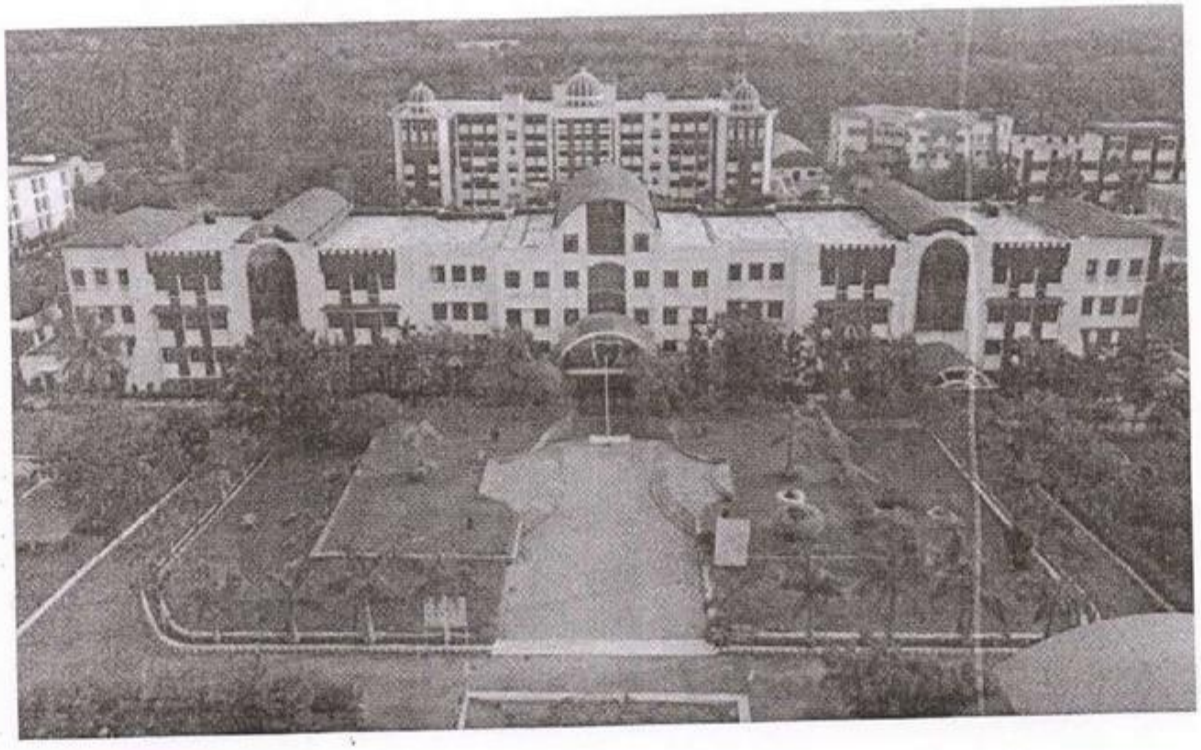
NEHRU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)
(Approved by AICTE, New Delhi and Affiliated to Anna University.)
An ISO 9001:2015 and ISO 14001:2015 Certified Institution
Re-Accredited by NAAC with A+ and Recognized by UGC with Section 2(f) and 12(B)
NBA Accredited UG Programmes: AERO| CSE
Thirumalayampalayam, Coimbatore-641105

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



CURRICULUM

M.E. – COMPUTER SCIENCE AND ENGINEERING

REGULATION-2023

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

Our Vision is to mould the youngsters to acquire sound knowledge in technical and scientific fields to face the future challenges by continuous upgradation of all resources and processes for the benefit of humanity as envisaged by our great leader Pandit Jawaharlal Nehru.

MISSION

- To build a strong centre of learning and research in engineering and technology.
- To facilitate the youth to learn and imbibe discipline, culture and spirituality.
- To produce quality engineers, dedicated scientists and leaders.
- To encourage entrepreneurship.
- To face the challenging needs of the global industries.

VISION AND MISSION OF THE DEPARTMENT

VISION

To produce highly competent and innovative Computing Professionals to meet the global demands

MISSION

- To impart quality education by creative teaching learning process
- To be technically competent, ethical and socially responsible throughout the professional career
- To inculcate leadership qualities and entrepreneurship culture to meet the global standards

I. PROGRAMEDUCATIONAL OBJECTIVES (PEOs)

Graduates can

PEO 1: Develop proficiency as a computer science engineer with an ability to solve a wide range of computational problems and have sustainable development in industry or any other work environment.

PEO 2: Analyze and adapt quickly to new environments and technologies, gather new information, and work on emerging technologies to solve multidisciplinary engineering problems.

PEO 3: Possess the ability to think analytically and logically to understand technical problems with computational systems for a lifelong learning which leads to pursuing research.

PEO 4: Adopt ethical practices to collaborate with team members and team leaders to build technology with cutting-edge technical solutions for computing systems

PEO 5: Strongly focus on design thinking and critical analysis to create innovative products and become entrepreneurs.

II. PROGRAM OUTCOMES (POs)

PO 1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO 2: An ability to write and present a substantial technical report/document.

PO 3: Students should be able to demonstrate a degree of mastery over the area of Computer Science and Engineering.

PO 4: Efficiently design, build and develop system application software for distributed and centralized computing environments in varying domains and platforms.

PO 5: Understand the working of current Industry trends, the new hardware architectures, the software components and design solutions for real world problems by Communicating and effectively working with professionals in various engineering fields and pursue research orientation for a lifelong professional development in computer and automation arenas.

PO 6: Model a computer-based automation system and design algorithms that explore the understanding of the tradeoffs involved in digital transformation.

III.PROGRAM SPECIFIC OUTCOMES (PSOs)

The Students will be able to

PSO 1: Professional Skills: Acquaint in-depth knowledge on the basic and advanced computer science domains like Data Sciences, Cryptography, Cloud and Distributed Computing, Neural Networks and Artificial Intelligence

PSO 2: Entrepreneurship and Successful Career: Apply the standard practices to have successful career path in the field of information and communication technology and entrepreneurship

SCHEME OF EXAMINATION
M.E. / M.Tech. - Computer Science and Engineering
Regulation 2023 - Choice Based Credit System
(Applicable to students admitted from the year 2023 -2024 onwards)

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
THEORY								
I	P23MA101	Applied Probability and Statistics for Computer Science Engineers	BSC	4	40	60	100	4
I	P23MG102	Research Methodology and IPR	RMC	2	40	60	100	2
I	P23CS103	Advanced Data Structures and Algorithms	PCC	3	40	60	100	3
I	P23CS104	Database Practices	PCC	5	50	50	100	4
I	P23CS105	Network Technologies	PCC	3	40	60	100	3
I	P23CS106	Principles of Programming Languages	PCC	3	40	60	100	3
I		Mandatory Course– I*	MC	2	100	-	100	0
PRACTICAL								
I	P23CS117	Advanced Data Structures and Algorithms Laboratory	PCC	4	60	40	100	2
			TOTAL	26	-	-	-	21

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
THEORY								
II	P23CS201	Internet of Things	PCC	5	50	50	100	4
II	P23CS202	Multicore Architecture and Programming	PCC	5	50	50	100	4
II	P23CS203	Machine Learning	PCC	5	50	50	100	4
II	P23CS204	Advanced Software Engineering	PCC	3	40	60	100	3
II		Professional Elective I	PEC	3	40	60	100	3
II		Professional Elective II	PEC	3	40	60	100	3
II		Mandatory Course– II*	AC	2				0
PRACTICAL								
II	P23CS215	Term Paper Writing and seminar	EEC	2	60	40	100	1
II	P23CS216	Software Engineering Laboratory	PCC	2	60	40	100	1
ENHANCEMENT COURSES								
			TOTAL	30	-	-	-	23

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
THEORY								
III	P23CS301	Security Practices	PCC	3	40	60	100	3
III		Professional Elective-III	PEC	3	40	60	100	3
III		Professional Elective-IV	PEC	5	40	60	100	4
III		Open Elective	OEC	3	40	60	100	3
PRACTICAL								
III	P23CS312	Project Work I	EEC	12	60	40	100	6
			TOTAL	26	-	-	-	19

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
PRACTICAL								
IV	P23CS411	Project Work II	P23CS411	24	60	40	100	12
			TOTAL	24	-	-	-	12

CURRICULUM
AND
SYLLABUS

NEHRU INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

REGULATIONS 2023

M.E. COMPUTER SCIENCE AND ENGINEERING
CHOICE BASED CREDITSYSTEM

CURRICULUM FOR SEMESTERS I TO IV

SEMESTER I

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODSPER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	P23MA101	Applied Probability and Statistics for Computer Science Engineers	BSC	3	1	0	4	4
2.	P23MG102	Research Methodology and IPR	RMC	2	0	0	2	2
3.	P23CS103	Advanced Data Structures and Algorithms	PCC	3	0	0	3	3
4.	P23CS104	Database Practices	PCC	3	0	2	5	4
5.	P23CS105	Network Technologies	PCC	3	0	0	3	3
6.	P23CS106	Principles of Programming Languages	PCC	3	0	0	3	3
7.		Mandatory Course– I*		2	0	0	2	0
PRACTICALS								
8.	P23CS117	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
			TOTAL	**19**	**1**	**6**	**26**	**21**

Course Code	Title					
P24MA101	APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	1	0	4		
Course pre-requisites	Matrices and Calculus, Statistics and Numerical Methods, Discrete Mathematics					

Course Objectives

1	To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
2	To enable students to understand the concepts of Probability and Random Variables.
3	To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the central limit theorem.
4	To apply the small / large sample tests through Tests of hypothesis.
5	To enable the students to use the co ncepts of multivariate normal distribution and principal components analysis.

Course Category	Basic Science Course (BSC)
Development Needs	Global / National

Course Description: This course deals with concepts required for the study of Machine Learning and Data Science. Statistics is a branch of science that is an outgrowth of the Theory of Probability. Probability & Statistics are used in Machine Learning, Data Science and Computer Science.

Course Content

Unit	Description	
I	**LINEAR ALGEBRA:** Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.	
	Contact Periods	**12**
II	**PROBABILITY AND RANDOM VARIABLES** : Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.	
	Contact Periods	**12**
III	**TWO DIMENSIONAL RANDOM VARIABLES**: Joint distributions – Marginal and conditional distributions – Functions of two-dimensional random variables – Regression curve – Correlation.	
	Contact Periods	**12**
IV	**TESTING OF HYPOTHESIS**: Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.	
	Contact Periods	**12**
V	**MULTIVARIATE ANALYSIS**: Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.	

Contact Periods	12
Total Periods	60

Course Outcomes Upon successful completion of the course, students will be able to:		Knowledge Level
CO 1	Apply the concepts of Linear Algebra to solve practical problems.	K3
CO 2	Understand the ideas of probability and random variables in solving engineering problems.	K2
CO 3	Understand the concept of two dimensional random variables and be equipped for a possible extension to multivariate analysis.	K2
CO 4	Understand statistical tests in testing hypotheses on data.	K2
CO 5	Apply the critical thinking based on empirical evidence and the scientific approach to knowledge development.	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Dallas E Johnson, "Applied multivariate methods for data Analysis", Thomson and Duxbury press, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, "Applied multivariate statistical Analysis", Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
3. Bronson, R.,"Matrix Operation" Schaum's outline series, Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, "Fundamentals of Applied probability and Random Processes", Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson India Education, Asia, 9th Edition, New Delhi, 2017.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	1	-	1	-	1
CO2	3	2	2	2	-	-	-	1	-	1	-	1
CO3	3	2	2	2	-	-	-	1	-	1	-	1
CO4	3	2	2	2	-	-	-	1	-	1	-	1
CO5	3	2	2	2	-	-	-	1	-	1	-	1

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Course designed by	Verified by
K. Ramesh Signature of the Faculty Member	P. T. Hemamalini Signature of the Chairperson-BoS
Dr. K. RAMESH / Mathematics Name and Department of the Faculty Member	(Dr. P. T. HEMAMALINI) Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105 Name and Seal of the Chairperson-BoS

Course Code	Title					
PG23MG102	RESEARCH METHODOLOGY AND IPR					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	2	0	0	2		

Course Pre-requisites	No Prior Knowledge on Research Methodology is required

Course Objectives

1	Identify an appropriate research problem in their interesting domain.
2	Understand ethical issues of preparation of research project thesis.
3	Understand the preparation of a research project thesis report.
4	Understand the law of patents and copyrights.
5	Understand the adequate knowledge on IPR.

Course Category	Research Methodology and IPR Course
Development Needs	Global

Course Description: To design, study and implement the concepts of research methodology and IPR.

