAP5-DCD Official Cert Guide, VMware Press
5. Automating vSphere with VMware vCenter Orchestrator
6. VMware Private Cloud Computing with vCloud Director
7. Managing and optimizing VMware vSphere deployment
8. Storage Networks: The Complete Reference, Robert Spalding
9. Storage Networking Protocol Fundamentals, James Long
10. Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems, Marc Farley

Practical (1744PITCM) (Skill development & Employability)

Managing Hyper-V environment with SCVMM 2012

Provisioning Self-service with AppController

Managing Private Cloud with AppController

Using Data Protection Manager for Backup and Recovery

Using Operations Manager for real-time monitoring

Using Advisor for proactive monitoring

Using Service Manager to standardize

Using Orchestrator for automation

Implementing Windows Azure Pack

Using Configuration Manager 2012 for managing and maintaining



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Part II

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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1743PITCF	Elective 1: Computer Forensics	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To provide an understanding Computer forensics fundamental
2. To analyze various computer forensics technologies
3. To provide computer forensics systems
4. To identify methods for data recovery.
5. To apply the methods for preservation of digital evidence.

Course Outcome:

After the successful completion of this course, learners will be able to:

CO1: Explain the definition of computer forensics fundamentals. (Level: Understand)

CO2: Describe the types of computer forensics technology. (Level: Understand)

CO3: Analyze various computer forensics systems. (Level: Analyse)

CO4: Illustrate the methods for data recovery, evidence collection and data seizure. (Level: Analyse and Apply)

Sr. No.	Modules / Units
1	UNIT 1
	Computer Forensics and Investigation Processes, Understanding Computing Investigations, The Investigator's Office and Laboratory, Data Acquisitions
2	UNIT 2


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	Processing Crime and Incident Scenes, Working with Windows and DOS Systems, Current Computer Forensics Tools.
3	UNIT 3
	Macintosh and Linux Boot Processes and File Systems, Computer Forensics Analysis, Recovering Graphics Files
4	UNIT 4
	Virtual Machines, Network Forensics, and Live Acquisitions, E-mail Investigations, Cell Phone and Mobile Device Forensics
5	UNIT 5
	Report Writing for High-Tech Investigations, Expert Testimony in High-Tech Investigations, Ethics and High-Tech Investigations

Reference Books
ELECTIVE 1:- Computer Forensics
<p>Reference books:</p> <ol style="list-style-type: none"> 1. Guide to Computer Forensics and Investigations Bell Nelson, Amelia Phillips, Christopher Steuart 4th Edition Cengage Learning 2. Computer Forensics A Pocket Guide Nathan Clarke I.T G.vernance Publishing 3. Computer Forensics: Computer Crime Scene Investigation John R. Vacca 2nd Edition, Charles River Media


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Practical (1745PITCF) (Skill development & Employability)

File System Analysis using The Sleuth Kit
Using Windows forensics tools
Using Data acquisition tools
Using file recovery tools
Using Forensic Toolkit (FTK)
Forensic Investigation using EnCase
Using Steganography tools
Using Password Cracking tools
Using Log Capturing and Analysis tools
Using Traffic capturing and Analysis tools
Using Wireless forensics tools
Using Web attack detection tools
Using Email forensics tools
Using Mobile Forensics software tools
Writing report using FTK


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Course Code:	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
1744PITES	Elective 2: Design of Embedded Control System	3	2 ½ hrs	25	75	100	4

Course Objectives:

1. To have knowledge about the basic working of a microcontroller system and its programming in assembly language and C language
2. To provide experience to integrate hardware and software for microcontroller applications systems.
3. To work with ATMEL Microcontrollers
4. To understand different instruction sets

Course Outcome:

After successful completion of course, Learners will be able to:

CO1: Explain the knowledge about microcontrollers embedded processors and their applications. (Level: Understand)

CO2: Explain the internal architecture and interfacing of different peripheral devices with Microcontrollers. (Level: Understand)

CO3: Write the programs for microcontrollers. (Level: Create)

CO4: Analyse the role of embedded systems in the security, monitoring and control industry. (Level: Analyse)

CO5: Program ARM Controller as per user need. (Level: Create)


