SIES COLLEGE OF COMMERCE & ECONOMICS
AUTONOMOUS
DEPARTMENT OF INFORMATION TECHNOLOGY

Date of BOS meeting: 16th January 2023

Name of BOS Chairperson: Ms. Bhavini Shah

Sr. No.	Heading	Particulars
1	Title of the course	M. Sc. (Information Technology)
2	Eligibility for admission	BSc IT, BSc CS, BE, BCA, BSc Physics, BSc Maths, BSc Statistics, BSc Electronics
3	Minimum percentage	40 %
4	Semesters	I & II
5	Level	PG
6	Pattern	02 years & 04 semesters CBGS
7	To be implemented from	From Academic year 2023-24 in a progressive manner

SIES COLLEGE OF COMMERCE & ECONOMICS
(AUTONOMOUS)
(Affiliated to University of Mumbai)
RE-ACCREDITED GRADE "A" BY NAAC

BOARD OF STUDIES
INFORMATION TECHNOLOGY

(WITH EFFECT FROM THE ACADEMIC YEAR 2023-2024)

SEMESTER I

Research in Computing

COURSE CODE: MIT - RMS1 - 505 **COURSE CREDIT: 04**

Course Objectives:

1. The learner will be able to define different methodologies and techniques used in research work.
2. The learner will be able to explain basic computer skills necessary for the conduct of research.
3. The learner will be able to apply the basic function and working of analytical instruments used in research .
4. The learner will be able to analyse the required numerical skills necessary to carry out research.
5. The learner will be able to summarize the research problem, appropriate research design.
6. The learner will be able to devise the concepts and procedures of sampling, data collection, analysis and reporting.

Sr. No	Modules/Units	No of Lectures
1.	**Introduction:** Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues	12
2.	**Beginning Stages of Research Process:** Problem definition, Qualitative research tools, Secondary data research	12
3.	**Research Methods and Data Collection:** Survey research, communicating with respondents, Observation methods, Experimental research	12
4.	**Measurement Concepts, Sampling and Field work:** Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size	12
5.	**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.	12

REFERENCE BOOKS:

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

Research in Computing Practical

COURSE CODE: MIT - RMPS1 - 506 **COURSE CREDIT: 02**

Practical No	Details
1	**Implement the following**
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	**Implement the following**
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	**Implement the following**
A	Perform testing of hypothesis using one sample test.
B	Perform testing of hypothesis using two sample test.
C	Perform testing of hypothesis using paired t-test.
4.	**Implement the following**
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.	**Implement the following**
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.	**Implement the following**
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.	**Implement the following**
A	Perform linear regression for prediction
B	Perform polynomial regression for prediction
10.	**Implement the following**
A	Perform multiple linear regression
B	Perform Logistic regression

Data Science

COURSE CODE: MIT - MAJS1 - 501 **COURSE CREDIT: 04**

Course Objectives:

1. Learner will be able to identify various programming abilities and recognize their use to develop various Data Science Models.
2. Learner will be able to demonstrate proficiency with statistical analysis of data.
3. Learner will be able to apply and interpret data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.
4. Learner will be able to analyse statistical data with professional statistical software.
5. Learners will be able to evaluate models to devise solutions to data science tasks.
6. Learners will be able to formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges.

Sr. No	Modules/Units	No of Lectures
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	12
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	12
3.	**Assess Superstep:** Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep	1

4.	**Process Superstep :** Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science, **Transform Superstep :** Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test.	12
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	12

REFERENCE BOOKS:

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

Data Science Practical

COURSE CODE: MIT - MJPS1 - 502 **COURSE CREDIT: 02**

Practical No	Details
---	Prerequisites to Data Science Practical.
1	Creating Data Model using Cassandra
2	Conversion from different formats to HOURS format
a	Text delimited csv format.
b	XML
c	JSON
d	MySQL Database
e	Picture (JPEG)
f	Video
g	Audio
3	Utilities and Auditing
4.	Retrieving Data
5.	Assessing Data
6.	Processing Data
7.	Transforming Data
8.	Organizing Data
9.	Generating Reports
10.	Data Visualization with Power BI

Cloud Computing

COURSE CODE: MIT - MAJS1 - 503 **COURSE CREDIT: 04**

Course Objectives:

1. Learner will be able to identify the technical foundations of cloud computing architectures, cloud service and deployment models.
2. Learner will be able to explain the principles of Parallel and Distributed Computing and virtualization and how this has enabled the development of Cloud Computing
3. Learner will be able to apply principles of best practice in cloud application design and management.
4. Learner will be able to analyse the problems and solutions to cloud security problems.
5. Learners will be able to choose among various cloud technologies for implementing applications.
6. Learners will be able to develop new ideas and innovations in cloud computing.