Course Content

Unit	Description	
I	**RESEARCH DESIGN:** Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys	
		Contact Periods 06
II	**DATA COLLECTION AND SOURCES:** Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.	
		Contact Periods 06
III	**DATA ANALYSIS AND REPORTING:** Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation	
		Contact Periods 06
IV	**INTELLECTUAL PROPERTY RIGHTS:** Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance	
		Contact Periods 06
V	**PATENTS:** Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.	
		Contact Periods 06
		Total Periods 30

Course Outcomes
Upon successful completion of the course, students will be able to:

CO 1	Identify an appropriate research problem in their interesting domain	K2
CO 2	Understand ethical issues of preparation of research project thesis	K2
CO 3	Understand the preparation of a research project thesis report	K2
CO 4	Understand the law of patents and copyrights	K2
CO 5	Understand the adequate knowledge on IPR	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. C.P. Kothari, "Research Methodology methods and Techniques", New Age International Publishers, Second Edition, 2004
2. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
3. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	1	1	1	1						
CO2	1	1	1	1	1	1						
CO3	1	1	1	1	1	1						
CO4	1	1	1	1	1	1						
CO5	1	1	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member: M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS: Dr. S. SUBASREE, M Tech. Ph.D, Professor and Head, Computer Science and Engineering, Nehru Institute of Engineering and Technology, Coimbatore TN India

Course Code	Title					
PG23CS103	ADVANCED DATA STRUCTURES AND ALGORITHMS					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Basic knowledge of one programming language (C, C++, Java, or Python)

Course Objectives

1	To understand the usage of algorithms in computing
2	To learn and use hierarchical data structures and its operations
3	To learn the usage of graphs and its applications
4	To select and design data structures and algorithms that is appropriate for problems
5	To study about NP Completeness of problems.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To design, study and implement the concepts data structures

Course Content

Unit	Description	
I	**ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS:** Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys	
	Contact Periods	**09**
II	**HIERARCHICAL DATA STRUCTURES:** Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.	
	Contact Periods	**09**
III	**GRAPHS:** Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation	
	Contact Periods	**09**
IV	**ALGORITHM DESIGN TECHNIQUES:** Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance	
	Contact Periods	**09**
V	**NP COMPLETE AND NP HARD:** Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Design data structures and algorithms to solve computing problems.	K2
CO 2	Choose and implement efficient data structures and apply them to solve problems.	K1
CO 3	Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.	K2
CO 4	Design one's own algorithm for an unknown problem.	K2
CO 5	Apply suitable design strategy for problem solving.	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.
3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	2	3	1	3						
CO2	3	1	1	1	2	3						
CO3	3	2	1	1	1	2						
CO4	3	1	1	-	2	1						
CO5	3	3	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
PG23CS104	DATABASE PRACTICES					
Semester: I	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic knowledge on Database Management System (DBMS), Knowledge on Basic Mathematics.

Course Objectives

1	To Describe the fundamental elements of relational database management systems
2	To Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
3	To Understand query processing in a distributed database system
4	To Understand the basics of XML and create well-formed and valid XML documents.
5	To Distinguish the different types of NoSQL databases

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To design, study and implement the concepts of database practices.

Course Content

Unit	Description	
I	**RELATIONAL DATA MODEL:** Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization	
	Contact Periods	09
II	**DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY:** Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.	
	Contact Periods	09
III	**XML DATABASES:** Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery	
	Contact Periods	09
IV	**NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS:** NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.	
	Contact Periods	09

V	**DATABASE SECURITY:** Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.	
	Contact Periods	**09**
	Total Periods	**45**

List of Experiments (Any 10)

1. Data Definition Language
2. Create, Alter and Drop
3. Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
4. Creating Views
5. Data Manipulation Language
6. Insert, Delete, Update
7. Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
8. Aggregate Functions
9. Set Operations and Nested Queries
10. Distributed Database Design and Implementation
11. Row Level and Statement Level Triggers
12. Accessing a Relational Database using PHP, Python and R
13. Creating XML Documents, Document Type Definition and XML Schema
14. Using a Relational Database to store the XML documents as text, data elements
15. Creating or publishing customized XML documents from pre-existing relational databases
16. Extracting XML Documents from Relational Databases and XML Querying
17. Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data
18. Store Hbase and Neo4j.
19. Writing simple queries to access databases created using MongoDB, DynamoDB,
20. Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
21. Implementing Access Control in Relational Databases.

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.	K2
CO 2	Understand and write well-formed XML documents	K1
CO 3	Apply methods and techniques for distributed query processing.	K2
CO 4	Design and Implement secure database systems.	K2
CO 5	Use the data control, definition, and manipulation languages of the NoSQL databases	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References	1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education 2016. 2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019. 3. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006 4. Raghu Ramakrishnan , Johannes Gehrke "Database Management Systems", Fourth Edition, McGraw Hill Education, 2015.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	1	3	1	3						
CO2	2	2	-	2	1	3						
CO3	3	1	2	1	1	2						
CO4	3	2	2	1	1	1						
CO5	2	3	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member: M.S.Vinu / CSE	Name and Seal of the Chairperson-BoS: Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India

Course Code	Title					
PG23CS105	NETWORK TECHNOLOGIES					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Basic knowledge on computer networks

Course Objectives

1	To understand the basic concepts of networks
2	To explore various technologies in the wireless domain
3	To study about 4G and 5G cellular networks
4	To learn about Network Function Virtualization
5	To understand the paradigm of Software defined networks

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To Learn and Design Wired and Wireless Networks

Course Content

Unit	Description	
I	**NETWORKING CONCEPTS:** Peer to Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. OSI Model. Packets, Frames, And Headers. Collision and Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.	
	Contact Periods	**09**
II	**WIRELESS NETWORKS:** Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee	
	Contact Periods	**09**
III	**MOBILE DATA NETWORKS:** 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mm Wave, Introduction to 6G.	
	Contact Periods	**09**
IV	**SOFTWARE DEFINED NETWORKS:** SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface.	

	Northbound Interface. Routing. ITU-T Model. Open Daylight. Open Daylight Architecture. Open Daylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface	
	Contact Periods	**09**
V	**NETWORK FUNCTIONS VIRTUALIZATION:** Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Explain basic networking concepts	K1
CO 2	Compare different wireless networking protocols	K1
CO 3	Describe the developments in each generation of mobile data networks	K2
CO 4	Explain and develop SDN based applications	K1
CO 5	Explain the concepts of network function virtualization	K1

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. James Bernstein, "Networking made Easy", 2018. (UNIT I)
2. HoudaLabiod, Costantino de Santis, HossamAfifi "Wi-Fi, Bluetooth, Zigbee and WiMax", Springer 2007 (UNIT 2)
3. Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 (UNIT 3)
4. Saad Z. Asif "5G Mobile Communications Concepts and Technologies" CRC press –2019 (UNIT 3)
5. William Stallings "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 1st Edition, Pearson Education, 2016.(Unit 4 and 5)
6. Thomas D.Nadeau and Ken Gray, SDN – Software Defined Networks, O"Reilly Publishers, 2013.
7. Guy Pujolle, "Software Networks", Second Edition, Wiley-ISTE, 2020

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	3	2	-	1	-						
CO2	1	3	3	3	-	1						
CO3	1	3	3	2	2	2						

CO4	1	2	2	1	2	1						
CO5	1	3	1	1	1	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu/CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore Tamil India Name and Seal of the Chairperson-BoS

Course Code	Title					
PG23CS106	PRINCIPLES OF PROGRAMMING LANGUAGES					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Basic knowledge on Programming Languages

Course Objectives

1	To understand and describe syntax and semantics of programming languages
2	To understand data, data types, and basic statements
3	To understand call-return architecture and ways of implementing them
4	To understand object-orientation, concurrency, and event handling in programming languages
5	To develop programs in non-procedural programming paradigms

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To design and implement the concepts through coding

Course Content

Unit	Description	
I	**SYNTAX AND SEMANTICS:** Evolution of programming languages – describing syntax – context – free grammars –attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom- up parsing.	
		Contact Periods 09
II	**DATA, DATA TYPES, AND BASIC STATEMENTS:** Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection –primitive data types–strings–array types– associative arrays–record types– union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed- mode assignments – control structures – selection – iterations – branching – guarded statements.	
		Contact Periods 09
III	**SUBPROGRAMS AND IMPLEMENTATIONS:** Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping	
		Contact Periods 09
IV	**OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING:** Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling	
		Contact Periods 09

V	**FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES:** Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Describe syntax and semantics of programming languages	K2
CO 2	Explain data, data types, and basic statements of programming languages	K1
CO 3	Design and implement subprogram constructs	K6
CO 4	Apply object-oriented, concurrency, and event handling programming constructs	K2
CO 5	Develop programs in Scheme, ML, and Prolog and Understand and adopt new programming language	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Robert W. Sebesta, "Concepts of Programming Languages", Eleventh Edition, Addison Wesley,2012
2. W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003
3. Michael L.Scott, "Programming Language Pragmatics", Fourth Edition, Morgan Kaufmann,2009.
4. R.KentDybvig,"TheSchemeprogramminglanguage",FourthEdition,MITPress, 2009
5. Richard A. O'Keefe, "The craft of Prolog", MIT Press, 2009
6. W.F.ClocksinandC.S.Mellish,"ProgramminginProlog:UsingtheISOStandard",Fifth Edition, Springer,2003

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	1	2	1	1	1						
CO2	2	1	2	1	1	2						
CO3	2	2	3	1	1	2						
CO4	1	2	1	1	1	2						
CO5	2	2	3	1	1	-						

3-High; 2-Medium; 1-Low		
CO \ PSO	**PSO1**	**PSO2**
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
PG23CS117	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY					
Semester: I	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	4	2		

Course pre-requisites	Basic of Programming Knowledge and Fundamentals

Course Objectives	
1	To acquire the knowledge of using advanced tree structures
2	To learn the usage of heap structures
3	To understand the usage of graph structures and spanning trees
4	To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
5	To understand the necessary mathematical abstraction to solve problems.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To design, study and implement the concepts data structures

Course Content

LIST OF EXPERIMENTS

1. Implementation of recursive function for tree traversal and Fibonacci
2. Implementation of iteration function for tree traversal and Fibonacci
3. Implementation of Merge Sort and Quick Sort
4. Implementation of a Binary Search Tree
5. Red-Black Tree Implementation
6. Heap Implementation
7. Fibonacci Heap Implementation
8. Graph Traversals
9. Spanning Tree Implementation
10. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11. Implementation of Matrix Chain Multiplication

Activity Selection and Huffman Coding Implementation

Contact Periods	15

Course Outcomes		
CO1	Design and implement basic and advanced data structures extensively.	K6
CO2	Design algorithms using graph structures.	K6
CO3	Design and develop efficient algorithms with minimum complexity using design techniques.	K6
CO4	Develop programs using various algorithms.	K2
CO5	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Tools for Assessment (40 Marks)				
Preparation	Conduct of Experiments	Calculations & Result	Viva-Voce	Total
20	30	40	10	100

Tools for Assessment (20 Marks)		
Model Exam I	Model Exam II	Total
10	10	60

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	2	-	1	-
CO2	1	3	3	3	-	1
CO3	1	3	3	2	2	2
CO4	1	2	2	1	2	1
CO5	1	3	1	1	1	2

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	1
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

SEMESTER II

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODSPER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	P23CS201	Internet of Things	PCC	3	0	2	5	4
2.	P23CS202	Multicore Architecture and Programming	PCC	3	0	2	5	4
3.	P23CS203	Machine Learning	PCC	3	0	2	5	4
4.	P23CS204	Advanced Software Engineering	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Mandatory Course– II*	AC	2	0	0	2	0
PRACTICALS								
8.	P23CS215	Term Paper Writing and seminar	EEC	0	0	2	2	1
9.	P23CS216	Software Engineering Laboratory	PCC	0	0	2	2	1
			TOTAL	**20**	**0**	**10**	**30**	**23**

Course Code	Title					
P23CS201	INTERNET OF THINGS					
Semester: I	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic Knowledge of Internet of Things

Course Objectives

1	To Understand the Architectural Overview of IoT
2	To Understand the IoT Reference Architecture and Real World Design Constraints
3	To Understand the various IoT levels
4	To understand the basics of cloud architecture
5	To gain experience in Raspberry PI and experiment simple IoT application on it

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Study advanced concepts of internet of things

Course Content

Unit	Description	
I	**INTRODUCTION:** Internet of Things- Domain Specific IoTs-IoTandM2M-Sensors for IoT Applications–Structure of IoT – IoT Map Device - IoT System Management with NETCONF-YANG.	
	Contact Periods	09
II	**IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS:** IETF architecture for IoT- IoT reference architecture-First Generation–Description & Characteristics–Advanced Generation–Description & Characteristics–Integrated IoT Sensors– Description & Characteristics.	
	Contact Periods	09
III	**IoT PROTOCOLS AND TECHNOLOGY:** SCADA and RFID Protocols – BAC net Protocol –Zig bee Architecture - 6LowPAN - CoAP –Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF-Module–Sensing Module.	
	Contact Periods	09
IV	**CLOUD ARCHITECTURE BASICS:** The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google App cloud platform in industry..	
	Contact Periods	09
V	**IOT PROJECTS ON RASPBERRY PI:** Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi – Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values- Persisting data External representation of sensor values-Exporting sensor data.	
	Contact Periods	09
	Total Periods	45

List of Experiments

1. Develop an application for LED Blink and Pattern using Arduino or Raspberry Pi
2. Develop an application for LED Pattern with Push Button Control using Arduino or Raspberry Pi
3. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5. Develop an application for home intrusion detection web application
6. Develop an application for Smart parking application using python and Django for web application

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand the various concept of the IoT and their technologies.	K2
CO 2	Develop the IoT application using different hardware platforms.	K1
CO 3	Implement the various IoT Protocols.	K2
CO 4	Understand the basic principles of cloud computing.	K2
CO 5	Develop and deploy the IoT application in to cloud environment.	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Pradeeka Seneviratne "Hands-On Internet of Things with Blynk" May 2018.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles(Eds), Architecting the Internet of Things,Springer,2011
4. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.
5. OvidiuVermesanPeterFriess,'InternetofThings–FromResearchandInnovationtoMarketDeployment', River Publishers, 2014.
6. N.Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd Edition Scitech Publishers, 2014.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	2	1	1	3						
CO2	3	2	1	2	3	2						
CO3	1	1	2	1	3	3						
CO4	2	3	2	1	2	2						
CO5	1	2	1	2	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1

CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu | CSE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. S. SUBASREE, M.Tech., Ph.D
Professor and Head
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore, TN, India

Course Code	Title					
P23CS202	MULTICORE ARCHITECTURE AND PROGRAMMING					
Semester: II	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic Knowledge of Multicore Architecture

Course Objectives

1	To understand the need for multi-core processors, and their architecture.
2	To understand the challenges in parallel and multithreaded programming.
3	To learn about the various parallel programming paradigms,
4	To develop multicore programs and design parallel solutions
5	To understand the need for multi-core processors, and their architecture.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Study advanced concepts of Multicore Architecture

