Seva Mandal Education Society's
Smt. Kamlaben Gambhirchand Shah Department of Computer Applications
under
Dr. Bhanuben Mahendra Nanavati College of Home Science (Autonomous)
NAAC Re-Accredited 'A+' Grade with CGPA 3.69 / 4
UGC Status: College with Potential for Excellence
'Best College Award 2016-17' adjudged by S.N.D.T. Women's University
Smt. Parmeshwari Devi Gordhandas Garodia Educational Complex
338, R.A. Kidwai Road, Matunga, Mumbai - 400019. Tel: 24095792 Email: smesedu@gmail.com

APPROVED SYLLABUS UNDER AUTONOMY

PROGRAMME: MASTER OF SCIENCE (COMPUTER SCIENCE)

DEPARTMENT OF COMPUTER APPLICATIONS
SEMESTER – II (2020-21)

PROGRAM OBJECTIVES

This program will enable the students to:

1. Gain in-depth knowledge in the key areas of computer science and practice in emerging, cutting edge Computational Technologies.
2. Develop software solutions to real world problems through Information Technological skills with international standards and facilitate them to be outstanding professionals.
3. Contribute to scientific research by independently designing, conducting and presenting the results of small-scale research.
4. Be a part of skilled manpower in the various areas of computer science such as Algorithm Analysis and Design, Data warehousing and Mining, Software Engineering, Advanced Computing technologies, Web-based Applications Development, and Data Science.

PROGRAM OUTCOME

The completion of the post-graduation programme:

1. Takes forward the knowledge gained by the students at the undergraduate level and provides them with an advanced level of learning and understanding of the subject.

2. Provides students with higher educational degree of technical skills in problem solving and application development.
3. Helps students to acquire an analytical and managerial skills to enhance employment potential.

PROGRAM SPECIFIC OUTCOME

1. The main outcome of this programme is enhancement in the Technical and Analytical skills of computer science enthusiasts and provide them with the perfect amalgamation of theory as well as practical knowledge in the various thrust areas of the field.
2. The students will acquire broad knowledge in core areas of computer science, current and emerging computing technologies.
3. The students also acquire a research oriented professional approach to provide sustainable solution to real life problems which can be solved using computational technologies.

Eligibility

- A Science Graduates in
  - BSc. (Physics),
  - BSc. (Maths.),
  - BSc (Elect.),
  - BSc. (IT),
  - B.Sc. (CS) or
  - BCA or
  - any engineering graduate in allied subject from the recognized university

  with an aggregate mark not less than 50% (Open Category) and 45% (Reserved category).

- Mathematics at 12th Level or 100 marks mathematics studied at graduation level is minimum requirement.

Master of Science (Computer Science)

SYLLABUS

M.Sc. (COMPUTER SCIENCE) SEMESTER - II (FIRST YEAR)

PROPOSED SYLLABUS FOR THE ACADEMC YEAR 2020-21

Course Code	Course	Course Type	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
			L	Pr./ Tu	Int.	Ext.	Total	
MCS201	Mobile Communication and Wireless Technology	CC	4	-	2	2	4	2
MCS202	Data Analytics and Mining	CC	4	-	2	2	4	2
MCS203	Research Methods and Statistical Analysis	SEC	4	-	2	2	4	2
MCSL204	Data Analytics and Mining Lab	CC	-	2	1	1	2	1
MCSL205	Statistics Lab	AECC	-	2	1	1	2	1
MCSL206	Advanced Java Lab	CC	-	2	1	1	2	1
MCSL207	Advanced Python Lab	CC	-	2	1	1	2	1
Choice Based Credit System (CBCS)								
MCS208A	Distributed Systems (CBCS)	SEC	4	-	2	2	4	2
MCS208B	Computer Graphics (CBCS)	SEC	4	-	2	2	4	2
MCS208C	Natural Language Processing (CBCS)	SEC	4	-	2	2	4	2
MCS208D	Swayam or other online courses (CBCS)	SEC	4	-	2	2	4	2
	Total		**16**	**8**			**24**	**-**