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Sr. No.	Modules / Units
1	<p>UNIT 1</p> <p>Introduction to microcontrollers Microprocessors and microcontrollers, History, Embedded vs external memory devices, 8-bit and 16-bit microcontrollers, RISC and CISC processors, Harvard and Von Neumann architectures, Commercial microcontroller devices. Industrial applications.</p> <p>Design with Atmel microcontrollers Architecture overview of Atmel 89C51, Pin description of 89C51, Using flash memory devices Atmel 89CXX, Power saving options.</p>
2	<p>UNIT 2</p> <p>PIC Microcontrollers Overview, PIC16C6X/7X, Reset actions, Oscillators, Memory organization, PIC16C6X/7X instructions, Addressing modes, I/O ports, Interrupts PIC16C61/71, PIC16C61/71 timers, PIC16C 71 ADC, PIC16F8XX Flash microcontrollers Introduction, pin diagram, status registers, options_reg registers, power control registers, PIC16F8 program memory, PIC16F8 data memory, Data EEPROM, Flash program EEPROM, Interrupts PIC16F877, I/O ports, Timers</p> <p>More about PIC microcontrollers Introduction, Capture/compare/PWM modules in PIC16F877, Master synchronous serial port (MSSP) module, USART, ADC</p>
3	<p>UNIT 3</p> <p>ARM Embedded Systems The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software,</p> <p>ARM Processor Fundamentals Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions, Architecture Revisions, ARM Processor Families</p>
4	<p>UNIT 4</p>




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	<p>Introduction to the ARM Instruction Set Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, Conditional Execution</p> <p>Introduction to the Thumb Instruction Set Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction</p>
5	UNIT 5
	<p>Writing and Optimizing ARM Assembly Code Writing Assembly Code, Profiling and Cycle Counting, Instruction Scheduling, Register Allocation, Conditional Execution, Looping Constructs, Bit Manipulation, Efficient Switches, Handling Unaligned Data</p>

Reference Books
Design of Embedded Control System
<p>Reference books:</p> <ol style="list-style-type: none"> 1. Microcontrollers theory and applications (Unit I and II) Ajay Deshmukh First Tata McGraw- Hill 2. ARM system developer's guide: designing and optimizing system. (Unit III to V) Andrew N. Sloss, Dominic Symes, Chris Wright. First Elsevier Publication

Practical (1746PITES) (Skill development & Employability)	
<p>Interfacing of LED, relay, Push Button Sending and Receive Data Serially to/from PC. Interfacing Wireless Module using ASK and FSK Interfacing PC Keyboard. Interfacing with EEPROM using I2C BUS. Using a Watchdog Timer. Using an External RTC. Design a 4 bit binary counter. DC Motor Control using PWM module. Interfacing of temperature sensor. Interfacing a 7 segment display. Scrolling text message on LED dot matrix display</p>	 PRINCIPAL NAGINDAS KHANDWALA COLLEGE OF COMMERCE ARTS & MANAGEMENT STUDIES AND SHANTABEN NAGINDAS KHANDWALA COLLEGE OF SCIENCE (AUTONOMOUS) MALAD (W), MUMBAI - 400 054

**Nagindas Khandwala College
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**Syllabus Of Course of
Master of Science Information Technology
(MSC IT) Programme**

Part II

Semester IV

Under Academic Autonomy and Credit, Grading and Semester System

(To be implemented during Academic Year- 2020-2021)

PRINCIPAL

**NAGINDAS KHANDWALA COLLEGE OF COMMERCE
ARTS & MANAGEMENT STUDIES AND SHANTABEN
NAGINDAS KHANDWALA COLLEGE OF SCIENCE
(AUTONOMOUS)
MALAD (W), MUMBAI - 400 064**

Course Code	Course	Hrs. of Instruction/Week	Exam Duration (Hours)	Maximum Marks			Credits
				C I E	SE E	Total	
1743PITIS	Intelligent Systems	3	2 1/2 Hours	25	75	100	4

Course Objectives

1. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
2. To create an understanding of the basic issues of knowledge representation and Logic and blind and heuristic search.
3. To provide an understanding of topics such as minimal, resolution, etc. that play an important role in AI programs.
4. To understand the role of agents in decision making.

