VIT Vidyalankar Institute of Technology
Accredited A+ by NAAC

Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Master of Technology

in

Computer Engineering

First Year Scheme & Syllabus

(With effect from the Academic Year 2022-23)

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated, and taken forward in a systematic manner. Therefore, autonomy for Vidyalankar Institute of Technology is not merely a transition from pre-cooked syllabi to self-designed curriculum. Autonomy curriculum of the Institute offers required academic flexibility with emphasis on industry requirements and market trends, employability, problem-solving approach and research ability which leads to improving competency level of learners with diverse strengths. In line with this, the curriculum framework designed is **Choice-Based Credit and Grading System (CBCGS)**. Number of credits for courses learnt by learners, internships and dissertation is finalized considering the scope of study and the ability that a learner should gain through the programme.

The curriculum planned by the Institute offer flexibility and diversity to learners to choose any set of courses from a basket of electives. Learner can also choose to specialize in a domain as per their field of interest. The selection of unique specialization tracks based on recent developments and industrial requirements is a salient feature of this curricula ensuring employability. Each specialization track has mandatory core courses positioned and sequenced to achieve sequential and integral learning for the required depth of the specific domain. Learner can choose to complete these courses in first year of the engineering programme that enables him/her to prepare for research during their final year. Credits additional to core course of track (if chosen), include dissertation, internships, publication/ copyright, advanced courses in the field of computer engineering, multi-disciplinary courses, special skill development courses and similar knowledge that make learner capable to do further research or work in industrial environment.

Thus, the academic plan of VIT envisages a shift from summative to formative and competency-based learning system which will enhance learner's ability towards higher education, employability and entrepreneurship.

Chairman, Board of Studies
Department of Computer Engineering
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

First Year M. Tech. Computer Engineering **Semester: I**

Course Structure and Evaluation Scheme of courses offered in A.Y. 2022-23

Sr. No.	Course			Head of Learning	Credits	Evaluation scheme (Marks)			Total marks (Passing@40% of total marks)
	Code	Nature	Name			ISA	MSE	ESE	
1	CE63	E	Advanced Data Structure & Algorithms	Theory	3	40	20	40	100
2	CE64	E	HPC, Cluster and Grid Computing	Theory	3	40	20	40	100
3	CE67	E	Probability and Statistics for Data Science	Theory	3	40	20	40	100
4	CE68	E	Smart Sensors and Internet of Things	Theory	3	40	20	40	100
5	CE69	E	Data Encryption and Compression	Theory	3	40	20	40	100
6#	ET72	E	Wireless Adhoc and Sensor Networks	-	3	-	-	-	-
7#	ET77	E	Embedded Communication Systems Design	-	3	-	-	-	-

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination
C=Compulsory, T=Tandem, E=Elective, A=Audit

Courses having course codes starting with ET are offered by Electronics and Telecommunication (EXTC) department. Details of these courses are as stated in M.Tech. Scheme and Syllabus document of EXTC.

First Year M. Tech. Computer Engineering **Semester: II**

Course Structure and Evaluation Scheme of courses offered in A.Y. 2022-23

Sr. No.	Course			Head of Learning	Credits	Evaluation scheme (Marks)			Total marks (Passing@40% of total marks)
	Code	Nature	Name			ISA	MSE	ESE	
1	CE65	E	Parallel Algorithms and Programming	Theory	3	40	20	40	100
2	CE66	E	Computational Intelligence	Theory	3	40	20	40	100
3	CE70	E	Data Preparation and Exploration	Theory	3	40	20	40	100
4	CE71	E	IoT - Application and Communication Protocol	Theory	3	40	20	40	100
5	CE72	E	Ethical Hacking and Digital Forensics	Theory	3	40	20	40	100
6#	ET74	E	Advanced Digital Signal Processing	-	3	-	-	-	-
7#	ET86	E	Reconfigurable Computing and FPGAs	-	3	-	-	-	-

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination
C=Compulsory, T=Tandem, E=Elective, A=Audit

Courses having course codes starting with ET are offered by Electronics and Telecommunication (EXTC) department. Details of these courses are as stated in M.Tech. Scheme and Syllabus document of EXTC.

Detailed syllabus of First Year Semester-I

Course Name: Advanced Data Structure and Algorithms

Course Code: CE63

Preamble:

This course introduces different Advanced Data Structures and aims to provide Mathematical Approach for Analysing the Complexities of Algorithms with their real-life applications.

