A.D.M COLLEGE FOR WOMEN (AUTONOMOUS),

NAGAPATTINAM-611 001

(Nationally Re-accredited with 'A' Grade by NAAC- 3rd Cycle)

PG DEPARTMENT OF COMPUTER SCIENCE

(for the candidates admitted from the academic year 2021-2023)

M.Sc. COMPUTER SCIENCE

SYLLABUS
(2021-2023 BATCH)

PG DEPARTMENT OF COMPUTER SCIENCE
M.Sc., COMPUTER SCIENCE COURSE STRUCTURE UNDER CBCS
(2021-2023 Batch)

OBE ELEMENTS

Programme Educational Objectives (PEO):

PEO 1	To provide advanced and in-depth knowledge of computer science and its applications
PEO 2	To prepare Post Graduates who will achieve peer-recognition; as an individual or in a through demonstration of good analytical, design and implementation skills.
PEO 3	To enable students pursue a professional career in Information and Communication Technology related industry, business and research
PEO 4	To impact professional knowledge and practical skills to the students.
PEO 5	To enable students to take up challenging jobs.

Programme Outcomes (PO):

On completion of the course the learner will be able

PO-1	Attain a sound understanding of the general principles of Computer Science.
PO-2	Obtain exposure to innovative, research-based topics within computing
PO-3	Acquire leadership qualities, and good communication, teamwork, social, and professional skills.
PO-4	Understand the impact of computer science solutions in a global and societal context
PO-5	Apply knowledge of computing to produce effective designs and solutions for specific problems

Programme Specific Outcomes (PSO):

On completion of the course the learner will be able

PSO - 1	Acquire academic excellence with an aptitude for higher studies and research.
PSO – 2	Attain knowledge to develop and apply new computer technologies.
PSO – 3	Contribute to the local society and the global community related to Computer Science.
PSO – 4	Identify, formulate, and solve computer science problems.
PSO – 5	Practice high standard of professional ethics.

M.Sc., COMPUTER SCIENCE 2021 – 2023 Batch

STRUCTURE OF THE PROGRAMME

Course	No. of Papers	Hours	Credit
Core Course (CC)	15	68	54
Elective Course (EC)	5	22	18
Self-Paced Learning (SPL)	1	-	2
Extra Credit Course (ECC)	1	-	2
Internship / Field Work	-	-	2
Project	1	30	16
Total	**23**	**120**	**90 (6)**

M.Sc. COMPUTER SCIENCE (2021-2023) BATCH
SCHEME OF THE PROGRAMME

SEM	COURSE CODE	COURSE	INST HOURS	CREDIT	EXAM HOURS	MARKS		TOTAL MARKS
						CIA	SE	
I	PGXA	Core Course -I (CC) Database and NoSQL	4	4	3	25	75	100
	PGXB	Core Course- II (CC) Design and Analysis ofAlgorithms	5	4	3	25	75	100
	PGXC	Core Course –III(CC) Modern Operating Systems	4	4	3	25	75	100
	PGXD	Core Course –IV (CC) Advanced JavaProgramming	5	4	3	25	75	100
	PGXEY	Core Course-V (CC) Mongodb Lab	4	3	3	40	60	100
	PGXFY	Core Course-VI (CC) Advanced Java ProgrammingLab	4	4	3	40	60	100
	PGXE1	Core Elective - I (EC) Any one from the list	4	4	3	25	75	100
	Total		**30**	**27**	*	*	*	**700**
II	PGXG	Core Course –VII (CC) Data Science Using Python	5	3	3	25	75	100
	PGXH	Core Course-VIII (CC) Big Data Analytics	4	3	3	25	75	100
	PGXI	Core Course- IX (CC) Distributed Technologies	5	3	3	25	75	100
	PGXJY	Core Course- X (CC) Distributed Technologies Lab	4	3	3	40	60	100
	PGXKY	Core Course- XI (CC) Advanced Python Lab	4	3	3	40	60	100
	PGXL	Self-Paced Learning (SPL) Virtualization & Cloud Computing	-	2	3	25	75	100
	PGXE2	Core Elective - II (EC) Any one from the list	4	3	3	25	75	100
	PGXE3	Core Elective -III (EC) Any one from the list	4	3	3	25	75	100
		Extra Credit Course (ECC) MOOC Online	-	2	-	-	-	Grade
	Total		**30**	**21(4)**	*	*	*	**800**

SEM	COURSE CODE	COURSE	INST HOURS	CREDIT	EXAM HOURS	MARKS		TOTAL
						C.I.A	E.E	
III	PGXM	Core Course - XII(CC) Data Mining and Data Warehousing	5	4	3	25	75	100
	PGXN	Core Course - XIII(CC) Data Mining Lab	5	4	3	40	60	100
	PGXO	Core Course– XIV (CC) Machine Learning and R Programming	5	4	3	25	75	100
	PGXPY	Core Course- XV(CC) Embedded Lab	5	4	3	40	60	100
	PGXE4	Core Elective- IV(EC) Any one from the list	5	4	3	25	75	100
	PGXE5	Core Elective– V(EC) Any one from the list	5	4	3	25	75	100
	Internship / Field Work (30 Hours)		-	2	-	-	-	Grade
	Total		**30**	**24(2)**	*	*	*	**600**
IV	PGXQP	Core Course -XVI(CC) Project	30	16	3	25	75	100
	Total		**30**	**16**	*	*	*	**100**
	Grand Total		**120**	**90 (6)**				**2200**