Sr. No	Modules/Units	No of Lectures
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. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.	12
2.	**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.	12

3.	**Specialized Cloud Mechanisms:** Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database. **Cloud Management Mechanisms:** Remote administration system, Resource Management System, SLA Management System, Billing Management System, **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	12
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. **Advanced Cloud Architectures:** Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture	12
5.	**Cloud Delivery Model Considerations:** Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: 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	12

REFERENCE BOOKS:

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

Cloud Computing Practical

COURSE CODE: MIT - MJPS1 - 504 **COURSE CREDIT: 02**

Practical No	Details
1	**Write a program for implementing Client Server communication model using TCP**
a	A client server based program using TCP to find if the number entered is prime.
b	A client server TCP based chatting application.
2	**Write a program for implementing Client Server communication model using UDP**
a	A client server based program using UDP to find if the number entered is even or odd.
b	A client server based program using UDP to find the factorial of the entered number
c.	A program to implement simple calculator operations like addition, subtraction, multiplication and division
d.	A program that finds the square, square root, cube and cube root of the entered number
3	**A multicast Socket example**
4.	**Write a program to show the object communication using RMI**
a	A RMI based application program to display current date and time
b	A RMI based application program that converts digits to words, e.g. 123 will be converted to one two three
5.	**Show the implementation of web services**
a	Implementing “Big” Web Service
b	Implementing Web Service that connects to MySQL database
6.	**Implement Xen virtualization and manage with Xen Center**

7.	**Implement virtualization using VMWare ESXi Server and managing with vCenter**
8.	**Implement Windows Hyper V virtualization**
9.	**Develop application for Microsoft Azure**
10.	**Develop application for Google App Engine**

ELECTIVES

Soft Computing Techniques

COURSE CODE: MIT - ELES1 - 507

COURSE CREDIT: 04

Course Objectives:

1. The learner will be able to define and describe the soft computing techniques such as fuzzy logic, neural networks and genetic algorithms.
2. The learner will be able to explain and demonstrate different soft computing techniques and their applications in various domains.
3. The learner will be able to apply the fundamentals of fuzzy sets and the principles of evolutionary algorithms to real-world problems.
4. The learner will be able to compare and contrast different neural network architectures.
5. The learner will be able to evaluate and compare solutions by various soft computing approaches for finding the optimal solutions.
6. The learner will be able to develop skills in designing various applications through the theoretical and practical components of soft computing techniques.

Sr. No	Modules/Units	No of Lectures
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	12
2.	Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network. 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. 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.	12
3.	UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine,	12

	Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network Third Generation Neural Networks: Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model.	
4.	Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets. Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Membership Function:features of the membership functions, fuzzification, methods of membership value assignments. Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.	12
5.	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. 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.	12

REFERENCE BOOKS:

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

Soft Computing Techniques Practical

COURSE CODE: MIT - ELPS1 - 508 **COURSE CREDIT: 02**

Practical No	Details
1	**Implement the following:**
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.
4.	**Implement the Following**
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
7.	**Implement the Following**

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

SEMESTER II

Image Processing

COURSE CODE: MIT - MAJS2 - 501 **COURSE CREDIT: 04**

Course Objectives:

- The learner will be able to explain the digital image and recognize types of images and its resolution .
- The learner will be able to summarize the methodology to process the images.
- The learner will be able to modify images for improving / restoring the quality of images.
- The learner will be able to compare the quality of images after restoring from compression or inverse transformation.
- The learner will be able to summarize the use of methodology for various operations on images like watermarking, compression, enhancement, restoration etc
- The learner will be able to design spatial / frequency domain filters to remove noise / artefact from images.