Pre-requisites:

1. Data Structures
2. Analysis of Algorithms

Course Objective:

- To provide mathematical approach for Analysis of Algorithms.
- To understand advanced data structures and its operations.
- To solve complex problems in real life applications.

Course Outcome:

Learner will be able to:
CO1: Describe analysis techniques for algorithms.
CO2: Appreciate the role of probability and randomization in the analysis of algorithm.
CO3: Identify appropriate data structure and design techniques for different problems.
CO4: Identify appropriate algorithm to be applied for the various application like Max Flow, Linear programming etc.
CO5: Understand Approximation and Optimization Algorithms.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	**ISA***	**MSE**	**ESE**	**Total**
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Fundamental of Algorithms	Complexity: Finding complexity by tree method, master method, proving technique (contradiction, mathematical induction). Amortized analysis- aggregate analysis, accounting analysis, potential analysis dynamic tables	6
2	Probabilistic Analysis and Randomized Algorithm	The hiring problem Indicator random variables, Randomized algorithms Probabilistic analysis and further uses of indicator random variable	6
3	Advanced Data Structure	Introduction to trees and heap Red-Black Trees: properties of red-black trees, Operations on Red-black trees Binomial Heaps: Binomial trees and binomial heaps, Operation on Binomial heaps Analysis of all above operations	12
4	Flow N/W Maximum Flow	Shortest Path, The Floyd - Warshall Algorithm, Johnson's Algorithm for sparse graphs, Flow Networks, The Ford-Fulkerson method, Maximum bipartite matching, Push relabel algorithms, The relabel-to-front algorithm.	10
5	Linear Programming	An Introduction to Linear Programming, Flows in networks, Bipartite matching, Duality, Zero- sum games, The simplex algorithm, Post script: circuit evaluation	5
6	Approximation & Optimization Algorithms	Approximation Algorithms: The vertex - cover problem, the travelling salesman problem, the set- covering problem, Randomization and linear programming, The subset- sum problem. Optimization Algorithms: Genetic Algorithm, K- means Algorithm	6
Total			**45**

Text Books:

1. 1.Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithm" PHI, India Second Edition.
2. Horowitz, Sahani and Rajsekaran, "Fundamentals of Computer Algorithm", Galgotia.
3. Harsh Bhasin, "Algorithms – Design and Analysis", Oxford, 2015.

Reference Books:

1. Rajeev Motwani, Prabhakar Raghavan," Randomized Algorithm", Cambridge University
2. S. K. Basu," Design Methods and Analysis of Algorithm", PHI
3. Vijay V. Vajirani," Approximation Algorithms", Springer.

Course Name: HPC, Cluster and Grid Computing

Course Code: CE64

Preamble:

The purpose of the course is to provide basic knowledge on the most important principles, methods, tools, systems, standards, etc. behind these two evolving basic technologies. Detailed description of the topic of the course is beyond the scope of this article.

Pre-requisites:

1. Computer Networks
2. Microprocessor
3. Operating Systems

Course Objectives:

- Understand different parallel processing approaches and platforms involved in achieving High Performance Computing.
- Understand design issues and limitations in Parallel Computing.
- Programming using message passing paradigm using open-source APIs, design algorithms suited for Multicore processor and OpenMP.
- Analyse and optimize performance parameters, for cluster and grid computing.

Course Outcome:

Learner will be able to:
CO1: Understand the cluster and grid computers
CO2: Understand task scheduling and resource allocation in cluster and grid environment
CO3: Understand middleware architecture in Cluster and Grid Environment
CO4: Understand the cluster and grid computing platform as an alternative to traditional supercomputers
CO5: Understand the use of Globus tools standards by following Cluster and Grid Systems
CO6: Understand the security aspects while computing with HPC and Grid computing