Course Outcomes:

- CO1: Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. (Level: Apply)
- CO2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them. (Level: Analyse)
- CO3: Develop intelligent algorithms for constraint satisfaction problems. (Level: Create)
- CO4: Design intelligent systems for Game Playing (Level: Create)
- CO5: Analyze the role of agents for decision making. (Level: Analyse)

Sr. No.	Modules / Units
1	UNIT 1 Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, Structure of Agents Problem Solving by searching: Problem-Solving Agents Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed Search and exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments
2	UNIT 2


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	<p>Games: Optimal Decisions in Games, Alpha—Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs</p> <p>Constraint Satisfaction, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems</p> <p>Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic</p> <p>First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic, Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution,</p>
3	UNIT 3
	<p>Planning: Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning</p> <p>Uncertain Knowledge and Reasoning: Acting under Uncertainty, Basic</p>

	<p>Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited, Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Relational and First-Order Probability Models, Approaches to Uncertain Reasoning,</p> <p>Probabilistic reasoning over time: Inference in Temporal Models, Hidden Markov Models, Kalman Filters, Dynamic Bayesian Networks, Keeping Track of Many Objects</p>
4	UNIT 4
	<p>Simple Decision Making: Combining Beliefs and Desires under Uncertainty, The Basis of Utility Theory, Utility functions, Multiattribute Utility Functions, Decision Networks,</p> <p>Complex Decision Making: Sequential Decision Problems, Value Iteration, Policy Iteration, Partially Observable MDPs, Decisions with Multiple Agents: Game Theory</p> <p>Knowledge in Learning: Review of Forms and types of Learning, Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming,</p>
5	UNIT 5



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Statistical and Reinforced Learning: Statistical Learning, Learning with Complete Data, Learning with Hidden Variables: The EM Algorithm, Reinforcement Learning, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Applications of Reinforcement Learning

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction.

Robotics: Introduction, Robot Hardware, Robotic Perception, Planning to Move, Planning Uncertain Movements, Moving, Robotic Software Architectures, Applications.

Reference Books

Intelligent Systems

Reference books:

1. Artificial Intelligence: A Modern Approach Stuart Russell, Peter Norvig 3rd Edition Pearson Education
2. Artificial Intelligence: Structures and Strategies for Complex Problem Solving George F.Luger Pearson Education
3. Artificial Intelligence Patrick Winston Pearson Education

Practical (1745PITIS) (Skill development & Employability)

Comment [1]: Focuses on employability

At least Eight practicals covering the entire syllabus must be taken.

1. Write a program for implementing the Depth First Search (DFS) Algorithm. And also write the algorithm for the same.
2. Write a program for implementing BFS algorithm.
3. Apply domain specific heuristic to generate possible solution for the AI problems using Greedy Best First Search.
4. Implement the mechanism of A* algorithm.
5. Implement recursive BFS.
6. Generate succession nodes and check possibility of finding solutions of the specified problems using:
 - a) Steepest Ascent Hill Climbing
 - b) Simulated Annealing
7. Optimize the search strategy for the suggested problems using:
 - a) Mini-Max algorithm
 - b) Alpha Beta Pruning
8. Find a solution to map-coloring as a constraint satisfaction problem using: Forward Checking
9. Show the implementation of Bayesian Network Classification.
10. Show the application of Hidden Markov Model.

All practicals can be done using C++ / R / MATLAB



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Project: 1747PITPR

(Skill development & Employability)

- The project topic may be undertaken in any area of Core Courses.
- Each of the students has to undertake a Project individually under the supervision of a teacher-guide.
- The student shall decide the topic in consultation with the teacher-guide concerned.
- College will allot P G Teacher for guidance to the students based on her / his specialization.
- There shall be double valuation of project by the teacher- guide concerned and an external examiner appointed by the College with equal weightage.
- The teacher-guide along with the external examiner appointed by the College for the valuation of project shall conduct viva voce examination with equal weightage.
- The project report shall be prepared as per the broad guidelines given below:
 - Project Report shall be typed in Times New Roman with one and half line spacing in 12 Font Size and 1.5 spacing.
 - The size of the Project Report shall be with a minimum of 50 pages.
 - Project Report shall be printed on both sides of the paper.
 - The Project Report shall be bounded.
- Minimum of Grade E in the project component is needed for passing
- In case of failing in the project work, the same project can be revised for ATKT examination
- Absence of student for viva voce: If any student fails to appear for the viva voce on the date and time fixed by the department, such student shall appear for the viva voce only along with students of the next batch.