Sr. No	Modules/Units	No of Lectures
1.	**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	12
2.	**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	12

	Presence of Noise Only-----Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position- Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections	
3.	**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 **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	12
4.	**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 **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	12
5.	**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)	12

REFERENCE BOOKS:

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

Image Processing Practical

COURSE CODE: MIT - MJPS2 - 502 **COURSE CREDIT: 02**

All practicals can be done in MATLAB / Scilab / Python

Note:

- Use of built-in functions for matrix operations and mathematical operations are allowed
- Use gray-level and color images or image matrices as input to all programs.

I		Basics
1	**a**	Program to calculate number of samples required for an image.
	b	Program to study the effects of reducing the spatial resolution of a digital image.
	c	Program to study the effects of varying the number of intensity levels in a digital image
	d	Program to perform image averaging (image addition) for noise reduction.
	e	Program to compare images using subtraction for enhancing the difference between images.
	f.	Image Registration.
	2.	Intensity transformation and Spatial Filtering
		IMAGE ENHANCEMENT
	A	Basic Intensity Transformation functions
		i. Program to perform Image negation **ii.** Program to perform threshold on an image. **iii.** Program to perform Log transformation **iv.** Power-law transformations **v.** Piecewise linear transformations a. Contrast Stretching b. Gray-level slicing with and without background. c. Bit-plane slicing
	B	1. Program to plot the histogram of an image and categorise 2. Program to apply histogram equalization
	C	Write a program to perform convolution and correlation
	D	Write a program to apply smoothing and sharpening filters on grayscale and color images a) Low Pass b) High Pass Note: Use all kernels mentioned in the reference book
	3.	Filtering in Frequency Domain
		a) Program to apply Discrete Fourier Transform on an image
		b) Program to apply Low pass and High pass filters in frequency domain
		c) Program to apply Laplacian filter in frequency domain
		d) Note: All other filters can be applied, studied and compared with filters in spatial domain.

	e) Program for high frequency emphasis filtering, high boost and homomorphic filtering.
4.	Image Denoising
	i. Program to denoise using spatial mean, median and adaptive mean filtering
	ii. Program for Image deblurring using inverse, Weiner filters
5.	Color Image Processing
	i. Program to read a color image and segment into RGB planes , histogram of color image
	ii. Program for converting from one color model to another model
	iii. Program to apply false colouring(pseudo) on a gray scale image
6.	Fourier Related Transforms
	Program to compute Discrete Cosine Transforms, Walsh -Hadamard Transforms, Haar Transform , Wavelet
7.	Image compression
	Program to apply compression and decompression algorithm on an image (Arithmetic, Huffman and LZW coding techniques.
8.	Morphological Image Processing
	i. Program to apply erosion, dilation, opening, closing
	ii. Program for detecting boundary of an image
	iii. Program to apply Hit-or-Miss transform
	iv. Program to apply morphological gradient on an image
	v. Program to apply Top-Hat/Bottom-hat Transformations
9.	Image Segmentation
	i. Program for Edge detection using a. Sobel, Prewitt, Marr-Hildreth and Canny
	ii. Illustrate Watershed segmentation algorithm
	iii. Any more to be included(to be consulted)
10.	Feature Extraction
	i. Apply Principal components for image description
	ii. Apply Harris-Stephens corner detector algorithm

Modern Networking

COURSE CODE: MIT - MAJS2 - 503 **COURSE CREDIT: 04**

Course Objectives:

- Learner will be able to identify state-of-the-art in modern networking protocols, architectures and applications.
- Learner will be able to explain modern networking concepts of SDN, NFV, IoT from a design and performance perspective.
- Learner will be able to apply the concepts of software defined networks.
- Learner will be able to analyse QoS and QoE of modern networking.
- Learners will be able to assess network function virtualization in detail .
- Learners will be able to design IoT applications in different domains.

