GUJARAT TECHNOLOGICAL UNIVERSITY

English for Research Paper Writing
SUBJECT CODE: 3700001
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	17
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4	17
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	4	17
4.	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4	17
5.	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4	16
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4	16

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcome:

At the end of the course, the student will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

GUJARAT TECHNOLOGICAL UNIVERSITY

Constitution of India
SUBJECT CODE: 3700005
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	**History of Making of the Indian Constitution** History Drafting Committee, (Composition & Working)	4	17
2.	**Philosophy of the Indian Constitution:** Preamble Salient Features	4	17
3.	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4	17
4.	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4	17

5.	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4	16
6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4	16

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

Course Outcome:

At the end of the course, the student will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
2. To address the growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

GUJARAT TECHNOLOGICAL UNIVERSITY

RESEARCH AND IPR

M.E. SEMESTER: I

Rationale:

To the Student:

The purpose of this subject is to orient the students to the scientific methodology of research and presenting their thesis. Research constitutes primarily of literature review, giving critical comments on the literature reviewed and identifying the gap, problem formulation, modeling in either an analytical or experimental set up, validating the model and solving the problem you set for yourself.

At the end, student should be able to present and defend the solution he/she has found, in a simple and easy manner. Communicating the research outcomes, is an art wherein, you do not want to either undermine or over emphasise the content, within the short time limit given for such presentations. The balance of critical technicality and overall outcomes is the key to an effective presentation. The language, content and articulation should be such as to convey in a unified manner, the gist of your work.

To the Teacher:

It is envisaged that the teacher will discuss actual case studies to make the student understand the concepts of demonstration of examples during theory. Theory classes will be used to explain each of the concepts in Module 1 and 2. This syllabus is based on the model AICTE course prescribed in May2018.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
1	0	2	2	0	0	80	20	100

Content:

	Module 1 Starting Research	**Teaching Hrs**
1.1	**Find what is expected of you**	
	Identify specific requirements for evaluation/review and what constitutes completion of your work	
	Find where the source is available	
	Establish proper methods for finding the relevant material from the source.	
1.2	**Analyse the question**	
	Identify key areas in your field	
	Determine the nature and extension of papers that you should read	
1.3	**Identify the gaps**	

	Learn to Critique existing knowledge and how to find the gap	
1.4	**Formulate the Problem Statement**	
	Understand what should be the key aspects of your problem statement	
	Examples of effective and ineffective Titles	
1.5	**Validation**	
	Identify problem and experimental/theoretical data for comparison with your model	
	Learn how to extrapolate/scale data for validation	
	Find what is acceptable level of error and justification thereof	
	Module 2 Finding Good Literature	
2.1	**Decide which sources you will need**	
	Differentiate between journals, conferences, books, magazines and their quality	
	Understand how to establish their quality and authenticity	
2.2	**Finding Information**	
	How to conduct effective searches	
	How to find relevant papers related to your area of research	
	How to capture critical information	
2.3	**Identify main ideas in scholarly literature**	
	Understand and identify the bias, theoretical position and evidence produced	
2.4	**Write notes to organize your ideas**	
	Compare ideas and concepts from different papers	
	Module 3 Writing and Presenting your Work	
3.1	**Effective technical writing**	
	How to write Report, Paper, Developing a Research Proposal, Format of research proposal	
3.2	**Build your argument**	
	Recognise the importance of emphasizing your point	
	Distinguish between your point and the evidence available	
	Acknowledge the evidence	
3.3	**Review and finalize your work**	
	Know and follow the Process of reviewing and proof reading your work	
	Use feedback to improve your work	
3.4	**Check the logistics of your presentation**	
	Identify the key message of your presentation	
	Understand the expectations and what will be the key review points	
3.5	**Develop the structure of your presentation**	
	Understand the key components of an oral presentation	
	Know the usual structure of a good presentation	
3.6	**Prepare for delivery of your Oral presentation**	
	Rehearse and time your presentation	
	Prepare to answer questions from the audience: Fundamental concepts should be spoken from memory as reviewer will be looking for evidence of your thorough understanding.	
	Read more than the content you are presenting; keep sources ready on hand for reference;	
	Module 4 Intellectual Property	
4.1	**Patents, Designs, Trade and Copyright.,**	
	Process of Patenting and Development: Technological research innovation, patenting, development.	