List of Elective Subjects:

Elective I	Elective II
1. Artificial Intelligence 2. High Performance Computing 3. Parallel and Distributed Computing	**1. Ethical Hacking** 2. Cryptography & Network Security 3. Adhoc and Sensor Networks
Elective III	**Elective IV**
1. Compiler Design **2.** MANET **3.** Software Project Management	**1. Embedded System** 2. Security in Computing 3. Grid Computing
Elective V	
1. Internet of Things **2.** Human Computer Interaction **3.** Web Services	

M. Sc. – ADD ON COURSE

Year	Sem.	Title of the Paper	Credit
I	II	Self-Paced Learning	2
I	II	Swayam / MOOC	2
III	IV	Internship Training	2

Semester-I / Core Course-I (CC)	DATABASE AND NOSQL	Course Code : PGXA
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks: 75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Understand the concept of database and data warehouses. • Knowledge on MongoDB query language. • Ability to comprehend the principles of NoSQL. • Understand the difference of NoSQL key value database and Document database • Know the concept of Column database • Understand the data modelling techniques	
UNIT	**CONTENT**	**HOURS**
I	**Database** Revolutions- System Architecture- Relational Database- Database Design Data Storage- Transaction Management- Data warehouse and Data Mining- Information Retrieval.	**12**
II	**Introduction to MongoDB** key features- Core Server tools- MongoDB through the JavaScript's Shell- Creating and Querying through Indexes- Document-Oriented, principles of schema design- Constructing queries on Databases- collections and Documents- MongoDBQuery Language.	**12**
III	**DATABASE**: RDBMS VS NOSQL - Data Management with Distributed Databases- ACID and BASE- Four types of NOSQL Databases. KEY VALUE DATABASES: Introduction to key value databases- Essential Features of Key value Databases- Key-Value Database Data Modeling Terms- Key-Value Architecture Terms- Key-Value Implementation Terms.	**12**
IV	**DOCUMENT DATABASE**: Introduction to Document Database: Document-	**12**

	managing Multiple Document in collection-Basic Operations on document Database- Types of Partitions- Data modeling and Query processing-Normalization, Denormalization, and the Search for proper Balance.	
V	**COLUMN DATABASE**: Introduction to Column Family Database: Utilizing Dynamic Control over Column- Indexing by row, column name and Time Stamp- Controlling Location of data- Reading and Writing Atomic Rows-Maintaining rows in Sorted Order- Column Family Database Features-Column family Database Versus Relational Database- Basic Components of Column Family database.	**12**
VI	Contemporary Issues: Expert lectures, online seminars – webinars	**-**

Text Book

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, SixthEdition, McGrawHill.
2. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley, 2015.

Reference Books

Kyle Banker, Piter Bakkum, Shaun Verch, MongoDB in Action, Dream tech Press.

Web Resources:

1. https://www.guru99.com/what-is mongodb.html#:~:text=MongoDB%20is%20a%20document%2Doriented,unit%20of%20data%20in%20MongoDB.
2. https://www.geeksforgeeks.org/mongodb-an-introduction/
3. https://intellipaat.com/blog/what-is-mongodb/
4. https://www.tutorialspoint.com/mongodb/index.html

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Define, compare and use the four types of NoSQL Databases (Document-oriented, KeyValue Pairs, Column-oriented and Graph).

CO2: Distinguish the different types of NoSQL databases.

CO3: Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.

CO4: Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.

CO5: Evaluate NoSQL database development tools and programming languages.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated
M - Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / Core Course- II (CC)	DESIGN AND ANALYSIS OF ALGORITHMS	Course Code :PGXB
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Define the basic concepts of algorithms and analyze the performance of algorithms. • Discuss various algorithm design techniques for developing algorithms. • Discuss various searching, sorting and graph traversal algorithms. • Understand NP completeness and identify different NP complete problems. • Discuss various advanced topics on algorithms	
UNIT	**CONTENT**	**HOURS**
I	Algorithm Definition – Algorithm Specification – Performance Analysis. Elementary Data Structures: Stacks and Queues – Trees – Dictionaries – Priority Queues – Sets and Disjoint Set Union – Graphs.	15
II	The General Method – Defective Chessboard – Binary Search – Finding The Maximum And Minimum – Merge Sort – Quick Sort – Selection - Strassen's Matrix Multiplication.	15
III	General Method - Container Loading - Knapsack Problem - Tree Vertex Splitting – Job Sequencing With Deadlines - Minimum Cost Spanning Trees - Optimal Storage On Tapes – Optimal Merge Patterns - Single Source Shortest Paths.	15
IV	The General Method – Multistage Graphs – All-Pairs Shortest Paths – Single-Source Shortest Paths - Optimal Binary Search Trees -	15

	String Editing - 0/1 Knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling. Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees – Biconnected Components and DFS.	
V	The General Method – The 8-Queens Problem – Sum of Subsets - Graph Coloring – Hamiltonian Cycles – Knapsack Problem Branch and Bound: The Method - 0/1 Knapsack Problem.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars	-

Text Books:

Ellis Horowitz, Satraj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, Second Edition, Reprint 2009.

