University of Mumbai

Uttari Bharat Sabha's

Ramanand Arya D.A.V. College

(Autonomous)

NAAC ACREDITATION: 'A' GRADE

BEST COLLEGE AWARD BY THE UNIVERSITY OF MUMBAI

MASTER OF SCIENCE
(M.Sc – Information Technology)

Two Year Integrated Programme-
Four Semesters
Course Structure

(Credit Based Semester and Grading System)

(Year of Implementation:2021-2022)

University of Mumbai

Uttari Bharat Sabha's

Ramanand Arya D.A.V. College

(Autonomous)

Master of Science(Information technology)

M.Sc. I.T. Programme

Under Choice Based Credit, Grading and Semester System

Course Structure

FIRST YEAR MSC IT

(To be implemented from Academic Year- 2021-2022)

Programme Code : PSIT101			**Programme Code : PSIT201**		
Course Code	**Semester I**	**Credits**	**Course Code**	**Semester II**	**Credits**
PSIT101	Research in Computing	**4**	PSIT201	Big Data Analytics	**4**
PSIT102	Data Science	**4**	PSIT202	Modern Networking	**4**
PSIT103	Cloud Computing	**4**	PSIT203	Microservices Architecture	**4**
PSIT104	Soft Computing Techniques	**4**	PSIT204	Image Processing	**4**
PSIT1P1	Research in Computing- practical	**2**	PSIT2P1	Big Data Analytics Practical	**2**
PSIT1P2	Data Science - practical	**2**	PSIT2P2	Modern Networking Practical	**2**
PSIT1P3	Cloud Computing - practical	**2**	PSIT2P3	Microservices Architecture Practical	**2**
PSIT1P4	Soft Computing Techniques - Practical	**2**	PSIT2P4	Image Processing Practical	**2**
	Total Credits	**24**		**Total Credits**	**24**

SECOND YEAR MSC IT

Programme Code : PSIT301			**Programme Code : PSIT401**		
Course Code	**Semester III**	**Credits**	**Course Code**	**Semester IV**	**Credits**
PSIT301	Technical Writing and Entrepreneurship Development	**4**	PSIT401	Block Chain	**4**
PSIT302	Security Breaches and Countermeasures	**4**	PSIT402	Cyber Forensic	**4**
PSIT303	Malware Analysis	**4**	PSIT403	Security Operation Center	**4**
PSIT304	Offensive Security	**4**	PSIT404	Information Security Auditing	**4**
PSIT3P1	Technical Writing and Entrepreneurship Development practical	**2**	PSIT4P1	Block Chain Practical	**2**
PSIT3P2	Security Breaches and Countermeasures practical	**2**	PSIT4P2	Cyber Forensic Practical	**2**
PSIT3P3	Malware Analysis - practical	**2**	PSIT4P3	Security Operation Center Practical	**2**
PSIT3P4	Offensive Security - Practical	**2**	PSIT4P4	Project	**2**
	Total Credits	**24**		**Total Credits**	**24**

- ✓ ***Note:*** *Project work is considered as a special course involving application of knowledge in solving/analyzing/exploring a real life situation/ difficult problem. Project work would be of 04 credits. A project work may be undertaken in any area of Elective Courses/ study area selected*

Program Specific Outcomes

PSO1: Ability to apply the knowledge of Information Technology with recent trends aligned with research and industry.

PSO2: Ability to apply IT in the field of Computational Research, Soft Computing, Big Data Analytics, Data Science, Image Processing, Artificial Intelligence, Networking and Cloud Computing.

PSO3: Ability to provide socially acceptable technical solutions in the domains of Information Security, Machine Learning, Internet of Things and Embedded System, Infrastructure Services as specializations.

PSO4: Ability to apply the knowledge of Intellectual Property Rights, Cyber Laws and Cyber Forensics and various standards in interest of National Security and Integrity along with IT Industry.