Sr. No	Modules/Units	No of Lectures
1.	**Modern Networking:** Elements of Modern Networking The Networking Ecosystem ,Example Network Architectures,Global Network Architecture,A Typical Network Hierarchy Ethernet Applications of Ethernet Standards Ethernet Data Rates Wi-Fi Applications of Wi-Fi,Standards Wi-Fi Data Rates 4G/5G Cellular First Generation Second Generation, Third Generation Fourth Generation Fifth Generation, Cloud Computing Cloud Computing Concepts The Benefits of Cloud Computing Cloud Networking Cloud Storage, Internet of Things Things on the Internet of Things, Evolution Layers of the Internet of Things, Network Convergence Unified Communications, Requirements and Technology Types of Network and Internet Traffic,Elastic Traffic,Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud Computing, and Mobile TrafficBig Data Cloud Computing,,Mobile Traffic, Requirements: QoS and QoE,,Quality of Service,Quality of Experience, Routing Characteristics, Packet Forwarding, Congestion Control ,Effects of Congestion,Congestion Control Techniques, SDN and NFV Software- Defined Networking,Network Functions Virtualization Modern Networking Elements	12

2.	**Software-Defined Networks** **SDN:** Background and Motivation, Evolving Network Requirements Demand Is Increasing,Supply Is IncreasingTraffic Patterns Are More ComplexTraditional Network Architectures are Inadequate, The SDN Approach Requirements SDN Architecture Characteristics of Software-Defined Networking, SDN- and NFV-Related Standards	12

	Standards- Developing Organizations Industry Consortia Open Development Initiatives, SDN Data Plane and OpenFlow SDN Data Plane, Data Plane Functions Data Plane Protocols OpenFlow Logical Network Device Flow Table Structure Flow Table Pipeline, The Use of Multiple Tables Group Table OpenFlow Protocol, SDN Control Plane SDN Control Plane Architecture Control Plane Functions, Southbound Interface Northbound InterfaceRouting, ITU-T Model, OpenDaylight OpenDaylight Architecture OpenDaylight Helium, REST REST Constraints Example REST API, Cooperation and Coordination Among Controllers, Centralized Versus Distributed Controllers, High- Availability Clusters Federated SDN Networks, Border Gateway Protocol Routing and QoS Between Domains, Using BGP for QoS Management IETF SDNi OpenDaylight SNDi SDN Application Plane SDN Application Plane Architecture Northbound Interface Network Services Abstraction Layer Network Applications, User Interface, Network Services Abstraction Layer Abstractions in SDN, Frenetic Traffic Engineering PolicyCop Measurement and Monitoring Security OpenDaylight DDoS Application Data Center Networking, Big Data over SDN Cloud Networking over SDN Mobility and Wireless Information-Centric Networking CCNx, Use of an Abstraction Layer	

3.	**Virtualization, Network Functions Virtualization:** Concepts and Architecture, Background and Motivation for NFV, Virtual Machines The Virtual Machine Monitor, Architectural Approaches Container Virtualization, NFV Concepts Simple Example of the Use of NFV, NFV Principles High-Level NFV Framework, NFV Benefits and Requirements NFV Benefits, NFV Requirements, NFV Reference Architecture NFV Management and Orchestration, Reference Points Implementation, NFV Functionality, NFV Infrastructure, Container Interface, Deployment of NFVI Containers, Logical Structure of NFVI Domains, ComputeDomain, Hypervisor Domain, Infrastructure Network Domain, Virtualized Network Functions, VNF Interfaces,VNFC to VNFC Communication,VNF Scaling, NFV Management and Orchestration, Virtualized Infrastructure Manager, Virtual Network Function Manager, NFV Orchestrator, Repositories, Element Management, OSS/BSS, NFV Use Cases Architectural Use Cases, Service-Oriented Use Cases, SDN and NFV Network Virtualization, Virtual LANs ,The Use of Virtual LANs,Defining VLANs, Communicating VLAN Membership, IEEE 802.1Q VLAN Standard, Nested VLANs, OpenFlow VLAN Support, Virtual Private Networks, IPsec VPNs, MPLS VPNs, Network Virtualization, Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, OpenDaylight's	12

	Virtual Tenant Network, Software-Defined Infrastructure, Software-Defined Storage, SDI Architecture	