Reference Books

1. Data Structures Using C - Langsam, Augenstien, Tenenbaum, PHI
2. Data structures and Algorithms, V.Aho, Hopcropft, Ullman , LPE
3. Introduction to design and Analysis of Algorithms - S.E. Goodman, ST. Hedetniem- TMH

Web-Resources:

https://www.iare.ac.in/sites/default/files/lecture_notes/DAA_LECTURE_NOTES_0.pdf

http://dmice.ac.in/wp-content/uploads/2017/05/DAA.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).

CO2: Distinguish the different types of NoSQL databases.

CO3: Explain the detailed architecture, define objects, load data, query data and performance tuneDocument-oriented NoSQL databases.

CO4: Demonstrate an understanding of the detailed architecture, define objects, load data, querydata and performance tune Column-oriented NoSQL databases.

CO5: Evaluate NoSQL database development tools and programming languages.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	M	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-I / Core Course- III (CC)	MODERN OPERATING SYSTEMS	Course Code :PGXC
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To acquire knowledge in Distributed operating. • To know the components of distributed resource management. • To know the components and management aspects of Real time, Mobile operating systems. • Use disk management and disk scheduling algorithms for better utilization of externalmemory. • Recognize file system interface, protection and security mechanisms.	
UNIT	**CONTENT**	**HOURS**
I	What is operating system? - The Operating System as a Extended Machine- The Operating System as a Resource Manager-History of Operating systems-The Operating system Zoo-Mainframe Operating systems-Server Operating System-Personal Computer Operating systems-Computer Hardware Review-Processor-I/O Devices-System calls-Operating System Structure-Client And Server Model-Process-Threads-Scheduling.	12
II	Basic Memory Management-Mono programming Without Swapping Or Paging-Modeling Multiprogramming-Swapping-Memory Management with Bitmaps-Linked Lists-Virtual Memory-Paging-Page Table-Translation Look side Buffers-Design Issues for Paging System- Local Versus Global Allocation Policies-Load Control- Segmentation-The Intel Pentium.	12
III	Files-File Types-File Attributes-File Operation-Memory Mapped	12

	Files-Directories-Single Level Directory Systems-Two Level Directory Systems-Hierarchical Directory Systems-File System Implementation. **Input/output**: Principles of I/O Hardware-Device Controllers-Memory Mapped I/O- Principles of I/O Software-Goals Of The Softwere - Programmed I/O-Interrupt I/O-I/O Using DMA.	
IV	Introduction to Multimedia – Multimedia Files- Multimedia Process Scheduling- Scheduling Homogeneous Processes-General Real Time Scheduling-Earliest Deadline First Scheduling. **Dead Lock**: Introduction to Dead Locks-Conditions For Deadlock- Deadlock Modeling-The Ostrich Algorithm-Dead Lock Detection And Recovery-Dead Lock Avoidance-Resource Trajectories-Safe And Unsafe States- The Banker's Algorithm for Single Resource- The Banker's Algorithm for Multiple Resource-Deadlock Prevention.	12
V	Distributed System-Network Hardware-Network Services and Protocols-File System Based Middleware-Shared Object Based Middleware. **Security:** The Security Environment-Threads-Intruders-Accidental Data Loss- Basics of Cryptography-Secret key. Cryptography-Digital Structure-User Authentication-Countermeasures- Attacks From Inside The System-Trojan Horses-Login Spoofing-Generic Security Attacks- Attacks From Outside The System-Virus Damage Scenarios-Mobile Code-Java Security.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars	-

Text Book

Andrew S. Tannenbaum and Herbert Bos, "Modern Operating Systems", Fourth Edition, Prentice Hall, 2014.

Reference Books

1. Jonathan Levin, “Mac OS X and iOS Internals: To the Apple‟s Core”, John Wiley & Sons, 2012.
2. Mike Ebbers, John Kettner, Wayne O‟Brien, Bill Ogden, “Introduction to the New Mainframe: z/OS Basics”, Third Edition, International Business Machines Corporation, 2011.
3. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", Wiley, Eighth edition, 2008.