PSO5: Ability to write effective project reports, research publications and content development and to work in multidisciplinary environment in the context of changing technologies

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NAAC ACREDITATION: 'A' GRADE

BEST COLLEGE AWARD BY THE UNIVERSITY OF MUMBAI

MASTER OF SCIENCE
(M. Sc I.T.)
(First Year: Semester I and II)

REVISED SYLLABUS
AND
QUESTIONPAPERPATTERN

(Credit Based Semester and Grading System)

(Year of Implementation:2021-2022)

Master of Science(Information Techonoly)

M.Sc. I.T. Programme

Under Choice Based Credit, Grading and Semester System
Course Structure

FIRST YEAR MSC IT

(To be implemented from Academic Year- 2021-2022)

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PSIT104	Soft Computing Techniques	**4**	PSIT204	Image Processing	**4**
PSIT1P1	Research in Computing- practical	**2**	PSIT2P1	Big Data Analytics Practical	**2**
PSIT1P2	Data Science - practical	**2**	PSIT2P2	Modern Networking Practical	**2**
PSIT1P3	Cloud Computing - practical	**2**	PSIT2P3	Micro services Architecture Practical	**2**
PSIT1P4	Soft Computing Techniques - Practical	**2**	PSIT2P4	Image Processing Practical	**2**
	Total Credits	**24**		**Total Credits**	**24**

Note :
First year Syllabus has been Revised in the Academic year 2021-2022 however second year syllabus will be revised in 2022-2023 .

Research In Computing

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

List of Practical

Practical no.	Title	No of Lections
1	Write a program for obtaining descriptive statistics of data.	3
2	Perform suitable analysis of given secondary data.	3
3	Perform testing of hypothesis using ttest.	3
4	Perform testing of hypothesis using chi-squared goodness-of-fit test.	3
5	Perform testing of hypothesis using Z-test.	3
6	Perform testing of hypothesis using one-way ANOVA.	3
7	Perform the Random sampling for the given data and analyse it	3
8	Compute different types of correlation	3
9	Perform linear regression for prediction.	3
10	Perform multiple linear regression	3

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Business Research Methods	William G.Zikmund, B.J Babin, J.C. Carr,	Cengage	8e	2016

Core Course
Data Science

Sr.No.	Modules/Units	No. of Lectures
1	**Data Science Technology Stack, Layered Framework, Business Layer and Utility Layer**	12 Lectures
	Data Science Technology Stack: Rapid Information Factory Ecosystem, Data Science Storage Tools, Data Lake, Data Vault, Data Warehouse Bus Matrix, Data Science Processing Tools ,Spark, Mesos, Akka, Cassandra, Kafka, Elastic Search, R, Scala, Python, MQTT, The Future **Layered Framework:** Definition of Data Science Framework, Cross- Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering **Business Layer**: Business Layer, Engineering a Practical Business Layer **Utility Layer**: Basic Utility Design, Engineering a Practical Utility Layer	
2	**Three Management Layers and Retrieve Superstep**	12 Lectures
	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 Super step** : Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources,	
3	**Assess Superstep**	12 Lectures
	Assess Superstep: Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep,	
4	**Process Superstep and Transform Superstep**	12 Lectures
	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.	
5	**Transform Superstep, Organize and Report Supersteps, Visualization**	12 Lectures

	techniques, Network Analysis and Recommender Systems	
	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. **Visualization techniques** : learning business intelligence techniques, visualization standpoint ability in extracting the data from different server, Collaboration and Sharing, Graphics, Showing the Difference. ***Network Analysis*** *: Betweenness Centrality, Eigenvector Centrality, Matrix Multiplication, Centrality, Directed Graphs and PageRank.* ***Recommender Systems****:Manual Curation ,Recommending What's Popular ,User-Based Collaborative Filtering, Item-Based Collaborative Filtering ,For Further Exploration.*	