Course Content

Unit	Description	
I	**MULTI-CORE PROCESSORS:** Single core to Multi-core architectures – SIMD and MIMD systems – Inter connection networks –Symmetric and Distributed Shared Memory Architectures–Cache coherence–Performance Issues– Parallel program design.	
	Contact Periods	09
II	**PARALLEL PROGRAM CHALLENGES:** Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers)– deadlocks and live locks – communication between threads(condition variables, signals, message queues and pipes).	
	Contact Periods	09
III	**SHARED MEMORYPROGRAMMING WITH OPEN MP:** Open MP Execution Model – Memory Model – Open MP Directives – Work-sharing Constructs –Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.	
	Contact Periods	09
IV	**DISTRIBUTED MEMORY PROGRAMMING WITH MPI:** Open MP Execution Model – Memory Model – Open MP Directives – Work-sharing Constructs –Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.	
	Contact Periods	09
V	**PARALLEL PROGRAM DEVELOPMENT:** Case studies–n-Body solvers–Tree Search–Open MP and MPI implementations and comparison.	
	Contact Periods	09
	Total Periods	45

PRACTICALS

1. Write a simple Program to demonstrate an Open-MP Fork-Join Parallelism.
2. Create a program that computes a simple matrix-vector multiplication b=Ax, either in C/C++.Use Open MP directives to make it run in parallel.
3. Create a program that computes the sum of all the elements in an array.
   A. (C/C++ program that finds the largest number in an array
   B. Use Open MP directives to make it run in parallel.
4. Write a simple Program demonstrating Message-Passing logic using Open-MP.
5. Implement the All-Pairs Shortest-Path Problem (Floyd's Algorithm) Using Open MP.
6. ImplementaprogramParallelRandomNumberGeneratorsusingMonteCarloMethodsinOpenMP.
7. Write a Program to demonstrate MPI-broadcast-and-collective-communication in C.
8. Write a Program to demonstrate MPI-scatter-gather-and-all gather in C.
9. Write a Program to demonstrate MPI-send-and-receive in C.
10. Write a Program to demonstrate by performing-parallel-rank-with-MPI in C

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Describe multicore architectures and identify their characteristics and challenges.	K2
CO 2	Identify the issues in programming Parallel Processors.	K1
CO 3	Write programs using Open MP and MPI.	K2
CO 4	Design parallel programming solutions to common problems.	K2
CO 5	Compare and contrast programming for serial processors and programming for parallelprocessors.	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. PeterS. Pacheco, "An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier,2021.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson,2011(unit2)
3. MichaelJ Quinn, "Parallel programming in C with MPI and Open MP, Tata Mc Graw Hill,2003.
4. Victor Alessandrini, Shared Memory Application Programming, 1stEdition, Concept sand Strategies in Multicore Application Programming, Morgan Kaufmann,2015.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture,CRCPress,2015.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping												
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	2	3	4	5	6						
CO2	1	1	1	2	1	2						
CO3	2	1	-	-	2	2						
CO4	1	-	2	1	1	2						
CO5	2	1	1	1	2	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M.Tech., Ph.D. Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CS203	MACHINE LEARNING					
Semester: II	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic Knowledge of Machine Learning.

Course Objectives

1	To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
2	To explore the different supervised learning techniques including ensemble methods
3	To learn different aspects of unsupervised learning and reinforcement learning
4	To learn the role of probabilistic methods for machine learning
5	To understand the basic concepts of neural networks and deep learning

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Study advanced concepts of Machine Learning

Course Content

Unit	Description	
I	**INTRODUCTION AND MATHEMATICAL FOUNDATIONS:** What is Machine Learning? Need – History – Definitions – Applications-Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability-Vector Calculus &Optimization –Decision Theory-Information theory.	
	Contact Periods	**09**
II	**SUPERVISED LEARNING:** Introduction – Discriminative and Generative Models – Linear Regression - Least Squares-Under – fitting / Over fitting - Cross-Validation – Lasso Regression -Classification - Logistic Regression - Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest-Evaluation of Classification Algorithms.	
	Contact Periods	**09**
III	**UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING:** Introduction – Clustering Algorithms - K–Means–Hierarchical Clustering – Cluster Validity – Dimensionality Reduction–Principal Component Analysis–Recommendation Systems-EM algorithm. Reinforcement Learning–Elements-Model based Learning–Temporal Difference Learning.	
	Contact Periods	**09**
IV	**PROBABILISTIC METHODS FOR LEARNING:** Introduction-NaïveBayesAlgorithm-MaximumLikelihood-MaximumApriori-BayesianBeliefNetworks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation-Sequence Models – Markov Models– Hidden Markov Models.	
	Contact Periods	**09**

V	**NEURAL NETWORKS AND DEEPLEARNING:** Neural Networks–Biological Motivation-Perceptron–Multi-layer Perceptron–Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning–Convolution Neural Networks–Recurrent Neural Networks–Use cases.	
	Contact Periods	**09**
	Total Periods	**45**

PRACTICALS

1. Give an example from our daily life for each type of machine learning problem.
2. Study at least 3Tools available for Machine Learning and discuss pros &cons of each.
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree.
4. Outline10 machine learning applications in healthcare.
5. Give5 examples whereas sequential models are suitable.
6. Give at least 5 recent applications of CNN.

List of Projects (data sets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand and outline problems for each type of machine learning.	K2
CO 2	Design a Decision tree and Random forest for an application.	K1
CO 3	Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.	K2
CO 4	Use a tool to implement typical Clustering algorithms for different types of applications.	K2
CO 5	Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References	1. S Sridhar (Author), M Vijayalakshmi (Author), "MACHINE LEARNING", 1 June 2021. 2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective" ,Chapman & Hall/CRC, 2nd Edition,2014. 3. Kevin Murphy,"Machine Learning: A Probabilistic Perspective",MITPress,2012 4. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press,2014 5. TomM Mitchell,"MachineLearning",McGrawHillEducation,2013. 6. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press,2012.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	2	1	3	1	1						
CO2	2	3	1	2	1	2						
CO3	1	1	2	1	-	2						
CO4	2	2	-	-	-	3						
CO5	3	3	1	1	1	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S.Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CS204	ADVANCED SOFTWARE ENGINEERING					
Semester: II	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	3	0	0	3		

Course Pre-requisites	Basic Knowledge of Software Engineering

Course Objectives

1	To understand the rationale for software development process models
2	To understand why the architectural design of software is important
3	To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
4	To understand the basic notions of a web service, web service standards, and service-oriented architecture.
5	To understand the different stages of testing from testing during development of a software system.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Study advanced concepts of Database Engineering

Course Content

Unit	Description	
I	**SOFTWARE PROCESS & MODELING:** Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction PrototypeEvaluation–PrototypeEvolution–Modelling–Principles–Requirements Engineering– Scenario-based Modelling – Class-based Modelling – Functional Modelling– Behavioural Modelling.	
	Contact Periods	**09**
II	**SOFTWARE DESIGN:** Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern-Based Design.	
	Contact Periods	**09**
III	**SYSTEM DEPENDABILITY AND SECURITY:** Dependable Systems – Dependability Properties – Socio technical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering –Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design –SecurityTestingandAssurance– ResilienceEngineering–Cybersecurity–SociotechnicalResilience– Resilient Systems Design.	
	Contact Periods	**09**
IV	**SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING:** Service-oriented Architecture – REST full Services – Service Engineering – Service Composition –Systems Engineering – Socio technical Systems – Conceptual Design – System Procurement –System Development – System Operation and Evolution – Real-time	

	Software Engineering–Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis –Real-time Operating Systems.
	Contact Periods 09
V	**SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT:** Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing –Black-Box Testing–Software Configuration Management (SCM)– SCM Repository–SCM Process –Configuration Management for Web and Mobile Apps.
	Contact Periods 09
	Total Periods 45

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Identify appropriate process models based on the Project requirements.	K2
CO 2	Understand the importance of having a good Software Architecture.	K1
CO 3	Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.	K2
CO 4	Understand the basic notions of a webservice, webservice standards, and service-oriented architecture.	K2
CO 5	Be familiar with various levels of Software testing.	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition,I an Somerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3rdEdition, Len Bass, Paul Clements and Rick-Kazman, Pearson India 2018
4. An integrated approach to Software Engineering, 3rdEdition, Pankaj Jalote, Narosa Publishing House,2018
5. Fundamentals of Software Engineering, 5thEdition, Rajib Mall, PHI Learning Private Ltd, 2018.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO 1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	2	1	1	3						
CO2	2	2	1	2	2	2						
CO3	1	1	2	1	2	3						
CO4	2	2	1	1	2	2						
CO5	1	2	1	2	1	1						

3-High; 2-Medium; 1-Low		
CO \ PSO	**PSO1**	**PSO2**
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member		Name and Seal of the Chairperson-BoS Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India

Course Code	Title					
P23CS215	TERM PAPER WRITING AND SEMINAR					
Semester: II	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	2	1		
PG CSE Programmes						
Course pre-requisites	Basic English Knowledge					

Course Objectives

1	In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.

Course Category	Employability Enhancement Course (EEC)
Development Needs	Global

Course Description: An understanding of the importance of term paper writing and seminar.

List of Experiments

The work involves the following steps

1. Selecting a subject, narrowing the subject in to a topic
2. Stating an objective.
3. Collecting the relevant bibliography(atleast15journalpapers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analyzing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation.

Please keep a file where the work carried out by you is maintained. Activities to be carried out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area &topic	1. List1 Special Interest Groups or professional society 2. List 2 journals 3. List2 conferences, symposia or workshops 4. List1 thesis title 5. List3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your	3rd week	**3%** (the selected information must be area specific and of international and national standard)

	area 7. Attach a call for papers(CFP) From your area.		
Collection of Journal papers in the topic in the context of the objective – collect 20& then filter	• You have to provide a complete list of references you will be using- Based on your objective - Search various digital libraries and Google Scholar • When picking papers to read – try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the fields you can quickly gain an overview, • Find relationships with respect toeachotherandtoyourtopicarea(classificationscheme/categorization) • Mark in the hard copy of papers whether complete work or section / sections of the paper are being considered	4thweek	6% (the list of standard papers and reason for selection)
Reading and notesforfirst5papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the	5thweek	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the Perspective of your survey)		
Reading and notesfornext5 papers	Repeat Reading Paper Process	6thweek	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about Each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7thweek	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about Each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification /categorization diagram	8thweek	8% (this component will be evaluated based on the linking and classification Among the papers)
Abstract	Prepare a draft abstract and give a presentation	9thweek	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce

Introduction Background	Write an introduction and background sections	10thweek	5%(clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	10% (this component will be evaluated based on the linking and classification Among the papers)
Your conclusions	Write your conclusions and future work	12thweek	5%(conclusions– Clarity and your ideas)
Final Draft	Complete the final draft of your paper	13thweek	10%(formatting, English, Clarity and linking) 4%Plagiarism Check Report
Seminar	Abrief15slides on your paper	14th& 15th week	10% (based on presentationand Viva-voce)
		Contact Periods	**30**

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S.Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Name and Seal of the Chairperson-BoS Nehru Institute of Engineering and Technology Coimbatore TN India

Course Code	Title					
P23CS216	SOFTWARE ENGINEERING LABORATORY					
Semester: II	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	2	1		

Course pre-requisites	Basic Software Engineering

Course Objectives

1	To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web.
2	Present case studies to demonstrate practical applications of different concepts.
3	Provide a scope to students where they can solve small, real-life problems

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To design, study and implement the concepts data structures

Course Content

LIST OF EXPERIMENTS

1. Write a Problem Statement to define a title of the project with bounded scope of project
2. Select relevant process model to define activities and related task set for assigned project
3. Prepare broad SRS (Software Requirement Specification) for the above selected projects
4. Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5. Develop the activity diagram to represent flow from one activity to another for software development
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for the assigned project
8. Write Test Cases to Validate requirements of assigned project from SRS Document
9. Evaluate Size of the project using function point metric for the assigned project
10. Estimate cost of the project using COCOMO and COCOCMOII for the assigned project
11. Use CPM/PERT for scheduling the assigned project
12. Use timeline Charts or Gantt Charts to track progress of the assigned project.

Contact Periods	**30**

Course Outcomes

CO1	Produce the requirements and use cases the client wants for the software being Produced	K6
CO2	Participate in drawing up the project plan. The plan will include at least extent and workassessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture	K6
CO3	Create and specify such a software design based on the requirement specification that the software can be implemented based on the design	K6
CO4	Assess the extent and costs of a project with the help of several different assessment methods	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Tools for Assessment (40 Marks)

Preparation	Conduct of Experiments	Calculations & Result	Viva-Voce	Total
20	30	40	10	100

Tools for Assessment (20 Marks)

Model Exam I	Model Exam II	Total
10	10	60

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	2	-	1	-
CO2	1	3	3	3	-	1
CO3	1	3	3	2	2	2
CO4	1	2	2	1	2	1
CO5	1	3	1	1	1	2

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	1
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Name and Seal of the Chairperson-BoS Coimbatore TN India

SEMESTER III

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	P23CS301	Security Practices	PCC	3	0	0	3	3
2.		Professional Elective-III	PEC	3	0	0	3	3
3.		Professional Elective-IV	PEC	3	0	2	5	4
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	P23CS312	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

Course Code	Title					
P23CS301	SECURITY PRACTICES					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Basic Knowledge of Security Practices

Course Objectives

1	To learn the core fundamentals of system and web security concepts
2	To have through understanding in the security concepts related to networks
3	To deploy the security essentials in IT Sector
4	To be exposed to the concepts of Cyber Security and cloud security
5	To perform a detailed study of Privacy and Storage security and related Issues

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Study advanced concepts of security practices.