Web Resources

http://materias.fi.uba.ar/7508/MOS4/Operating.Systems.4th.Edi.pdf

https://acadndtechy.files.wordpress.com/2015/01/real-time-systems-rajib-mall-pearson-education-india-2007.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: To understand the main components of an OS & their functions.
CO2: To study the process management and scheduling.
CO3: To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
CO4: To understand the concepts and implementation Memory management policies and virtual memory.
CO5: To study the need for special purpose operating system with the advent of new emerging technologies.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-I / Core Course-IV(CC)	ADVANCED JAVA PROGRAMMING	Course Code : PGXD
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To learn why Java is useful for the design of desktop and web applications. • To learn how to implement object-oriented designs with Java. • To identify Java language components and how they work together in applications. • To design and program stand-alone Java applications. • To understand how to use Java APIs for program development	
UNIT	**CONTENT**	**HOURS**
I	**J2EE OVERVIEW:** J2EE and J2SE- The Birth of J2EE - J2EE. **J2EE Multitier Architecture:** The Tier - J2EE Multi-Tier Architecture - Client Tier Implementation- Classification of Clients - Web Tier Implementation. **J2EE Best Practices:** The Enterprise Application-Session Management- Presentation and Processing- Model View Controller.	15
II	JAVA REMOTE METHOD INVOCATION : RMI Concept- Remote Interface- Passing Objects - The RMI Process - Sever side - Client side. **JAVA Servlets:** Java Servlets and Common Gateway Interface Programming- Benefits of using a Java Servlet – A simple Java Servlet – Anatomy of Java Servlet – Deployment Descriptor – Reading Data from a Client – Working with Cookies – Tracking Sessions.	15

III	JSP - JSP Tags- Variables and Objects- Methods -Control Statements- Loops -Tomcat- Request String -User Session - Cookies - Session Objects. **EJB:** Enterprise Java Beans-The EJB container- EJB Classes- EJB Interfaces- Referencing EJB- Relationship Elements - Session Java Bean –Stateless vs. Stateful - Creating a Session Java Bean-Entity Java Bean -The JAR file.	15
IV	INTRODUCTION TO SPRING Simplifying Java Development – Containing Beans – Surveying Bean Landscape. **Spring Configuration:** Wiring Beans – With Java – With XML.	15
V	SPRING ON THE WEB Spring MVC – Simple Controller – Request Input – Processing Forms. WEB VIEWS:Creating JSP Web Views – Defining Layout– JSP Libraries	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars	-

Text Books:

1. Jim Keogh," The Complete Reference J2EE ", Tata McGraw Hill, New Delhi, 2012.Units: I, II, III
2. Craig Walls, "Spring in Action" 4 Ed, Manning Publication, New York, 2015

Reference Books:

1. McGovern," J2EE 1.4 Bible", Wiley, Chennai, India, 2007.
2. Nicholas S. Williams,"Professional Java for Web Applications: Featuring Web Sockets, Spring Framework, JPA Hibernate and Spring Security

Web-Resources:

https://web.iiit.ac.in/~nagarjuna.psug08/J2ME%20-%20The%20Complete%20Reference.pdf

https://doc.lagout.org/programmation/Spring%20Boot%20in%20Action.pdf

https://livebook.manning.com/#!/book/spring-in-action-fifth-edition/chapter-2/23

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Understand the fundamental concepts of the J2EE Technologies
CO2: Comprehend the principles of J2EE programming.
CO3: Learn the communication of client and server in the programming paradigm.
CO4: Understand the concept of JSP and EJB
CO5:Ability to connect Spring with XML and Develop programming skills in Spring using web views.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-I / Core Course-V(CC)	**MONGODB LAB**	**Course Code: PGXEY**
Instruction Hours: 4	**Credits: 3**	**Exam Hours: 3**
Internal Marks : 40	**External Marks:60**	**Total Marks: 100**

Course Objectives:

- Create a simple Structured query program
- Design database using MongoDB
- Apply distributed techniques for querying documents and modification
- Ability to process and design forms to upload the JSON files
- Test and debug regular expression and indexing
- Design and Manipulate forms to provide user authentication

List of Practical's

1. Simple SQL Programs
2. MongoDB Create & Insert Database
3. MongoDB Query Document
4. MongoDB Query Modifications
5. JSON file program
6. Search Text
7. Regular Expression
8. Operation on Document
9. MongoDB Replication
10. MongoDB Indexing

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Configure persistence with Mongodb CO2: Connect to Mongodb CO3: Create a Database CO4: Create our Collections CO5: Create relations between documents and Use Query in Mongodb

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-I / Core Course-VI(CC)	ADVANCED JAVA PROGRAMMING LAB	Course Code: PGXFY
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks : 40	External Marks:60	Total Marks: 100

Course Objectives:

- To understand how to design, implement, test, debug, and document programs that use basic data types and computation, simple I/O, conditional and control structures, string handling and functions.
- Using Graphics, Animations and Multithreading for designing Simulation and Game based applications.
- Design and develop Web applications
- Designing Enterprise based applications by encapsulating an application's business logic.
- Designing applications using pre-built frameworks.

List of Practical's

1. Remote Method Invocation
2. Servlet
3. Servlet with JDBC
4. JSP
5. JSP Cookies
6. JSP with JDBC
7. EJB: Session Bean
8. Simple Spring application
9. Spring based forms
10. JSP Web Views

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Demonstrate programming language concepts RMI, Servlet
CO2: Write, debug, and document well-structured J2EE applications
CO3: Demonstrate the behavior of JSP and Cookies
CO4: Implement JSP connection with JDBC
CO5: Develop programming aspect with spring based forms, apply the concept of JSP using web views

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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W-Weakly Correlated

