AC – 07/07/2023
Item No. – **6.29 (N)**

As Per NEP 2020

University of Mumbai

Title of the program

A- P.G. Diploma in Information Technology
B- M.Sc. (Information Technology) (Two Year) } **2023-24**

C- M.Sc. (Information Technology) (One Year) - **2027-28**

Syllabus for

Semester – Sem I & II

Ref: GR dated 16th May, 2023 for Credit Structure of PG

Preamble

1) Introduction

Master of Science (Information Technology) is a Programme designed to meet the needs of the market for expertise in Information Technology (IT). The Programme is intended to address the increasing demand in the work-place for IT professionals with a broad and sound knowledge of both technical and managerial skills. A master degree is granted to individuals who have undergone study demonstrating a mastery or high-order overview of a specific area.

2) Aims and Objectives

1. To equip postgraduate students with an integrated set of skills that will allow them to develop their professional careers in Information Technology.
2. To equip students with the theoretical and practical knowledge that is necessary to enable them to understand the design of complex computer applications/science.
3. The programme also prepares students to embrace future developments in the field and has a demonstrated professional relevance.
4. The programme helps students to acquire the latest skills and build their future capabilities using world-class technology. At the end of this programme, a student will possess a strong foundation of computer systems and information technology.
5. Dexterity in advanced programming languages; power to build sophisticated software for wide area of applications.
6. Skills to work with higher end applications in internet technologies; also managerial ability to analyze, design, develop and to maintain software development.

3) Learning Outcomes

1. Apply the knowledge of mathematics, science and computing in the core information technologies.
2. Identify, design, and analyze complex computer systems and implement and interpret the results from those systems.
3. Design, implement and evaluate a computer-based system, or process component, to meet the desired needs within the realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Review literature and indulge in research using research based knowledge and methods to design new experiments, analyze, and interpret data to draw valid conclusions.
5. Select and apply current techniques, skills, and tools necessary for computing practice and integrate IT-based solutions into the user environment effectively.
6. Apply contextual knowledge to assess professional, legal, health, social and cultural issues during profession practice.
7. Analyze the local and global impact of computing on individuals, organizations, and society.
8. Apply ethical principles and responsibilities during professional practice.
9. Function effectively as a team member or a leader to accomplish a common goal in a multidisciplinary team.
10. Communicate effectively with a range of audiences using a range of modalities including written, oral and graphical.
11. Apply the knowledge of engineering and management principles to manage projects effectively in diverse environments as a member or a leader in the team.
12. Engage in independent and life-long learning for continued professional development

4) Any other point (if any)

5) Credit Structure of the Program (Sem I, II, III, & IV)

R:___________

Credit Distribution Structure for Two Years/ One Year PG
(M.Sc (Information Technology))

Year	**Level**	**Sem**	**Major**				**RM**	**OJT/FP**	**RP**	**Cum. Cr.**	**Degree**
			Mandatory			Electives					
1	6.0	Sem I	2*4+2*2 + 2			4	4	-	-	22	PG Diploma (after 3 Years Degree)
			Data Science(501)	TH	4	Security Breaches and Countermeasures (506a) (PR) **(OR)** Data Center Technologies (506b) **(OR)** Image Processing (506c)	Research Methodology(510)				
			Data Science Practical(502)	PR	2						
			Soft Computing Techniques(503)	TH	4						
			Soft Computing Techniques Practical(504)	PR	2						
			Cloud Computing(505)	TH	2						
		Sem II	2*4+2*2 + 2			4	-	(517)4	-	22	
			Big Data Analytics (511)	TH	4	Malware Analysis (PR) (516a) **(OR)** Cloud Management (PR) (516b) **(OR)** Computer Vision (PR) (516c)					
			Big Data Analytics Practical (512)	PR	2						
			Modern Networking (513)	TH	4						
			Modern Networking Practical (514)	PR	2						
			Microservices Architecture (515)	TH	2						
Cum. Cr. For PG Diploma			28			8	4	4		44	
Exit Option: PG Diploma (44 credits) after Three Year UG Degree											