4.	**Defining and Supporting User Needs**, Quality of Service, Background, QoS Architectural Framework, Data Plane, Control Plane, Management Plane, Integrated Services Architecture, ISA Approach ISA Components, ISA Services, Queuing Discipline, Differentiated Services, Services, DiffServ Field, DiffServ Configuration and Operation, Per-Hop Behavior, Default Forwarding PHB, Service Level Agreements, IP Performance Metrics, OpenFlow QoS Support, Queue Structures, Meters, QoE: User Quality of Experience, Why QoE?,Online Video Content Delivery, Service Failures Due to Inadequate QoE Considerations QoE-Related Standardization Projects, Definition of Quality of Experience, Definition of Quality, Definition of Experience Quality Formation Process, Definition of Quality of Experience, QoE Strategies in Practice, The QoE/QoS Layered Model Summarizing and Merging the ,QoE/QoS Layers, Factors Influencing QoE, Measurements of QoE, Subjective Assessment, Objective Assessment, End-User Device Analytics, Summarizing the QoE Measurement Methods, Applications of QoE Network Design Implications of QoS and QoE Classification of QoE/ QoS Mapping Models, Black-Box Media-Based QoS/QoE Mapping Models, Glass- Box Parameter-Based QoS/QoE Mapping Models,Gray-Box QoS/QoE Mapping Models, Tips for QoS/QoE Mapping Model Selection,IP- Oriented Parameter-Based QoS/QoE Mapping Models,Network Layer QoE/QoS Mapping Models for Video Services, Application Layer QoE/QoS Mapping Models for Video Services Actionable QoE over IP-Based Networks, The System-Oriented Actionable QoE Solution, The Service-Oriented Actionable QoE Solution, QoE Versus QoS Service Monitoring, QoS Monitoring Solutions, QoE Monitoring Solutions, QoE-Based Network and Service Management, QoE-Based Management of VoIP Calls, QoE-Based Host-Centric Vertical Handover, QoE-Based Network-Centric Vertical Handover	12
5.	**Modern Network Architecture:** Clouds and Fog, Cloud Computing, Basic Concepts, Cloud Services, Software as a Service, Platform as a Service, Infrastructure as a Service, Other Cloud Services, XaaS, Cloud Deployment Models, Public Cloud Private Cloud Community Cloud, Hybrid Cloud, Cloud Architecture, NIST Cloud Computing Reference Architecture,ITU- T Cloud Computing Reference Architecture, SDN and NFV, Service Provider Perspective Private Cloud Perspective, ITU-T Cloud Computing Functional Reference Architecture, **The Internet of Things:** Components The IoT Era Begins, The Scope of the Internet of Things Components of IoT-Enabled	12

	Things, Sensors, Actuators, Microcontrollers, Transceivers, RFID, The Internet of Things: Architecture and Implementation, IoT Architecture,ITU-T IoT Reference Model, IoT World Forum Reference Model, IoT Implementation, IoTivity, Cisco IoT System, ioBridge, Security Security Requirements, SDN Security Threats to SDN, Software- Defined Security, NFV Security, Attack Surfaces, ETSI Security Perspective, Security Techniques, Cloud Security, Security Issues and Concerns, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Securityas a Service, Addressing Cloud Computer Security Concerns, IoT Security, The Patching Vulnerability, IoT Security and Privacy Requirements Defined by ITU-TAn IoT Security Framework, Conclusion	

REFERENCE BOOKS:

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud	William Stallings	Addison-Wesley Professional		October 2015
2.	SDN and NFV Simplified A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization	**Jim Doherty**	Pearson Education, Inc		
3.	Network Functions Virtualization (NFV) with a Touch of SDN	Rajendra Chayapathi Syed Farrukh Hassan	Addison-Wesley		
4.	CCIE and CCDE Evolving Technologies Study Guide	Brad dgeworth, Jason Gooley, Ramiro Garza Rios	Pearson Education, Inc		2019

Modern Networking Practical

COURSE CODE: MIT - MJPS2 - 504 **COURSE CREDIT: 02**

All practicals are expected to be performed on GNS3/EVE-Ng network Emulator/MININET