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Semester-II / Core Course-VII(CC)	DATA SCIENCE USING PYTHON	Course Code:PGXG
Instruction Hours: 5	Credits: 3	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Explore Python language fundamentals, including basic syntax, variables, and types • Create and manipulate regular Python lists • Use functions and import packages • Build Numpy arrays, and perform interesting calculations • Create and customize plots on real data • Supercharge your scripts with control flow, and get to know the Pandas Data Frame	
UNIT	**CONTENT**	**HOURS**
I	WHY PYTHON FOR DATA ANALYSIS? Essential Python Libraries – Installation and setup python basics: The python Interpreter- Ipython Basics- Data Structure and Sequences: Tuple – list	15
II	NUMPY BASICS:Arrays and Vectorized Computation -The NumPy ndarray: A Multidimensional Array Object - Universal Functions: Fast Element-wise Array Functions - File Input and Output with Arrays - Linear Algebra - Random Number Generation	15
III	GETTING STARTED WITH PANDAS :Introduction to pandas Data Structures - Essential Functionality - Summarizing and Computing Descriptive Statistics - Handling Missing Data - Hierarchical Indexing - Other pandasTopics.	15

IV	DATA LOADING, STORAGE, AND FILE FORMATS: Reading and Writing Data in Text Format - Binary Data Formats - Interacting with HTML and Web APIs - Interacting with Databases - Data Wrangling: Clean, Transform, Merge, Reshape.	15
V	PLOTTING AND VISUALIZATION:A Brief matplotlib API Primer - Plotting Functions in pandas -Python Visualization Tool Ecosystem - Time Series.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Book:

1. Wes McKinney, "Python for Data Analysis", Published by O'Reilly Media, 2012, ISBN: 978-1-449-31979-3
2. Jake Vander Plas, "Python Data Science Handbook",O'Reilly Media Publishers, 2016.

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a ComputerScientist'", 2nd edition, Updated for Python3,Shroff/O'ReillyPublishers,2016
2. (http://greenteapress.com/wp/thinkpython/)
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python - Revised and Updated for Python 3.2", Network Theory Ltd., 2011.http://www.network- theory.co.uk/docs/pytut/)

Web-Resources:

https://www.tutorialspoint.com/python/python_data_science

http://astronomi.erciyes.edu.tr/wpcontent/uploads/astronom/pdf/OReilly%20Python%20for%20Data%20Analysis.pdf

https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Understanding the basic concepts of Python
CO2: Preparing and pre-processing data
CO3: Visualizing the results of analytics effectively
CO4: Basic understanding of NumPy and Pandas
CO5: Ability to use conditional loops and list by python and Learn the Visualization through Matplotlib

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Course-VIII(CC)	BIG DATA ANALYTICS	Course Code: PGXH
Instruction Hours: 4	**Credits: 3**	**Exam Hours: 3**
Internal Marks : 25	**External Marks:75**	**Total Marks: 100**

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Understand the Big Data Platform and its Use cases • Provide an overview of Apache Hadoop • Provide HDFS Concepts and Interfacing with HDFS • Understand Map Reduce Jobs • Provide hands on Hodoop Eco System	
UNIT	**CONTENT**	**HOURS**
I	**FUNDAMENTALS OF BIG DATA**: The Evolution of Data Management – Understanding the waves of Managing Data – Defining Big Data – Building a Successful Big Data Management Architecture – Examining Big Data Types : Defining Structured Data – Defining Unstructured Data – Looking at Real Time and Non Real Time Requirements - Digging into Big Data Technology Components : Exploring the Big Data Stack – Redundant Physical Infrastructure – Security Infrastructure – Operational Databases – organizing data Services and Tools – Analytical Data Warehouses – Big Data Analytics – Big Data Applications.	15
II	DEFINING BIG DATA ANALYTICS: Using Big Data to	15

	get Results – Modifying Business Intelligence Products to Handle Big Data – Studying Big Data Analytics Examples – Big Data Analytics Solutions – Understanding Text Analytics and Big Data : Exploring Unstructured Data – Analysis and Extraction Techniques – Putting Results Together with Structured Data – Putting Big Data to use – Text Analytics Tools for Big Data – Customized Approaches for Analysis of Big Data : Building New Models and Approaches to Support Big Data - Understanding Different Approaches to Big Data Analysis - Characteristics of a Big Data Analysis Framework.	
III	OPERATIONALIZING BIG DATA: Making Big Data a Part of Your Operational Process - Integrating Big Data - Incorporating big data into the diagnosis of diseases - Understanding Big Data Workflows - Workload in context to the business problem - Ensuring the Validity, Veracity, and Volatility of Big Data - Security and Governance for Big Data Environments : Security in Context with Big Data - Understanding Data Protection Options - The Data Governance Challenge - Putting the Right Organizational Structure in Place - Developing a Well Governed and Secure Big Data Environment.	15
IV	APPLIANCES AND BIG DATA WAREHOUSES: Integrating Big Data with the Traditional Data Warehouse - Big Data Analysis and the Data Warehouse - Changing the Role of the Data Warehouse - Changing Deployment Models in the Big Data Era - Examining the Future of Data Warehouses - Examining the Cloud and Big Data : Defining the Cloud in the Context of Big Data - Understanding Cloud Deployment and Delivery Models - The Cloud as an Imperative for Big Data - Making Use of the Cloud for Big Data - Providers in the Big Data Cloud Market.	15

V	MAP REDUCE FUNDAMENTALS :Tracing the Origins of MapReduce - Understanding the map Function - Adding the reduce Function - Putting map and reduce Together - Optimizing MapReduce Tasks - Exploring the World of Hadoop : Explaining Hadoop - Understanding the Hadoop Distributed File System - HadoopMapReduce - The Hadoop Foundation and Ecosystem - Building a Big Data Foundation with the Hadoop Ecosystem - Managing Resources and Applications with Hadoop YARN - Storing Big Data with HBase - Mining Big Data with Hive - Interacting with the Hadoop Ecosystem.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

"Big Data" by Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman, WileyPublications, 2014.