Course Content

Unit	Description	
I	**SYSTEM SECURITY:** Model of network security – Security attacks, services and mechanisms – OSI security architecture - A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.	
		Contact Periods 09
II	**NETWORK SECURITY:** Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.	
		Contact Periods 09
III	**SECURITY MANAGEMENT:** Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit	
		Contact Periods 09
IV	**CYBER SECURITY AND CLOUD SECURITY:** Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA	
		Contact Periods 09
V	**PRIVACY AND STORAGE SECURITY:** Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.	
		Contact Periods 09
		Total Periods 45

Course Outcomes

Upon successful completion of the course, students will be able to:		
CO 1	Understand the core fundamentals of system security	K2
CO 2	Apply the security concepts to wired and wireless networks	K1
CO 3	Implement and Manage the security essentials in IT Sector	K2
CO 4	Explain the concepts of Cyber Security and Cyber forensics	K2
CO 5	Be aware of Privacy and Storage security Issues.	K2
K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.		

References	1. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022 2. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017. 3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	2	1	3	1	1						
CO2	2	3	1	2	1	2						
CO3	1	1	2	1	-	2						
CO4	2	2	-	-	-	3						
CO5	3	3	1	1	1	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S.Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Name and Seal of the Chairperson-BoS

SEMESTER IV

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	P23CS411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES
SEMESTER II, ELECTIVE I

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	P23CSP01	Foundations of Data Science	PEC	3	0	0	3	3
2.	P23CSP02	Cloud Computing Technologies	PEC	3	0	0	3	3
3.	P23CSP03	Wireless Communications	PEC	3	0	0	3	3
4.	P23CSP04	Agile Methodologies	PEC	3	0	0	3	3
5.	P23CSP05	Advanced Operating System	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE II

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	P23CSP06	High Performance Computing For Big Data	PEC	3	0	0	3	3
2.	P23CSP07	Web Analytics	PEC	3	0	0	3	3
3.	P23CSP08	Cognitive Computing	PEC	3	0	0	3	3
4.	P23CSP09	Quantum Computing	PEC	3	0	0	3	3
5.	P23CSP10	Information Retrieval Techniques	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE III

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	P23CSP11	Mobile and Pervasive Computing	PEC	3	0	0	3	3
2.	P23CSP12	Data Visualization Techniques	PEC	3	0	0	3	3
3.	P23CSP13	Compiler Optimization Techniques	PEC	3	0	0	3	3
4.	P23CSP14	Natural Language Processing	PEC	2	0	2	4	3
5.	P23CSP15	GPU Computing	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S.NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	P23CSP16	Devops and Micro services	PEC	3	0	2	5	4
2.	P23CSP17	Deep Learning	PEC	3	0	2	5	4
3.	P23CSP18	Block-chain Technologies	PEC	3	0	2	5	4
4.	P23CSP19	Full Stack Web Application Development	PEC	3	0	2	5	4
5.	P23CSP20	Bioinformatics	PEC	3	0	2	5	4

LIST OF OPEN ELECTIVES FOR PPROGRAMMES

S.NO.	COURSE CODE	COURSETITLE	PERIODSPER WEEK			CREDITS
			L	T	P	
1.	P23CSO014	IoT for Smart Systems	3	0	0	3
2.	P23CSO017	Smart Grid	3	0	0	3
3.	P23CSO018	Big Data Analytics	3	0	0	3
4.	P23CSO019	Internet of Things and Cloud	3	0	0	3
5.	P23CSO020	Medical Robotics	3	0	0	3

Course Code	Title					
P23CSP01	FOUNDATIONS OF DATA SCIENCE					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Principles of Programming Languages, Machine Learning

Course Objectives

1	To apply fundamental algorithms to process data.
2	Learn to apply hypotheses and data into actionable predictions.
3	Document and transfer the results and effectively communicate the findings using visualization techniques.
4	To learn statistical methods and machine learning algorithms required for Data Science
5	To develop the fundamental knowledge and understanding of concepts to become a data science professional.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To learn the fundamental knowledge of data science.

Course Content

Unit	Description	
I	**INTRODUCTION TO DATA SCIENCE:** Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.	
	Contact Periods	**09**
II	**MODELING METHODS:** Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.	
	Contact Periods	**09**
III	**INTRODUCTION TO R:** Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.	
	Contact Periods	**09**
IV	**MAP REDUCE:** Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.	
	Contact Periods	**09**
V	**DATA VISUALIZATION:** Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph using graphics parameters - Case studies.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO 1	Obtain, clean/process and transform data.	K1
CO 2	Analyze and interpret data using an ethically responsible approach.	K4
CO 3	Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.	K3
CO 4	Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.	K3
CO 5	Formulate and use appropriate models of data analysis to solve business-related challenges.	K5
K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.		

References

1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
2. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
3. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
5. Nathan Yau, "Visualize This: The FlowingData Guide to Design, Visualization, and Statistics", Wiley, 2011.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	3	-	2	2						
CO2	-	-	2	3	-	-						
CO3	1	-	-	-	3	3						
CO4	2	1	-	3	-	-						
CO5	1	-	3	3	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	2	1
CO3	2	2
CO4	2	2

CO5	3	1
Course designed by		Verified by
Signature of the Faculty Member		Signature of the Chairperson-BoS
Name and Department of the Faculty Member	M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS

Dr. S. SUBASREE, M Tech. Ph.D.
Professor and Head
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore TN India

Course Code	Title					
P23CSP02	CLOUD COMPUTING TECHNOLOGIES					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Network Technologies

Course Objectives

1	To gain expertise in Virtualization, Virtual Machines and deploy a practical ,virtualization solution
2	To understand the architecture, infrastructure and delivery models of cloud computing.
3	To explore the roster of AWS services and illustrate the way to make applications in AWS
4	To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
5	To develop the cloud application using various programming model of Hadoop and Aneka

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To learn the fundamental knowledge of cloud computing technologies.

Course Content

Unit	Description	
I	**VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE:** Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data centre automation.	
	Contact Periods	**09**
II	**CLOUD PLATFORM ARCHITECTURE:** Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges	
	Contact Periods	**09**
III	**AWS CLOUD PLATFORM – IAAS:** Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manage.	
	Contact Periods	**09**
IV	**PAAS CLOUD PLATFORM:** Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage	

	Services- REST API- Blops.	
	Contact Periods	**09**
V	**PROGRAMMING MODEL:** Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system – Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Employ the concepts of virtualization in the cloud computing	K3
CO 2	Identify the architecture, infrastructure and delivery models of cloud computing	K4
CO 3	Develop the Cloud Application in AWS platform	K6
CO 4	Apply the concepts of Windows Azure to design Cloud Application	K3
CO 5	Develop services using various Cloud computing programming models.	K6

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.
4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
5. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guide‖, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	-	2	2	1						
CO2	2	3	1	-	-	1						
CO3	3	-	3	-	1	3						
CO4	-	-	-	2	-	3						
CO5	3	2	-	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	2	2
CO2	1	1
CO3	2	2
CO4	2	2
CO5	2	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M.Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP03	WIRELESS COMMUNICATIONS					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Network Technologies

Course Objectives

1	To understand the basic concepts in cellular communication.
2	To learn the characteristics of wireless channels.
3	To understand the impact of digital modulation techniques in fading.
4	To get exposed to diversity techniques in wireless communication.
5	To acquire knowledge in multicarrier systems.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To learn the fundamental knowledge of wireless communications.

Course Content

Unit	Description	
I	**CELLULAR CONCEPTS:** Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring Repeaters for Range Extension-Microcell Zone Concept	
	Contact Periods	**09**
II	**THE WIRELESS CHANNEL:** Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels	
	Contact Periods	**09**
III	**PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS:** Performance of flat fading and frequency selective fading – Impact on digital modulation techniques –- Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.	
	Contact Periods	**09**
IV	**DIVERSITY TECHNIQUES:** Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combing – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.	
	Contact Periods	**09**
V	**MULTI-CARRIER MODULATION:** Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio-Frequency and Timing offset.	

	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Design solutions for cellular communication.	K5
CO 2	Determine the capacity of wireless channels.	K2
CO 3	Analyze the performance of the digital modulation techniques in fading channels.	K4
CO 4	Apply various diversity techniques in wireless communication.	K3
CO 5	Design multicarrier systems in wireless communication.	K5

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Theodore.S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2010.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Wiley Series in Telecommunications, Cambridge University Press, 2005.
4. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies" CRC press – 2019. 5. Keith Q. T. Zhang, "Wireless Communications: Principles, Theory and Methodology" 1st edition, John Wiley & Sons, 2016.
5. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House, 2004.
6. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, "Professional Hadoop Solutions",John Wiley & Sons Inc., 2013.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	2	2	3	2						
CO2	3	2	3	-	-	-						
CO3	2	-	-	2	3	3						
CO4	3	3	-	2	3	3						
CO5	2	3	3	2	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1

CO3	3	2
CO4	3	2
CO5	3	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S.Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP04	AGILE METHODOLOGIES					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Research Methodology and IPR

Course Objectives

1	To learn the fundamental principles and practices associated with each of the agile development methods
2	To apply the principles and practices of agile software development on a project of interest and relevance to the student.
3	To provide a good understanding of software design and a set of software technologies and APIs.
4	To do a detailed examination and demonstration of Agile development and testing techniques.
5	To understand Agile development and testing.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To learn the fundamental knowledge of Agile Methodologies

Course Content

Unit	Description	
I	**AGILE SOFTWARE DEVELOPMENT:** Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges. Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality	
	Contact Periods	**09**
II	**AGILE AND SCRUM PRINCIPLES:** Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values	
	Contact Periods	**09**
III	**AGILE PRODUCT MANAGEMENT:** Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue	
	Contact Periods	**09**
IV	**AGILE REQUIREMENTS AND AGILE TESTING:** User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test	
	Contact Periods	**09**

V	**AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS:** Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools. Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Analyze existing problems with the team, development process and wider organization	K4
CO 2	Apply a thorough understanding of Agile principles and specific practices.	K3
CO 3	Select the most appropriate way to improve results for a specific circumstance or need	K2
CO 4	Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems	K4
CO 5	Evaluate likely successes and formulate plans to manage likely risks or problems	K5

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)
2. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
3. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
4. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.
5. Craig Larman, "Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.
6. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	1	3	-	2	3						
CO2	2	-	3	3	1	3						

CO3	3	-	-	-	3	3						
CO4	2	-	1	2	3	3						
CO5	1	3	-	-	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	2	2
CO5	2	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu/CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech, Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP05	ADVANCED OPERATING SYSTEM					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Database Practices, Operating System.

Course Objectives

1	To get a comprehensive knowledge of the architecture of distributed systems.
2	To understand the deadlock in distributed environments.
3	To Understand the shared memory issues and their solutions.
4	To know the security issues and protection mechanisms for distributed environments.
5	To get a knowledge of multiprocessor operating systems and database operating systems.

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: To learn the fundamental knowledge of operating system.

Course Content

Unit	Description	
I	**INTRODUCTION:** Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations - inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis.	
		Contact Periods 09
II	**DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT:** Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems – issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems – design issues – log structured file systems.	
		Contact Periods 09
III	**DISTRIBUTED SHARED MEMORY AND SCHEDULING:** Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous checkpointing and recovery – checkpointing for distributed database in replicated distributed databases.	

	Contact Periods	**09**
IV	**DATA SECURITY:** Protection and security -preliminaries, the access matrix model and its implementations.-safety in matrix model- advanced models of protection. Data security – cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography – multiple encryption – authentication in distributed systems.	
	Contact Periods	**09**
V	**MULTIPROCESSOR AND DATABASE OPERATING SYSTEM:** Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues-threads process synchronization and scheduling. Database Operating systems :Introduction-requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms – concurrency control algorithms: data replication.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand and explore the working of Theoretical Foundations of OS.	K2
CO 2	Analyze the working principles of Distributed Deadlock Detection and resource. management	K1
CO 3	Understand the concepts of distributed shared memory and scheduling mechanisms	K2
CO 4	Understand and analyze the working of Data security	K2
CO 5	Apply the learning into multiprocessor system architectures.	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	3	2	2	1	3						
CO2	2	2	3	2	1	-						
CO3	1	1	-	3	2	1						
CO4	1	1	2	1	2	2						
CO5	-	-	-	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	1	2
CO2	2	1
CO3	3	2
CO4	2	2
CO5	-	-

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

M.S.Vinu

Dr. S. SUBASREE, M Tech. Ph.D
Professor and Head
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore TN India

Course Code	Title					
P23CSP06	High Performance Computing for Big Data					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Scalable Infrastructure, Data Management.

Course Objectives

1	To learn the fundamental concepts of High-Performance Computing.
2	To learn the network & software infrastructure for high performance computing.
3	To understand real time analytics using high performance computing.
4	To learn the different ways of security perspectives and technologies used in HPC.
5	To understand the emerging big data applications.

Course Category	Professional Elective Course (PEC)
Development Needs	Global

Course Description: High-performance computing (HPC) for big data involves handling large volumes of data with complex processing requirements efficiently.