Practical no.	Title	No of Lections
1	Creating Data Model using Cassandra	3
2	Conversion from different formats to HOURS format. a.Text delimited CSV to HORUS format. b. XML to HORUS Format c. JSON to HORUS Format d. MySql Database to HORUS Format e. Picture (JPEG) to HORUS Format (Spyder) f. Video to HORUS Format f1. Movie to Frames f2. Frames to Horus (Spyder) g. Audio to HORUS Format	3
3	Utilities and Auditing a Fixers Utilities 1 Removing leading or lagging spaces from a data entry 2 Removing nonprintable characters from a data entry 3 Reformatting data entry to match specific formatting criteria. B Data Binning or Bucketing C Averaging of Data D Outlier Detection E Audit :Loggin	3
4	Retrieving Data a Perform the following data processing using R.() b Program to retrieve different attributes of data c.Data Pattern d Loading IP_DATA_ALL: (LoadingIP_DATA_C_VKHCG,LoadingIP_DATA_CORE,Loading COUNTRY-CODES,LoadingDE_Billboard_Locations,LoadingGB_Postcode_Full,LoadingGB_Postcode_Warehouse,LoadingGB_Postcode_Shops,LoadingEuro_ExchangeRates, Load: Profit_And_Loss) (load all these) Vermeulen PLC • Designing a routing diagram for company • Planning a schedule of jobs to be performed for the router network Krennwallner AG • Picking content for billboards • Understanding your online visitor data XML processing Hillman Ltd Befor this Program understand the business terms in book • Planning the locations of the warehouses • Planning the shipping rules for best-fit international logistics • Adopting the best packing option for shipping in containers • Creating a delivery route Global Post Codes(R) Clark Ltd o Person Base Data o Connecting to other Data Sources A Program to connect to different data sources.(SQLite,MySQL,Microsoft Excel)	3
5	Assessing Data a.Perform error management on the given data using pandas package. b.Write Python / R program to create the network routing diagram from the given data on routers c. Write a Python / R program to build directed acyclic graph (DAG) d.Write a Python / R program to pick the content for Bill Boards from the given data Picking Content for Billboards (Assess-DE-Billboard)	3

	new warehouses using the given data. h. Using the given data, write a Python / R program to plan the shipping routes for best-fit international logistics. i. Write a Python / R program to decide the best packing option to ship in container from the given data. j. Write a Python program to create a delivery route using the given data. Creating a delivery route Global Post Codes Clark Ltd k. Write a Python program to create Simple forex trading planner from the given data. l. Write a Python program to process the balance sheet to ensure that only good data is processing. Write a Python program to store all master records for the financial calendar m. Write a Python program to generate payroll from the given dat	
6	Processing Data a. Build the time hub, links, and satellites.	3
7	Transforming Data 1 Transform-Gunnarsson_is_Born.py 2 dimension Person, dimension Time, and factPersonBornAtTime (SUN MODEL) 3 Building a Data Warehouse 4 Simple Linear Regression	3
8	Organising Data 1 Horizontal Style 2 Vertical Style 3 Island Style 4 Secure Vault Style 5 Association Rule Mining lift=P(x,y)/P(x)P(y) 6 Create a Network Routing Diagram Organise-billboards.py 7 Create a Delivery Route Organise-Routes.py 8 Clark Ltd(Simple Forex Trading Planner) Organise-Forex.py	3
9	Generating Reports Report Superstep(Vermeulen PLC) 1 Raport-Network-Routing-Customer.py Krennwallner AG 2 Report_Billboard.py Hillman Ltd 3 Report_Reading_Container.py Clark Ltd (Financials) 4 Report-Balance-Sheet.py	3
10	Data Visualisation with Power BI&tableau	3

Reference Books:

Books and References:					
Sr. No.	**Title**	**Author/s Publisher**	**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

Core Course
Cloud computing

Sr.No.	Modules/Units	No. of Lectures
1	Introduction to cloud computing, **Principles of Parallel and Distributed Computing and Virtualization**	12 Lectures
	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, CloudS torage Device, Cloud usage monitor, Resource replication readymade environment.	
2	**Cloud Computing Architecture, Fundamental Cloud Security and Industrial Platforms and New Development**	12 Lectures
	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.	
3	**Specialized Cloud Mechanisms, Cloud Management Mechanisms and Cloud Security Mechanisms**	12 Lectures
	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), SingleSign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images	
4	**Fundamental Cloud Architectures and Advanced Cloud Architectures**	12 Lectures

	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 **Specialized cloud Architecture: Direct I/O Access architecture, Direct LUN access architecture**	
5	**Cloud Delivery Model Considerations, Cost Metrics and Pricing Models and Service Quality Metrics and SLAs**	12 Lectures
	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	

Note:

One tutorial per batch per week in addition to number of lectures stated above(Batch size as per the University norms)

List of Practicals

Practical no.	Title	No of Lections
1	Write a program for implementing Client Server communication model using TCP.	3
2	Write a program for implementing Client Server communication model using UDP .	3
3	A multicast Socket example.	3
4	Write a program to show the object communication using RMI.	3
5	Show the implementation of web services.	3

6	Implement Xen virtualization and manage with Xen Center	**3**
7	Implement virtualization using VMWare ESXi Server and managing with vCenter	**3**
8	Implement Windows Hyper V virtualization	**3**
9	Develop application for Microsoft Azure.	**3**

Reference Books:

Title	Author(s)	Publisher
Mastering Cloud Computing Foundations and ApplicationsProgramming	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi	Elsevier
Cloud Computing Concepts, Technology & Architecture	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini	Prentice Hall
Distributed and Cloud Computing, FromParallel Processing to the Internet of Things	Kai Hwang, Jack Dongarra, Geoffrey Fox	MK Publishers

Core Course
Soft computing Techniques

Sr.No.	Modules/Units	No. of Lectures
1	Introduction of soft computing, Fuzzy Computing, Neural Computing Genetic Algorithms, Associative Memory Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, And applications of soft computing	12 Lectures
	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. *Memory concept, types of memory models, Brain pattern detection psychology*.	
2	Artificial Neural Network, Supervised Learning Network, Associative Memory Networks	12 Lectures
	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, RadialBasisFunction,TimeDelayNetwork,FunctionalLinkNetworks, Tree NeuralNetwork. Associative Memory Networks: Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield	
3	Unsupervised Learning Networks, Third Generation Neural Network	12 Lectures
	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, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascadecorrelation 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 Relations and Fuzzy Relations, Defuzzification, and Fuzzy Arithmetic and Fuzzy measures:	12 Lectures
	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,. 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.	
5	Fuzzy Rule base and Approximate reasoning, Genetic Algorithm	12 Lectures
	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,	

List of Practicals

Practical no.	Title	No of Lections
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.	3
2	Implement the following a. Generate AND/NOT function using McCulloch-Pitts neural net. **b.** Generate XOR function using McCulloch-Pitts neural net	3
3	Implement the Following a. Write a program to implement Hebb's rule **b.** Write a program to implement of delta rule.	3
4	Implement the Following a. Write a program for Back Propagation Algorithm	3

	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	**3**
6	Implement the Following a. Kohonen Self organizing map. b. Adaptive resonance theory	**3**
7	Implement the Following . a. Write a program for Linear separation b. Write a program for Hopfield network model for associative memory	**3**
8	Implement the Following a. Membership and Identity Operators | in, not in **b.** Membership and Identity Operators is, is not	**3**
9	Implement the Following **a.** Find ratios using fuzzy logic **b.** Solve Tipping problem using fuzzy logic	**3**
10	Implement the Following **a.** Implementation of Simple genetic algorithm **b.** Create two classes: City and Fitness using Genetic algorithm	**3**

Reference Books:

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.SivanandamS. N.Deepa	Wiley	3rd	2019
3.	Neuro-Fuzzy and Soft Computing	J.S.R.Jang, C.T.SunandE.Mizutani	Prentice Hallof 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

SEMESTER - II

Core Courses (CC)

Big Data Analytics

Sr.No.	Modules/Units	No. of Lectures
1	Introduction to Big Data, Characteristics of Data, Key roles for New Big Data Ecosystems, Big Data Analytics and Data Analytics Life Cycle	12 Lectures
	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, Classificationof Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics LifeCycle*Data science Vs data analytics,Data science Vs machine learning*	
2	Analytical Theory and Methods	12 Lectures
	Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing,Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models.	
3	Analytical Theory and Methods	12 Lectures
	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	
4	Data Product, Building Data Products at Scale with Hadoop	12 Lectures

	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, Frame work for Python and Hadoop Streaming, Hadoop Streaming, Map Reduce with Python Advanced Map Reduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications.	
5	Distributed Analysis and Patterns, Computing with Keys Relational data with Sqoop, Analytics with higher level APIs, Pig, Spark's higher level APIs	12 Lectures
	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. *Data mart and data lake introduction*	