Reference Book

"Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics" by Soumendra Mohanty, Madhu Jagadeesh and Harsha Srivatsa, A press Media, Springer Science + Business Media New York, 2013

Web-Resources:

https://www.ti.rwth-aachen.de/teaching/BigData/FBDA.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: To provide an overview of an exciting growing field of Big Data analytics.
CO2: To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
CO3: To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
CO4: To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
CO5: To introduce to the students several types of big data like social media, web graphs and data streams.

apping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Course-IX(CC)	DISTRIBUTED TECHNOLOGIES	Course Code:PGXI
Instruction Hours: 5	Credits: 3	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• This course aims to build concepts regarding the fundamental principles of distributed systems. • The design issues and distributed operating system concepts are covered. • To learn the principles, architectures, algorithms and programming models used in Distributed systems. • To examine state-of-the-art distributed systems, such as Google File System. • To design and implement sample distributed systems.	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION TO DISTRIBUTED COMPUTING: Challenges involved in establishing remote connection – Strategies involved in remote computation – Current Distributed computing practices through Dot Net and Java technologies.	15
II	ADVANCED **ADO. NET**:Disconnected Data Access – Grid view, Details View, Form View controls – Crystal Reports – Role of ADO, NET in Distributed Applications.	15
III	ADVANCED ASP.NET:AdRotator, Multiview, Wizard and Image Map Controls – Master Pages – Site Navigation – Web Parts – Uses of these controls and features in Website development.	15
IV	ADVANCED FEATURES OF ASP.NET :Security in ASP,	15

	NET – State Management in ASP, NET – Mobile Application development in ASP, NET – Critical usage of these features in Website development.	
V	WEB SERVICES:Role of Web services in Distributed Computing – WSDL, UDDI, SOAP concepts involved in Web Services – Connected a Web Service to a Data Base – Accessing a Web Servicethrough ASP, NET application.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

Walther, ASP, NET 3.5, SAMS Publication, 2005.

Web-Resources:

http://www.sigc.edu/qb-18/cs/I%20M.Sc%20CS-%20Distributed%20Technologies.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Understand the features of Dot Net Framework along with the features of C#.

CO2: Build well-formed XML Document and implement Web Service using Java.

CO3: Students will identify the core concepts of distributed systems: the way in which several machines organize to correctly solve problems in an efficient, reliable and scalable way.

CO4: Students will examine how existing systems have applied the concepts of distributed systems in designing large systems, and will additionally apply these concepts to develop sample systems.

CO5: Apply Web Services concept in database.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Course-X(CC)	DISTRIBUTED TECHNOLOGIES LAB	Course Code: PGXJY
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks : 40	External Marks:60	Total Marks: 100

Course Objectives:

- To provide fundamental concept of Internet, JavaScript, XML, JSP, and ASP with a view to developing professional software development skills
- To examine state-of-the-art distributed systems, such as Google File System.
- To design and implement sample distributed systems.
- To learn the practical knowledge of using distributed application development packages

List of Practical's

1. Create a table and insert a few records using Disconnected Access.
2. Develop a project to update and delete few records using Disconnected Access.
3. Develop a project to view the records using GridView, DetailsView, FormView Controls.
4. Develop a project to generate a crystal report from an existing database.
5. Design a web page that makes uses of Ad Rotator Control.
6. Design a web page involving Multi View or Wizard Control.
7. Make use of Image Control involving two hot spots in a web page.
8. Design a simple web site that makes use of Master Pages.
9. Establish the security features in a simple web site with five pages.
10. Use state management concepts in a mobile web application.
11. Develop a web service that has an ASP.NET client.
12. Develop a web service to fetch a data from a table and send it across to the client

Course Outcomes

On completion of this lab course the students will be able to

CO1: Use the features of Dot Net Framework along with the features of C#.

CO2: Create user interactive web pages using ASP.Net.

CO3: Build well-formed XML Document and implement Web Service using Java.

CO4: Students will examine how existing systems have applied the concepts of distributed systems in designing large systems, and will additionally apply these concepts to develop sample systems.