4.2	**International Scenario:**	
	International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
4.3	**Patent Rights**	
	Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	
4.4	**New Developments in IPR**	
	Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies	

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel, "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Propertyin New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcome:

At the end of the course the students should be able to:

1. Conduct a quality literature review and find the research gap.
2. Identify an original and relevant problem and identify methods to find its solution
3. Validate the model
4. Present and defend the solution obtained in an effective manner in written or spoken form.
5. Follow research ethics
6. Understand IPR protection for further research and better products

GUJARAT TECHNOLOGICAL UNIVERSITY

Computer Engineering (Software Engineering)
Distributed Systems
SUBJECT CODE: 3710213

Type of course: Elective

Prerequisite: Operating System, Computer Network,Data Structures and Algorithms

Rationale: This subject will give introduction to traditional and distributed computing system. Students will be introduced to various issues in design of distributed system. They will also learn how to mitigate those risks and attacks.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No	Content	Total Hrs	% Weightage
1	**Introduction to DS:** Introduction to Distributed Systems, Distributed system models, Design issues in DS	3	8%
2	**Communication in Distributed System:** Inter process communication: Message passing model, Remote procedure call and implementation issues, Point to point and Group communication , Client Server model & its implementation, Socket programming, Case Studies: SUN RPC, DEC RPC	7	15%
3	**Synchronization in distributed systems:** Introduction, Temporal ordering of events, Clock synchronization, mutual exclusion, Deadlock in distributed systems, Election algorithms	8	15%
4	**Remote Method Invocation:** Introduction, Java RMI Architecture, API for Java RMI, Client Callback, Stub downloading	3	8%
5	**Common Object Request Broker Architecture:** Introduction, Interface, Inter-ORB Protocol, Object server and object client, Naming service, Object service,	4	10%
6	**Processes and processors in distributed systems:** Threads, system model, processor allocation, scheduling in distributed systems: Load balancing and sharing approach, fault tolerance, Real time distributed systems, Process migration and related issues	8	15%

7	**Distributed File Systems:** Introduction, features & goal of distributed file system, file models, file accessing models, file sharing semantics, file caching scheme, file replication, fault tolerance, trends in distributed file system, case study- HDFS.	**8**	**15%**
8	**Distributed Shared Memory:** Introduction, general architecture of DSM systems, design and implementation issues of DSM, granularity, structure of shared memory space, consistency models, replacement strategy, thrashing	**5**	**10%**
9	**Advanced Topics:** Simple Object Access Protocol, Distributed Computing Paradigm (Message queue system, mobile agent, object spaces)	**2**	**4%**

Reference Books:

1. "Distributed Computing – Principles and Applications", M. L. Liu, Pearson.
2. "Distributed Operating Systems Concepts and Design" , Pradeep K Sinha, PHI
3. "Distributed Systems Concepts and Design " George Colouris, Jean Dollimore, Tim Kindberg, Pearson

Course Outcome:

After learning the course the students should be able to:

- Understand the difference between traditional client server architecture and distributed architecture
- Understand the importance and issues of distributed system
- Implement socket programing, RMI and CORBA

List of Experiments:

1. Write a Program to implement Concurrent Echo Client Server Application.
2. Write a Program to implement Concurrent Day Time Server Application.
3. Write a program to solve Producer-Consumer Problem using thread.
4. Write a program to implement Calculator using Socket in java.
5. Implement RPC Programming.
6. Implementation of Server that adds given two values by the clients using Java RMI.
7. Write a program to create CORBA based client server application
8. Implementing Bully Election algorithm for synchronization
9. Implementing Ring Election algorithm for synchronization
10. Write a Program to Increment a Counter in Shared Memory.

GUJARAT TECHNOLOGICAL UNIVERSITY

Mathematical Foundation of Computer Science
SUBJECT CODE: 3710214

Type of course: Core

Prerequisite: Discrete Mathematics

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No	Content	Total Hrs	% Weightage
1	Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains	**7**	**15**
2	Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood	**7**	**15**
3	Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment	**8**	**16**
4	Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems	**11**	**23**
5	**Computer science and engineering applications:** Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning	**10**	**21**
6	Recent Trands in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision	**5**	**10**

Reference Books:

1. John Vince, Foundation Mathematics for Computer Science, Springer
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis

4. Alan Tucker, Applied Combinatorics, Wiley

Course Outcome:

After learning the course the students should be able to:

- To understand the mathematical fundamentals that is prerequisites for avariety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning
- To developthe understanding ofthe mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency
- To study various sampling and classification problems.