Course Content

Unit	Description	
I	**INTRODUCTION**: The Emerging IT Trends- IOT/IOE-Apache Hadoop for big data analytics-Big data into big insights and actions – Emergence of BDA discipline – strategic implications of big data – BDA Challenges – HPC paradigms – Cluster computing – Grid Computing – Cloud computing – Heterogeneous computing – Mainframes for HPC - Supercomputing for BDA – Appliances for BDA.	
	Contact Periods	**09**
II	**NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA**: Design of Network Infrastructure for high performance BDA – Network Virtualization – Software Defined Networking – Network Functions Virtualization – WAN optimization for transfer of big data – started with SANs- storage infrastructure requirements for storing big data – FC SAN – IP SAN – NAS – GFS – Panasas – Luster file system – Introduction to cloud storage.	
	Contact Periods	**09**
III	**REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING:** Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics – operational analytics – HPC Architecture models – In Database analytics – In memory analytics	
	Contact Periods	**09**

IV	**SECURITY AND TECHNOLOGIES**: Security, Privacy and Trust for user – generated content: The challenges and solutions – Role of real time big data processing in the IoT – End to End Security Framework for big sensing data streams – Clustering in big data.	
	Contact Periods	**09**
V	**EMERGING BIG DATA APPLICATIONS**: Deep learning Accelerators – Accelerators for clustering applications in machine learning - Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome Sequencing	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand the basics concepts of High-Performance computing systems.	K1
CO 2	Apply the concepts of network and software infrastructure for high performance computing	K3
CO 3	Use real time analytics using high performance computing.	K3
CO 4	Apply the security models and big data applications in high performance computing	K3
CO 5	Understand the emerging big data applications.	K1

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High- Performance Big-Data Analytics: Computing Systems and Approaches", Springer, 1st Edition, 2015
2. "Big Data Management and Processing", Kuan-Ching Li , Hai Jiang, Albert Y. Zomaya, CRC Press,1st Edition,2017.
3. "High Performance Computing for Big Data: Methodologies and Applications", Chao wang ,CRC Press,1st Edition,2018
4. "High-Performance Data Mining And Big Data Analytics" , Khosrow Hassibi, Create Space Independent Publishing Platform,!st Edition,2014
5. "High performance computing: Modern systems and practices", Thomas Sterling, Matthew Anderson, Morgan Kaufmann publishers,1st Edition,2017

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment /	Attendance	Total

			Seminar / Case Study		
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	3	1	-	-						
CO2	-	-	2	3	2	3						
CO3	1	-	1	-	1	3						
CO4	3	1	-	-	3	-						
CO5	1	-	-	2	3	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S.Vinu Name and Department of the Faculty Member	Dr. S. SUBASREE, M.Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP07	WEB ANALYTICS					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Data Collection Tools, Website Tagging, Data Analysis Skills.

Course Objectives

1	To understand the Web analytics platform, and their evolution.
2	To learn about the various Data Streams Data.
3	To learn about the benefits of surveys and capturing of data
4	To understand Common metrics of web as well as KPI related concepts.
5	To learn about the various Web analytics versions.

Course Category	Professional Elective Course (PEC)
Development Needs	Global

Course Description: Web analytics involves collecting, analyzing, and interpreting data related to website usage and visitor behavior.

Course Content

Unit		
I	**INTRODUCTION**: Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.	
		Contact Periods 09
II	**DATA COLLECTION**: Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E- commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.	
		Contact Periods 09
III	**QUALITATIVE ANALYSIS**: Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, selecting optimal web analytic tool, Understanding click stream data quality, identifying unique page definition, Using cookies, Link coding issues.	
		Contact Periods 09
IV	**WEB METRICS**: Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non-e-commerce sites): Improving bounce rates, optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need	

	for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.	
	Contact Periods	**09**
V	**WEB ANALYTICS 2.0:** Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data, ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand the Web analytics platform, and their evolution.	K2
CO 2	Use the various Data Streams Data.	K3
CO 3	Know how the survey of capturing of data will benefit.	K3
CO 4	Understand Common metrics of web as well as KPI related concepts.	K2
CO 5	Apply various Web analytics versions in existence.	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed, 2012
2. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed, 2010.
3. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons, 2002

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	-	3	2	3	2						
CO2	2	2	3	1	1	1						
CO3	3	-	3	2	2	2						
CO4	1	2	3	1	1	1						

CO5	2	-	3	2	2	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member: M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS: Dr. S. SUBASREE, M Tech. Ph.D, Professor and Head, Computer Science and Engineering, Nehru Institute of Engineering and Technology, Coimbatore TN India

Course Code	Title					
P23CSP08	COGNITIVE COMPUTING					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Advanced Analytics, Semantic Understanding, Computational Resources.

Course Objectives

1	To familiarize Use the Innovation Canvas to justify potentially successful products.
2	To learn various ways in which to develop a product idea.
3	To understand about how Big Data can play vital role in Cognitive Computing
4	To know about the business applications of Cognitive Computing
5	To get into all applications of Cognitive Computing

Course Category	Professional Elective Course (PEC)
Development Needs	Global

Course Description: Cognitive computing involves simulating human thought processes in a computerized model.

Course Content

Unit		
I	**FOUNDATION OF COGNITIVE COMPUTING**: Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services	
		Contact Periods 09
II	**NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS**: Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations	
		Contact Periods 09
III	**BIG DATA AND COGNITIVE COMPUTING:** Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics	
		Contact Periods 09

IV	**BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING:** Preparing for change ,advantages of new disruptive models , knowledge meaning to business, difference with a cognitive systems approach , meshing data together differently, using business knowledge to plan for the future , answering business questions in new ways , building business specific solutions , making cognitive computing a reality , cognitive application changing the market The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing	
	Contact Periods	**09**
V	**APPLICATION OF COGNITIVE COMPUTING:** Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Explain applications in Cognitive Computing.	K2
CO 2	Describe Natural language processor role in Cognitive computing.	K2
CO 3	Explain future directions of Cognitive Computing	K2
CO 4	Evaluate the process of taking a product to market	K3
CO 5	Comprehend the applications involved in this domain.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, "cognitive computing and Big Data Analytics", Wiley, 2015
2. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences", The MIT Press, 1999
3. Noah D. Goodman, Joshua B. Tenenbaum, The Prob Mods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	3	2	-	2	-						

CO2	2	-	3	1	3	-						
CO3	1	2	-	-	3	-						
CO4	-	-	2	2	1	1						
CO5	2	2	1	-	1	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

M.S.Vinu / CSE

Dr. S. SUBASREE, M Tech. Ph.D
Professor and Head,
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore TN India

Course Code	Title					
P23CSP09	QUANTUM COMPUTING					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Quantum Software Development Skills, Error Correction

Course Objectives

1	To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
2	To understand the Quantum state transformations and the algorithms.
3	To understand entangled quantum subsystems and properties of entangled states
4	To explore the applications of quantum computing

Course Category	Professional Elective Course (PEC)
Development Needs	Global

Course Description: Quantum computing holds promise for revolutionizing various fields by harnessing the principles of quantum mechanics to perform computations that would be infeasible for classical computers.

Course Content

Unit	Description	
I	**QUANTUM BUILDING BLOCKS**: The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere.	
	Contact Periods	**09**
II	**QUANTUM STATE TRANSFORMATIONS**: Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.	
	Contact Periods	**09**
III	**QUANTUM ALGORITHMS**: Computing with Superpositions, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations.	
	Contact Periods	**09**
IV	**ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION**: Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph states and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing	
	Contact Periods	**09**
V	**QUANTUM INFORMATION PROCESSING**: Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	

Contact Periods	**09**
Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand the basic principles of quantum computing	K2
CO 2	Gain knowledge of the fundamental differences between conventional computing and quantum computing	K2
CO 3	Understand several basic quantum computing algorithms	K2
CO 4	Understand the classes of problems that can be expected to be solved well by quantum computers	K2
CO 5	Simulate and analyze the characteristics of Quantum Computing Systems	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021.
3. Parag Lala, Quantum Computing, 2019
4. Eleanor Rieffel and Wolfgang Polak, Quantum Computing A Gentle Introduction, 2011
5. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002
6. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
7. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	2	3	-	1	-						
CO2	1	2	3	-	2	-						
CO3	-	1	3	2	3	2						
CO4	2	-	2	2	1	3						
CO5	3	-	1	2	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2

CO4	3	2
CO5	3	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
Name and Department of the Faculty Member		Name and Seal of the Chairperson-BoS

M.S.Vinu | CSE

Dr. S. SUBASREE, M.Tech., Ph.D
Professor and Head,
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore TN India

Course Code	Title					
P23CSP10	Information Retrieval Techniques					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Indexing Techniques, Text Processing and Analysis

Course Objectives

1	To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
2	To get an understanding of machine learning techniques for text classification and clustering
3	To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
4	To get an understanding of machine learning techniques for text classification and clustering
5	To understand the concepts of digital libraries

Course Category	Professional Elective Course (PEC)
Development Needs	Global

Course Description: Information retrieval (IR) techniques are essential for efficiently accessing and retrieving relevant information from large collections of data.

Course Content

Unit		
I	**INTRODUCTION: MOTIVATION**: Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR — IR Versus Web Search–Components of a Search engine.	
	Contact Periods	**09**
II	**MODELLING**: Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing	
	Contact Periods	**09**
III	**INDEXING**: Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency	
	Contact Periods	**09**
IV	**EVALUATION AND PARALLEL INFORMATION RETRIEVAL**: Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Non-traditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria – Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce.	

	Contact Periods	**09**
V	**SEARCHING THE WEB**: Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Build an Information Retrieval system using the available tools.	K4
CO 2	Identify and design the various components of an Information Retrieval system.	K4
CO 3	Categorize the different types of IR Models.	K2
CO 4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.	K3
CO 5	Design an efficient search engine and analyze the Web content structure.	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, "Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.
2. Stefan Buttcher, Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2016.
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, "Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	1	3	3	2						
CO2	1	1	1	3	2	1						
CO3	2	1	2	3	3	3						
CO4	1	2	2	1	2	3						
CO5	2	2	3	3	1	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2

CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
M.S.V Signature of the Faculty Member	S. Subasree Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP11	MOBILE AND PERVASIVE COMPUTING					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Fundamental Programming Skills

Course Objectives	
1	To understand the basics of Mobile Computing and Personal Computing
2	To learn the role of cellular networks in Mobile and Pervasive Computing
3	To expose to the concept of sensor and mesh networks
4	To expose to the context aware and wearable computing
5	To learn to develop applications in mobile and pervasive computing environment

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Mobile and Pervasive Computing is a field focused on the development, deployment, and management of mobile and pervasive (ubiquitous) computing systems.

Course Content

Unit	Description	
I	**INTRODUCTION:** Differences between Mobile Communication and Mobile Computing – Contexts and Names – Functions – Applications and Services – New Applications – Making Legacy Applications Mobile Enabled – Design Considerations – Integration of Wireless and Wired Networks – Standards Bodies – Pervasive Computing – Basics and Vision – Principles of Pervasive Computing – Categories of Pervasive Devices.	
	Contact Periods	**09**
II	**3G AND 4G CELLULAR NETWORKS:** Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – Wi-Max IEEE 802.16d/e – Wi-Max Internetworking with 3GPP	
	Contact Periods	**09**
III	**SENSOR AND MESH NETWORKS:** Sensor Networks – Role in Pervasive Computing – In Network Processing and Data Dissemination – Sensor Databases – Data Management in Wireless Mobile Environments – Wireless Mesh Networks – Architecture – Mesh Routers – Mesh Clients – Routing – Cross Layer Approach – Security Aspects of Various Layers in WMN – Applications of Sensor and Mesh networks	
	Contact Periods	**09**
IV	**CONTEXT AWARE COMPUTING & WEARABLE COMPUTING**: Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene Analysis – Delaunay Triangulation and Voronoi graphs – Types of Context – Role of Mobile Middleware – Adaptation and Agents – Service Discovery Middleware Health BAN- Medical and Technological Requirements-Wearable Sensors-Intra-BAN communications	
	Contact Periods	**09**

V	**APPLICATION DEVELOPMENT:** Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone	
	Contact Periods	**45**
	Total Periods	**45**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Design a basic architecture for a pervasive computing environment	K2
CO 2	Design and allocate the resources on the 3G	K4
CO 3	Analyze the role of sensors in Wireless networks	K3
CO 4	Work out the routing in mesh network	K3
CO 5	Deploy the location and context information for application development	K5

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applications and Service Creation", 2nd ed, Tata McGraw Hill, 2017.
2. Reto Meier, "Professional Android 2 Application Development", Wrox Wiley,2010.
3. Pei Zheng and Lionel M Li, 'Smart Phone & Next Generation Mobile Computing', Morgan Kaufmann Publishers, 2006.
4. Frank Adelstein, 'Fundamentals of Mobile and Pervasive Computing', TMH, 2005
5. Jochen Burthardt et al, 'Pervasive Computing: Technology and Architecture of Mobile Internet Applications', Pearson Education, 2003

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	3	-	2	2						
CO2	-	-	2	3	-	-						
CO3	1	-	-	-	3	3						
CO4	2	1	-	3	-	-						
CO5	1	-	3	3	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	2	1

CO3	2	2
CO4	2	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member: M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS: Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India

Course Code	Title					
P23CSP12	DATA VISUALIZATION TECHNIQUES					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Data Understanding, Visualization Design Principles, and Storytelling.

Course Objectives

1	To develop skills to both design and critique visualizations.
2	To introduce visual perception and core skills for visual analysis
3	To understand technological advancements of data visualization
4	To understand various data visualization techniques
5	To understand the methodologies used to visualize large data sets

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Data visualization techniques are essential for effectively communicating insights and patterns hidden within datasets.

Course Content

Unit	Description	
I	**INTRODUCTION AND DATA FOUNDATION:** Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Pre-processing - Data Sets	
	Contact Periods	**09**
II	**FOUNDATIONS FOR VISUALIZATION:** Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson's Affordance theory – A Model of Perceptual Processing.	
	Contact Periods	**09**
III	**VISUALIZATION TECHNIQUES:** Spatial Data: One-Dimensional Data - Two-Dimensional Data – .Three-Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data: Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques – Line Based Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.	
	Contact Periods	**09**
IV	**INTERACTION CONCEPTS AND TECHNIQUES:** Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space – Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.	
	Contact Periods	**09**

V	**RESEARCH DIRECTIONS IN VISUALIZATIONS:** Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications
	Contact Periods 09
	Total Periods 45

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Visualize the objects in different dimensions.	K3
CO 2	Design and process the data for Visualization.	K4
CO 3	Apply the visualization techniques in physical sciences	K6
CO 4	Apply the virtualization techniques for research projects	K3
CO 5	Identify appropriate data visualization techniques given particular requirements imposed by the data.	K6

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1.Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
2. Colin Ware, "Information Visualization Perception for Design", 4th edition, Morgan Kaufmann Publishers, 2021.
3. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2nd Edition, 2007.
4. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	-	2	2	1						
CO2	2	3	1	-	-	1						
CO3	3	-	3	-	1	3						
CO4	-	-	-	2	-	3						
CO5	3	2	-	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	2	2
CO2	1	1
CO3	2	2

CO4	2	2
CO5	2	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M.Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP13	COMPILER OPTIMIZATION TECHNIQUES					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Understanding of Compiler Architecture, Data Structures and Algorithms.