SEMESTER-II	**1 Credit=25 Marks** **Total Credits = 24** **Total Marks = 24*25=600**

COURSE TITLE : MOBILE COMMUNICATION AND WIRELESS TECHNOLOGY

Course Objectives:

- To learn the concepts of wireless communication and mobile networks
- To identify different wireless technologies and its applications
- To acquire knowledge on generation of cellular networks and its standards used

Learning Outcomes:

The students will be able to:

- Understand the concept of cellular communications, advantages and its limitations
- Compare the various wireless technologies and its applications
- Apply the appropriate technology in the applications

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS201	**Mobile Communication and Wireless Technology**	**4**	**-**	**2**	**2**	**4**	**2**

Module No.	Objective	Content	Evaluation
1	To introduce to basic concepts of wireless networking	**Fundamentals of Wireless Technology** Introduction to Mobile and wireless communications, Overview of radio transmission frequencies, Signal Antennas, Signal Propagation, Multiplexing – SDM,FDM, TDM,CDM, Modulation – ASK,FSK,PSK, Advanced FSK, Advanced PSK, OFDM, Spread Spectrum – DSSS,FHSS, Wireless Transmission Impairments – Free Space Loss, Fading, Multipath Propagation, Atmospheric Absorption, Error Correction – Reed Solomon, BCH, Hamming code, Convolution Code (Encoding and Decoding)	Students will be evaluated by taking viva. (Marks 05)
2	To elaborate wireless and cellular wireless network	**Wireless and Cellular wireless Networks** Wireless network, Wireless network Architecture, Classification of wireless networks – WBAN, WPAN, WLAN, WMAN, WWAN., IEEE 802.11, IEEE 802.16, Bluetooth – Standards, Architecture and Services, Cellular wireless Networks, Principles of cellular networks – cellular network organization, operation of cellular systems, Handoff., Generation of cellular networks – 1G, 2G, 2.5G, 3G and 4G.	Written Unit Test – I (Marks 25)
3	To elaborate the concept of mobile	**Mobile Communication System** GSM – Architecture, Air Interface, Multiple Access Scheme, Channel Organization, Call Setup Procedure,	Written Class Test will be conducted. (Marks 10)

	communicatio n system	Protocol Signaling, Handover, Security, GPRS – Architecture, GPRS signaling, Mobility management, GPRS roaming, network, CDMA2000- Introduction, Layering Structure, Channels,Logical Channels, Forward Link and Reverse link physical channels, W-CDMA – Physical Layers, Channels, UMTS – Network Architecture, Interfaces, Network Evolution, Release 5, FDD and TDD, Time Slots, Protocol Architecture, Bearer Model, Introduction to LTE	
4	To elaborate different layers of mobile network	**Mobile network, transport and application layers** Mobile IP – Dynamic Host Configuration Protocol, Mobile Ad Hoc Routing Protocols– Multicast routing, TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP , TCP over 2.5 / 3G wireless Networks, WAP Model- Mobile Location based services - WAP Gateway –WAP protocols – WAP user agent profile, Caching model-wireless bearers for WAP - WML – WMLScripts – WTA.	Assignments will be given for the above topics. (Marks 10)

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Unit test** • **Viva Test** • **Class Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Saha Misra (2010), *Wireless Communications and Networks, 3G and Beyond*, Second Edition, McGraw Hill Education
2) Vijay K. Garg, *Wireless Network Evolution 2G to 3G*, (2011), Pearson Publications.