List of Experiments:

1. Analyze the concpt of randomization. Implement a program in a language that supports graphics to Push the balls from left and right allowing random movement and then let them fall in rectangle bins.Show graphically how they form curve
2. Consider that there are two parties party1 and party2 contesting for elections. Consider candidate from either party1 or party2. Consider voting population and ask them about their likelihood to vote for the candidate from party1. Now Ask the population again to show their likelihood for candidate after candidate gives speech. Now again rate the candidate through voting population. Implement a program to do this. Use WEKA tool to simulate this.
3. Write a program that takes two inputs- size of the house(no of rooms) and location of the house and accordingly give price of the house. Classify the house as very costly,costly,affordable,cheap.
4. Consider website of your institute. Represent the link structure by directed graph. Apply and implement algorithm to traverse the graph and to reach a faculty's web page in your department
5. Graph theory problem – there are k aircrafts and have to be assigned n flights. The time interval of ith flight is (ti1,ti2). If the time interval overlaps for the flights the same aircraft cannot be assigned to both the flights.Vertices of the graph are flights.Two vertices are connected if the corresponding time intervals overlap. Simulate the problem by applying graph theory. Use simulation tool to simpulate or programming language to implement graph

GUJARAT TECHNOLOGICAL UNIVERSITY

Advanced Data Structures
SUBJECT CODE: 3710215

Type of course: Core

Prerequisite: UG level course in Data Structures

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No	Content	Total Hrs	% Weightage
1	**Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing	7	15
2	**Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	5	10
3	**Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	9	19
4	**Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	12	25
5	**Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.	10	21
6	Recent Trands in Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem	5	10

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Outcome:

After learning the course the students should be able to:

- Understand the implementation of symbol table using hashing techniques
- Develop and analyze algorithms for red-black trees, B-trees and Splay trees
- Develop algorithms for text processing applications
- Identify suitable data structures and develop algorithms for computational geometry problems

List of Experiments:

(Note: At least 12 Practicals should be performed from the list.)

1. Write a program which creates Binary Search Tree. And also implement recursive and non-recursive tree traversing methods inorder, preorder and post-order for the BST.
2. Write a program to implement any two hashing methods. Use any one of the hashing method to implement Insert, Delete and Search operations for Hash Table Management.
3. Explain Dictionary as an Abstract Data Type. Implement Dictionary using suitable Data Structure.
4. Write a program which creates AVLTree. Implement Insert and Delete Operations in AVL Tree. Note that each time the tree must be balanced.
5. Implement Red-Black Tree.
6. Implement 2-3 Tree.
7. Implement B Tree.
8. Implement a program for String Matching using Boyer-Moore Algorithm on a text file content.
9. Implement a program for String Matching using Knuth-Morris-Pratt Algorithm on a text file content.
10. Implement Huffman-Coding Method. Show the result with suitable example.
11. Implement Longest Common Subsequence(LCS) Problem using Dynamic Programming Method. Show the DP table and also find the particular solution of given strings.
12. Implement One Dimensional and Two Dimensional Range Searching in any language.
13. Write a program which creates Priority Search Tree. Implement Insert and Search Operations in this Tree.
14. Write a program which creates Skip Lists. Implement Insert, Search and Update Operations in Skip-Lists.
15. Design a simple search engine to display the possible websites upon entering a search query. Use suitable data structure for storage and retrieval.
16. Prepare a Report/Presentation on Recent trends on Hashing/Trees/Computational Geometry to solve ay of recent evolving problem in real world.

GUJARAT TECHNOLOGICAL UNIVERSITY

Computer Engineering
Machine Learning
SUBJECT CODE: 3710216

Type of course:

Prerequisite: Data Structures, Basics of Probability and Statistics

Rationale: Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. This subject will help students to learn patterns and concepts from data without being explicitly programmed in various IOT nodes and also motivates them to design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No	Content	Total Hrs	% Weightage
1	**Supervised Learning (Regression/Classification)** Basic methods**:** Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	10	15%
2	**Unsupervised Learning** Clustering**:** K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)	7	15%
3	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6	20%
4	Sparse Modelling and Estimation, Modelling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9	20%
5	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9	20%
6	Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT	5	10%

	applications.		

References:

1. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press, 2012.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2009 (freely available online)
3. Machine Learning in Action, Peter Harrington, Manning, dreamtech press
4. Machine Learning for Big Data, Jason Bell, Wiley
5. Machine Learning in Python, Michael Bowles, Wiley
6. Machine Learning with TensorFlow for dummies, Matthew Scarpino, Wiley
7. Python Machine Learning By Example, Yuxi Liu, Packt
8. Advance Machine Learning with Python, John Hearty, Packt
9. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press
10. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2007.