Course Objectives

1	To understand the optimization techniques used in compiler design
2	To be aware of the various computer architectures that support parallelism.
3	To become familiar with the theoretical background needed for code optimization
4	To understand the techniques used for identifying parallelism in a sequential program.
5	To learn the various optimization algorithms

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Compiler optimization techniques are essential for improving the performance and efficiency of compiled code.

Course Content

Unit	Description	
I	**INTRODUCTION:** Language Processors - The Structure of a Compiler – The Evolution of Programming Languages- The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator - Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.	
	Contact Periods	**09**
II	**INSTRUCTION-LEVEL PARALLELISM:** Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling –Global Code Scheduling – Advanced code motion techniques – Interaction with Dynamic Schedulers- Software Pipelining.	
	Contact Periods	**09**
III	**OPTIMISING FOR PARALLELISM AND LOCALITY-THEORY:** Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse-Array data dependence Analysis.	
	Contact Periods	**09**
IV	**OPTIMISING FOR PARALLELISM AND LOCALITY:** – APPLICATION Finding Synchronisation - Free Parallelism – Synchronisation Between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.	
	Contact Periods	**09**
V	**INTERPROCEDURAL ANALYSIS:** Basic Concepts – Need for Inter procedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Inter procedural Analysis - Context- Sensitive Pointer-Analysis – Data log Implementation by Binary Decision Diagrams.	
	Contact Periods	**09**

	Total Periods	**45**
Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO 1	Design and implement techniques used for optimization by a compiler.	K5
CO 2	Modify the existing architecture that supports parallelism.	K2
CO 3	Modify the existing data structures of an open source optimising compiler.	K4
CO 4	Design and implement new data structures and algorithms for code optimization.	K3
CO 5	Critically analyse different data structures and algorithms used in the building of an optimising compiler.	K5
K1: Remembering; K2: Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.		
References	1.Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers: Principles, Techniques and Tools", Second Edition, Pearson Education,2008. 2.Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers, 2002. 3.Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, 2007 4.John Hopcroft, Rajeev Motwani, Jeffrey Ullman, "Introduction To Automata Theory Languages, and Computation", Third Edition, Pearson Education, 2007.	

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	2	2	3	2						
CO2	3	2	3	-	-	-						
CO3	2	-	-	2	3	3						
CO4	3	3	-	2	3	3						
CO5	2	3	3	2	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1
Course designed by		**Verified by**

Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India

Course Code	Title					
P23CSP14	NATURAL LANGUAGE PROCESSING					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	2	0	2	3		

Course Pre-requisites	Mathematics and Programming Skills.

Course Objectives

1	To understand basics of linguistics, probability and statistics
2	To study statistical approaches to NLP and understand sequence labeling
3	To outline different parsing techniques associated with NLP
4	To explore semantics of words and semantic role labeling of sentences
5	To understand discourse analysis, question answering and chatbots

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Natural Language Processing (NLP) involves the interaction between computers and humans through natural language.

Course Content

Unit	Description	
I	**INTRODUCTION** Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata	
	Contact Periods	06
II	**STATISTICAL NLP AND SEQUENCE LABELING** N-grams and Language models – Smoothing -Text classification- Naïve Bayes classifier – Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labeling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging	
	Contact Periods	06
III	**CONTEXTUAL EMBEDDING** Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm-Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing - Transition Based - Graph Based	
	Contact Periods	06
IV	**COMPUTATIONAL SEMANTICS** Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition Bank- FrameNet- Selectional Restrictions - Information Extraction - Template Filling	
	Contact Periods	06
V	**DISCOURSE ANALYSIS AND SPEECH PROCESSING** Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture	
	Contact Periods	06
	Total Periods	30

LIST OF EXPERIMENTS

1. Download nltk and packages. Use it to print the tokens in a document and the sentences from it.
2. Include custom stop words and remove them and all stop words from a given document using nltk or spacy package
3. Implement a stemmer and a lemmatizer program.
4. Implement a simple Part-of-Speech Tagger
5. Write a program to calculate TFIDF of documents and find the cosine similarity between any two documents.
6. Use nltk to implement a dependency parser.
7. Implement a semantic language processor that uses WordNet for semantic tagging.
8. Project - (in Pairs) Your project must use NLP concepts and apply them to some data. a. Your project may be a comparison of several existing systems, or it may propose a new system in which case you still must compare it to at least one other approach. b. You are free to use any third-party ideas or code that you wish as long as it is publicly available. c. You must properly provide references to any work that is not your own in the write- up. d. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Possible Projects

1. Sentiment Analysis of Product Reviews
2. Information extraction from News articles
3. Customer support bot
4. Language identifier
5. Media Monitor
6. Paraphrase Detector
7. Identification of Toxic Comment
8. Spam Mail Identification.

Contact Periods	**30**
Total Periods	**60**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand basics of linguistics, probability and statistics associated with NLP	K2
CO 2	Implement a Part-of-Speech Tagger	K1
CO 3	Design and implement a sequence labeling problem for a given domain	K2
CO 4	Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP	K2
CO 5	Implement a simple chatbot using dialogue system concepts	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References	1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (Prentice Hall Series in Artificial Intelligence), 2020 2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019 3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019 4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009. 5. Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	2	3	1	1	-						
CO2	2	2	2	3	-	3						
CO3	3	-	3	3	-	3						
CO4	1	-	2	3	-	3						
CO5	1	-	2	3	-	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

M.S. Vinu

Dr. S. SUBASREE, M Tech. Ph.D
Professor and Head
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore TN India

Course Code	Title					
P23CSP15	GPU COMPUTING					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Computer Architecture, Basics of Parallel and Distributed Computing

Course Objectives

1	To understand the basics of GPU architectures
2	To understand CPU GPU Program Partitioning
3	To write programs for massively parallel processors
4	To understand the issues in mapping algorithms for GPUs
5	To introduce different GPU programming models.

Course Category	Professional Core Course (PCC)
Development Needs	· Global

Course Description: This course provides a comprehensive introduction to GPU (Graphics Processing Unit) computing, focusing on the principles and techniques for leveraging GPUs for high-performance parallel computing.

Course Content

Unit	Description	
I	**GPU ARCHITECTURE:** Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.	
	Contact Periods	**09**
II	**CUDA PROGRAMMING:** Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.	
	Contact Periods	**09**
III	**PROGRAMMING ISSUES:** Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.	
	Contact Periods	**09**
IV	**OPENCL BASICS:** OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples	
	Contact Periods	**09**

V	**ALGORITHMS ON GPU:** Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster.
	Contact Periods 09
	Total Periods 45

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Describe GPU Architecture CO2	K2
CO 2	Write programs using CUDA , identify issues and debug them	K1
CO 3	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication	K2
CO 4	Write simple programs using OpenCL	K2
CO 5	Identify efficient parallel programming patterns to solve problems	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1.Shane Cook, CUDA Programming: "A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.

2.David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015. 3. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.

3.Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming, Addison - Wesley, 2010.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	3	2	2	1	3						
CO2	2	2	3	2	1	-						
CO3	1	1	-	3	2	1						
CO4	1	1	2	1	2	2						
CO5	-	-	-	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	1	2
CO2	2	1
CO3	3	2

CO4	2	2
CO5	-	-
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M Tech, Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP16	DEVOPS AND MICRO SERVICES					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic Understanding of Software Development, Basic Knowledge of Networking.

Course Objectives

1	To learn the basic concepts and terminology of DevOps
2	To gain knowledge on Devops platform
3	To understand building and deployment of code
4	To be familiar with DevOps automation tools
5	To learn basics of MLOps

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: This course offers a comprehensive introduction to the principles and practices of DevOps and Microservices, essential for modern software development and IT operations.

Course Content

Unit		
I	**INTRODUCTION:** Software Engineering - traditional and Agile process models - DevOps -Definition - Practices -DevOps life cycle process - need for DevOps –Barriers	
		Contact Periods 09
II	**DEVOPS PLATFORM AND SERVICES:** Cloud as a platform - IaaS, PaaS, SaaS - Virtualization - Containers –Supporting Multiple Data Centers - Operation Services - Hardware provisioning- software Provisioning - IT services - SLA - capacity planning - security - Service Transition - Service Operation Concepts	
		Contact Periods 09
III	**BUILDING, TESTING AND DEPLOYMENT:** Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing -Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management	
		Contact Periods 09
IV	**DEVOPS AUTOMATION TOOLS:** Infrastructure Automation- Configuration Management - Deployment Automation - Performance Management - Log Management - Monitoring	
		Contact Periods 09
V	**MLOPS:** mlops - Definition - Challenges -Developing Models - Deploying to production - ModelGovernance - Real world examples	
		Contact Periods 09
		Total Periods 45

LIST OF EXPERIMENTS

1. Creating a new Git repository, cloning existing repository, Checking changes into a Git repository, Pushing changes to a Git remote, Creating a Git branch
2. Installing Docker container on windows/Linux, issuing docker commands
3. Building Docker Images for Python Application
4. Setting up Docker and Maven in Jenkins and First Pipeline Run
5. Running Unit Tests and Integration Tests in Jenkins Pipelines

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Implement modern software Engineering process	K3
CO 2	Work with DevOps platform	K2
CO 3	Build, test and deploy code	K4
CO 4	Explore DevOps tools	K2
CO 5	Correlate MLOps concepts with real time examples	K3

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Len Bass, Ingo Weber and Liming Zhu, —"DevOps: A Software Architect's Perspective", Pearson Education, 2016
2. Joakim Verona - "Practical DevOps" - Packet Publishing , 2016
3. Viktor Farcic -"The DevOps 2.1 Toolkit: Docker Swarm" - Packet Publishing, 2017
4. Mark Treveil, and the Dataiku Team-"Introducing MLOps" - O'Reilly Media-2020

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	1	2	3	-						
CO2	3	2	-	-	3	-						
CO3	3	2	2	3	2	3						
CO4	3	2	1	2	3	-						
CO5	3	2	2	1	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2

CO5	3	2
Course designed by		Verified by
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore Tamil nadu Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP17	DEEP LEARNING					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic Knowledge on Mathematics, Machine Learning Basics.

Course Objectives

1	Develop and Train Deep Neural Networks.
2	Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
3	Build and train RNNs, work with NLP and Word Embeddings
4	The internal structure of LSTM and GRU and the differences between them
5	The Auto Encoders for Image Processing

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: This course provides a comprehensive introduction to the field of deep learning, covering the fundamental concepts, techniques, and applications.

Course Content

Unit	Description	
I	**DEEP LEARNING CONCEPTS:** Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data	
	Contact Periods	**09**
II	**NEURAL NETWORKS:** About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters	
	Contact Periods	**09**
III	**CONVOLUTIONAL NEURAL NETWORK:** About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R- CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO	
	Contact Periods	**09**
IV	**NATURAL LANGUAGE PROCESSING USING RNN:** About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co- occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) .	

	Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gatedrecurrent unit GRU
	Contact Periods 09
V	**DEEP REINFORCEMENT & UNSUPERVISED LEARNING:** About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders
	Contact Periods 09
	Total Periods 45

LIST OF EXPERIMENTS

1. Feature Selection from Video and Image Data
2. Image and video recognition
3. Image Colorization
4. Aspect Oriented Topic Detection & Sentiment Analysis
5. Object Detection using Autoencoder

Contact Periods	30
Total Periods	75

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Feature Extraction from Image and Video Data	K2
CO 2	Implement Image Segmentation and Instance Segmentation in Images	K3
CO 3	Implement image recognition and image classification using a pretrained network (Transfer Learning)	K3
CO 4	Traffic Information analysis using Twitter Data	K4
CO 5	Autoencoder for Classification & Feature Extraction	K3

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						

CO1	2	2	-	3	3	3						
CO2	2	2	2	3	3	2						
CO3	2	2	2	3	2	3						
CO4	2	2	1	3	3	3						
CO5	2	2	-	3	2	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSP18	BLOCK-CHAIN TEHNOLOGIES					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course pre-requisites	Basic Understanding of Networking and Distributed Systems

Course Objectives

1	This course is intended to study the basics of Blockchain technology.
2	During this course the learner will explore various aspects of Blockchain technology like application in various domains
3	By implementing, learners will have idea about private and public Blockchain, and smart contract

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: This course provides an in-depth introduction to blockchain technologies, exploring the fundamental principles, architecture, and real-world applications.

Course Content

Unit	Description	
I	**INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN:** Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain	
	Contact Periods	**09**
II	**BITCOIN AND CRYPTOCURRENCY:** Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency	
	Contact Periods	**09**
III	**INTRODUCTION TO ETHEREUM:** Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts	
	Contact Periods	**09**
IV	**INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING** Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types	
	Contact Periods	**09**
V	**BLOCKCHAIN APPLICATIONS:** Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins	

Contact Periods	**09**
Total Periods	**45**

LIST OF EXPERIMENTS

1. Create a simple Blockchain in any suitable programming language
2. Use Geth to Implement Private Ethereum Block Chain.
3. Build Hyperledger Fabric Client Application.
4. Build Hyperledger Fabric with Smart Contract.
5. Create Case study of Block Chain being used in illegal activities in real world.
6. Using Python Libraries to develop Block Chain Application

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand and explore the working of Blockchain technology	K2
CO 2	Analyze the working of Smart Contracts	K4
CO 3	Understand and analyze the working of Hyperledger	K2
CO 4	Apply the learning of solidity to build de-centralized apps on Ethereum	K3
CO 5	Develop applications on Blockchain	K6

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1.Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

2.Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016.