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	ISA	MSE	ESE	Total
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction	Introduction to distributed and high-performance computing. Basic terms: distributed computing, HPC, HPCC, network computing, Internet computing, cluster, grid, meta-computing, middleware, etc; milestones of the history, some representative applications Parallel Architectures Classifications SMP, MPP, NUMA, Clusters and Components of a Parallel Machine, Conventional Supercomputers and its limitations, Multi-processor, and Multi Computer based Distributed Systems.	8
2	Cluster and Grid	Cluster Components Processor/machine, High Speed Interconnections goals, topology, latency, bandwidth, Example Interconnect: Myrinet, Inifiniband, QsNet, Fast Ethernet, Gigabit Ethernet, Light weight Messaging system/Light weight communication Protocols, Cluster Middleware Job/Resource Management System, Load balancing, scheduling of parallel processes, Enforcing policies, GUI,	10
3	Introduction to programming tools	Introduction to programming tools such as PVM, MPI, Cluster Operating Systems Examples: Linux, MOSIX, CONDOR, Message passing standards: PVM (Parallel Virtual Machine), MPI (Message Passing Interface)	4
4	Different components of Grid	Grid fabric, Grid middleware, Grid applications and portal, Globus toolkit Ver.2.4, web services, MDS, GRAM, Grid toolkit approach: Globus Hourglass concept, communication, Grid monitoring, Tasks, Types architecture, components, Characteristics of Grid, Computational services, Computational Grids, Data grids/ Storage grids, management, and applications	10
5	Security	Confidentiality, integrity, and availability. Authentication authorization assurance, auditing accounting. Grid security cryptography	5
6	Fault Tolerance	Fault detection and diagnosis of Clusters and Grids. Recent advances in cluster and grid computing. Integrity, Digital Signature, Digital Certificates, Certificate Authority, MD 5, RSA, GSI, GSSAPI, Directory Service, LDAP, GRID FTP, GASS	8
Total			**45**

Text Books:

1. R. K. Buyya, High Performance Cluster Computing: Programming and Applications, PHI , 1999
2. D. Janakiram, Grid Computing, Tata Mcgraw Hill , 2005.
3. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing" . Pearson Education, , Second Edition 2007.
4. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, "Heterogeneous Computing with OpenCL", Elsevier, Second Edition, 2013

Reference Books:

1. J. J. Jos & R. K. Buyya, High Performance Cluster Computing: Architecture and Systems, PHI , 1999
2. P. Jalote, Fault Tolerance in Distributed Systems, Prentice Hall, 1994, P. Jalote, Fault Tolerance in Distributed Systems, Prentice Hall, 1994, Prentice Hall , 1994

Course Name: Probability and Statistics for Data Science

Course Code: CE67

Preamble:

This required course for the M.Tech. with specialization in Data Science should be taken in the first year of study. It covers fundamental concepts in probability and statistics from a data-science perspective.

Pre-requisites:

1. Engineering Mathematics
2. Probability and Statistics

Course Objectives:

- To understand basic statistical foundations for roles of Data Scientist.
- To develop problem-solving skills.
- To infer about the population parameters using sample data and perform hypothesis testing.
- To understand importance and techniques of predicting a relationship between data and determine the goodness of model fit.

Course Outcome:

Learners will be able to:
CO1: Develop various visualizations of the data in hand.
CO2: Analyse a real-world problem and solve it with the knowledge gained from sampling and probability distributions.
CO3: Analyse large data sets and perform data analysis to extract meaningful insights.
CO4: Develop and test a hypothesis about the population parameters to draw meaningful conclusions.
CO5: Fit a regression model to data and use it for prediction

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction	Data and Statistics: Elements, Variables, and Observations, Scales of Measurement, Categorical and Quantitative Data, Cross-Sectional and Time Series Data, Descriptive Statistics, Statistical Inference, Descriptive Statistics: Tabular and Graphical Summarizing Categorical Data, Summarizing Quantitative Data, Cross Tabulations and Scatter Diagram. Descriptive Statistics: Numerical Measures: Measures of Location, Measures of Variability, Measures of Distribution Shape, Relative Location, and Detecting Outliers, Box Plot, Measures of Association Between Two Variables	7
2	Probability	Probability: Experiments, Counting Rules, and Assigning Probabilities, Events and Their Probabilities, Complement of an Event, Addition Law Independent Events, Multiplication Law, Baye's theorem. Discrete Probability Distributions Random Variables, Discrete Probability Distributions, Expected Value and Variance, Binomial Probability Distribution, Poisson Probability Distribution. Continuous Probability Distributions: Uniform Probability Distribution, Normal Curve, Standard Normal Probability Distribution, Computing Probabilities for Any Normal Probability Distribution	8
3	Sampling and Sampling Distributions	Sampling from a Finite Population, Sampling from an Infinite Population, Other Sampling Methods, Stratified Random Sampling, Cluster Sampling, Systematic Sampling, Convenience Sampling, Judgment Sampling. Interval Estimation: Population Mean: Known, Population Mean: Unknown, Determining the Sample Size, Population Proportion.	4
4	Hypothesis Tests	Developing Null and Alternative Hypotheses, Type I and Type II Errors, Population Mean: Known Population Mean: Unknown Inference About Means and Proportions with Two Populations-Inferences About Population Variances, Inferences About a Population Variance, Inferences About Two Population Variances. Tests of Goodness of Fit and Independence,	4

