

Mahatma Education Society's
Pillai College of Arts, Commerce & Science
(Autonomous)

Affiliated to University of Mumbai
New Panvel



Syllabus for T. Y. B. Sc. CS Semester VI
Program: B. Sc. Computer Science

(Semester based Credit and Grading system for the
academic year 2019-20)

Semester VI

Course Code	Course Type	Course Title	Theory/ Practical	Marks	Credits	Lectures/ Week
Elective-I (Select Any Two)						
PUSCS601	Core	Wireless Sensor Networks and Mobile Communication	Theory	100	3	3
PUSCS602	Core	Cloud Computing	Theory	100	3	3
PUSCS609	Core	Cyber Forensics	Theory	100	3	3
Elective-II (Select any Two)						
PUSCS603	Core	Information Retrieval	Theory	100	3	3
PUSCS604	Core	Data Science	Theory	100	3	3
PUSCS610	Core	Digital Image Processing	Theory	100	3	3
PUSCS605	Skill enhancement	Ethical Hacking	Theory	100	2	3
PUSCS606P	Practical of Elective-I	(PUSCS601, PUSCS602,PUSCS609) Any Two	Practical	100	2	6
PUSCS607P	Practical of Elective-II	(PUSCS603, PUSCS604, PUSCS610) Any two	Practical	100	2	6
PUSCS605P	Skill enhancement	PUSCS605(Practical of Skill Enhancement)	Practical	50	1	3
PUSCS608	Internship	Internship	Practical	50	1	3
Total				800	20	

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Wireless Sensor Networks and Mobile Communication
Subject Code	PUSCS601
Level of the Subject	Medium

Objectives:

1. To understand the connections of different wireless devices and their compatibility
2. To conceptualize and understand the framework and to have a firm grip over wireless network.

Unit No.	Name of Unit	Topic No.	Content	No. of Lectures
1	Introduction and Sensor Node Hardware and Network Architecture	1.1	Introduction: Introduction to Sensor Networks, unique constraints and challenges. Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks.	15L
		1.2	Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC. Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.	
2	Medium Access Control Protocols and	2.1	Medium Access Control Protocols: Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study.	15L

	Routing Protocols	2.2	Routing Protocols : Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks.	
3	Transport Control Protocols and Wireless Transmission	3.1	Transport Control Protocols : Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols.	15L
		3.2	Introduction, Wireless Transmission and Medium Access Control: Applications, A short history of wireless communication.	
4	Telecommunication, Satellite and Broadcast Systems	4.1	Wireless Transmission: Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems.	15L
		4.2	Telecommunication, Satellite and Broadcast Systems: GSM: Mobile services, System architecture, Radio interface, Protocols, Localization And Calling, Handover, security, New data services; DECT: System architecture, Protocol architecture; ETRA, UMTS and IMT- 2000. Satellite Systems: History, Applications, Basics: GEO, LEO, MEO; Routing, Localization, Handover.	
	Total Lectures			60

Expected Outcomes:

1. To list various applications of wireless sensor networks, describe the concepts, protocols, design, implementation and use of wireless sensor networks.
2. To implement and evaluate new ideas for solving wireless sensor network design issues.

Reference Books :

1. Protocols and Architectures for Wireless Sensor Network, Holger Kerl, Andreas Willig, John Wiley and Sons, 2005
2. Wireless Sensor Networks Technology, Protocols, and Applications ,Kazem Sohraby, Daniel Minoli and TaiebZnati, John Wiley & Sons, 2007
3. Mobile communications, Jochen Schiller,2nd Edition, Addison wisely, Pearson Education,2012
4. Fundamentals of Wireless Sensor Networks, Theory and Practice, Waltenequs Dargie, Christian Poellabauer , Wiley Series on Wireless Communication and Mobile Computing, 2011
5. Networking Wireless Sensors, Bhaskar Krishnamachari , Cambridge University Press, 2005

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Wireless Sensor Networks and Mobile Communication
Subject Code	PUSCS606P
Level of the Subject	Medium

Practical No	Details
1.	Understanding the Sensor Node Hardware. (For Eg. Sensors, Nodes(Sensor mote), Base Station, Graphical User Interface.)
2.	Exploring and understanding TinyOS computational concepts:- Events, Commands and Task. - nesC model - nesC Components
3.	Understanding TOSSIM for - Mote-mote radio communication - Mote-PC serial communication
4.	Create and simulate a simple adhoc network
5.	Understanding, Reading and Analyzing Routing Table of a network.
6.	Create a basic MANET implementation simulation for Packet animation and Packet Trace.
7.	Implement a Wireless sensor network simulation.
8.	Create MAC protocol simulation implementation for wireless sensor Network.
9.	Simulate Mobile Adhoc Network with Directional Antenna
10.	Create a mobile network using Cell Tower, Central Office Server, Web browser and Web Server.Simulate connection between them.