Course Outcome:

After learning the course the students should be able to:

1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyse various machine learning approaches and paradigms.

List of Experiments:

- Minimum 10 experiments based on the contents.
- Mini Project in a group of max. 3 students
- Writing a research paper on selected topic from content with latest research issues in that topic

Major Equipments:

- Modern System with related software

List of Open Source Software/learning website:

https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/

https://www.rstudio.com/online-learning/

GUJARAT TECHNOLOGICAL UNIVERSITY

Wireless Sensor Networks
SUBJECT CODE: 3710217

Type of course: Elective

Prerequisite: None

Rationale: Advancements in the areas of sensor design, information technologies and wireless networks have evolved the wireless sensor networks. The wireless sensor networks connect the physical world to computing world. WSN is useful in developing a large number of applications, including the protection of civil infrastructure, habitat monitoring, agriculture, health care. However, the design, operation and performance is a challenging task.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction –Motivation, Definitions and background, challenges and constraints, Applications	2	2
2	Single Node Architecture – Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, examples of sensor nodes	3	3
3	Network Architecture – Sensor network scenarios, optimization goals, design principles, service interfaces,gateway concepts	4	5
4	Physical layer – Introduction, wireless channel and communication fundamentals,physical layer and transceiver design considerations in WSNs	3	5
5	MAC protocols – Fundamentals of MAC protocols, Low duty cycle protocols and wakeup concepts, contention based protocols, schedule based protocols, The IEEE 802.15.4 MAC protocol	4	10
6	Link Layer Protocols – Tasks and requirements, Framing, Link Management	4	5
7	Naming and addressing – Fundamentals, address and name management, Assignment of MAC address, Distributed assignment of locally unique addresses, content based and geographic addressing.	4	10
8	Time Synchronization, Localization and positioning – Time synchronization problem, protocols, properties of localization and positioning procedures, lateration problem, single hop localization, positioning in multihop environments	4	10

9	Routing protocols – Forwarding and routing, MANET protocols, gossiping and agent based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, Mobile nodes	**8**	20
10	Data centric and content based networking –Introduction, Data centric routing, Data aggregation, data centric storage	**4**	10
11	Transport layer and quality of service – The transport layer and QoS in wireless sensor networks, Coverage and deployment, Reliable data transport, single packet delivery, block delivery, congestion control and rate control	**4**	10
12	Security – Challenges of security, security attacks, Protocols and mechanisms for security, IEEE 802.15.4 and ZigBee Security	**4**	10

Reference Books:

1) Holger Karl and Andreas Willig, "Protocols and Architectures for wireless sensor networks, WILEY
2) W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010
3) KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience 2007
4) Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010
5) Jun Zheng, Abbas Jamalipour, " Wireless Sensor Networks – A networking perspective", WILEY
6) Kazem Sohraby,Daniel Minoli,Taieb Znati, "wireless sensor Networks Technology, Protocols and applications", WILEY
7) Jr. Edgar H. Callaway, Wireless Sensor Networks: Architecture and Protocols, Auerbach, 2003
8) Fundamentals of Sensor Network Programming: Applications and Technology By Sridhar S. Iyengar, NandanParameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley
9) AzzedineBoukerche, Handbook of Algorithms for Wireless Networking and Mobile Computing, Chapman & Hall/CRC, 2006
10) Philip Levis, " TinyOS Programming"

Course Outcomes:

After completion of course, students would be able to:

- Describe and explain radio standards and communication protocols for wireless sensor networks.
- Explain the function of the node architecture and use of sensors for various applications.
- Be familiar with architectures, functions and performance of wireless sensor
- networks systems and platforms.

List of Experiments:

1) Implement a campus sensor communication application for assignment file transfer using Bluetooth.
2) Implement a campus sensor communication application for assignment file transfer using wireless LAN.
3) Implement a campus sensor communication application for assignment file transfer using ZigBee.
4) Implement a campus sensor communication application for assignment file transfer using WiMax/hotspot.

5) Implement TinyOS. Perform analysis of various routing protocols
6) Perform analysis of various routing protocols on sensor network simulator.
7) Perform analysis of various MAC protocol on sensor network simulator and find how it affects the energy efficiency.