CO5: Performing Database operations for various web applications.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Course-XI(CC)	ADVANCED PYTHON LAB	Course Code: PGXKY
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks : 40	External Marks:60	Total Marks: 100

Course Objectives:

- Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
- Express different Decision Making statements and Functions.
- Understand and summarize different File handling operations.
- Explain how to design GUI Applications in Python and evaluate different databaseoperations

List of Practical's

1. Write Python applications using variables, data types
2. Write Python application using strings and functions.
3. Write Python applications using loops, arrays, sorting
4. Write Python applications using dictionaries, lists and tuples.
5. Write Python applications using matrices.
6. Create Calculator Program
7. Array Function using Numpy
8. Aggregation function using Numpy
9. Data Operation using Scipy Basics
10. Pandas Basics
11. Twitter API Integration for tweet Analysis

Course Outcomes

On completion of the course the learner will be able to

CO1: Design forms using various functions

CO2: Apply rich controls and conditional statement logic in Python

CO3: Demonstrate the functionality of stack and regular expressions through Python

CO4: Ability to Create and manipulate array functions using Numpy

CO5: Ability to Create indexing scripts using Pandas and Build applications using Pandas

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II/ Self-Paced Learning (SPL)	VIRTUALISATION AND CLOUD COMPUTING	Course Code:PGXL
Instruction Hours: -	Credits: 2	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To learn the different types of cloud computing services. • To make a cloud computing application unique, managing and working with cloud security. • Understand the concepts, characteristics, delivery models and benefits of cloud computing • Understand the key security and compliance challenges of cloud computing • Understand the different characteristics of public, private and hybrid cloud deployment models.	
UNIT	**CONTENT**	**HOURS**
I	**INTRODUCTION** Evolution of Cloud Computing -System Models for Distributed and Cloud Computing - NIST Cloud Computing Reference Architecture - Infra structure as a Service (IaaS) - Resource Virtualization - Platform as a Service (PaaS) - Cloud platform & Management - Software as a Service (SaaS) - Available Service Providers.	-
II	**VIRTUALIZATION*:*** Basics of virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures – Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices – Desktop virtualization -	-

	Server Virtualization - Linux KVM, Xen, Qemu, LXC, OpenVZ	
III	CLOUD INFRASTRUCTURE: FOSS Cloud Software Environments - Eucalyptus, Open nebula, OpenStack - OpenStack Architecture - Compute, Object Storage, Image Service, Identity, Dashboard, Networking, Block Storage, Metering, Basic Cloud Orchestration and Service Definition.	-
IV	PROGRAMMING MODEL: Parallel and Distributed programming Paradigms - MapReduce, Twister and Iterative MapReduce - Mapping Applications - Programming Support - Apache Hadoop - HDFS, Hadoop I/O, Hadoop configuration, MapReduce on Hadoop.	-
V	SECURITY IN THE CLOUD: Security Overview - Cloud Security Challenges - Software-as-a-Service Security - Security Governance - Risk Management - Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security - Qubes - Desktop security through Virtualization	-
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, FromParallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. John W.Ritting house and James F.Ransome "Cloud Computing: Implementation,Management, and Security", CRC Press, 2010.

Reference Book

Prashanta Kumar Das and Ganesh Chandra Daka, "Design and Use of VirtualizationTechnology in Cloud Computing", IGIGlobal, 2017.

Web-Resources:

http://www.sridevienggcom/documents/cse/cloud%20computing.pdf

http://textofvideo.nptel.ac.in/106105167/lec7.pdf

https://nptel.ac.in/courses/106104182/

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Posses knowledge on Cloud Computing and its architecture
CO2: Acquire knowledge on Virtualization techniques
CO3: Understand cloud infrastructure services
CO4: Identify the parallel and distributed programming paradigms
CO5: Handle various cloud computing tools to learn the Cloud security and security challenges

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

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W-Weakly Correlated

N – No Correlation

Semester-III / Core Course-XII(CC)	DATA MINING AND DATA WAREHOUSING	Course Code: PGXM
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To understand the practical methods and techniques for building a data warehouse. • To understand data mining concepts, tasks and their techniques. • To understand the basic principles, concepts and applications of data warehousing and data mining. • Ability to do Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment. • Have a good knowledge of the fundamental concepts that provide the foundation of data mining.	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION :What is Data mining, Data mining - important Data mining - various kind of data mining Functionalities – Various kinds of Patterns Pattern Interesting Classification of Data mining Systems Data mining Task Primitives Integration of Data Mining System Major issues in Data Mining.	15
II	DATA PROCESSING :Process the Data Descriptive Data Summarization – Measuring Central Tendency Dispersion of Data Graphic Displays of –Basic Descriptive Data Summaries Data Cleaning Data Integration and Transformation data Reduction Data Discrimination -	15

	Concept Hierarchy Generation	
III	DATA WAREHOUSE OLAP TECHNOLOGY :An overview - Data Warehouse Multidimensional Data Model Data Warehouse Architecture Data Warehouse Implementation from Data Warehouse to Data mining	15
IV	MINING Frequent Patterns Associations Correlations - Basic Concepts Road Map Efficient Scalable Frequent Item set Mining methods Mining – Various Kinds of Association rules Analysis - Association mining to Correlation Constrain Based Association mining .	15
V	Classification – Prediction – Cluster analysis - Applications and trends in data mining.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

1. Data Mining (Concepts and Techniques) Second Ed , Author : Jiawei Han and Micheline Kamber Publishers : Morgan Kaufmann Publishers (An imprint of Elsevier)