List of practicals

Practical no.	Title	No of Lectures
1	Install, configure and run Hadoop and HDFS ad explore HDFS	3
2	Implement word count / frequency programs using MapReduce	3
3	Implement an MapReduce program that processes a weather dataset.	3
4	Implement an application that stores big data in Hbase / MongoDB and manipulate it using R / Python	3
5	Implement the program in practical 4 using Pig	3
6	Configure the Hive and implement the application in Hive.	3
7	Write a program to illustrate the working of Jaql	3
8	Implement the following: a. Implement Decision tree classification techniques b. Implement SVM classification techniques	3
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.	3
10	Solve the Following: a. CLASSIFICATION MODEL a. Install relevant package for classification. b. Choose classifier for	3

	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.	

Reference Books:

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Big Data and Analytics	Subhashini ChellappanSeema 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

Core Courses (CC)
Modern Networking

Sr.No.	Modules/Units	No. of Lectures
1	Elements of Modern Networking and Requirements and Technology	12 Lectures
	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 ApplicationsofWi-Fi,StandardsWi-FiDataRates4G/5GCellularFirst 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 Traffic Big 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	
2	Software-Defined Networks, SDN Data Plane and Open Flow and SDN Application Plane	12 Lectures
	Software-Defined Networks SDN: Background and Motivation, Evolving Network Requirements Demand Is Increasing, Supply Is Increasing Traffic Patterns Are More Complex Traditional Network Architectures are Inadequate, The SDN ApproachRequirementsSDNArchitectureCharacteristicsofSoftware-Defined Networking, SDN- and NFV-Related Standards Standards- Developing Organizations Industry Consortia Open Development Initiatives, SDN Data Plane and Open Flow SDN Data Plane, Data Plane Functions Data Plane Protocols Open Flow Logical Network Device Flow Table Structure Flow Table Pipe line, The Use of Multiple Tables Group Table Open Flow Protocol, 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 Policy Cop Measurement and Monitoring Security Open Daylight 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	Network Functions Virtualization, NFV Functionality and Network virtualization	12 Lectures
	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, Compute Domain, 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 NetworkVirtualization, VirtualLANs ,The Use Of Virtual LANs, Defining VLANs, Communicating VLAN Membership ,IEEE 802.1Q VLAN Standard, Nested VLANs, Open Flow VLAN Support, Virtual Private Networks, IPsec VPNs, MPLS VPNs, Network Virtualization, Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, Open Daylight's Virtual Tenant Network, Software-Defined Infrastructure, Software- Defined Storage, SDI Architecture	
4	Quality of Service and **Quality of Experience**	12 Lectures
	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, Diff Serv Field, Diff Serv Configuration and Operation, Per-Hop Behavior, Default Forwarding PHB, Service Level Agreements, IP Performance Metrics, Open Flow QoS SuppZort, Queue Structures, Meters, 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	
5	Modern Network Architecture,Internet of things, Security and The Impact of the new Networking in IT Careers	12 Lectures
	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 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 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, DataProtection, **The Imapact of the new Networking on IT careers** **The Changing role of Network professionals, changing responsibilities,** **Impact on job positions.**	

Practical no.	Title	No of Lectures
1	*Configure IP SLA Tracking and Path Control*	3
2	*Using the AS_PATH Attribute*	3
3	*Configuring IBGP and EBGP Sessions, Local Preference and MED*	3
4	*Secure the Management Plane*	3
5	*Configure and Verify Path Control*	3
6	*Configure IP SLA Tracking and Path Control*	3
7	*Inter-VLAN Routing.*	3
8	*Cisco MPLS Configuration*	3
9	*Configuring VRF-lite on Cisco routers.*	3
10	Using the OpenDaylight SDN Controller with the Mininet Network Emulator	3

Reference Books:

Title	Author(s)	Publisher
Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud	William Stallings	Addison-Wesley Professional
SDN and NFV Simplified A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization	**Jim Doherty**	Pearson Education, Inc
Network Functions Virtualization (NFV) with a Touch of SDN	Rajendra Chayapathi Syed Farrukh Hassan	Addison- Wesley
CCIE and CCDE Evolving Technologies Study Guide	Brad dgeworth, Jason Gooley, Ramiro Garza Rios	Pearson Education, Inc