Major Equipment:

Computer systems having following minimum technical configurations
Processor:i3 or i5 or higher
RAM : minimum 4 GB
HDD : 1 TB
Internet and wifi connectivity
Licence Window/Linux operating system

List of Open Source Software/learning website:

1) **nptel.ac.in**

GUJARAT TECHNOLOGICAL UNIVERSITY

Operating System Design
SUBJECT CODE:3710218

Type of course: Elective

Prerequisite: Data Structure, Algorithms and Operating system concepts

Rationale:. The objective of the course is to provide introduction to operating system design and concept of process, process lifecycle and scheduling approaches.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Unit 1:** Overview of Operating Systems, Operating system functions and design issues, Design approaches, Types of advanced operating systems.	5	10
2	**Unit 2:** Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and micro-kernels.	6	15
3	**Unit 3:** Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: Semaphores, monitors, Process deadlock and deadlock handling strategies.	7	15
4	**Unit 4:** Memory management, Virtual memory concept, Virtual machines, I/O Management, File and disk management,	7	15
5	**Unit 5:** Operating system security, Secure operating systems, Security goals, Trust model, Threat model, Access Control Fundamentals – Protection system – Lampson's Access Matrix, Mandatory protection systems, Reference monitor, Security in Ordinary OS – Unix, Windows	10	20
6	**Unit 6:** Distributed Operating system: Architecture, Design issues, Distributed mutual exclusion, Distributed deadlock detection, shared memory, Distributed scheduling. **Multiprocessor operating systems:** architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.	10	20
7	**Unit 7:** Recent trends in Operating system design and their applicability to HPC.	3	5

Reference Books:

1. Advanced concept in operating system: M. Singhal, N.G. Shivratri
2. Operating system internal and design principles: William Stallings
3. Operating System Security, Trent Jaeger, Morgan & Claypool Publishers, 2008.
4. The Design of the Unix Operating System, Maurice J Bach, PHI

Course Outcome:

After learning the course the students should be able to:

- Understanding advanced concepts in operating systems.
- Understand security issues in operating systems.
- Learning principles of Distributed and multiprocessor operating systems

List of Experiments

- Implement inter process communication using semaphore
- Implement inter process communication using monitor
- Implement inter process communication using shared memory
- Implement inter process communication using message queue
- Develop any client-server based program and demonstrate covert channel
- Case study – Windows, Linux kernel, Android

GUJARAT TECHNOLOGICAL UNIVERSITY

Data Science
SUBJECT CODE: 3710219

Type of course: Elective

Prerequisite: Data Structures, Basics of Probability and Statistics

Rationale: Data Science is a blend of many fields, including many sub domains of mathematics, computer science, computational science, statistics, and information science. In contrast to "pure" mathematicians, statisticians, or computer and information scientists, a data scientist has a breadth of experience across all of these fields, but may not have as much knowledge as a specialist in any particular field. This subject will help students to efficiently conduct computational analysis with their own knowledge domain.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**An Introduction to core concepts & technologies:** Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	6	10%
2	**Data collection and management:** Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources	7	15%
3	**Data analysis:** Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	10	25%
4	**Data visualisation:** Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	11	25%
5	Applications of Data Science, Technologies for visualisation, Bokeh (Python)	7	15%
6	Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	7	10%

Reference Books:

1. Doing Data Science, Cathy O'Neil and Rachel Schutt, Straight Talk From The Frontline. O'Reilly.
2. Introduction to Data Science, Davy Cielen, Arno D B Meysman and Mohamed Ali, Manning, dreamtech press
3. Practical Data Science, Nina Zumwl and John Mount, Manning, dreamtech press
4. The Data Science Handbook, Field Cady, Wiley
5. Getting Started with Data Science, Murtaza, Haider, Pearson
6. Data Science and Big Data Analytics, EMC Education Services, Wiley
7. Data Science, John D Kellehar, MIT Press
8. Mining of Massive Datasets. v2.1, Jure Leskovek, AnandRajaraman and Jeffrey Ullman, Cambridge University Press

Course Outcome:

After learning the course the students should be able to:

- Explain how data is collected, managed and stored for data science;
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
- Implement data collection and management scripts using MongoDB

List of Experiments

- Minimum 10 experiments based on the contents.
- Mini Project in a group of max. 3 students
- Writing a research paper on selected topic from content with latest research issues in that topic

Major Equipments:

- Modern System with related software

List of Open Source Software/learning website:

https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/

https://www.rstudio.com/online-learning/

Additional Resources:

Books for Unit 1 and 2:

1. Data Mining Concepts & Techniques, J Han, M Kamber, J Pei ((chapter 2 & 3)
2. Data science process flowchart from "Doing Data Science", Cathy O'Neil and Rachel Schutt, 2013 (chapter 2)
3. Data Science and Big Data Analytics, EMC Education Services, Wiley

Unit 1: An introduction to core concepts and technologies

https://www.edureka.co/blog/what-is-data-science/
https://intellipaat.com/blog/what-is-data-science/

Data types:

https://www.youtube.com/watch?v=hZxnzfnt5v8
https://www.youtube.com/watch?v=zHcQPKP6NpM&t=247s
https://www.youtube.com/watch?v=zHcQPKP6NpM&t=247s
http://www.mymarketresearchmethods.com/types-of-data-nominal-ordinal-interval-ratio/

Tools:
https://www.ngdata.com/top-tools-for-data-scientists/

8 open Source Big Data Tools to use in 2018:

https://towardsdatascience.com/8-open-source-big-data-tools-to-use-in-2018-e35cab47ca1d

Basic Libraries for Data Science:
https://www.upwork.com/hiring/data/15-python-libraries-data-science/

Unit 2: Data collection and management

Data collection:
http://bigdata-madesimple.com/3-effective-methods-of-data-collection-for-market-research/
Data Wrangling with example:
https://towardsdatascience.com/intro-to-data-science-part-2-data-wrangling-75835b9129b4
https://medium.fr7eecodecamp.org/discovering-the-secrets-of-baseball-with-data-56f793852de0
Data Analysis with example:
https://medium.com/@williamkoehrsen/data-analysis-with-python-19434f5d6324
Data cleaning with example:
https://www.kdnuggets.com/2016/03/doing-data-science-kaggle-walkthrough-cleaning-data.html
5 APIS a data scientist must know:
https://www.analyticsvidhya.com/blog/2016/11/an-introduction-to-apis-application-programming-interfaces-5-apis-a-data-scientist-must-know/

Data storage

https://searchstorage.techtarget.com/definition/big-data-storage

http://www.enterprisestorageforum.com/storage-management/storage-trends/top-10-trends-for-data-storage-with-big-data-analytics.html

https://www.computerweekly.com/tip/Big-data-storage-management-challenges-and-how-to-deal-with-them

Multiple data sources:

https://www.allerin.com/blog/top-5-sources-of-big-data

http://tdan.com/combining-data-from-multiple-sources-join-integrate-blend/19877

https://www.techrepublic.com/blog/big-data-analytics/use-normalization-and-etl-to-get-the-big-data-results-you-want/

https://www.youtube.com/watch?v=f0nMfV1GvOg

Books for Units 3 to 6

Book1: Data Mining Concepts and Techniques by Jiawei Han, MichelineKamber and Jian Pei

Book2: Statistics and Data Analysis by A. Abebe (available online in .pdf format

Unit 3 Data Analysis

- For Introduction, Terminology and Concepts
  - Chapter 3 of Book1 for Data analysis process
  - https://www.tutorialspoint.com/excel_data_analysis/data_analysis_overview.htm
  - https://www.tutorialspoint.com/excel_data_analysis/data_analysis_process.htm
- Introduction to statistics, central tendencies and distributions, Variance, distribution properties and arithmetic
  - Section 2.2 (Basic Statistical Descriptions of Data) of book
  - http://statistics.wikidot.com/ch3
  - https://www.listendata.com/2014/04/descriptive-statistics.html
- Central Limit Theorem (CLT)
  - Chap. 6 from Book2
  - https://web.stanford.edu/class/archive/cs/cs109/cs109.1178/lectureHandouts/190-central-limit-theorem.pdf
  - https://towardsdatascience.com/understanding-the-central-limit-theorem-642473c63ad8
  - https://www.tutorialspoint.com/statistics/central_limit_theorem.htm
- Basic Machine Learning Algorithms, Linear regression, SVM, Naïve Bayes
  - **Machine Learning**
    - https://www.geeksforgeeks.org/machine-learning/(What is machine learning, applications of machine learning, classification of machine learning methods)
  - **Naïve Bayes**
    - Section 8.3 from Book1
    - https://www.geeksforgeeks.org/naive-bayes-classifiers/
  - **SVM**
    - Section 9.3 from Book1
    - https://machinelearningmastery.com/support-vector-machines-for-machine-learning/
    - https://www.analyticsvidhya.com/blog/2017/09/understaing-support-vector-machine-example-code/
  - **Linear Regression**
    - http://cs229.stanford.edu/notes/cs229-notes1.pdf
    - https://www.geeksforgeeks.org/linear-regression-python-implementation/
    - http://ufldl.stanford.edu/tutorial/supervised/LinearRegression/