Practical No	Details
1	Configure IP SLA Tracking and Path Control Topology
2	Using the AS_PATH Attribute
3	Configuring IBGP and EBGP Sessions, Local Preference, and MED
4	Secure the Management Plane
5	Configure and Verify Path Control Using PBR
6	IP Service Level Agreements and Remote SPAN in a Campus Environment
7	Inter-VLAN Routing
8	Simulating MPLS environment
9	Simulating VRF
10	Simulating SDN with • OpenDaylight SDN Controller with the Mininet Network Emulator • OFNet SDN network emulator
11	Simulating OpenFlow Using MININET

ELECTIVES

Big Data Analytics

COURSE CODE: MIT - MAJS2 - 505 **COURSE CREDIT: 04**

Course Objectives:

- The Learner will be able to discover and define what is Big Data Analytics, its challenges and its uses in real time.
- The Learner will be able to classify and describe the different analytical methods and algorithms, models in Big Data Analytics.
- The Learner will be able to apply different classification methods and discover different analysis methodologies used in Big Data Analytics.
- The Learner will be able to analyse and connect with different Hadoop architectures and explain about distributed file systems, frameworks like Spark with PySpark.
- The Learner will be able to evaluate design patterns and data queries with HIVE.
- The Learner will be able to prepare and construct data analysis models using different analysis techniques and methods, tools of Big Data Analytics.

Sr. No	Modules/Units	No of Lectures
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	12
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.	12

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, Determining Sentiments	12

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 Pythonand Hadoop Streaming, Hadoop Streaming, MapReduce with Python, Advanced MapReduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications,	12
5.	**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, Injesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher level APIs.	12

REFERENCE BOOKS:

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Big Data and Analytics	Subhashini Chellappan Seema Acharya	Wiley	First	
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	2018

Big Data Analytics Practical

COURSE CODE: MIT - MJPS2 - 506 **COURSE CREDIT: 02**

Practical No	Details
1	Install, configure and run Hadoop and HDFS ad explore HDFS.
2	Implement word count / frequency programs using MapReduce
3	Implement an MapReduce program that processes a weather dataset.
4	Implement an application that stores big data in Hbase / MongoDB and manipulate it using R / Python
5	Implement the program in practical 4 using Pig.
6	Configure the Hive and implement the application in Hive.
7	Write a program to illustrate the working of Jaql.
8	Implement the following:
a.	Implement Decision tree classification techniques
b.	Implement SVM classification techniques
9	Solve the following:
a.	REGRESSION MODEL Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. require (foreign), require(MASS).
b.	MULTIPLE REGRESSION MODEL Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.
10	Solve the Following:
a.	CLASSIFICATION MODEL a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.
b.	CLUSTERING MODEL a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.

DEPARTMENT OF INFORMATION TECHNOLOGY
PROPOSED SCHEME OF EXAMINATION

Evaluation Scheme

Internal Evaluation (40 Marks)

The internal assessment marks shall be awarded as follows:

1. **30 marks (Any one of the following):**
   - **a.** Written Test or
   - **b.** SWAYAM (Advanced Course) of minimum 20 hours and certification exam completed or
   - **c.** NPTEL (Advanced Course) of minimum 20 hours and certification exam completed or
   - **d.** Valid International Certifications (Prometric, Pearson, Certiport, Coursera, Udemy and the like)
   - **e.** One certification marks shall be awarded one course only. For four courses, the students will have to complete four certifications.
   - **f.** Research paper publication
2. **10 marks**
   - **a.** Assignments/ Group discussions/ Debates/ Quiz/ Subject specific case study/ Mini Project/ Presentation/ Field work/ Program implementation/ any other

External Examination: (60 marks)

	All questions are compulsory	
Q1	(Based on Unit 1) Attempt ***any two*** of the following:	12
a.		
b.		
c.		
d.		
Q2	(Based on Unit 2) Attempt ***any two*** of the following:	12
Q3	(Based on Unit 3) Attempt ***any two*** of the following:	12
Q4	(Based on Unit 4) Attempt ***any two*** of the following:	12
Q5	(Based on Unit 5) Attempt ***any two*** of the following:	12

Practical Evaluation (50 marks)

A certified copy journal is essential to appear for the practical examination.

1.	Practical Question 1	20
2.	Practical Question 2	20
3.	Journal	5
4.	Viva Voce	5

OR

1.	Practical Question	40
2.	Journal	5
3.	Viva Voce	5