Module No.	Module name	Content	No. of Hours
		Goodness of Fit Test: A Multinomial Population, Test of Independence.	
5	Regression	Simple Linear Regression: Simple Linear Regression Model, Regression Model and Regression Equation, Estimated Regression Equation, Least Squares Method, Coefficient of Determination, Correlation Coefficient, Model Assumptions, testing for Significance, Using the Estimated Regression Equation for Estimation and Prediction Residual Analysis: Validating Model Assumptions, Residual Analysis: Outliers and Influential Observations. Multiple Regression: Multiple Regression Model, Least Squares Method, Multiple Coefficient of Determination, Model Assumptions, Testing for Significance, Categorical Independent Variables, Residual Analysis.	8
6	Time Series Analysis and Forecasting	Time Series Patterns, Forecast Accuracy, Moving Averages and Exponential Smoothing, Trend Projection, Seasonality and Trend and Time Series Decomposition. Nonparametric Methods: Sign Test, Wilcoxon Signed-Rank Test, Mann-Whitney-Wilcoxon Test, Kruskal-Wallis Test, Rank Correlation.	5
Total			**45**

Text Books:

1. Data Science from Scratch, FIRST PRINCIPLES WITH PYTHON, O'Reilly, Joel Grus
2. Data Science from Scratch (oreillystatic.com)
3. Practical Time Series Analysis, Prediction with statistics and Machine Learning, O'Reilly, Aileen Nielsen [DOWNLOAD] O'Reilly Practical Time Series Analysis PDF (lunaticai.com)
4. R for data science: Import, Tidy, Transform, Visualize, And Model Data, O'Reilly , Garrett Grolemund, Hadley Wickham
5. Python for Data Analysis, 2nd Edition, O'Reilly Media, Wes McKinney

Reference Books:

1. Data Science for Dummies Paperback, Wiley Publications, Lillian Pierson
2. Storytelling with Data: A Data Visualization, Guide for Business Professionals, Wiley Publications, Cole Nussbaumer Knaflic
3. Probability and Statistics for Engineering and the Sciences, Cengage Publications Jay L. Devore

Course Name: Smart Sensors and Internet of Things

Course Code: CE68

Preamble:

This course introduces learners an overview of concepts, main trends and challenges of Internet of Things. Develop the ability to use Internet of Things related software and hardware technologies. And provide the knowledge of data management business processes and analytics of IoT

Pre-requisites:

3. Basic programming knowledge
4. Basics of wireless networks

Course Objectives:

- To provide knowledge on Sensor Principles.
- To provide familiarity with different sensors and their application in real life.
- To develop necessary technical skill to select suitable smart sensors, components of IOTs with associated knowledge of interface electronics and signal conditioning

Course Outcome:

Learners will be able to:
CO1: Ability to identify, formulate suitable sensors for engineering applications
CO2: Explain and interpret the Internet of Things concepts and challenges.
CO3: Experiment with the software and hardware IoT Technologies.
CO4: Understand data management and business processes and analytics of IoT
CO5: Design and develop small IoT applications to create smart objects