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Cloud Computing
Subject Code	PUSCS602
Level of the Subject	Medium

Objectives:

1. Computing concepts, technologies, architecture, implantations and applications.
2. To expose the learners to frontier areas of Cloud Computing, while providing sufficient foundations to enable further study and research.

Unit No.	Name of Unit	Topic No.	Content	No.of Lectures
	Introduction to Cloud Computing	1.1	Introduction to Cloud Computing, Characteristics and benefits of Cloud Computing,	15L
		1.2	Basic concepts of Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing	
		1.3	Elements of Parallel Computing. Elements of Distributed Computing. Technologies for Distributed Computing	
		1.4	Cloud Computing Architecture. The cloud reference model. Infrastructure as a service. Platform as a service. Software as a service	
2	Virtualization	2.1	Types of clouds, Characteristics of Virtualized Environments.	15L
		2.2	Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing.	
		2.3	Pros and Cons of Virtualization. Virtualization using KVM, Creating virtual machines	

3	Introduction to OpenStack	3.1	oVirt - management tool for virtualization environment. Open challenges of Cloud Computing	15L
		3.2	Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations,	
		3.3	OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks	
4	Cloud Security Mechanisms	4.1	Controller deployment, Networking deployment, Block Storage deployment, Compute deployment,	15L
		4.2	Deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat,	
		4.3	Cloud Security Mechanisms - Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups	
Total Lectures				60

Expected Learning Outcomes:

1. To articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing using open source technology.
2. To identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc. They should explain the core issues of cloud computing such as security, privacy, and interoperability.

Reference Books :

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, Tata McGraw Hill Education Private Limited, 2013
2. OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016
3. OpenStack Essentials, Dan Radez, PACKT Publishing, 2015
4. OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Cloud Computing
Subject Code	PUSCS602P
Level of the Subject	Medium

Practical No	Details
1.	Study of Cloud Computing & Architecture
2.	Installation and Configuration of virtualization using KVM.
3.	Study and implementation of Infrastructure as a Service
4.	Study and implementation of Storage as a Service
5.	Study and implementation of identity management
6.	Study Cloud Security management
7.	Write a program for web feed.
8.	Study and implementation of Single-Sign-On.
9.	User Management in Cloud.
10.	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Cyber Forensics
Subject Code	PUSCS602 (Elective)
Level of the Subject	Medium

Objectives:

1. To understand the procedures for identification, preservation, and extraction of electronic evidence,
2. To understand the auditing and investigation of network and host system intrusions, analysis and documentation of information gathered

Unit No.	Name of Unit	Topic No.	Name of Topic	No. of Lectures
1	Computer, Network and Mobile Forensics	1.1	Computer Forensics :Introduction to Computer Forensics and standard procedure, Incident Verification and System Identification, Recovery of Erased and damaged data, Disk Imaging and Preservation, Data Encryption and Compression, Automated Search Techniques, Forensics Software.	15L
		1.2	Network Forensic: Introduction to Network Forensics and tracking network traffic, Reviewing Network Logs, Network Forensics Tools, Performing Live Acquisitions, Order of Volatility, Standard Procedure	
		1.3	Cell Phone and Mobile Device Forensics: Overview, Acquisition Procedures for Cell Phones and Mobile Devices	
2	Internet, Messenger and Browser Forensics	2.1	Internet Forensic: Introduction to Internet Forensics, World Wide Web Threats, Hacking and Illegal access, Obscene and Incident transmission, Domain Name Ownership	15L

			Investigation, Reconstructing past internet activities and events	
		2.2	E-mail Forensics : e-mail analysis, e-mail headers and spoofing, Laws against e-mail Crime,	
		2.3	Messenger Forensics: Yahoo Messenger Social Media Forensics: Social Media Investigations	
		2.4	Browser Forensics: Cookie Storage and Analysis, Analyzing Cache and temporary internet files, Web browsing activity reconstruction	
3	Investigation, Evidence presentation and Legal aspects of Digital Forensics:	3.1	Investigation, Evidence presentation and Legal aspects of Digital Forensics: Authorization to collect the evidence , Acquisition of Evidence, Authentication of the evidence	15L
		3.2	Analysis and Reporting: An Analysis of the evidence, Reporting on the findings, Testimony	
4	Introduction to Legal aspects of Digital Forensics	4.1	Introduction to Legal aspects of Digital Forensics: Laws & regulations, Information Technology Act, Giving Evidence in court	15L
		4.2	Case Study – Cyber Crime cases	
			Total Lectures	60