Core Course

Microservices Architecture

Sr.No.	Modules/Units	No. of Lectures
1	Microservices, Microservices Value Proposition Designing Microservice Systems, Establishing a Foundation	12 Lectures
	Microservices: Understanding Microservices, Adopting Microservices,The Microservices Way. **Microservices Value Proposition:** Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. **Designing Microservice Systems:** The Systems Approach to Microservices, A Microservices Design Process, **Establishing a Foundation:** Goals and Principles, Platforms, Culture.	
2	Service Design, System Design and Operations Adopting Microservices in Practice	12 Lectures
	Service Design: Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies, **System Design and Operations:** Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting. **Adopting Microservices in Practice** Solution Architecture Guidance,Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.	
3	Building Microservices with ASP.NET Core, Delivering Continuously, Building Microservice with ASP.NET Core And BackingServices	12 Lectures
	Building Microservices with ASP.NET Core: Introduction, Installing .NET Cor a Console App, Building ASP.NET Core App. **Delivering Continuously:** Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Dicker Hub. **Building Microservice with ASP.NETCore:**Microservice, TeamService, API Fir Development, Test First Controller, Creating a CI pipeline, Integration Testi the team service Docker Image. **BackingServices** Microservices Ecosystems, Building the location Service, Enhancing Team Se *Docker Swarm, Docker swarm Vs Kubernetes comparing containers, cloud native concept*	
4	Creating Data Service, Event Sourcing and CQRS, Building an ASP.NET Core Web Application	12 Lectures

	And Service Discovery	
	Creating Data Service: Choosing a Data Store**,** Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise the Data Service. **Event Sourcing and CQRS:** Event Sourcing, CQRS pattern, Event Sourcing and CQRS, Running the samples. **Building an ASP.NET Core Web Application:** ASP.NET Core Basics, Building Cloud-Native Web Applications. **Service Discovery:** Cloud Native Factors, Netflix Eureka, Discovering And Advertising ASP.NET Core Services. DNS and Platform Supported Discovery	
5	Configuring Microservice Ecosystems, Securing Applications and Microservices, Building Real-Time Apps and Services And Putting It All Together	12 Lectures
	Configuring Microservice Ecosystems: Using Environment Variables with Docker, Using Spring Cloud ConfigServer, Configuring Microservices with etcd, **Securing Applications and Microservices:** Security in the Cloud, Securing ASP.NET Core Web Apps, Securing ASP.NET Core Microservices. **Building Real-Time Apps and Services:** Real-Time Applications Defined, Websockets in the Cloud, Using a Cloud Messaging Provider, Building the Proximity Monitor. **Putting It All Together:** Identifying and Fixing Anti-Patterns, Continuing the Debate over Composite Microservices, The Future.	

List of Practicals

Practical no.	Title	No of Lectures
1	Building APT.NET Core MVC Application	3
2	Building ASP.NET Core REST API	3
3	Working with Docker, Docker Commands, Docker Images and Containers	3
4	Installing software packages on Docker, Working with Docker	3
5	Working with Docker Swarm.	3
6	Working with Circle CI for continuous integration.	3
7	Creating Microservice with ASP.NET Core.	3
8	Working with Kubernetes	3
9	Creating Backing Service with ASP.NET Core.	3
10	Building real-time Microservice with ASP.NET Core.	3

Reference Books:

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Microservice Architecture: *Aligning Principles, Practices, andCulture*	Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike Amundsen	O'Reilly	First	2016
2.	Building Microservices with ASP.NET Core	Kevin Hoffman	O'Reilly	First	2017
3.	Building Microservices: Designing Fine-Grained Systems	Sam Newman	O'Reilly	First	
4.	Production-ready Microservices	Susan J. Fowler	O'Reilly		2016

Core Course

Image Processing

Sr.No.	Modules/Units	No. of Lectures
1	**Digital Image Fundamentals and Intensity Transformations and Spatial Filtering**	12 Lectures
	Introduction: DigitalImageProcessing,OriginsofDigitalImageProcessing, 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 (Low pass) Spatial Filters, Sharpening (High pass) Spatial Filters, High pass, Band reject, and B and pass Filters from Low pass Filters, Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering	
2	**Filtering in the Frequency Domain and Image Restoration and Reconstruction**	12 Lectures
	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 Low pass Frequency Domain Filters, Image Sharpening Using High pass 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, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections	
3	**Color Image Processing, Image Compression and Watermarking and Image Transforms**	12 Lectures
	Color Image Processing: Color Fundamentals, Color Models, Pseudo color 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, Digital Image Water marking, **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.	