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	ISA	MSE	ESE	Total
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction to Internet of Things and smart sensors	IoT Paradigm, IoT Architecture – State of the Art, IoT Protocols, IoT Communication Models, IoT in Global Context, Cloud Computing, Big Data Analytics, Concepts of Web of Things, Concept of Cloud of Things with emphasis on Mobile Cloud Computing, Smart Objects.	10
2	Open – Source Prototyping Platforms for IoT	Basic Arduino Programming Extended Arduino Libraries, Arduino – Based Internet Communication, Raspberry PI, Sensors and Interfacing.	6
3	IoT Technology	RFID + NFC, Wireless Networks + WSN, RTLS + GPS, Agents + Multi – Agent Systems, Composition Models for the Web of Things and resources on the Web, Discovery, Search, IoT Mashups and Others.	7
4	Wireless Sensor Networks	History and Context, The Node, Connecting Nodes, Networking Nodes, Secured Communication for IoT	6
5	Data Management, Business Process and Analytics	Data Management, Business Process in IoT, IoT Analytics, Creative Thinking Techniques, Modification, Combination Scenarios, Decentralized and Interoperable Approaches, Object – Information Distribution Architecture, Object Naming Service (ONS), Service Oriented Architecture, Network of Information, Etc.	12
6	Application and Use Cases	Concrete Applications and Use – Cases of Web Enabled Things: Energy Management and Smart Homes, Ambient Assisted Living, Intelligent Transport, Etc. M2M, Industrial IoT Applications.	4
Total			**45**

Text Books:

6. The Internet of Things (MIT Press) by Samuel Greengard.
7. The Internet of Things (Connecting objects to the web) by Hakima Chaouchi ,Wiley .
8. Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madisetti

Reference Books:

4. The Internet of Things Key applications and Protocols, 2nd Edition, (Wiley Publication) by Olivier Hersent, David Boswarthick and Omar Elloumi.
5. IoT –From Research and Innovation to Market development, River Publication by Ovidiu Vermesan and Peter Friess.

Course Name: Data Encryption and Compression

Course Code: CE69

Preamble:

This course introduces learners to process image and video signals which is incredibly important skill to master for engineering learners. The course focusses on details of cryptographic systems as well to make learners aware of the details regarding various encryption algorithms used.

Pre-requisites:

1. Advanced Data Structures and Algorithms – Strongly Related
2. Cryptography and Network Security - Strongly Related
3. Object-Oriented Programming – Weakly Related
4. Operating Systems - Weakly Related

Course Objectives:

- Understanding of data compression methods for text, images, video, and audio.
- Understand the concepts of cryptography and different algorithms to provide system security.
- Learn the various types of cyber-attacks and methods to mitigate them.

Course Outcome:

Learners will be able to:

CO1: Apply various techniques for text compression and evaluate performance of the coding techniques.

CO2: Explain digital audio, perceptual audio coding and MPEG audio compression standard.

CO3: Describe different lossless and lossy image and video compression techniques and standards.

CO4: Differentiate between symmetric and asymmetric cryptography and describe different symmetric cryptographic techniques and standards.

CO5: Describe different algorithms under public key cryptography and methods that provide the goals of integrity, authentication and non-repudiation

CO6: Explain network security facilities designed to protect a computer system from security threats and ethical issues related to computer and network security.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	ISA	MSE	ESE	Total
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Data Compression	Loss less compression, Lossy compression, measure of performance, modelling and coding, different types of models, and coding techniques. Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW.	6
2	Audio Compression	High quality digital audio, frequency and temporal masking, lossy sound compression, μ-law and A-law companding, and MP3 audio standard	6
3	Image and Video Compression	PCM, DPCM JPEG, JPEG –LS, and JPEG 2000 standards, Intra frame coding, motion estimation and compensation, introduction to MPEG - 2 H-264 encoder and decoder	5
4	Data Security	Data Security Concepts, Security goals, cryptography, stenography cryptographic attacks, services and mechanics, Block Cipher and Encryption Link State and Distance Vector algorithms, Routing in the Internet RIP, OSPF, and BGP	10
5	Number Theory and Asymmetric Key Cryptography	Number Theory and Asymmetric Key Cryptography Public Key Encryption and RSA, Cryptographic Data Integrity Algorithms, Message integrity, message authentication, MAC, hash function, HMAC, and digital signature algorithm	10
6	System Security	Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.	8
Total			**45**

Text books:

1. Khalid Sayood , 3rd Edition, |Introduction to Data Compression|, Morgan Kauffman.
2. Mark Nelson, Jean-Loup Gailly,||The Data Compression Book||, 2nd edition, BPB Publications.
3. William Stallings ,|Cryptography and Network Security Principles and Practices 5th Edition||, Pearson Education.
4. Behrouz A. Forouzan, |Cryptography and Network Security||, Tata McGraw-Hill.