<table>
<tr><th>Year</th><th>Level</th><th>Sem (2yr)</th><th colspan="4">Major</th><th>RM</th><th>OJT/FP</th><th>RP</th><th>Cum. Cr.</th><th>Degree</th></tr>
<tr><td rowspan="11">2</td><td rowspan="11">6.5</td><td rowspan="6">Sem III</td><td colspan="3">2*4+2*2 + 2</td><td>4</td><td>-</td><td>-</td><td>(607)4</td><td>22</td><td rowspan="12">PG Degree after 3-yr UG or PG Degree after 4-yr UG</td></tr>
<tr><td>Advanced AI (601)</td><td>TH</td><td>4</td><td rowspan="5">Natural Language Processing (606a) (OR) Security Operations Center (PR) (606b) (OR) Server Virtualization on VMWare Platform (PR) (606c)</td></tr>
<tr><td>Advanced AI Practical (602)</td><td>PR</td><td>2</td></tr>
<tr><td>Machine Learning (603)</td><td>TH</td><td>4</td></tr>
<tr><td>Machine Learning Practical (604)</td><td>PR</td><td>2</td></tr>
<tr><td>Storage as a Service (605)</td><td>TH</td><td>2</td></tr>
<tr><td rowspan="5">Sem IV</td><td colspan="3">2*4+2*2</td><td>4</td><td>-</td><td>-</td><td>(616)6</td><td>22</td></tr>
<tr><td>Blockchain (611)</td><td>TH</td><td>4</td><td rowspan="4">Robotic Process Automation (PR) (615a) (OR) Cyber Forensics (PR) (615b) (OR) Advanced IoT (PR) (615c)</td></tr>
<tr><td>Blockchain Practical (612)</td><td>PR</td><td>2</td></tr>
<tr><td>Deep Learning (613)</td><td>TH</td><td>4</td></tr>
<tr><td>Deep Learning Practical (614)</td><td>PR</td><td>2</td></tr>
<tr><td colspan="3">Cum. Cr. For 1 Yr PG Degree</td><td colspan="3">26</td><td>8</td><td></td><td></td><td>10</td><td>44</td></tr>
<tr><td colspan="3">Cum. Cr. For 2 Yr PG Degree</td><td colspan="3">54</td><td>16</td><td>4</td><td>4</td><td>10</td><td>88</td></tr>
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Sign of HOD
Dr. Mrs. R. Srivaramangai
Dept of Information Technology

Sign of Dean
Prof. Shivram Garje
Science & Technology

Syllabus

M.Sc(Information Technology)

(Sem. I & II)

Semester I

Programme Code : _____ Programme Name:M. Sc (Information Technology)

Course Code:501 **Total Credits:** 04 (60 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Data Science **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Pre requisite:

Basic understanding of statistics

Course Objectives (COs)

To enable the students to:

CO1 : Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics.

CO2 : Practice problem analysis and decision-making.

CO3 : Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.

MODULE I:	**(2 CREDITS)**
Unit 1: Data Science Introduction & Basics a. **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. b. **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 c. **Business Layer:** Business Layer, Engineering a Practical Business Layer d. **Utility Layer:** Basic Utility Design, Engineering a Practical Utility Layer	15 Hrs [OC1, OC2, OC3]
Unit 2: Statistics for Data Science a. **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 b. **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. c. **Assess Superstep:** Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep	15 Hrs [OC4, OC5, OC6]
MODULE II :	**(2 CREDITS)**
Unit 3: Data Analysis with Python & Data Visualization a. **Process Superstep :** Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science,	15 Hrs [OC7, OC8,

b. **Transform Superstep :** Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test.	OC9, OC10]
Unit 4: Machine Learning for Data Science a. **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. b. **Organize and Report Supersteps :** Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference	15 Hrs [OC11,OC12, OC13, OC14]

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
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

Course Outcomes(OCs)

Upon completing this course, the student will be able to:

1. Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
2. Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
3. Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.
4. Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
5. Apply principles of Data Science to the analysis of business problems.
6. Use data mining software to solve real-world problems.
7. Employ cutting edge tools and technologies to analyze Big Data.
8. Apply algorithms to build machine intelligence.
9. Demonstrate use of team work, leadership skills, decision making and organization theory.