Unit 4 Data Visualization

- Introduction
  - Section 2.3 from Book1
- Types of data visualization
  - https://info.datalabsagency.com/blog/data-visualization-news/15-most-common-types-of-data-visualisation , https://datavizcatalogue.com/
- Data for visualization
  - Data types (already covered in Unit 1)
  - Data Encoding

        - https://www.oreilly.com/library/view/designing-data-visualizations/9781449314774/ch04.html
        - http://paldhous.github.io/ucb/2016/dataviz/week2.html
        - http://www.faculty.jacobs-university.de/llinsen/teaching/340131/Lecture03.pdf
- Retinal variables, mapping variables to encoding, visual encoding
    - https://www.targetprocess.com/articles/visual-encoding/
    - http://vda.univie.ac.at/Teaching/Vis/13s/LectureNotes/05_visual_encodings.pdf
    - https://www.cs.sfu.ca/~torsten/Teaching/Cmpt467/LectureNotes/05_visual_mappings.pdf

Unit 5

- Applications of Data Science – Applications in healthcare, finance, ecommerece, education, and agriculture can be covered.
    https://www.analyticsvidhya.com/blog/2015/09/applications-data-science/
    - Healthcare:
        - https://medium.com/activewizards-machine-learning-company/top-7-data-science-use-cases-in-healthcare-cddfa82fd9e3
        - https://www.datapine.com/blog/big-data-examples-in-healthcare/
        - http://article.sciencepublishinggroup.com/pdf/10.11648.j.ajtab.20180402.14.pdf
    - Finance
        - https://www.mastersindatascience.org/industry/finance/
        - https://www.techemergence.com/predictive-analytics-in-finance/
    - E-commerce:
        - https://towardsdatascience.com/5-data-science-project-every-e-commerce-company-should-do-8746c5ab4604
        - https://www.datascience.com/blog/data-science-for-ecommece-businesses-predictive-modeling
        - https://dataconomy.com/2017/07/6-ways-use-big-data-ecommerce/
    - Education:
        - https://www.expresscomputer.in/magazine/data-analytics-in-education-sector-to-see-high-growth/14468/
        - https://www.analyticsindiamag.com/top-6-ways-make-education-institutions-smarter-data-analytics/
        - https://www.allerin.com/blog/4-ways-big-data-is-transforming-the-education-sector
    - Agriculture:
        - https://www.analyticsvidhya.com/blog/2018/05/data-analytics-in-the-indian-agriculture-industry/
        - https://www.wur.nl/upload_mm/6/0/4/307c3061-35ea-4339-a33b-d21f047d2d38_Wolfert%20et%20al%20Big%20Data%20in%20Smart%20Farming.pdf
        - https://www.sciencedirect.com/science/article/pii/S0308521X16303754
- Technologies for visualization
    - https://tdwi.org/articles/2011/11/09/research-excerpt-data-visualization-technology.aspx
- Bokeh (Python)
    - https://bokeh.pydata.org/en/latest/
    - https://www.analyticsvidhya.com/blog/2015/08/interactive-data-visualization-library-python-bokeh/

Unit 6

- Recent trends in various data collection techniques - https://www.tutorialspoint.com/statistics/data_collection.htm https://avaresearch.com.au/different-types-of-data-collection-methodologies/
- Various visualization techniques – already covered in Unit 4
- Application development methods used in data science
    - Python Programming
    - R Programming

    **Students must be able to implement concepts learned in data science (concepts learned in previous units) using Python and R programming

GUJARAT TECHNOLOGICAL UNIVERSITY

Parallel Programming Tools and Model
SUBJECT CODE:3710220

Type of course: Elective

Prerequisite: Data Structures, Design and Analysis of Algorithms, Computer Architecture