Reference Books:

1. The Data Compression Book – Mark Nelson.
2. Data Compression: The Complete Reference – David Salomon.
3. Introduction to Data Compression – Khalid Sayood, Morgan Kaufmann Publishers.

Detailed syllabus of First Year Semester-II

Course Name: Parallel Algorithms and Programming

Course Code: CE65

Preamble:

To familiarize learners with the fundamental concepts, techniques, and tools of parallel computing. Participation in this course will enable you to better use parallel computing in your application area and will prepare you to take advanced courses in more specific areas of parallel computing.

Pre-requisites:

1. Data Structures and Algorithms – Strongly Related
2. Computer Organization and Architecture - Strongly Related
3. Operating Systems - Weakly Related

Course Objectives:

- Understand different parallel processing approaches and platforms involved in achieving Parallel Performance Computing.
- Understand design Issues and limitations in Parallel Computing.
- Learn to programming using Parallel graph search &, tree traversal algorithms.
- Analyze and optimize performance parameters.
- Understand Parallel Algorithm and programming technologies.

Course Outcome:

Learners will be able to:
CO1: Gain basic understanding of fundamental concepts in parallel computing.
CO2: Identify and leverage common parallel computing patterns.
CO3: Know about parallel computing model like PRAM, LMCC etc.
CO4: Analyse the computational complexity of parallel algorithms.
CO5: Properly assess efficiency and scalability of a parallel algorithm/application.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction: Parallel Processing	Shared Memory Multiprocessing, Distributed Shared Memory – Message Passing Parallel Computers.	6
2	Processes & Shared Memory Programming	Processes - Shared Memory Programming – General Model Of Shared Memory Programming – Forking-Creating Processes – Joining Processes - Process Model Under UNIX.	8
3	Basic Parallel Programming Techniques	Loop Splitting – Ideal Speedup – Spin-Locks, Contention And Self- Scheduling	7
4	Parallel sorting algorithms	Hyper quick sort, Merge sort, Bionic merge Sort, odd even transposition, Enumeration sort (sorting on the CRCW model, CREW model and EREW model)	8
5	Parallel searching algorithms	Searching on a sorted sequence (EREW,CREW,CRCW), Searching on a random sequence (EREW, CREW, CRCW, Tree and Mesh) Sequential selection algorithm, Parallel selection algorithm (EREW parallel solution)	8
6	Parallel graph algorithms	Parallel graph search &, tree traversal algorithms, Graph colouring, Minimal spanning tree, Shortest path algorithm	8
Total			**45**

Text Books:

1. Scalable Parallel Computing: Technology, Architecture, Programming By Kai Hwang, Zhiwei Xu, McGraw Hill, 1998.
2. Advanced Computer Architecture: Parallelism, Scalability, Programmability, By Kai Hwang, Naresh Jotwani, McGraw Hill, Second Edition, 2010.

Reference Books:

1. Introduction To Parallel Programming - By Steven Brawer.
2. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, By Pearson Publication.
3. Introduction To Parallel Processing – By M. Sasikumar, Dinesh Shikhare And P. Ravi Prakash

Course Name: Computational Intelligence

Course Code: CE66

Preamble:

This course introduces learners to various computational intelligence techniques. Learners will become familiarized with Neural Network, Fuzzy logic & Evolutionary techniques. Course will also offer in-depth understanding to apply computational Intelligence to different applications.

Pre-requisites:

1. Soft Computing
2. Mathematics
3. Artificial Intelligence

Course Objectives:

- To explore the various computational intelligence techniques
- To become familiarize with Neural Network, Fuzzy Logic and Evolutionary techniques
- To learn to apply computational intelligence to different applications

Course Outcome:

Learner will be able to:

CO1: Understand the importance of computational Intelligence.
CO2: Examine the nature of problem and find suitable Artificial Neural Network techniques to solve it.
CO3: Understand operations and properties of Fuzzy Sets.
CO4: Compare and contrast traditional algorithms with nature inspired algorithms.
CO5: To apply the concepts of natural immune system using rule-based machine learning and develop artificial immune system.
CO6: Design and implement various intelligent systems.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction to Computational Intelligence paradigms	Artificial Neural Networks, Fuzzy Systems, Genetic Algorithms, Swarm Intelligence, Artificial Immune System, Applications.	6
2	Artificial Neural Networks	Basic models of ANN: NN Architecture, MP Neuron, Linear separability, activation functions, types of learning. Learning Rules: Hebbian, Perceptron, Delta, Winner-take all. Supervised NN: Perceptron Network: SDPTA, SCPTA, MCPTA, Adaline networks.	11
3	Fuzzy Systems	Fuzzy Sets: Definition, operations, properties, relations, characteristics, membership functions, defuzzification.	8
4	Optimization	GA: Selection, Encoding, Crossover, Mutation, Examples. Swarm Intelligence: Single Solution Particle Swarm Optimization: Guaranteed Convergence PSO, Social-Based Particle Swarm Optimization, Hybrid Algorithms, Sub-Swarm Based PSO, Multi-Start PSO Algorithms, Repelling Methods, Binary PSO. Ant Algorithm: Simple Ant Colony Optimization	10
5	Artificial Immune System	Natural Immune System: Classical view, Antibodies and antigens. Artificial Immune Models: Artificial Immune system algorithm, classical view models, CLONALG	4
6	Applications	Character Recognition, Genetics Algorithm in game playing, Colour Recipe prediction- Single MLP approach ANT algorithm/Swarm Intelligence – TSP, Best path Finding	6
Total			**45**

Text Books:

1. Computational Intelligence An Introduction, Andries P. Engelbrecht, Wiley, 2nd Edition
2. Principles of Soft Computing, S.N. Sivanandam, S.N. Deepa, Wiley, 2nd edition
3. Introduction to Artificial Neural Systems, Jacek M. Zurada, West Publication

Reference Books:

1. Pattern Recognition, Theodoridis and Koutroumbas , 4th Edition, Academic Press.

Course Name: Data Preparation and Exploration

Course Code: CE70

Preamble:

Learners will learn how to prepare data for visualization, perform exploratory data analysis and develop meaningful data visualization. They will work with variety of real-world data sets and learn how to prepare data sets for analysis by cleaning and reformatting.

Pre-requisites:

1. Python

Course Objectives:

- To prepare data for analysis to uncover interesting structure and unusual observations.
- To learn data exploratory analysis techniques for appropriate analysis and to define what we would expect to see in the data.
- To interpret the results of visual inference and assess the strengths and adequacy of data analysis.

Course Outcomes:

Learners will be able to:
CO1: Find out how analysts decide which data to collect for analysis.
CO2: Learn about structured and unstructured data, data types, and data formats.
CO3: Learn how to gather and prepare data for analysis
CO4: Identify and apply various data cleaning techniques
CO5: Learn data exploratory analysis techniques
CO6: Apply visualization techniques on datax

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Data types and structures	How to generate data and how analysts decide which data to collect for analysis. Structured and unstructured data, data types, and data formats	6
2	Bias, credibility, privacy, ethics, and access	When data analysts work with data. Identify different types of bias in data and how to ensure credibility in data. Explore open data and the relationship between and importance of data ethics and data privacy.	7
3	Data Gathering and Preparation	Data Munging, Wrangling, Data formats, parsing and transformation, Scalability, and real-time issues	8
4	Data Cleaning	Consistency checking, Heterogeneous and missing data, Data Quality, Data Transformation, and segmentation	8
5	Exploratory Analysis	Descriptive and comparative statistics, Clustering and association, Hypothesis generation	8
6	Visualization	Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	8
Total			**45**

Text Books:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Reference Books:

1. Data Preparation for Data Mining by Dorian Pyle, Morgan Kaufmann Publishers, Inc.

Course Name: IoT- Application and Communication Protocol

Course Code: CE71

Preamble:

The Internet of Things (IoT) is a course about the new paradigm of objects interacting with people, with information systems, and with other objects. The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations and applications.