REFERENCE BOOKS:

1) Yi Bang Lin, ImrichChlamtac, *Wireless and Mobile Network Architectures*, Wiley India.
2) Dr. Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, *Wireless and Mobile Networks, Concepts and Protocols*, Wiley India
3) K. Fazel, S. Kaiser, (2010), *Multi-Carrier and Spread Spectrum Systems - From OFDM and MC-CDMA to LTE and WiMAX*, Second Edition, Wiley publications
4) Yi-Bing Lin, Ai-Chun Pang, (2012), *Wireless and Mobile All-IP Networks*, Wiley Publications

COURSE TITLE : DATA ANALYTICS AND MINING

Course Objectives:

- To acquire the knowledge of various concepts and tools behind mining data for business intelligence
- To Study data mining algorithms, methods and tools
- To Identify business applications of data mining

Learning Outcomes:

The students will be able to:

- Apply data mining concepts for data analysis and report generation
- Develop industry level data mining skills using software tools
- Make use of relevant theories, concepts and techniques to solve real-world business problems

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS202	Data Analytics and Mining	4	-	2	2	4	2

Module No.	Objective	Content	Evaluation
1	This module introduces students to the concept of data analytics	**Data Analytics** Introduction, Data Summarization and visualization, Linear, Non-linear regression, model selection	Online Test (Marks 5)
2	This module provides background on data objects and statistical concepts. It introduces techniques for preprocessing data before mining.	**Data Mining and Data Preprocessing** What is data mining?, Knowledge discovery- KDD process, related technologies - Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods. Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies. introduction to data warehousing, OLAP, and data generalization. Data Cube Computation and Multidimensional Data Analysis	Written Unit Test – I (Marks 25)
3	This unit covers supervised learning method as classification and Prediction	**Classification and Prediction** Decision tree, Bayesian classification, rule-based classification, neural networks, support vector machines, associative classification, k-nearest-neighbor classifier, case-based reasoning.	Assignments will be given for the above topics. (Marks 10)
4	This unit covers unsupervised learning method as clustering	**Clustering and Association Rule Mining** Partitioning, hierarchical, density-based, grid-based, and model-based methods data clustering.	Assignments will be given for

	and association rule mining To gain detailed insights of outlier detection	Mining Frequent Patterns, Associations, and Correlations Outlier Detection: Detection of anomalies, such as the statistical, proximity-based, clustering-based, and classification-based methods.	the above topics. (Marks 10)

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1. Shashi Shekhar and Sanjay Chawla, (2003), *Spatial Databases: A Tour*, Prentice Hall (ISBN 013-017480-7)
2. Avi Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, 5th edition, (2010), McGraw-Hill

REFERENCE BOOKS:

1. Stefano Ceri and Giuseppo Pelagatti, (1984), *Distributed Database; Principles & Systems*, McGraw-Hill International Editions
2. Raghu Ramakrishnan and Johannes Gehrke, (2002), *Database Management Systems*, 3rd edition, McGraw-Hill.
3. Elmasri and Navathe, (2003), *Fundamentals of Database Systems*, 6thEdition, Addison. Wesley.
4. Shio Kumar Singh, (2011), *Database Systems: Concepts, Design and Applications*, 2nd edition, Pearson Publishing
5. Multi-dimensional aggregation for temporal data. M. Böhlen, J. Gamper, and C.S. Jensen. In Proc. of EDBT-2006, pp. 257-275, (2006).
6. R.H. Güting and M. Schneider (2005), *Moving objects databases*, Morgan Kaufmann Publishers, Inc.
7. Paulraj Ponniah, (2010), *Data Warehousing fundamentals*, JohnWiley.

COURSE TITLE : RESEARCH METHODS AND STATISTICAL ANALYSIS

Course Objectives:

- To understand Research and Research Process

- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Learning Outcomes:

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyse and report data
- Present complex data or situations clearly
- Review and analyse research findings Get the knowledge of objectives and types of research

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS203	**Research Methods and Statistical Analysis**	**4**	**-**	**2**	**2**	**4**	**2**

Module No	Objective	Content	Evaluation
1	To introduce students to the concept of research	**Introduction to Research methodology** An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, defining a Research Problem, Techniques involved in Defining a Problem	Unit Test-1 (Marks-25)
2	To elaborate importance of literature review and research design	**Review of Literature, Research Design** Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling. Measurement and Scaling Techniques Measurement in Research	
3	To learn data collection and processing methods	**Data Collection and Processing** Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate method Data Processing Operations, Elements of Analysis.	Assignment (Marks-10)
4	To learn data analysis and presentation of the results	**Statistical Analysis and Presentation** Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation, Quantitative data analysis, Techniques of Hypotheses, Parametric or Standard Tests Basic concepts, Tests for Hypotheses I and II, Important	Online Test (Marks-15)

		parameters limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a non-parametric Test, Conversion of Chi to Phi, Caution in using Chi-square test, representation of research.	