Course Code:502 **Total Credits:** 02 (60 Lecture Hrs) **University assessment:** 25 marks	**Course Name:** Data Science Practical **Total Marks:** 50 marks **College/Department assessment:** 25 marks

Pre requisites:

Basic understanding of statistics and basic programming logic

Course Objectives (OCs)

To enable the students to:

CO1 To Develop statistical and analytical modelling using data science concepts

CO2 To develop data visualization

CO3 To Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences

Units	Sr No.	Name of Practical	Lecture Hrs (2 credits)
I	1	Creating and using database in Cassandra	15 Hrs (OC1-OC4)
	2	Write the programs for the following:	
	2a	Text Delimited CSV to HORUS format	
	2b	XML to HORUS format	
	2c	JSON to HORUS format	
	2d	MySql database to HORUS format	
	2e	Picture(JPEG) to HORUS format	
	2f	Video to HORUS format	
	2g	Audio to HORUS format	
	3a	Fixers Utilities	
	3b	Data Binning or Bucketing	
	3c	Averaging of data	
	3d	Outlier Detection	
	3e	Logging	
II	4a	Perform following data processing using R	20 Hrs (OC5-OC7)
	4b	Program retrieve different attributes of data	
	4c	Data pattern	
	4d	Loading IP_DATA_ALL	
	5a	Perform error management on the given data using pandas package	
	5b	Write python/R program to create the network routing diagram from the given data on routers	
	5c	Write a python/R program to build acyclic graph	
	5d	Write python/R program to pick the content for BillBoards from the given data	
	5e	Write a python/R program to generate GML file from given csv file	
	5f	Write python/R program to plan location of warehouse from the given data	
	5g	Write python/R program using data science via clustering to determine new warehouse using the given data	
	5h	Using the given data Write python/R program to plan the shipping routers from best-fit international logistics	
	5i	Write python/R program to delete the best packing option to ship in container from the given data	
	5j	Write python program to create delivery route using the given data	
	5k	Write python program to crate simple forex trading planner from the given data	

	5l	Write python program to process the balance sheet to ensure the only good data is processing	
	5m	Write python program to generate payroll from the given data	
III	6	Build the time hub, links and satellites	15 Hrs (OC8-OC9)
	7	Transforming data	
	8	Organizing data	
	9	Generating data	
	10	Data visualisation using power Bi	

Course Outcomes(OCs)

Upon completing this course, the student will be able to:

OC 1. Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
OC 2. Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
OC 3. Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.
OC 4. Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
OC 5. Apply principles of Data Science to the analysis of business problems.
OC 6. Use data mining software to solve real-world problems.
OC 7. Employ cutting edge tools and technologies to analyze Big Data.
OC 8. Apply algorithms to build machine intelligence.
OC 9. Demonstrate use of team work, leadership skills, decision making and organization theory.