4	**Morphological Image Processing and Image Segmentation I: Edge Detection, Thresholding, Region Detection**	12 Lectures
	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	
5	**Image Segmentation II: Active Contours: Snakes and Level Sets, Feature Extraction**	12 Lectures
	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)	

List of Practicals

Practical no.	Title	No of Lectures
1	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.	3
2	Intensity transformation and Spatial Filtering IMAGE ENHANCEMENT A Basic Intensity Transformation functions	3

	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	
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	3
4	Image Denoising 1.Program to denoise using spatial mean, median and adaptive mean filtering ii. Program for Image deblurring using inverse, Weiner filters	3
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	3
6	Fourier Related Transforms Program to compute Discrete Cosine Transforms.	3
7	Image compression Program to apply compression and decompression algorithm on an image (Arithmetic, Huffman and LZW coding techniques.	3
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	3
9	Image Segmentation i. Program for Edge detection using a. Sobel, Prewitt, Marr-Hildreth and Canny ii. Illustrate Watershed segmentation algorithm	3
10	Feature Extraction i. Apply Principal components for image description ii. Apply Harris-Stephens corner detector algorithm	3

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

Scheme of Evaluation

The performance of the learners will be evaluated in two Components. One component will be the Internal Assessment component carrying 40% marks and the second component will be the Semester-wise End Examination component carrying 60% marks. The allocation of marks for the Internal Assessment and Semester End Examinations will be as shown below:-

A) Internal Assessment: 40 **%**

Question Paper Pattern

(Internal Assessment- Courses without Practical Courses)

Sr. No.	Particular	Marks
1	**One class test (20 Marks)**	
	Match the Column/ Fill in the Blanks/ Multiple Choice Questions ***(1 Mark each)***	08 Marks
	Answer in Brief (Attempt Any Three of the Five) ***(04 Marks each)***	12 Marks
02	One case study / project with presentation based on curriculum to be assessed by the teacher concerned	10 Marks
03	Presentation/ Viva / Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulationand exhibit of leadership qualities in organizing related academic activities	10 Marks

Practical Exam: 50marks **Time 2½ Hrs**

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**

B) Semester End Examination: 60 %

i) Duration: The examination shall be of 2 Hours duration

ii) Theory question paper pattern

- There shall be five questions each of 12 marks.
- All questions shall be compulsory with internal choice within the questions.
- Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the topic.
  (Detail question paper pattern has been given separately)

Passing Standard

The learners to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 Out of 60) separately, to pass a particular semester A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Question Paper Pattern

(Practical Courses)

Maximum Marks: 60

Questions to be set: 03

Duration: 2 Hrs.

All Questions are Compulsory Carrying 12 Marks each.

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

Note:

Practical question of 12 marks may be divided into two sub questions of 6/6 and 4/4/4 Marks. If the topic demands, instead of practical questions, appropriate theory question may be asked.

Evaluation pattern of the Project Work (100 Marks)

The Project Report shall be evaluated in two stages viz..

Evaluation of Project Report (Bound Copy)	**60 Marks**
▪ Introduction and other areas covered	20 Marks
▪ Research Methodology, Presentation, Analysis and interpretation of data	30 Marks
▪ Conclusion & Recommendations	10 Marks
▪ **Conduct of Viva-voce**	**40 Marks**
▪ In the course of Viva-voce, the questions may be asked such as ▪ importance / relevance of the study, objective of the study, methodology of the study/ mode of Enquiry (question responses)	10 Marks
▪ Ability to explain the analysis, findings, concluding observations, ▪ recommendation, limitations of the Study	20 Marks
▪ Overall Impression (including Communication Skill)	10 Marks