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Brinoy J Oates, (2006), *Researching Information Systems and Computing*, Sage Publications India Pvt Ltd

REFERENCE BOOKS:

1) Kothari, C.R., (1985), Research Methodology, Methods and Techniques, third edition, New Age International
2) Juliet Corbin & Anselm Strauss, (2008), Basic of Qualitative Research (3rd Edition), Sage Publications
3) Willkinson K.P, L Bhandarkar, (2010), Formulation of Hypothesis, Hymalaya Publication, Mumbai
4) John W Best and V. Kahn, (2010), Research in Education, PHI Publication.

COURSE TITLE : DATA ANALYTICS AND MINING LAB

Course Objectives:

- To acquire the knowledge of various concepts and tools behind data mining for business intelligence
- To Study data mining algorithms, methods and tools
- To Identify business applications of data mining

Learning Outcomes:

The students will be able to:

- Apply data mining concepts for analysis of data
- Develop industry level data mining skills using software tools
- Make use of relevant theories, concepts and techniques to solve real-world business problems

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCSL204	**Data Analytics and Mining Lab**	**-**	**2**	**1**	**1**	**2**	**1**

Module No	Objective	Content	Evaluation
1	To elaborate the concept of data preprocessing	**Data Preprocessing** Data cleaning, data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, experiments with Weka - filters, discretization	Students will be evaluated using Lab Manual. (Marks 05)
3	To implement classification and prediction	**Data Mining (Supervised Learning) Using Weka/R Miner** Classification Prediction	Practical Exam will be conducted. (Marks 15)
4	To implement clustering and association rule mining	**Data Mining (Unsupervised Learning) using Weka/R Miner** Clustering Association Rule Mining	
2	To gain detailed insights of outlier detection	**Outlier Detection** Detection of anomalies, such as the statistical, proximity-based, clustering-based, and classification-based methods.	Class Test (Marks 05)
Softwares used: Advanced Excel, XLMiner,Weka, IBM SPSS Statistics			

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Lab Manuals** • **Practical Test** • **Class Test**	**25 Marks**
External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1. S.C.Gupta, V.K.Kapoor, *Fundamental of Mathematical Statistics*
2. Efraim Turban, Ramesh Sharda, Dursun Delen, David King, (2013), *Business Intelligence* (2nd Edition), Pearson

REFERENCE BOOKS:

1. Swain Scheps, (2008), *Business Intelligence for Dummies*, Wiley Publications
2. Inmon, (1993), *Building the Data Warehouse*, Wiley
3. Dunham, Margaret H, (2006), *Data Mining: Introductory and Advanced Topics*, Prentice Hall
4. Witten, Ian and Eibe Frank, (2011), *Data Mining: Practical Machine Learning Tools and Techniques*, Second Edition, Morgan Kaufmann
5. MacLennan Jamie, Tang ZhaoHui and Crivat Bogdan, (2009), *Data Mining with Microsoft SQL Server 2008*, Wiley India Edition

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COURSE TITLE : STATISTICS LAB

COURSE OBJECTIVES:

- To equip the students with a working knowledge of probability, statistics, and modelling in the presence of uncertainties.
- To understand the concept of hypothesis and significance tests
- To help the students to develop an intuition and an interest for random phenomena and to introduce both theoretical issues and applications that may be useful in real life.