Expected Outcomes:

1. Student will be able to plan and prepare for all stages of an investigation - detection, initial response and management interaction.
2. Student will be able to investigate various media to collect evidence, report them in a way that would be acceptable in the court of law.

Reference Books :

1. Guide to computer forensics and investigations, Bill Nelson, Amelia Philips and Christopher Steuart, course technology, 5th Edition, 2015
2. Incident Response and computer forensics, Kevin Mandia, Chris Prosise, Tata McGrawHill, 2nd Edition, 2003

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Cyber Forensics Practical
Subject Code	PUSCS602P (Elective)
Level of the Subject	Medium

Practical No	Details
1.	Creating a Forensic Image using FTK Imager/Encase Imager : <ul style="list-style-type: none"> - Creating Forensic Image - Check Integrity of Data - Analyze Forensic Image
2.	Data Acquisition: <ul style="list-style-type: none"> - Perform data acquisition using: - USB Write Blocker + Encase Imager - SATA Write Blocker + Encase Imager - Falcon Imaging Device
3.	Forensics Case Study: <ul style="list-style-type: none"> - Solve the Case study (image file) provide in lab using Encase Investigator or Autopsy
4.	Capturing and analyzing network packets using Wireshark (Fundamentals) : <ul style="list-style-type: none"> -Identification of the live network - Capture Packets - Analyze the captured packets
5.	Analyze the packets provided in lab and solve the questions using Wireshark : <ul style="list-style-type: none"> - What web server software is used by www.snopes.com? - About what cell phone problem is the client concerned? - According to Zillow, what instrument will Ryan learn to play? - How many web servers are running Apache?
6.	Using Sysinternals tools for Network Tracking and Process Monitoring : <ul style="list-style-type: none"> - Check Sysinternals tools

	<ul style="list-style-type: none"> - Monitor Live Processes - Capture RAM - Capture TCP/UDP packets - Monitor Hard Disk - Monitor Virtual Memory - Monitor Cache Memory
7.	<p>Recovering and Inspecting deleted files</p> <ul style="list-style-type: none"> - Check for Deleted Files - Recover the Deleted Files - Analyzing and Inspecting the recovered files <p>Perform this using recovery option in ENCASE and also Perform manually through command line</p>
8.	Acquisition of Cell phones and Mobile devices
9.	<p>Email Forensics</p> <ul style="list-style-type: none"> - Mail Service Providers - Email protocols - Recovering emails - Analyzing email header
10.	<p>Web Browser Forensics</p> <ul style="list-style-type: none"> - Web Browser working - Forensics activities on browser - Cache / Cookies analysis - Last Internet activity

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Information Retrieval
Subject Code	PUSCS603
Level of the Subject	Medium

Objectives:

1. To provide an overview of the important issues in classical and web information retrieval.
2. To give an up-to- date treatment of all aspects of the design and implementation of systems for gathering, indexing, and searching documents and of methods for evaluating systems

Unit No.	Name of Unit	Topic No.	Content	No. of Lectures
1	Introduction to Information Retrieval	1.1	Introduction to Information Retrieval: Introduction, History of IR, Components of IR, and Issues related to IR	15L
		1.2	Retrieval Model: Boolean retrieval, Dictionaries and tolerant retrieval.	
2	Link Analysis and Specialized Search	2.1	Link Analysis :Link Analysis, hubs and authorities, Pagerank and HITS algorithms	15L
		2.2	Similarity, Hadoop & Map Reduce, Evaluation	
		2.3	Specialized Search: Personalized search, Collaborative filtering and content-based recommendation of documents and products	
		2.4	Handling “invisible” Web, Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval	
3	Web Search Engine and XML Retrieval	3.1	Web Search Engine: Web search overview, web structure, the user, paid placement	15L
		3.2	Optimization and Architecture: search engine optimization/spam, Web size measurement, search engine	

			optimization/spam, Web Search Architectures.	
		3.3	XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric versus data-centric XML retrieval	
4	Content Based Image Retrieval	4.1	Introduction: Introduction to Content Based Image Retrieval System	15L
		4.2	Feature Extraction: Color features, texture features and shape features, Block truncation coding and K-means clustering	
		Total Lectures		60

Expected Outcomes:

1. Understand the field of information retrieval and its relationship to search engines.
2. Understand how to apply information retrieval models.