Course Code: 503 **Total Credits:** 04 (60 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Soft Computing Techniques **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Pre-requisite: Basic **Knowledge** on AI

Course Objectives (COs):

To enable the students to:

- **CO1:** Soft computing concepts like fuzzy logic, neural networks and genetic algorithm, where Artificial Intelligence is mother branch of all.
- **CO2** All these techniques will be more effective to solve the problem efficiently **:**

MODULE I:	**(2 CREDITS)**
Unit I **a) 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. **b) Artificial Neural Network -** Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network**.** **c) Supervised Learning Network -** Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network	15 Hrs [OC1-OC3]
Unit II **a) Associative Memory Networks -** Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks. Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. **b) Special Networks -** Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network **c) Third Generation Neural Networks -** Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model. **d) UnSupervised Learning Networks -** Fixed weight competitive nets	15 Hrs [OC4-OC5]
MODULE II:	**(2 CREDITS)**
Unit III **a) Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets -** Classical sets, Fuzzy sets. **b) Classical Relations and Fuzzy Relations -** Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.	15 Hrs OC6

c) **Membership Function -** features of the membership functions, fuzzification, methods of membership value assignments. d) **Defuzzification -** Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. e) **Fuzzy Arithmetic and Fuzzy measures -** fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.	
Unit IV a) **Fuzzy Rule base and Approximate reasoning -** Fuzzy proportion, formation of rules, decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Fuzzy logic control systems, control system design, architecture and operation of FLC system, FLC system models and applications of FLC System. b) **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.Differential Evolution Algorithm, Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	15 Hrs [OC7-OC8]

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Artificial Intelligence and Soft Computing	Anandita Das Battacharya	SPD	3rd	2018
2.	Principles of Soft computing	S.N.Sivanandam S.N.Deepa	Wiley	3rd	2019
3.	Neuro-Fuzzy and Soft Computing	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
6.	Genetic Algorithms: Search, Optimization and Machine Learning	Davis E.Goldberg	Addison Wesley		1989
7.	Introduction to AI and Expert System	Dan W. Patterson	Prentice Hall of India		2009

Course Outcomes(OCs)

Upon completing this course, the student will be able to:

OC1 Gain a solid understanding of the fundamental concepts underlying soft computing, including the differences between soft computing and traditional hard computing methods.

OC2 Familiarize with a variety of soft computing techniques such as fuzzy logic, neural networks, genetic algorithms, swarm intelligence, and probabilistic reasoning.

OC3 Apply soft computing techniques to solve real-world problems from various domains such as engineering, finance, healthcare, and more.

OC4 Formulate problems in a way that lends itself to the application of soft computing techniques, taking into account the uncertainties and imprecisions present in real-world data.

OC5 Understnad of how fuzzy logic works and its applications in modeling and decision-making under uncertainty.

OC6 Gain knowledge of neural network architectures, training algorithms, and their applications in pattern recognition, regression, and classification tasks.

OC7 Understand genetic algorithms, their components, and their use in optimization problems and search spaces.

OC8 Familiarize with swarm intelligence algorithms such as ant colony optimization and particle swarm optimization, and their applications in optimization and search problems.

Course Code: 504 **Total Credits:** 02 (60 Lecture Hrs) **University assessment:** 25 marks	**Course Name:** Soft Computing Techniques Practical **Total Marks:** 50 marks **College/Department assessment:** 25 marks

Pre requisites:

Basic understanding of statistics and basic programming logic with AI basics

Course Objectives (COs)

CO1. Hands-On Implementation
CO2. Algorithm Understanding
CO3. Real-World Applications
CO4. Develop students' programming skills by experimenting with soft computing algorithms.
CO5. Train students to visualize and interpret the results of soft computing techniques effectively.