LEARNING OUTCOMES:

The students will be able to:

- Distinguish between quantitative and categorical data
- Apply different statistical measures on data
- Identify, formulate and solve problems

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCSL205	Statistics Lab	-	2	1	1	2	1

Module No.	Objective	Content	Evaluation
1	To elaborate software for data analysis	**Introduction to the software used for data analysis** Environment, entering data and formatting, handling data files, performing calculations, handling utilities, formulae and functions	Lab manual for 05 marks
2	To demonstrate visualization of data	**Visualizing** Handling different types of data variables, creating tables, frequency distribution tables and presenting the data in the forms of Charts, Diagrams, graphs, polygons and plots	Online test of 10 marks

3	To implement the methods to find Measures of Central Tendency, dispersion, Skewness	**Data Descriptors and Hypothesis Testing** Measure of Central Tendencies, Dispersions, skewness, Hypothesis testing and estimation, Goodness of Fit	Practical test of 10 marks
4	To perform Correlation and regression to analyse data	**Correlation and Regression** Using SPSS Statistics find correlation and regression in sample data	
Note: Softwares used: Advanced Excel, XLMiner, IBM SPSS Statistics			

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Lab Manuals** • **Practical Test** • **Online Test**	**25 Marks**
External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1. S. C. Gupta, V. K. Kapoor, (2016) *Fundamental of Mathematical Statistics*

REFERENCE BOOKS:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, David King, (2013), *Business Intelligence* (2nd Edition), Pearson
2. Swain Scheps, (2008), *Business Intelligence for Dummies*, Wiley Publications
3. Healy, K. (2019). Data Visualization – A Practical Introduction. USA: Princeton University Press .
4. Keith McCormick, J. S. (2017). SPSS Statistics for Data Analysis and Visualization Kindle Edition. USA: WileY.

COURSE TITLE : ADVANCED JAVA LAB

Course Objectives:

- To prepare students to excel and succeed in industry / technical profession through global, rigorous education.
- Excellence through application development.
- To provide students with a solid foundation on Tools, Technology and Framework

LEARNING OUTCOMES:

- Students will demonstrate a high degree of proficiency in programming enabling them for careers in software engineering with competencies to design, develop, implement and integrate software applications and computer systems.
- Students will develop confidence for self-education and ability for life-long learning

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCSL207	Advanced Java Lab	-	2	1	1	2	1

Module No.	Objective	Content	Evaluation
1	To implement database connectivity in Java Application	**JDBC** All data base operation using Access /oracle/MySQL as backend	Lab manual for 05 marks
2	To demonstrate the use of Servlets	**Servlets** A Simple Servlet Generating Plain text/ HTML, program based on cross page posting and post back posting (client request and server response)	Online test of 15 marks
3	To demonstrate the use of Java Server Pages	**JSP** Sample program to demonstrate JSP syntax and semantics, program based on directive and error object, program based on cookies and Sessions	Practical test of 15 marks
4	To implement MVC architecture	**Introduction to Framework: Struts** Basic Configuration for struts, Program based on Action validation and control in struts, Program based on integration of JSP and Servlets with struts	Practical test of 15 marks

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Lab Manuals** • **Practical Test** • **Online Test**	**25 Marks**

External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1) Herbert schildt, *The complete reference JAVA2*, (2014)Tata McGraw Hill
2) Sharanam Shah and vaishali shah, *Core Java for beginners, (2010)* SPD

REFERENCE BOOKS:

1) Sharanam Shah and vaishali shah, *Struts 2 for beginners*, (2016)SPD
2) Dreamtech, *Advance Java-Savalia,Core, Java 6 Programming Black Book*, Wiley (2005)
3) Marty Hall and Larry Brown, *Core Servlets and Java Server Pages*: Vol I: Core Technologies 2/e , Pearson (2010)
4) Sharnam Shah and Vaishali Shah, *Java EE 6 for Server Programming for professionals*, (20180) SPD

COURSE TITLE :ADVANCED PYTHON LAB

COURSE OBJECTIVES:

- To introduce students to use of Python programming to solve data analytics problems
- To elaborate students to statistical analysis using Python programming

LEARNING OUTCOMES:

- The students will be able to improve Problem solving and programming capability
- The students will learn data analytics through python programming

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCSL207	**Advanced Python Lab**	**-**	**2**	**1**	**1**	**2**	**1**

Module No.	Objective	Content	Evaluation
1	To describe various libraries required for data analytics	**Operations using Libraries for data analytics** Anaconda, Numpy, Scipy, Pandas, Matplotlib, Seaborn, Scikit-learn, Jupyter Notebook: Create Documentation, Code mode, Markdown mode	Lab manual for 05 marks
2	To elaborate statistical analysis using Python	**Practical on Statistics using python** Mean, Median, Mode, Z-scores, Bias -variance dichotomy, Sampling and t-tests, Sample vs Population statistics, Random Variables, Probability distribution function, Expected value, Binomial	Practical test of 5 marks

		Distributions, Normal Distributions, Central limit Theorem, Hypothesis testing, Z-Stats vs T-stats, Type 1 type 2 error, Chi Square test ANOVA test and F-stats	
3	To study special libraries in Python such as Numpy and Scipy	**Practical on Numpy, Scipy** NUMPY: Creating NumPy arrays, Indexing and slicing in NumPy, Downloading and parsing data, creating multidimensional arrays, NumPy Data types, Array tributes, Indexing and Slicing, creating array, views copies, Manipulating array shapes I/O, SCIPY: Introduction to SciPy, Create function, modules of SciPy	Practical test of 10 marks
4	To study special libraries in Python such as Numpy and Scipy	**Practical on Matplotlib** MATPLOTLIB: Scatter plot, Bar charts, histogram, Stack charts, Legend title Style, Figures and subplots, plotting function in pandas, Labelling and arranging figures, Save plots	Online Class test of 5 marks

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Lab Manuals** • **Practical Test** • **Online Test**	**25 Marks**
External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1) Martin C. Brown, *Complete Reference: Python*., (2015) McGraw Hill
2) Brown, M. C. (2018). Python: The Complete Reference Paperback . USA: McGraw Hill Education.

REFERENCE BOOKS:

1) Allen Downey, Jeff Elkner and Chris Meyers, (2017), *How To Think Like A Computer Scientist: Learning With Python*,DreamTech
2) Wesley J Chun, (2018), *Core Python Programming*, Prentice Hall
3) Lutz and David Ascher, (2016), *Learning Python*, O'Reilly

CHOICE BASE CREDIT SYSTEM (CBCS)

COURSE TITLE : DISTRIBUTED SYSTEMS (CBCS)

Course Objectives:

- To learn the principles, architectures, algorithms and programming models used in distributed systems.
- To examine state-of-the-art distributed systems, such as Google File System.
- To design and implement sample distributed systems.
- To transform students' computational thinking from designing applications for a single computer system, towards that of distributed systems.

Learning Outcomes:

The students will be able to:

- Identify the core concepts of distributed systems: the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
- Examine how existing systems have applied the concepts of distributed systems in designing large systems, and will additionally apply these concepts to develop sample systems.

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS208A	Distributed Systems (CBCS)	4	-	2	2	4	2

Module No.	Objective	Content	Evaluation
1	This module will enable students to introduce concepts related to distributed computing systems.	**Characterization of Distributed Systems** Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, termination detection.	Written Unit Test – I (Marks 25)
2	This module covers solutions to the problem of mutual exclusion, which is important for correctness in distributed systems with	**Distributed Mutual Exclusion** Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and nontoken-based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.	Assignments will be given for the above topics. (Marks 10)

	shared resources.		
3	To introduce students to the concept of Agreement protocol and the abstraction & use of file systems	**Agreement Protocols** Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. Distributed Resource Management: Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.	Assignments will be given for the above topics. (Marks 5)
4	The students will learn about the Failure Recovery in Distributed Systems and Fault Tolerance concepts	**Failure Recovery in Distributed Systems** Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols.	Online Class test will be conducted. (Marks 5)
5	The students will understand the transactions and concurrency Control mechanisms in Distributed systems	**Transactions and Concurrency Control** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.	Online Class test will be conducted. (Marks 5)