Reference Books :

1. Introduction to Information Retrieval, C. Manning, P. Raghavan, and H. Schütze, Cambridge University Press, 2008
2. Modern Information Retrieval: The Concepts and Technology behind Search, Ricardo Baeza -Yates and Berthier Ribeiro – Neto, 2 nd Edition, ACM Press Books 2011.
3. Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler and Trevor Strohman, 1 st Edition, Pearson, 2009.
4. Information Retrieval Implementing and Evaluating Search Engines, Stefan Büttcher, Charles L. A. Clarke and Gordon V. Cormack, The MIT Press; Reprint edition (February 12, 2016)

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Information Retrieval
Subject Code	PUSCS603P
Level of the Subject	Medium

Practical No	Details
1.	Write a program to demonstrate bitwise operation.
2.	Implement Page Rank Algorithm.
3.	Implement Dynamic programming algorithm for computing the edit distance between strings s1 and s2. (Hint. Levenshtein Distance)
4.	Write a program to Compute Similarity between two text documents.
5.	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).
6.	Implement a basic IR system using Lucene.
7.	Write a program for Pre-processing of a Text Document: stop word removal.
8.	Write a program for mining Twitter to identify tweets for a specific period and identify trends and named entities.
9.	Write a program to implement simple web crawler
10.	Write a program to parse XML text, generate Web graph and compute topic specific page rank.

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Digital Image Processing
Subject Code	PUSCS604(Elective)
Level of the Subject	Medium

Objectives:

1. To study two-dimensional Signals and Systems and to understand image fundamentals and transforms necessary for image processing.
2. To study the image enhancement techniques in spatial and frequency domain
3. To study image segmentation and image compression techniques.

Unit No.	Name of Unit	Topic No.	Content	No. of Lectures
1	Introduction to Image-processing System	1.1	Introduction to Image-processing System :Introduction, Image Sampling, Quantization, Resolution, Human Visual Systems, Elements of an Image-processing System, Applications of Digital Image Processing	15L
		1.2	2D Signals and Systems : 2D signals, separable sequence, periodic sequence, 2D systems, classification of 2D systems, 2D Digital filter	
		1.3	Convolution and Correlation : 2D Convolution through graphical method, Convolution through 2D Z—transform, 2D Convolution through matrix analysis, Circular Convolution, Applications of Circular Convolution, 2D Correlation	
		1.4	Image Transforms: Need for transform, image transforms, Fourier transform, 2D Discrete Fourier Transform, Properties of 2D DFT, Importance of Phase,	

			Walsh transform, Hadamard transform, Haar transform, Slant transform, Discrete Cosine transform, KL transform	
2	Image Enhancement	2.1	Image Enhancement : Image Enhancement in spatial domain, Enhancement through Point operations, Histogram manipulation, Linear and nonlinear Gray Level Transformation, local or neighborhood operation,	15L
		2.2	Filtering: Median Filter, Spatial domain High pass filtering, Bit-plane slicing, Image Enhancement in frequency domain, Homomorphic filter, Zooming operation, Image Arithmetic	
3	Binary and Color Image processing	3.1	Binary Image processing :Mathematical morphology, Structuring elements, Morphological image processing, Logical operations, Morphological operations, Dilation and Erosion, Distance Transform	15L
		3.2	Colour Image processing : Colour images, Colour Model, Colour image quantization, Histogram of a colour image	
4	Image Segmentation and Compression	4.1	Image Segmentation: Image segmentation techniques, Region approach, Clustering techniques, Thresholding, Edge-based segmentation, Edge detection, Edge Linking, Hough Transform	15L
		4.2	Image Compression: Need for image compression, Redundancy in images, Image-compression scheme, Fundamentals of Information Theory, Run-length coding, Shannon-Fano coding, Huffman Coding, Arithmetic Coding, Transform-based compression, Image-compression standard	
	Total Lectures			60

Expected Outcomes:

1. To review the fundamental concepts of a digital image processing system and analyze the images in the frequency domain using various transforms.
2. To evaluate the techniques for image enhancement and image segmentation and apply various compression techniques.