Rationale: Parallel computing has become mainstream and very affordable today with the growing number of cores on a chip. Programming them efficiently has become an indispensable knowledge for the future. Parallel Programming Tools and Techniques is a hands-on course involving significant parallel programming on compute-clusters, multi-core CPUs and massive-core GPUs.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hours	Module Weightage
1	**Introduction to Parallel Programming Paradigms and performance analysis:** Necessary background to follow an parallel programming course. Issues when programming multicore architectures. General introduction of the main techniques and basic features of current performance analysis tools.	3	6%
2	**Parallel Architecture:** Introduction to parallel hardware: Multi-cores and multiprocessors, Parallel Architecture Components, Flynn's Taxonomy, Amdahl's Law, Network Topology, Multiprocessor organization and Cache Coherence, Cache Coherence Protocols, Memory Consistency models.	8	17%
3	**Shared and Distributed Memory Programming : OpenMP, MPI and PVM:** Synchronization Locks and barriers, Hardware primitives for efficient lock implementation, Lock algorithms, Relaxed consistency models, High-level language memory models (such Java and/or C++), Memory fences, Summary of basic features in OpenMP, MPI, PVM and POSIX thread API. Advanced features in OpenMP, MPI, PVM and hybrid programming.	11	23%
4	**Data acquisition and performance analytics:** Tracing of sequential and parallel applications, Trace processing and performance analytics, Profiling, Profile Tools.	4	8%
5	**Models and performance prediction**: Trace-based modeling of parallel performance. Architectural parameters: CPU, memory, interconnect.	3	6%
6	**Dataflow programming and novel paradigms for accelerator-based architectures**: Dataflow paradigms (OmpSs). Runtime exploitation of parallelism and architecture hiding. Advanced parallel programming using accelerators: CUDA, OpenCL, OpenACC and others if any.	9	19%

7	**Principles of Parallel Algorithm Design:** Embarrassingly Parallel Computations, Partitioning and Divide-and-Conquer Strategies, Pipelined Computations, Synchronous Computations, Load Balancing and Termination Detection, Sorting Algorithms, Numeric Algorithms, Image Processing Algorithms	7	15%
8	**Analysis and optimization of real applications**: Analysis of large applications (sequential and/or parallel) and optimization using hybrid programming paradigms (dataflow, shared- and distributed-memory and accelerators).	3	6%

Reference Books:

1) Parallel Programming in OpenMP, Rohit Chandra, Leo Dagum, Dave Kohr, Dror Maydan, Jeff McDonald, Ramesh Menon, Academic Press Morgan Kaufmann Publishers, San Diego, CA, 2001.
2) Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
3) CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)
4) Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann,2011.
5) M Herlihy and N Shavit, The Art of Multiprocessor Programming Morgan Kaufmann, 2008.
6) J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach,4th Ed., Morgan Kaufmann/Els India, 2006.
7) M. SasiKumar, Dinesh Shikhare P. Raviprakash, Introduction to Parallel Processing, PHI Publication
8) V. Rajaraman And C. Siva Ram Murthy, Parallel Computers – Architecture And Programming, Second Edition, PHI Publication
9) M. J. Quinn, Parallel Computing: Theory and Practice, McGraw Hill, Second Edition
10) Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar "Introduction to Parallel Computing", Second Edition, Addison Wesley, 2003. ISBN: 0-201-64865
11) Wilkinson, M.Allen,"Parallel Programming Techniques and Applications using networked workstations and parallel computers", Prentice Hall, 1999.

Course Outcomes:

- Classify parallel architectures parameters that are essential for the classification of modern parallel processing systems.
- Design efficient parallel solutions to scientific problems
- Implement parallel programs in prominent programming models and evaluate their performance using various metrics

Practical List:

Use Valgrind, Vtune Amplifier, Nvidia Visual Profiler and Nvidia Nsight to identify hotspots and other parameters for detailed analysis of following the practicals.

1) Calculate standard deviation using Pthread, OpenMP and MPI.
2) Write parallel code for Matrix Matrix Multiplication using MPI cluster of 4 nodes, OpenMP, PVM cluster of 4 nodes, OpenACC and CUDA and compare and plot the performance in terms of execution time for Matrix size of 1000 x 1000, 5000 x 5000, 10,000 x 10,000, 20,000 x 20,000.
3) Write the programs in MPD or in C with the Pthreads library for the following:

a) Sequential Jacobi iteration program
b) Parallel Jacobi iteration program
c) Sequential multigrid program
d) Parallel multigrid program

4) Perform Monte Carlo simulation using NVIDIA's CURAND library for random number generation.

Write your own small program to compute the average value of

$$az^2 + bz + c$$

where z is a standard Normal random variable (i.e. zero mean and unit variance, which is what the random number generator produces) and a, b, c are constants which you should store in constant memory.

It is suggested to use each thread to average over 100 values, and then write this to a device array which gets copied back to the host for the averaging over the contributions from each of the threads.

(Note: the average value should be close to a + c.)

5) Implement 3D Laplace Finite Solver using CUDA and OpenACC.