EVALUATION:

Evaluation	Details **(* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)**	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Singhal & Shivaratri, (2006), *Advanced Concept in Operating Systems*, McGraw Hill
2) Ramakrishna,Gehrke, (2007) *Database Management Systems*, Mc Grawhill

REFERENCE BOOKS:

1) Coulouris, Dollimore, Kindberg, (2005), Distributed System: Concepts and Design, Pearson Education
2) Tenanuanbaum, Steen, (2001), Distributed Systems, PHI
3) Gerald Tel, Distributed Algorithms, Cambridge University Press

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COURSE TITLE : COMPUTER GRAPHICS (CBCS)

COURSE OBJECTIVES:

- To understand the concepts of output primitives of Computer Graphics.
- To learn 2D and 3D graphics Techniques.

LEARNING OUTCOMES:

The students will be able to:

- Demonstrate the algorithms to implement output primitives of Computer Graphics
- Apply and analyse 2D and 3D techniques

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS209	**Computer Graphics (CBCS)**	**4**	**-**	**2**	**2**	**4**	**2**

Module No.	Objective	Content	Evaluation
1	To introduce students to computer graphics	**Introduction to Computer Graphics** Elements of Computer Graphics, Graphics display systems	Written Unit Test – I (Marks 25)
2	To elaborate on primitive algorithms to generate outputs	**Output primitives and its algorithms** Points and Lines, Line Drawing algorithms: DDA line drawing algorithm, Bresenham's drawing algorithm, Circle and Ellipse generating algorithms: Mid-point Circle algorithm, Mid-point Ellipse algorithm, Parametric Cubic Curves: Bezier curves. Fill area algorithms: Scan line polygon fill algorithm, Inside-Outside Tests, Boundary fill algorithms, Flood fill algorithms	
3	To introduce students to various transformation	**2D Geometric Transformations & Clipping** Basic transformations, Matrix representation and Homogeneous Coordinates, Composite transformation, shear & reflection. Transformation between coordinated	Online Class test will be conducted. (Marks 15)

	and clipping	systems, Window to Viewport coordinate transformation, Clipping operations – Point clipping Line clipping: Cohen – Sutherland line clipping, Midpoint subdivision, Polygon Clipping: Sutherland – Hodgeman polygon clipping ,Weiler – Atherton polygon clipping	
4	To elaborate on basic 3D and fractal concepts	**Basic 3D concepts and Fractals** 3D object representation methods: B-REP, sweep representations, CSG, Basic transformations, Reflection, shear, Projections – Parallel and Perspective Halft one and Dithering technique. Fractals and self-similarity: Koch Curves/snowflake, Sirpenski Triangle	Assignments will be given for the above topics. (Marks 10)

EVALUATION:

Evaluation	Details **(* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)**	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) David F. Rogers, James Alan Adams, (1990), *Mathematical elements for computer graphics*, McGraw-Hill
2) Bloomenthal, J. (2019). Computer Graphics: Implementation and Explanation Paperback. USA: Independently published.
3) Fabio Ganovelli, M. C. (2019). Introduction to Computer Graphics: A Practical Learning Approach (Chapman & Hall/CRC Computer Graphics, Geometric Modeling, and Animation). USA: Chapman and Hall/CRC.

REFERENCE BOOKS:

1) Donald Hearn and M Pauline Baker, *Computer Graphics* C Version (2015) Pearson Education.
2) Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing* (3rd Edition) (2016), Pearson Education.

COURSE TITLE : NATURAL LANGUAGE PROCESSING (CBCS)

COURSE OBJECTIVES:

- This course introduces the fundamental concepts and techniques of natural language processing (NLP).
- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.