Reference Books

1. Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw-Hill Education Pvt. Ltd., 2009
2. Digital Image Processing 3rd Edition, Rafael C Gonzalez, Richard E Woods, Pearson, 2008
3. Scilab Textbook Companion for Digital Image Processing, S. Jayaraman, S. Esakkirajan And T. Veerakumar, 2016 (https://scilab.in/textbook_companion/generate_book/125)

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Digital Image Processing Practical
Subject Code	PUSCS604P(Elective)
Level of the Subject	Medium

Practical No	Details
1.	2D Linear Convolution, Circular Convolution between two 2D matrices
2.	Circular Convolution expressed as linear convolution plus alias
3.	Linear Cross correlation of a 2D matrix, Circular correlation between two signals and Linear autocorrelation of a 2D matrix, Linear Cross correlation of a 2D matrix
4.	DFT of 4x4 gray scale image
5.	Compute discrete cosine transform, Program to perform KL transform for the given 2D matrix
6.	Brightness enhancement of an image, Contrast Manipulation, image negative
7.	Perform threshold operation, perform gray level slicing without background
8.	Image Segmentation
9.	Image Compression
10.	Binary Image Processing and Colour Image processing

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Data Science
Subject Code	PUSCS604
Level of the Subject	Medium

Objectives:

1. Understanding basic data science concepts. Learning to detect and diagnose common data issues, such as missing values, special values, outliers, inconsistencies, and localization.
2. Making students aware of how to address advanced statistical situations, Modeling and Machine Learning.

Unit No.	Name of Unit	Topic No.	Name of Topic	No. of Lectures
1	Introduction to Data Science	1.1	What is Data? Different kinds of data, Introduction to high level programming language + Integrated Development Environment (IDE), Exploratory Data Analysis (EDA) + Data Visualization, Different types of data sources,	15L
		1.2	Data Management: Data Collection, Data cleaning/extraction, Data analysis & Modeling	
2	Data Curation & Data Transformations	2.1	Data Curations: What is Data Curation, Lifecycle, Query languages and Operations to specify and transform data, Structured/schema based systems as users and acquirers of data, Semi-structured systems as users and acquirers of data, Unstructured systems in the acquisition and structuring of data.	15L
		2.2	Amazon series: Large scale data systems, Amazon Web Services (AWS)	

		2.3	Data transformations: Dimension reduction, Feature extraction, Smoothing and aggregating	
3	Statistical Modelling and Machine Learning:	3.1	Introduction to model selection: Regularization, bias/variance tradeoff e.g. parsimony, AIC, BIC, Cross validation, Ridge regressions and penalized regression e.g. LASSO	15L
		3.2	Software Quality Assurance : Quality Concepts, Quality Movement, Background Issues, SQA activities, Formal approaches to SQA, Statistical Quality Assurance, Software Reliability	
		3.3	Unsupervised Learning: Principal Components Analysis (PCA), k-means clustering, Hierarchical clustering, Ensemble methods	
4	Advance Machine Learning (NLP)	4.1	Natural Language Processing: What is NLP , Working of NLP, Tokenization, Stopwards, Chunking, POS Tagging, Named Entity Recognition, Lemmatization, Word net.	15L
		4.2	Recommendation Systems: Context Based recommendation systems & Collaborative Filtering.	
		Total Lectures		60

Expected Outcomes:

1. Students should be able to understand & comprehend the problem.
2. Students should be able to define suitable statistical method to be adopted.

Reference Books :

1. Doing Data Science, Rachel Schutt and Cathy O’Neil, O’Reilly,2013
2. Mastering Machine Learning with R, Cory Lesmeister, PACKT Publication,2015
3. Hands-On Programming with R, Garrett Golemund,1st Edition, 2014
4. An Introduction to Statistical Learning, James, G., Witten, D., Hastie, T., Tibshirani, R.,Springer,2015

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Data Science Practical
Subject Code	PUSCS604P
Level of the Subject	Medium

Practical No	Details
1.	Practical Of various types of Data Visualization Plots
2.	Practical Of Exploratory Data Analysis for Handling Missing and Categorical values.
3.	Practical of Principal Component Analysis
4.	Practical of Clustering
5.	Practical of Time-series forecasting
6.	Practical of Simple/Multiple Linear Regression.
7.	Practical of Logistics Regression
8.	Practical of Hypothesis testing.
9.	Practical of Analysis of Variance.
10.	Practical of Decision Tree.