3.Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014.

4.Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.

5.D. Drescher, Blockchain Basics. Apress, 2017

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	1	3	2	2	3						
CO2	2	1	2	3	2	2						
CO3	2	1	3	1	2	1						
CO4	2	1	2	3	2	2						
CO5	-	-	-	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu | CSE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. S. SUBASREE, M Tech. Ph.D
Professor and Head
Computer Science and Engineering
Nehru Institute of Engineering and Technology
Coimbatore TN India

Course Code	Title					
P23CSP19	FULL STACK WEB APPLICATION DEVELOPMENT					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Basic Understanding of Web Technologies and Basic Programming Skills.

Course Objectives

1	Develop TypeScript Application
2	Develop Single Page Application (SPA)
3	Able to communicate with a server over the HTTP protocol
4	Learning all the tools need to start building applications with Node.js
5	Implement the Full Stack Development using MEAN Stack

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: This course provides a comprehensive introduction to full stack web application development, covering both front-end and back-end technologies.

Course Content

Unit	Description	
I	**FUNDAMENTALS & TYPESCRIPT LANGUAGE:** Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators	
		Contact Periods 09
II	**ANGULAR:** About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two-way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. Http Client. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.	
		Contact Periods 09
III	**NODE.JS:** About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and Typed Arrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON	
		Contact Periods 09
IV	**EXPRESS.JS:** How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine.	

	Jade. EJS. Parameters. Routing. route(path). Router Class. Request Object. Response Object. Error Handling. RESTful	
	Contact Periods	**09**
V	**MONGODB:** Introduction to MongoDB. Documents. Collections. Sub collections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying the Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework	
	Contact Periods	**09**
	Total Periods	**45**

LIST OF EXPERIMENTS

LIST OF EXPERIMENTS

1. Accessing the Weather API from Angular
2. Accessing the Stock Market API from Angular
3. Call the Web Services of Express.js From Angular
4. Read the data in Node.js from MongoDB
5. CRUD operation in MongoDB using Angular

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Develop basic programming skills using Javascript	K2
CO 2	Implement a front-end web application using Angular	K3
CO 3	Will be able to create modules to organise the server	K6
CO 4	Build RESTful APIs with Node, Express and MongoDB with confidence	K1
CO 5	Will learn to Store complex, relational data in MongoDB using Mongoose	K2

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Adam Freeman, Essential TypeScript, Apress, 2019
2. Mark Clow, Angular Projects, Apress, 2018
3. Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4. Pro Express.js, Azat Mardan, Apress, 2015
5. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO 2	PO 3	PO 4	PO 5	PO6						

CO1	-	-	2	3	3	3						
CO2	-	-	2	3	3	3						
CO3	2	-	1	-	3	3						
CO4	2	-	2	-	3	3						
CO5	3	3	-	-	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	2	1
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member: M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS: Dr. S SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India

Course Code	Title					
P23CSP20	BIOINFORMATICS					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		

Course Pre-requisites	Biology, Mathematics and Statistics.

Course Objectives	
1	Exposed to the need for Bioinformatics technologies
2	Be familiar with the modeling techniques
3	Learn microarray analysis
4	Exposed to Pattern Matching and Visualization
5	To know about Microarray Analysis

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: This course offers a comprehensive introduction to bioinformatics, the interdisciplinary field that applies computational methods to analyze and interpret biological data.

Course Content		
Unit	Description	
I	**INTRODUCTION:** Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System	
	Contact Periods	09
II	**DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS** Bio informatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.	
	Contact Periods	09
III	**MODELING FOR BIOINFORMATICS:** Hidden Markov modeling for biological data analysis – Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecular modeling – Computer programs for molecular modeling	
	Contact Periods	09
IV	**PATTERN MATCHING AND VISUALIZATION:** Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization– Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of biological sequences – DNA, Protein, Amino acid sequences	
	Contact Periods	09
V	**MICROARRAY ANALYSIS:** Microarray technology for genome expression study – image analysis for data extraction – pre-processing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis –	

	Compared Evaluation of Scientific Data Management Systems– Cost Matrix – Evaluation model – Benchmark – Trade-offs.
Contact Periods	**09**
Total Periods	**45**

LIST OF EXPERIMENTS

LIST OF EXPERIMENTS

1. Manipulating DNA strings
2. Use Protein Data Bank to visualize and Analyze the Proteins from protein database
3. Explore the Human Genome with the SciPy Stack
4. Hidden Markov Model for Biological Sequence
5. Molecular Modeling using MMTK package
6. Sequence Alignment using Bio python, Pairwise and multiple sequence alignment using Clustal W and BLAST
7. Simple generation and manipulation of genome graphs
8. DNA data handling using Bio python
9. Chaos Game Representation of a genetic sequence
10. Visualize the microarray data using Heatmap

Contact Periods	**30**
Total Periods	**75**

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand the different Data formats	K2
CO 2	Develop machine learning algorithms	K6
CO 3	Develop models for biological data	K6
CO 4	Apply pattern matching techniques to bioinformatics data – protein data genomic data	K3
CO 5	Apply micro array technology for genomic expression study	K3

K1: Remembering; K2:Understanding; K3:Applying; K4:Analyzing; K5:Evaluating;K6:Creating.

References

1. Yi-Ping Phoebe Chen (Ed), "Bio Informatics Technologies", First Indian Reprint, Springer Verlag, 2007.
2. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2015.
3. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press,2019

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	-	-	-	3						

CO2	1	1	2	2	1	2						
CO3	1	2	1	1	3	3						
CO4	1	2	2	2	2	2						
CO5	1	2	1	-	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	2	2
CO2	2	1
CO3	2	2
CO4	2	1
CO5	2	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Name and Department of the Faculty Member: M.S. Vinu / CSE	Name and Seal of the Chairperson-BoS: Dr. S. SUBASREE, M.Tech. Ph.D, Professor and Head, Computer Science and Engineering, Nehru Institute of Engineering and Technology, Coimbatore TN India

Course Code	Title					
P23CSO014	IOT FOR SMART SYSTEMS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Proficiency in programming languages such as Python, C++, or Java to create and manage connected devices.

Course Objectives

1	To study about Internet of Things technologies and its role in real time applications.
2	To introduce the infrastructure required for IoT
3	To familiarize the accessories and communication techniques for IoT.
4	To provide insight about the embedded processor and sensors required for IoT
5	To familiarize the different platforms and Attributes for IoT

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Cover the basics, including the various sensors, connectivity options, and data processing methods used in IoT systems

Course Content

Unit	Description	
I	**INTRODUCTION TO INTERNET OF THINGS:** Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.	
	Contact Periods	**09**
II	**IOT ARCHITECTURE:** IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.	
	Contact Periods	**09**
III	**PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT PROTOCOLS:** NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. **WIRELESS TECHNOLOGIES FOR IoT:** WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.	
	Contact Periods	**09**
IV	**IOT PROCESSORS:** Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, and Maintainability. **Embedded processors for IOT:** Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.	
	Contact Periods	**09**
V	**CASE STUDIES :** Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense	
	Contact Periods	**09**
	Total Periods	**60**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO 1	Analyze the concepts of IoT and its present developments.	K2
CO 2	Compare and contrast different platforms and infrastructures available for IoT	K4
CO 3	Explain different protocols and communication technologies used in IoT	K2
CO 4	Analyze the big data analytic and programming of IoT	K2
CO 5	Implement IoT solutions for smart applications	K3
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creati		

References

1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach "Internet of Things",Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi " The Internet of Things", Wiley,2016.
3. Samuel Greengard, "The Internet of Things", The MIT press, 2015.
4. 4. Adrian McEwen and Hakim Cassimally "Designing the Internet of Things "Wiley,2014.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	-	-	-	-	-						
CO2	1	-	-	-	-	-						
CO3	1	2	3	2	1	1						
CO4	1	2	2	1	1	1						
CO5	1	-	3	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M.Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSO017	SMART GRID					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Basic Understanding of Power System and Power Electronics Engineering

Course Objectives

1	To Study Smart Grid technologies, different smart meters and metering infrastructure.
2	To know about the function of smart grid.
3	To familiarize the power quality management issues in Smart Grid.
4	To familiarize the high performance computing for Smart Grid applications
5	To get familiarized with the communication networks for Smart Grid applications

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Covers the fundamental aspects of the smart grid and its application to the existing power system

Course Content

Unit	Description	
I	**INTRODUCTION TO SMART GRID :** Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.	
	Contact Periods	09
II	**SMART GRID TECHNOLOGIES:** Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts	
	Contact Periods	09
III	**SMART METERS AND ADVANCED METERING INFRASTRUCTURE:** Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.	
	Contact Periods	09

IV	**POWER QUALITY MANAGEMENT IN SMART GRID** : Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.
	Contact Periods 09
V	**HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS:** Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.
	Contact Periods 09
	Total Periods 60

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Relate with the smart resources, smart meters and other smart devices.	K4
CO 2	Explain the function of Smart Grid.	K2
CO 3	Experiment the issues of Power Quality in Smart Grid.	K2
CO 4	Analyze the performance of Smart Grid.	K2
CO 5	Recommend suitable communication networks for smart grid applications	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	1	3	2	-	-						
CO2	1	3	3	3	1	1						
CO3	2	3	3	3	1	-						
CO4	2	3	2	3	1	-						
CO5	1	2	2	2	2	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1

CO3	3	2
CO4	3	2
CO5	3	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSO018	BIG DATA ANALYTICS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Computer Networks and Distributed Systems

Course Objectives

1	To understand the basics of big data analytics
2	To understand the search methods and visualization
3	To learn mining data streams
4	To learn frameworks
5	To gain knowledge on R language

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Big Data Analytics is a field focused on analyzing large and complex data sets to uncover hidden patterns, correlations, and insights that can drive decision-making and innovation.

Course Content

Unit	Description	
I	**INTRODUCTION TO BIG DATA:** Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis –Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.	
	Contact Periods	**09**
II	**SEARCH METHODS AND VISUALIZATION:** Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies –Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques.	
	Contact Periods	**09**
III	**MINING DATA STREAMS:** Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	
	Contact Periods	**09**
IV	**FRAMEWORKS:** MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation.	
	Contact Periods	**09**

V	**R LANGUAGE:** Overview, Programming structures: Control statements -Operators -Functions - Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists -Data frames -Classes, Input/output, String manipulations.
	Contact Periods 09
	Total Periods 60

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Understand the basics of big data analytics	K2
CO 2	Ability to use Hadoop, Map Reduce Framework.	K4
CO 3	Ability to identify the areas for applying big data analytics for increasing the business outcome.	K2
CO 4	Gain knowledge on R language	K2
CO 5	Contextually integrate and correlate large amounts of information to gain faster insights.	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creatin

References

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.
3. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.
4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
5. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	-	-	-	-	-						
CO2	1	-	-	-	-	-						
CO3	1	2	3	2	1	1						
CO4	1	2	2	1	1	1						
CO5	1	-	3	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2

CO5	3	1
Course designed by		**Verified by**
Signature of the Faculty Member		Signature of the Chairperson-BoS
M.S.Vinu / CSE Name and Department of the Faculty Member		Dr. S. SUBASREE, M Tech. Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSO019	INTERNET OF THINGS AND CLOUD					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	Programing knowledge is must for learning IOT, Communication Technology and communication protocols.

Course Objectives

1	To understand Smart Objects and IoT Architectures
2	To learn about various IOT-related protocols
3	To build simple IoT Systems using Arduino and Raspberry Pi.
4	To understand data analytics and cloud in the context of IoT
5	To develop IoT infrastructure for popular applications

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: practical experience in the development of Cloud-based IoT systems and exposure to appropriate hardware and software platforms that underpin such development.

Course Content

Unit	Description	
I	**FUNDAMENTALS OF IoT:** Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.	
	Contact Periods	**09**
II	**PROTOCOLS FOR IoT:** Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.	
	Contact Periods	**09**
III	**CASE STUDIES/INDUSTRIAL APPLICATIONS** Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.	
	Contact Periods	**09**
IV	**CLOUD COMPUTING INTRODUCTION:** Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.	
	Contact Periods	**09**
V	**IoT AND CLOUD :** IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security	
	Contact Periods	**09**
	Total Periods	**60**

Course Outcomes
Upon successful completion of the course, students will be able to:

CO 1	Understand the various concept of the IoT and their technologies.	K2
CO 2	Develop IoT application using different hardware platforms	K1
CO 3	Implement the various IoT Protocols	K2
CO 4	Understand the basic principles of cloud computing	K2
CO 5	Develop and deploy the IoT application into cloud environment	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. 'The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
4. Simon Walkowiak, "Big Data Analytics with R" PackT Publishers, 2016
5. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	-		-	-	-						
CO2	-	2	3	2	-	-						
CO3	-	2	2	-	-	-						
CO4	1	2	3	-	-	-						
CO5	-	-	3	-	-							

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M Tech. Ph.D Professor and Head, Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

Course Code	Title					
P23CSO020	MEDICAL ROBOTICS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		

Course Pre-requisites	May require a foundation in robotics, programming, or biology.