Units	Sr. No.	Details	Lecture Hrs 2 Credits
I	**1**	Implement the following:	20 Hrs [OC1-OC2]
	A	Design a simple linear neural network model.	
	B	Calculate the output of neural net using both binary and bipolar sigmoidal function.	
	2	Implement the following:	
	A	Generate AND/NOT function using McCulloch-Pitts neural net.	
	B	Generate XOR function using McCulloch-Pitts neural net.	
	3	Implement the Following	
	A	Write a program to implement Hebb's rule.	
	B	Write a program to implement of delta rule.	
II	**4**	Implement the Following	20 Hrs [OC3-OC5]
	A	Write a program for Back Propagation Algorithm	
	B	Write a program for error Backpropagation algorithm.	
	5.	Implement the Following	
	A	Write a program for Hopfield Network.	
	B	Write a program for Radial Basis function	
	6.	Implement the Following	
	A	Kohonen Self organizing map	
	B	Adaptive resonance theory	
III	**7.**	Implement the Following	20 Hrs [OC6-OC7]
	A	Write a program for Linear separation.	
	B	Write a program for Hopfield network model for associative memory	
	8.	Implement the Following	
	A	Membership and Identity Operators | in, not in,	
	b.	Membership and Identity Operators is, is not	
	9.	Implement the Following	
	A	Find ratios using fuzzy logic	
	B	Solve Tipping problem using fuzzy logic	
	10.	Implement the Following	

	A	Implementation of Simple genetic algorithm	
	B	Create two classes: City and Fitness using Genetic algorithm	

Course Outcomes(COs)

Upon completing this course, the student will be able to:

OC 1: Identify and describe soft computing techniques and their roles in building intelligent machines

OC 2: Recognize the feasibility of applying a soft computing methodology for a particular problem

OC 3: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

OC 4: Apply genetic algorithms to combinatorial optimization problems

OC 5: Apply neural networks for classification and regression problems

OC 6: Effectively use existing software tools to solve real problems using a soft computing approach

OC 7: Evaluate and compare solutions by various soft computing approaches for a given problem.

Course Code: 505 **Total Credits:** 04 (60 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Cloud Computing **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Pre requisite: Basic knowledge of Computer Networks, Operating Systems

Course Objectives(COs)

CO1. To learn how to use Cloud Services.

CO2. To implement Virtualization.

CO3. To implement Task Scheduling algorithms.

CO4. Apply Map-Reduce concept to applications.

CO5. To build Private Cloud.

CO6. Broadly educate to know the impact of engineering on legal and societal issues involved.

Units	S.No	Details	Lecture Hrs 2 Credits
I	a) b) c)	**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. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.	**15Hrs** **[OC1-OC3]**
II	a) b) c)	**Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. **Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure.	**15 Hrs** **[OC4-OC6]**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
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.	Distributed and Cloud Computing, From Parallel Processing to the Internet of Things	Kai Hwang, Jack Dongarra, Geoffrey Fox	MK Publishers	--	2012

Course Outcomes(COs)

Upon completing this course, the student will be able to:

- OC1 Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures.
- OC2 Design different workflows according to requirements and apply map reduce programming model.
- OC3 Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
- OC4 Create combinatorial auctions for cloud resources and design scheduling algorithms for computing cloud.
- OC5 Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application
- OC6 Broadly educate to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing.

Course Code: 506a **Total Credits:** 04 (120 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Security Breaches and Countermeasures Practical **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Prerequisite:

Basic Networking and Security concepts

Course Objectives(COs):

- To get the insight of the security loopholes in every aspect of computing.
- To understand the threats and different types of attacks that can be launched on computing systems.
- To know the countermeasures that can be taken to prevent attacks on computing systems.
- To test the software against attacks.

Units	Sr. No	Details	Lecture Hrs 2 Credits
I	a)	1. Use the following tools to perform footprinting and reconnaissance	20 Hrs [OC1]
		2. Recon-ng (Using Kali Linux)	
		3. FOCA Tool	
		4. Windows Command Line Utilities	
		5. Ping	
	b)	6. Tracert using Ping	
		7. Tracert	
		8. NSLookup	
		9. Website Copier Tool – HTTrack	
		10. Metasploit (for information gathering)	
	c)	11. Whois Lookup Tools for Mobile – DNS Tools, Whois, Ultra Tools Mobile	
		12. Smart Whois	
		13. eMailTracker Pro	
		14. Tools for Mobile – Network Scanner, Fing – Network Tool, Network Discovery Tool, Port Droid Tool	
	d)	a. Scan the network using the following tools:	
		i. Hping2 / Hping3	
		ii. Advanced IP Scanner	
		iii. Angry IP Scanner	
	e)	iv. Masscan	
		v. NEET	
		vi. CurrPorts	
		vii. Colasoft Packet Builder	
		viii. The Dude	
	f)	ix.	
		b. Use Proxy Workbench to see the data passing through it and save the data to file.	
		c. Perform Network Discovery using the following tools:	