LEARNING OUTCOMES:

The students will be able to:

- Understand key concepts from NLP those are used to describe and analyze language
- Understand POS tagging and context free grammar for English language
- Understand semantics and pragmatics of English language for processing

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS208C	Natural Language Processing (CBCS)	4	-	2	2	4	2

Module No.	Objective	Content	Evaluation
1	To introduce students to text representation in computers	**Introduction** Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications., Text representation in computers, encoding schemes., Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK.	Written Unit Test – I (Marks 25)
2	To elaborate on finite state automata	**Language Grammar** Regular expressions, Finite State Automata, word recognition, lexicon, Morphology, acquisition models, Finite State Transducer, N-grams, smoothing, entropy, HMM, ME, SVM, CRF. Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.	Assignments will be given for the above topics. (Marks 10)
3	To introduce students on parsing	**Parsing** Unification, probabilistic parsing, TreeBank. Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary-based approaches. Discourse- Reference resolution, constraints on co-reference, algorithm for	Assignments will be given for the above topics. (Marks 5)

		pronoun resolution, text coherence, discourse structure	
4	To demonstrate uses of NLP	**Applications of NLP** Spell-checking, Summarization Information Retrieval-Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.	Online Class test will be conducted. (Marks 10)

EVALUATION:

Evaluation	Details **(* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)**	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Daniel Jurafsky and James H Martin. (2009), *Speech and Language Processing*, 2e, Pearson Education
2) Dwight Gunning, S. G. (2019). Natural Language Processing Fundamentals: Build Intelligent Applications that Can Interpret the Human Language to Deliver Impactful Results. USA: Packt publishing.

REFERENCE BOOKS:

1) James A. (1994), *Natural language Understanding* 2e, Pearson Education
2) Bharati A., Sangal R., Chaitanya V.. (2000), *Natural language processing: a Paninian perspective*, PHI
3) Siddiqui T., Tiwary U. S.. (2008), *Natural language processing and Information retrieval*, OUP

COURSE: SWAYAM OR OTHER ONLINE COURSES (CBCS)
CREDIT - 04

OBJECTIVES:

Through the medium of online courses we aim to:

- Offer high quality, job-relevant online education to students
- Engage learners in the learning process by better user-accessibility and time flexibility.
- Help the students in their endless pursuit of knowledge through online resources such as videos, research papers, books, articles & course modules

- Provide a user-friendly platform for learner that can help them in achieving their goals in their desired working area.

OUTCOMES:

On completion of the online course, the student will be able to:

- Earn credits on completion of the course
- Learn courses that are valuable to them professionally and personally & enhance their employability quotient
- Graduate with an industry-relevant university credential

Code No.	Course	TC	Th C	Tu C	Int	Ext	Total
BCA208D	SWAYAM OR OTHER ONLINE COURSES (CBCS)	4	2	2	50	50	100

Sr. No.	Name of the Course	Portal	Duration	Enrolment date	Exam date
1	Deep Learning By Prof. Prabir Kumar Biswas – IIT Kharagpur	NPTEL	12 weeks	14-Sep-2020 to 21-Sep-2020	19-Dec-2020
2	Programming, Data Stuctures & Algorithms using Python By Prof. Madhavan Mukund – Chennai Mathematical Institute	NPTEL	8 weeks	14-Sep-2020 to 21-Sep-2020	18-Dec-2020
3	Fundamentals of Artificial Intelligence By Prof. Shyamanta M. Hazarika – IIT Guwahati	NPTEL	12 weeks	14-Sep-2020 to 21-Sep-2020	19-Dec-2020
4	Introduction to Machine Learning By Prof. Balaraman Ravindran – IIT Madras	NPTEL	12 weeks	14-Sep-2020 to 21-Sep-2020	20-Dec-2020

5	Introduction to Internet of Things By Prof. Sudip Misra – IIT Kharagpur	NPTEL	12 weeks	14-Sep-2020 to 21-Sep-2020	20-Dec-2020
6	Introduction to Robotics By Prof. Asokan T, Prof. Balaraman Ravindran, Prof. Krishna Vasudevan – IIT Madras	NPTEL	12 weeks	14-Sep-2020 to 21-Sep-2020	20-Dec-2020

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