Course Objectives

1	To explain the basic concepts of robots and types of robots
2	To discuss the designing procedure of manipulators, actuators and grippers
3	To impart knowledge on various types of sensors and power sources
4	To explore various applications of Robots in Medicine
5	To impart knowledge on wearable robots

Course Category	Professional Core Course (PCC)
Development Needs	Global

Course Description: Medical robotics integrates knowledge from various fields

Course Content

Unit	Description	
I	**INTRODUCTION TO ROBOTICS:** Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization. **SENSORS AND ACTUATORS :** Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models	
	Contact Periods	**09**
II	**MANIPULATORS & BASIC KINEMATICS:** Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems. **NAVIGATION AND TREATMENT PLANNING:** Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor	
	Contact Periods	**09**
III	**SURGICAL ROBOTS:** Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study	
	Contact Periods	**09**
IV	**REHABILITATION AND ASSISTIVE ROBOTS:** Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study	
	Contact Periods	**09**

V	**WEARABLE ROBOTS:** Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human– robot physical interaction (pHRI), Wearable Robotic Communication - case study	
	Contact Periods	**09**
	Total Periods	**60**

Course Outcomes
Upon successful completion of the course, students will be able to:

CO 1	Describe the configuration, applications of robots and the concept of grippers and actuators	K2
CO 2	Explain the functions of manipulators and basic kinematics	K2
CO 3	Describe the application of robots in various surgeries	K2
CO 4	Design and analyze the robotic systems for rehabilitation	K6
CO 5	Design the wearable robots	K6

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating.

References

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw Hill, First edition, 2003
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008
3. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, "Robotics, control", sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	2	-	-	-						
CO2	3	2	3	-	1	-						
CO3	3	3	3	-	1	-						
CO4	3	2	3	-	1	-						
CO5	3	2	3	-	1	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
M.S. Vinu / CSE Name and Department of the Faculty Member	Dr. S. SUBASREE, M.Tech., Ph.D Professor and Head Computer Science and Engineering Nehru Institute of Engineering and Technology Coimbatore TN India Name and Seal of the Chairperson-BoS

MANDATORY COURSES (AC)

Registration for any of these courses is optional to students

SL NO.	COURSE CODE	COURSETITLE	PERIODSPER WEEK			CREDITS
			L	T	P	
1.	P23MG01	Disaster Management	2	0	0	0
2.	P23MC01	English for Research Paper Writing	2	0	0	0
3.	P23MC03	Constitution of India	2	0	0	0
4.	P23MC04	Natramil Illakiyam	2	0	0	0

FOUNDATION COURSES (FC)

S.NO	COURSE CODE	COURSETITLE	PERIODSPER WEEK			CREDITS	Sem
			Lecture	Tutorial	Practical		
1.	P23MA102	Advanced Mathematical Methods	3	1	0	4	1

PROFESSIONAL CORE COURSES(PCC)

S.NO	COURSE CODE	COURSETITLE	PERIODSPERWEEK			CREDITS	SEM
			Lecture	Tutorial	Practical		
1.	P23CS103	Advanced Data Structures and Algorithms	3	0	0	3	I
2.	P23CS104	Database Practices	3	0	2	4	I
3.	P23CS105	Network Technologies	3	0	0	3	I
4.	P23CS106	Principles of Programming	3	0	0	3	I
5.	P23CS117	Advanced Data Structures and Algorithms Laboratory	0	0	4	2	I
6.	P23CS201	Internet of Things	3	0	2	4	II
7.	P23CS202	Multicore Architecture and Programming	3	0	2	4	II
8.	P23CS203	Machine Learning	3	0	2	4	II
9.	P23CS204	Advanced Software Engineering	3	0	0	3	II
10.	P23CS216	Software Engineering Laboratory	0	0	2	1	II
11.	P23CS301	Security Practices	3	0	0	3	III

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSETITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	P23MG02	Research Methodology and IPR	2	0	0	2	I

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO	COURSE CODE	COURSETITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.		Technical Seminar	0	0	2	1	1
2.		Project Work I	0	0	12	6	3
3.		Project Work II	0	0	24	12	4

SUMMARY

S. No.	NAME OF THE PROGRAMME: M.E. COMPUTER SCIENCE AND ENGINEERING					
	SUBJECTAREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	15	16	03	00	34
3.	PEC	00	06	07	00	13
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	01	06	12	19
7.	Non-Credit/Audit Course	-	-	-	-	
8.	**TOTAL CREDIT**	**21**	**23**	**19**	**12**	**75**

Course Code	Title					
P23MC01	ENGLISH FOR RESEARCH PAPER WRITING					
Semester: I/II	L	T	P	Credits	CIA: 100 Marks	ESE: -
	2	0	0	0		

Course pre-requisites	

Course Objectives

1	Teach how to improve writing skills and level of readability.
2	Tell about what to write in each section.
3	Summarize the skills needed when writing a title.
4	Infer the skills needed when writing the conclusion.
5	Ensure the quality of paper at very first-time submission.

Course Category	Mandatory Course
Development Needs	National

Course Description: This will help the students to acquire basic skills of report writing and reflective journal writing during their case studies and project works.

Course Content

Unit	Description	
I	**INTRODUCTION TO RESEARCH PAPER WRITING:** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
	Contact Periods	6
II	**PRESENTATION SKILLS:** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	
	Contact Periods	6
III	**TITLE WRITING SKILLS:** 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, Methods, Results, Discussion, Conclusions, The Final Check	
	Contact Periods	6
IV	**RESULT WRITING SKILLS:** 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	
	Contact Periods	6
V	**VERIFICATION SKILLS:** Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission	
	Contact Periods	6
	Total	**30 Periods**

Course Outcomes

CO 1	Understand that how to improve your writing skills and level of readability
CO 2	Learn about what to write in each section

CO 3	Understand the skills needed when writing a Title
CO 4	Understand the skills needed when writing the Conclusion
CO 5	Ensure the good quality of paper at very first-time submission
Reference Books	1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011 2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006 3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006 4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/Seminar /Case Studies	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	1	1	1	1
CO 2	2	2	1	2	2	1
CO 3	3	2	1	3	3	1
CO 4	2	2	1	2	2	1
CO 5	2	2	1	2	2	1

3-High; 2-Medium; 1-Low

Course designed by	Verified by
R. Hg. Signature of the Faculty Member	Signature of the chairperson-BoS
Dr. R. Deepa. ASP-SEH. Name and Department of the Faculty Member	Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105 Name and Seal of the chairperson-BoS

Course Code	Title					
P23MG01	DISASTER MANAGEMENT					
Semester: I/ II	L	T	P	Credits	CIA: 100 Marks	ESE: -
	2	0	0	0		

Course pre-requisites	-

Course Objectives

1	Summarize basics of disaster.
2	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4	Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5	Develop the strengths and weaknesses of disaster management approaches.

Course Category	Mandatory Course
Development Needs	National

Course Description: This will help the students to acquire basic idea of disaster and helps to eradicate and manage during the disaster

Course Content

Unit	Description	
I	**INTRODUCTION:** Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	
	Contact Periods	**6**
II	**REPERCUSSIONS OF DISASTERS AND HAZARDS:** Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	
	Contact Periods	**6**
III	**DISASTER PRONE AREAS IN INDIA** Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; PostDisaster Diseases and Epidemics.	
	Contact Periods	**6**
IV	**DISASTER PREPAREDNESS AND MANAGEMENT:** Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.	
	Contact Periods	**6**
V	**RISK ASSESSMENT:** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	
	Contact Periods	**6**
	Total	**30 Periods**

Course Outcomes	
CO 1	Ability to summarize basics of disaster
CO 2	Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO 3	Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO 4	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO 5	Ability to develop the strengths and weaknesses of disaster management approaches
Reference Books	1. 1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009. 2. 2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007. 3. 3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi,2001.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/Seminar /Case Studies	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	1	1	1	1
CO 2	2	2	1	2	2	1
CO 3	3	2	1	3	3	1
CO 4	2	2	1	2	2	1
CO 5	2	2	1	2	2	1

3-High; 2-Medium; 1-Low

Course designed by	Verified by
Signature of the Faculty Member	Signature of the chairperson-BoS
Sukanya.S, MBA Name and Department of the Faculty Member	Dr. P.T. VIJAYA RAJAKUMAR Professor and Director Department of Management Studies Nehru Institute of Engineering and Technology Coimbatore Name and Seal of the chairperson-BoS

Course Code	Title					
P23MC03	CONSTITUTION OF INDIA					
Semester: I / II	L	T	P	Credits	CIA: 100 Marks	ESE: -
	2	0	0	0		

Course pre-requisites	

Course Objectives	
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 nation hood in the early years of Indian nationalism.
3	To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

Course Category	Mandatory Course
Development Needs	National

Course Description: This will help the students to acquire basic civil rights and constitutional rights which are in INDIA

Course Content

Unit	Description	
I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION:** History, Drafting Committee, (Composition & Working)	
	Contact Periods	3
II	**PHILOSOPHY OF THE INDIAN CONSTITUTION:** Preamble, Salient Features	
	Contact Periods	3
III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND 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.	
	Contact Periods	6
IV	**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.	
	Contact Periods	6
V	**LOCAL ADMINISTRATION :** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.	
	Contact Periods	6
VI	**ELECTION COMMISSION:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	
	Contact Periods	6

		Total	30 Periods
Course Outcomes			
CO 1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics		
CO 2	Discuss the intellectual origins of the framework of argument that informed the conceptualization.		
CO 3	Social reforms leading to revolution in India.		
CO 4	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.		
CO 5	Discuss the passage of the Hindu Code Bill of 1956.		
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. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.		

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/Seminar /Case Studies	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	1	1	1	1
CO 2	2	2	1	2	2	1
CO 3	3	2	1	3	3	1
CO 4	2	2	1	2	2	1
CO 5	2	2	1	2	2	1

3-High; 2-Medium; 1-Low

Course designed by	Verified by
Signature of the Faculty Member	Signature of the chairperson-BoS
Dr. R. Deepa ASP-SEN. Name and Department of the Faculty Member	Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105 Name and Seal of the chairperson-BoS

Course Code	Title				
P23MC04	நற்றமிழ் இலக்கியம்				
Semester:I/II	L	T	P	Credits	Internal Assessment:100 Marks
	2	0	0	0	
Course pre-requisites	Higher Secondary Level				

Course Objectives	
1	To learn the extensive literature of classical Tamil.
2	To review the morality of Tamil Literature.
3	To realize the two epic Tamil literatures.
4	To understand the role of ethics in Sangam literature.
5	To examine Tamil modern literature.

Course Category	Humanities, Social Science and Management Course (HSMC)
Development Needs	Global/National

Course Description: Used to explores the extensive literature of classical and modern Tamil literature based on its morality, epics and ethics of Tamil community.

Course Content

Unit	Description	
I	**சங்க இலக்கியம்:** 1. தமிழின் துவக்க நூல் தொல்காப்பியம் – எழுத்து, சொல்,பொருள், 2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம், 3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி, 4. புறநானூறு (95,195) - போரை நிறுத்திய ஔவையார்.	Contact periods 06
II	**அறநெறித் தமிழ்:** 1. அறநெறி வகுத்த திருவள்ளுவர் அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ், 2. பிற அறநூல்கள் - இலக்கிய மருந்து ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்).	Contact periods 06
III	**இரட்டைக் காப்பியங்கள்:** 1. கண்ணகியின் புரட்சி சிலப்பதிகார வழக்குரை காதை, 2. சமூகசேவை இலக்கியம் மணிமேகலை சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை.	Contact periods 06
IV	**அருள்நெறித் தமிழ்:** 1.சிறுபாணாற்றுப்படை பாரி முல்லைக்குத் தேர் கொடுத்தது. பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைச் நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள், 2.நற்றிணை - அன்னைக்குரிய புன்னை சிறப்பு, 3.திருமந்திரம் (617,618) இயமம் நியமம் விதிகள், 4.தர்மச்சாலையை நிறுவிய வள்ளலார். 5.புறநானூறு சிறுவனே வள்ளலானான, 6. அகநானூறு (4) வண்டு நற்றிணை (11) நண்டு கலித்தொகை (11) யானை, புறா ஐந்திணை 50 (27) மான ஆகியவை பற்றிய செய்திகள்.	Contact periods 06

V	**நவீன தமிழ் இலக்கியம்:** 1. உரைநடைத் தமிழ். தமிழின் முதல் புதினம், தமிழின் முதல் சிறுகதை. கட்டுரை இலக்கியம், பயண இலக்கியம், நாடகம், 2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும், 3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும், 4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும், 5. அறிவியல் தமிழ், 6.இணையத்தில் தமிழ், 7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.
	Contact Periods 06
	Total Periods 30

Course Outcomes

Upon successful completion of the course, students will be able to:

CO 1	Remember the extensive literature of Tamil and its classical nature.	K1
CO 2	Remember the morality of Tamil literature.	K1
CO 3	Understand the two epic Tamil literature.	K2
CO 4	Understand the role of ethics in Sangam literature.	K2
CO 5	Understand the Tamil modern literature.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Text Books	1. தமிழகவரலாறு – மக்களும்பண்பாடும் – .கே. கேபிள்ளை (வெளியீடு:தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள் கழகம். 2. வாழ்வியல் களஞ்சியம் தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்.
Reference Books	1. தமிழ் இணைய கல்விக்கழகம் - Tamil Virtual University - www.tamilvu.org. 2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - https //ta.wikipedia.org. 3. தர்மபுர ஆதீன வெளியீடு. 4. .தமிழ்கலைக்களஞ்சியம் தமிழ் வளர்ச்சித்துறை - thamilvalarchithurai.com. 5. அறிவியல் களஞ்சியம் தமிழ்ப் பல்கலைக்கழகம , தஞ்சாவூர்.

Tools for Assessment (40 Marks)

CIAI	CIAII	CIAIII	Assignment/Seminar/ Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	2	-	-	1
CO2	-	1	2	-	-	1
CO3	-	1	2	-	-	1
CO4	-	1	2	-	-	1
CO5	-	1	2	-	-	1

3-High;2-Medium;1-Low

CO \ PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. DEEPAK.A. S&H Dept Name and Department of the Faculty Member	Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105 Name and Seal of the Chairperson-BoS