	g)	i. Solar Wind Network Topology Mapper	
		ii. OpManager	
		iii. Network View	
		iv. LANState Pro	
		d. Use the following censorship circumvention tools:	
		i. Alkasir	
	h)	ii. Tails OS	
		e. Use Scanning Tools for Mobile – Network Scanner, Fing – Network Tool, Network Discovery Tool, Port Droid Tool	
II	a)	a. Perform Enumeration using the following tools:	20 Hrs [OC2-OC3]
		i. Nmap	
		ii. NetBIOS Enumeration Tool	
		iii. SuperScan Software	
		iv. Hyena	
		v. SoftPerfect Network Scanner Tool	
		vi. OpUtils	
		vii. SolarWinds Engineer's Toolset	
		viii. Wireshark	
	b)	b. Perform the vulnerability analysis using the following tools:	
		i. Nessus	
		ii. OpenVas	
		a. Perform mobile network scanning using NESSUS.	
		b. Perform the System Hacking using the following tools:	
		i. Winrtgen	
		ii. PWDump	
		iii. Ophcrack	
		iv. Flexispy	
	d)	v. NTFS Stream Manipulation	
		vi. ADS Spy	
		vii. Snow	
		viii. Quickstego	
		ix. Clearing Audit Policies	
	e)	x. Clearing Logs	
		a. Use wireshark to sniff the network.	
		b. Use SMAC for MAC Spoofing.	
		c. Use Caspa Network Analyser.	
		d. Use Omnipeek Network Analyzer.	
		a. Use Social Engineering Toolkit on Kali Linux to perform Social Engineering using Kali Linux.	
		b. Perform the DDOS attack using the following tools:	
III	a)	i. HOIC	20 Hrs [OC4-OC5]
		ii. LOIC	
		iii. HULK	
		iv. Metasploit	

		c. Using Burp Suite to inspect and modify traffic between the browser and target application.	
	b)	a. Perform Web App Scanning using OWASP Zed Proxy.	
		b. Use droidsheep on mobile for session hijacking	
		c. Demonstrate the use of the following firewalls:	
		i. Zonealarm and analyse using Firewall Analyzer.	
		ii. Comodo Firewall	
		d. Use HoneyBOT to capture malicious network traffic.	
	c)	e. Use the following tools to protect attacks on the web servers:	
		i. ID Server	
		ii. Microsoft Baseline Security Analyzer	
		iii. Syhunt Hybrid	
		a. Protect the Web Application using dotDefender.	
		b. Demonstrate the following tools to perform SQL Injection:	
	d)	i. Tyrant SQL	
		ii. Havij	
		iii. BBQSQL	
		Use Aircrack-ng suite for wireless hacking and countermeasures.	
		Use the following tools for cryptography	
		i. HashCalc	
	e)	ii. Advanced Encryption Package	
		iii. MD5 Calculator	
		iv. TrueCrypt	
		v. CrypTool	

Books and References:					
Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	CEHv10, Certified Ethical Hacker Study Guide	Ric Messier	Sybex - Wiley	-	2019
2.	All in One, Certified Ethical Hacker	Matt Walker	Tata McGraw Hill	-	2012
3.	CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide	I.P. Specialist	IPSPECIALIST	-	2018

Course Outcome(OCs)
Upon completing this course, the student will be able to:

OC 1: The student should be able to identify the different security breaches that can occur. The student should be able to evaluate the security of an organization and identify the loopholes. The student should be able to perform enumeration and network scanning.