Pre-requisites:

1. Computer Networks
2. Wireless sensor network
3. Mobile computing

Course Objectives:

- To equip learners with the fundamental knowledge and basic technical competence in the field of Internet of Things (IoT)
- Introduce multiple way of data communication and networking.
- Identify the IoT networking components with respect to OSI layer

Course Outcome:

Learners will be able to:
CO1: Understand the basics of IoT and communication protocols
CO2: Understand design methodology and hardware platforms involved in IoT
CO3: Understand the different Data link and network layer protocols involved in IoT
CO4: Understand the different transport and session protocols involved in IoT
CO5: Design of Secured IoT applications
CO6: Design IoT Applications using appropriate protocols.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	ISA	MSE	ESE	Total
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction	IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, IoT Sensors, Sensors for IoT Applications, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics. Sensors for IoT Applications	6
2	IoT Reference Architecture	Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints	8
3	IoT Data link layer and Network layer protocols	PHY/MAC Lay'er(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4,IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP	12
4	IoT Transport layer and session layer protocols	Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT	8
5	IoT service layer protocol and security protocol	Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC802.15.4 , 6LoWPAN, RPL, Application Layer	6
6	Application in IoT	IOT Applications. IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment's, Industry 4.0 concepts. Case study on: Lighting as a service, Intelligent Traffic systems, Smart Parking and Smart water management.	5
Total			**45**

Text Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The EvolvingWorld of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet ofThings: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2015.

Reference Books:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things",ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014

Course Name: Ethical Hacking and Digital Forensics

Course Code: CE72

Preamble:

Ethical hacking and Digital evidence feature in just about every part of our personal and business lives. Legal and business decisions hinge on having timely data about what people have done. This course provides understanding of how to conduct investigations to correctly gather, analyse and present digital evidence to both business and legal audiences. It also outlines the tools to locate and analyse digital evidence on a variety of devices, how to keep up to date with changing technologies, and laws and regulations in digital forensics.

Pre-requisites:

1. System security

Course Objectives:

- Understand the concepts of Ethical Hacking and Digital Forensics, various tools and methodologies used in Digital Forensics and concepts of Mobile Forensics.
- Apply Digital Forensics tools to generate Forensic report which can be used for legal or administrative cases.

Course Outcome:

Learners will be able to:
CO1: Understand the fundamentals of Ethical Hacking.
CO2: Understand the fundamentals of Digital Forensics.
CO3: Achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system, mobile, email etc.
CO4: Investigate attacks, IDS, technical exploits and router attacks and "Trap and Trace" computer networks.
CO5: Investigate attacks on Mobile devices.
CO6: Apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Evaluation Scheme:

Head of Learning	ISA	MSE	ESE	Total
Theory	40	20	40	100

ISA*: Specific rubric for the 40 marks of the In-Semester Assessment (ISA) will be, as stated by the course teacher in their Academic Administration Plan (AAP) for the current half of the academic year.

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Ethical Hacking Methodology	Introduction, Steps of Ethical Hacking: Planning, Reconnaissance, Scanning, Exploitation, post exploitation and result reporting. Ethical Hacking Tool: Metasploit	6
2	Introduction to computer forensics and Digital Forensics	Computer Forensics Fundamentals, Types of Computer Forensics Technology – Types of Computer Forensics Systems-Data Recovery and Evidence Collection– Forensic duplication and preservation of DE, Understanding Computer Investigation. Digital Forensic, Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics	9
3	Computer Forensics Tools	Evaluating Computer Forensics Tool Needs, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Tool Comparisons, Other Considerations for Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools, Computer Forensics Hardware Tools, Forensic Workstations, Using a Write-Blocker.	9
4	Network Forensics	Technical Exploits and Password Cracking, Introduction to Intrusion Detection systems, Types of IDS Understanding Network intrusion and attacks, Analysing Network Traffic, Collecting Network based evidence, Evidence Handling. Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers as Response Tools	9
5	Mobile Device Forensics	Crime and mobile phones, evidence, forensic procedures, files present in SIM cards, device data, external memory dump, and evidence in memory card, operator's networks.	6
6	Forensic Investigation Report and Forensic Tools	Report: Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report. Computer Forensic Tools: need and types of computer forensic tools, task performed by computer forensic tools. Study of open-source Tools like SFIT, Autopsy etc. to acquire, search, analyse and store digital evidence	6
Total			**45**

Text Books:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.
2. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic : The fascinating world of Digital Evidences" Wiley India Pvt Ltd 2017.

Reference Books:

1. Cory Altheide, Harlan Carvey "Digital forensics with open source tools "Syngress Publishing, Inc. 2011.
2. Chris McNab, Network Security Assessment, By O'Reily.
3. Clint P Garrison "Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010
4. Bill Nelson,Amelia Phillips,Christopher Steuart, "Guide to Computer Forensics and Investigations". Cengage Learning, 2014
5. Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008.
6. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.