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Ethical Hacking
Subject Code	PUSCS605
Level of the Subject	Medium

Objectives:

1. To understand the ethics, legality, methodologies and techniques of hacking.
2. To Learn different advanced ethical hacking techniques

Unit No.	Name of Unit	Topic No.	Content	No. of Lectures
1	Information Security	1.1	Attacks and Vulnerabilities Introduction to information security : Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security-Functionality-Ease of Use Triangle	15L
		1.2	Types of malware :Worms, viruses, Trojans, Spyware, Rootkits Types of vulnerabilities : OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, input parameter manipulation	
		1.3	Broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, OWASP Mobile Top 10, CVE Database	
		1.4	Types of attacks and their common prevention mechanisms : Keystroke	

			Logging, Denial of Service (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, Session Hijacking, Clickjacking, Cookie Theft, URL Obfuscation, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs	
2	Ethical Hacking – I (Introduction and pre-attack)	2.1	Case-studies : Recent attacks – Yahoo, Adult Friend Finder, eBay, Equifax, WannaCry, Target Stores, Uber, JP Morgan Chase, Bad Rabbit	15L
		2.2	Introduction: Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why is Ethical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?	
		2.3	Signing NDA, Compliance and Regulatory concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing.	
3	Ethical Hacking	3.1	Approach : Planning - Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report	15L
		3.2	Enterprise strategy : Repeated PT, approval by security testing team, Continuous Application Security Testing.	
		3.3	Phases: Reconnaissance/footprinting/Enumeration, Phases: Scanning, Sniffing	
4	Enterprise Security	4.1	Phases : Gaining and Maintaining Access : Systems hacking – Windows and Linux – Metasploit and Kali Linux, Keylogging,	15L

			Buffer Overflows, Privilege Escalation, Network hacking - ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IPspoofing, SYN Flooding, Smurf attack,	
		4.2	Applications hacking : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security, Malware analysis : Netcat Trojan, wrapping definition, reverse engineering	
		4.3	Phases : Covering your tracks : Steganography, Event Logs alteration Additional Security Mechanisms : IDS/IPS, Honeypots and evasion techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines)	
		Total Lectures		60

Expected Outcomes:

1. Learner will know to identify security vulnerabilities and weaknesses in the target applications.
2. They will also know to test and exploit systems using various tools and understand the impact of hacking in real time machines.

Reference Books :

1. Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007
3. Certified Ethical Hacker: Michael Gregg, Pearson Education,1st Edition, 2013
4. Certified Ethical Hacker: Matt Walker, TMH,2011
5. http://www.pentest-standard.org/index.php/PTES_Technical_Guidelines
6. https://www.owasp.org/index.php/Category:OWASP_Top_Ten_2017_Project
7. https://www.owasp.org/index.php/Mobile_Top_10_2016-Top_10
8. https://www.owasp.org/index.php/OWASP_Testing_Guide_v4_Table_of_Contents
9. https://www.owasp.org/index.php/OWASP_Secure_Coding_Practices_-_Quick_Reference_Guide
10. <https://cve.mitre.org/>
11. <https://access.redhat.com/blogs/766093/posts/2914051>
12. <http://resources.infosecinstitute.com/applications-threat-modeling/#gref>
13. <http://www.vulnerabilityassessment.co.uk/Penetration%20Test.html>.

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	VI
Subject Name	Ethical Hacking Practical
Subject Code	PUSCS605P
Level of the Subject	Medium

Practical No	Details
1.	Use Google and Whois for Reconnaissance
2.	Use CrypTool <ul style="list-style-type: none"> a. to encrypt and decrypt passwords using RC4 algorithm b. Use Cain and Abel for cracking Windows account password using Dictionary attack and to decode wireless network passwords
3.	<ul style="list-style-type: none"> a. Run and analyze the output of following commands in Linux – ifconfig, ping, netstat, traceroute b. Perform ARP Poisoning in Windows
4.	Use NMap scanner to perform port scanning of various forms – ACK, SYN, FIN, NULL, XMAS
5.	<ul style="list-style-type: none"> a. Use Wireshark (Sniffer) to capture network traffic and analyze b. Use Nemesy to launch DoS attack
6.	Simulate persistent cross-site scripting attack
7.	Session impersonation using Firefox and Tamper Data add-on
8.	Perform SQL injection attack
9.	Create a simple keylogger using python
10.	Using Metasploit to exploit (Kali Linux)