OC 2: The student should be able to identify the vulnerability in the systems, breach the security of the system, identify the threats due to malware and sniff the network. The student should be able to do the penetration testing to check the vulnerability of the system towards malware and network sniffing.

OC 3: The student should be able to perform social engineering and educate people to be careful from attacks due to social engineering, understand and launch DoS and DDoS attacks, hijack and active session and evade IDS and Firewalls. This should help the students to make the organization understand the threats in their systems and build robust systems.

OC 4: The student should be able to identify the vulnerabilities in the Web Servers, Web Applications, perform SQL injection and get into the wireless networks. The student should be able to help the organization aware about these vulnerabilities in their systems.

OC 5: The student should be able to identify the vulnerabilities in the newer technologies like mobiles, IoT and cloud computing. The student should be able to use different methods of cryptography.

Course Code: 506b **Total Credits:** 04 (60 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Data Center Virtualization **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Pre requisites:

Basic knowledge of Computer Networks and Cloud Computing

Course Objectives(COs):

- Identify important requirements to design and support a data center.
- Determine a data center environment's requirement including systems and network architecture as well as services.
- Evaluate options for server farms, network designs, high availability, load balancing, data center services, and trends that might affect data center designs.
- Assess threats, vulnerabilities and common attacks, and network security devices available to protect data centers.
- Design a data center infrastructure integrating features that address security, performance, and availability.
- Measure data center traffic patterns and performance metrics.

Units	Details	Lectures 4 Credits
	Module I	
I	a) **Virtualization -** Virtualization History and Definitions b) **Virtualization and Network Technologies – I -** Data Center Network Evolution Beginning of Network Virtualization c) **Virtualization and Network Technologies – II -** Ace Virtual Contexts Virtual Device Contexts	**15** **[OC1]**
II	a) **Fooling Spanning Tree** b) **Virtualized Chassis with Fabric Extenders -** History of Data Centers c) **Virtualization in Storage Technologies – I -** Storage Evolution	**15** **[OC2]**
	Module II	
III	a) **Virtualization in Storage Technologies – II -** Islands in SAN b) **Secret Identities** One Cable to Unite Us All c) **Server Evolution**	**15** **[OC3]**
IV	a) **Changing Personalities** b) **Transcending the Rack -** Moving Targets c) **End to End Virtualization -** Virtual Data Center and Cloud Computing	**15** **[OC4-OC5]**

Books and References:					
Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Data Center Virtualization Fundamentals	Gustavo Alessandro Andrade Santana	Cisco Press	1st	2014

Course Outcomes(OCs):

After completion of the course, a student should be able to:

OC 1: Understand basic concepts in Virtualization.
OC 2: Use concepts of Load Balancing and Aggregation /virtual switching
OC 3: Configure Data center Migration and Fabric Building
OC 4: Understand various Changes in Server Architecture
OC 5: Use the concepts of Cloud computing and how to move towards a cloud computing technology.

Course Code: 506c **Total Credits:** 04 (60 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Image Processing **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Prerequisites:
Fundamental knowledge of graphics and Mathematics
Course Objectives(COs):

CO1. Review the fundamental concepts of a digital image processing system.
CO2. Analyze images in the frequency domain using various transforms.
CO3. Evaluate the techniques for image enhancement and image restoration.
CO4. Categorize various compression techniques.
CO5. Interpret Image compression standards.
CO6. Interpret image segmentation and representation techniques.