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Course Code	Course	Hrs. of Instruction/Week	Exam Duration (Hours)	Maximum Marks			Credits
				C I E	SE E	Total	
1743PITES	Elective 1 Real time Embedded System	3	2 1/2 Hours	25	75	100	4

Course Objectives:

1. To have knowledge about the basic working of a microcontroller system and its programming in assembly language and C language.
2. To provide experience to integrate hardware and software for microcontroller applications systems.
3. To understand the memory system of embedded systems
4. To understand the process behind task scheduling, communication and real time databases.

Course Outcomes:

After completion of this course, learners will be able to:

CO1: Explain knowledge about microcontrollers embedded processors and their applications. (Level: Understand)

CO2: Explain the internal architecture and interfacing of different peripheral devices with Microcontrollers. (Level: Understand)

CO3: Perform scheduling, communication and create real time databases with an embedded system. (Level: Analyse and Apply)

CO4: Identify the role of embedded systems in industry. (Level: Analyse and Apply)

CO5: Create Embedded Products which are real time in nature. (Level: Create)

Sr. No.	Modules / Units
1	<p>UNIT 1</p> <p>Introduction- What is Real Time System, Application of real time system, A Basic Model of Real time system, Characteristics of Real Time System, Safety and Reliability, Types of Real Time Task, Timing Constraints, Modeling Timing Constraints.</p> <p>Embedded Operating Systems Fundamental Components, Example: Simple Little Operating System</p> <p>Caches The Memory Hierarchy and Cache Memory, Cache Architecture, Cache Policy</p>
2	<p>UNIT 2</p>



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	<p>Exception and Interrupt Handling Exception Handling, Interrupts, Interrupt Handling Schemes</p> <p>Firmware Firmware and Bootloader, Example: Sandstone</p> <p>Memory Management Moving from an MPU to an MMU, How Virtual Memory Works, Details of the ARM MMU, Page Tables, The Translation Lookaside Buffer, Domains and Memory Access Permission, The Caches and Write Buffer.</p>
3	UNIT 3
	<p>Real Time Task Scheduling Types of real time task and their characteristics, Task Scheduling, Clock driven scheduling, Hybrid Schedulers, Event Driven Scheduling, Earliest Deadline first scheduling, Rate Monotonic Algorithm.</p> <p>Handling Resource Sharing and Dependencies Resource sharing among real time task, Priority Inversion, Priority inheritance protocol, Highest locker protocol, priority ceiling protocol, Different types of priority inversion Under PCP, Important features of PCP, Resource sharing Protocol, Handling Task Dependencies.</p>
4	UNIT 4
	<p>Real Time Communication Basic Concept, Real Time Communication in Lan, Soft/Hard Real Time communication in a Lan, Bounded Access Protocol for Lans, Performance comparison, Real time communication over Packet Switched networks, QoS framework, Routing, Resource reservation, Rate Control, QoS Model-Integrated services and Differentiated Services.</p>
5	UNIT 5
	<p>Real Time Databases Concept and Example of real time databases, Real time databases application design issues, Characteristics of temporal data, Concurrency control in real-time databases. Case study on commercial real time databases</p>



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Reference Books

Real Time Embedded Systems

Reference books:

1. Real-Time Systems: Theory and Practice. Rajib Mall First Pearson Publication.
2. ARM system developer's guide: designing and optimizing system. (Ch-8,Ch-9,Ch-12, Ch-14) software/Andrew N. Sloss, Dominic Symes, Chris Wright. First Elsevier Publication
3. Embedded Systems Design S. Heath Second Edition Newnes Publication
4. Real-Time Systems: Theory and Practice. Rajib Mall First Pearson Publication

Practical (1745PITES) (Skill development & Employability)

Schedule a task periodically; after 5 min xyz task has to perform (Hint JITTER).

Schedule a task non periodically; no specific time stamp is set for any task.

Shared resources management using SEMAPHORE.

Shared resources management using MUTEX.

Implement scheduling algorithm FIFO.

Implement scheduling algorithm ROUND ROBIN.

Implement scheduling algorithm RATE MONOTONIC.

Implement Inter process communication (IPC) using NAMED PIPES.

IPC using simple PIPES.

IPC using MAIL BOXES.

Using Client Socket & Server Socket (UDP/TCP) maintain data received from client node.

Small demonstration of Kernel Level & User Level Communications

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