Units	Sr. No	Module I	Lecture Hrs 4 Credits
I	a) b) c)	**Introduction:** Digital Image Processing, Origins of Digital Image Processing, Applications and Examples of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, **Digital Image Fundamentals:** Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Basic Mathematical Tools Used in Digital Image Processing, **Intensity Transformations and Spatial Filtering:** Basics, Basic Intensity Transformation Functions, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters, Highpass, Bandreject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering	**15**
II	a) b)	**Filtering in the Frequency Domain:** Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of the 2-D DFT and IDFT, Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using Highpass Filters, Selective Filtering, Fast Fourier Transform **Image Restoration and Reconstruction:** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-----Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function,	**15**

	c)	Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections **Wavelet and Other Image Transforms:** Preliminaries, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms	
		Module II	
III	**a)** b) c)	**Color Image Processing:** Color Fundamentals, Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, Color Image Smoothing and Sharpening, Using Color in Image Segmentation, Noise in Color Images, Color Image Compression. **Image Compression and Watermarking:** Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, 8 Bit-plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Digital Image Watermarking, **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms, Morphological Reconstruction, Morphological Operations on Binary Images, Grayscale Morphology	**15**
IV	**a)** **b)** **c)**	**Image Segmentation I: Edge Detection, Thresholding, and Region Detection:** Fundamentals, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Superpixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation **Image Segmentation II: Active Contours: Snakes and Level Sets:** Background, Image Segmentation Using Snakes, Segmentation Using Level Sets. **Feature Extraction:** Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	**15**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Digital Image Processing	Gonzalez and Woods	Pearson/Prentice Hall	Fourth	2018
2.	Fundamentals of Digital Image Processing	A K. Jain	PHI		
3.	The Image Processing Handbook	J. C. Russ	CRC	Fifth	2010

OC 1: Understand the relevant aspects of digital image representation and their practical implications.

OC 2: Have the ability to design pointwise intensity transformations to meet stated specifications.

OC 3: Understand 2-D convolution, the 2-D DFT, and have the abitilty to design systems using these concepts.

OC 4: Have a command of basic image restoration techniques.

OC 5: Understand the role of alternative color spaces, and the design requirements leading to choices of color space.

OC 6: Appreciate the utility of wavelet decompositions and their role in image processing systems.

OC 7: Have an understanding of the underlying mechanisms of image compression, and the ability to design systems using standard algorithms to meet design specifications.

Course Code: 507 **Total Credits:** 04 (60 Lecture Hrs) **University assessment:** 50 marks	**Course Name:** Research Methodology **Total Marks:** 100 marks **College/Department assessment:** 50 marks

Pre requisites	Basic knowledge of statistical methods. Analytical and logical thinking.

Course Objectives(COs)

CO1. To be able to conduct business research with an understanding of all the latest theories.

CO2. To develop the ability to explore research techniques used for solving any real world or innovate problem.

Units	Details	Lecture Hrs (4 Credits)
	Module I	
I	a) **Introduction:** Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues b) **Beginning Stages of Research Process:** Problem definition, Qualitative research tools, Secondary data research	**15 [OC1-OC2]**
II	a) **Research Methods and Data Collection:** Survey research, communicating with respondents, Observation methods, Experimental research	**15 [OC3-OC4]**
	Module II	
III	a) **Measurement Concepts, Sampling and Field work:** Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size	**15 [OC5-OC6]**
IV	a) **Data Analysis and Presentation:** Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis.	**15 [OC7-OC8]**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Business Research Methods	William G.Zikmund, B.J Babin, J.C. Carr, Atanu Adhikari, M.Griffin	Cengage	8e	2016
2.	Business Analytics	Albright Winston	Cengage	5e	2015

3.	Research Methods for Business Students Fifth Edition	Mark Saunders			2011
4.	Multivariate Data Analysis	Hair	Pearson	7e	2014

Course Outcomes(OCs)

A learner will be able to:

OC 1: solve real world problems with scientific approach.
OC 2: develop analytical skills by applying scientific methods.
OC 3: recognize, understand and apply the language, theory and models of the field of business analytics
OC 4: foster an ability to critically analyze, synthesize and solve complex unstructured business problems
OC 5: understand and critically apply the concepts and methods of business analytics
OC 6: identify, model and solve decision problems in different settings
OC 7: interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
OC 8: create viable solutions to decision making problems