Reference Book

1. Data Mining (Next Generation Challenges and Future Directions) Author : Karguta, Joshi,Sivakumar & Yesha Publishers : Printice Hall of India (2007)
2. Data Mining (Practical Machine Learning Tools and Techniques (Second Edition) Author: Ian H. Witten & Eibe Frank Publishers: Morgan Kaufmann Publishers (An imprintof Elsevier).
3. Data Warehousing, Data mining & OLAP (Edition 2004) Author: Alex Benson, Stephen V. Smith Publishers: Tata McGraw – Hill

Web-Resources:

shodhganga.inflibnet.ac.in/jspui/bitstream/10603/199511/16/16_references.pdf
http://www.vssut.ac.in/lecture_notes/lecture1428550844.pdf
https://nptel.ac.in/courses/106105174/

Course Outcomes:

On completion of the Course, Students should be able to do

CO1:To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.

CO2: To enable students to effectively identify sources of data and process it for data mining

CO3: To impart knowledge of tools used for data mining

CO4: To provide knowledge on how to gather and analyze large sets of data to gain useful business understanding.

CO5: To make students well versed in all data mining algorithms, methods of evaluation.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Course-XIII(CC)	**DATA MINING LAB**	**Course Code: PGXN**
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks : 40	**External Marks:60**	**Total Marks: 100**

Course Objectives:

- To get hands on experience in developing applications using data mining tool.
- To evaluate the different models of OLAP and data preprocessing.
- To enlist various algorithms used in information analysis of Data Mining Techniques.
- To demonstrate the knowledge retrieved through solving problems.
- Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting.

List of Practical's

Exercise 1

Preprocessing

a. Datatype Conversion

b. Data Transformation

Exercise 2

Filters- Practical

a. Replace Missing Values

b. Add Expression

Exercise 3

Feature Selection Select Attributes- Practical

a. Filter

b. Wrapper

c. Dimensionality Reduction

Exercise 4

Supervised Technique

Classifier - Function - Practical

a. Multilayer Perceptron Tree - Practical

Exercise 5

Classifier- Bayes –Practical

a. Naive Bayes Rule- Practical

b. Zero R

Exercise 6

Unsupervised TechniquesClustering- Theory

Partitioned – Algorithm –Practical Hierarchical Algorithm –

Practical Semi Supervised Algorithm – Practical

Exercise 7

Association Rule Mining

A-Priori –Algorithm –Practical Predictive A-Priori

–Practical

Exercise 8

Experimenter

Dataset – Test – Practical Algorithm based –Test –

Practical

Exercise *9*

Knowledge Flow

Feature Selection – PracticalClustering –Practical

Exercise 10

Knowledge Flow Classification – Practical

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Perform exploratory analysis of the data to be used for mining.

CO2: Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.

CO3: Define and apply metrics to measure the performance of various data mining algorithms.

CO4: Develop skills and apply data mining tools for solving practical problems

CO5: Advance relevant programming skills and gain experience and develop research skills by reading the data mining literature.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Course-XIV(CC)	MACHINE LEARNING AND R PROGRAMMING	Course Code: PGXO
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Understand Machine Learning and R • Gain basic ideas on Types and Methods in ML • Fetch insights on R Package • Implement and apply the different categories of Machine Learning Algorithms • Apply the machine learning concept using R Programming	
UNIT	**CONTENT**	**HOURS**
I	**Introducing Machine Learning** : What is ML? – Varieties of ML – Types of Learning –Sample Applications – Introducing ML: Origins of Machine Learning (ML) – Uses and Abuses of ML – How do Machines Learn? – Steps to apply ML to your data choosing a ML algorithm – Using R for Machine Learning: Installing and Loading R Packages.	15
II	Lazy Learning – Classification Using Nearest Neighbors : Understanding Classification using Nearest Neighbours (NN): KNN Algorithm – Calculating Distance – Choosing an appropriate K – Preparing data for use with KNN – Why is the KNN algorithm lazy? - Probabilistic Learning - Classification using Naïve Bayes: Understanding Naïve Bayes - Basic concepts of Bayesian Methods – The Naïve Bayes	15

	Algorithm - Naïve Bayes classification – #Laplace Estimator# – using Numeric features with Naïve Bayes.	
III	Divide and Conquer – Classification using Decision Trees and Rules : Understanding Decision Trees - Divide and Conquer – C5.0 decision Tree algorithm – Understanding Classification Rules – Separate and Conquer – The One Rule algorithm – The RIPPER algorithm – Rules for Decision Trees – Forecasting Numeric Data – Regression Methods : Understanding Regression – Simple Linear Regression – #Ordinary Least Squares Estimation# – Correlations – Multiple Linear Regression – Understanding Regression Trees and model trees.	15
IV	Black Box Methods: Neural Networks and Support Vector Machines (SVM) :Understanding Neural Networks: From biological to Artificial Neurons – Activation Functions –Network Topology – Training Neural Networks with Backpropagation – Modelling the strength of concrete with ANNs: Collecting Data – Exploring and Preparing the data – Training a model on the data – Evaluating model performance – improving model performance – Understanding SVM: Classification with hyper planes – Finding the maximum margin – Using Kernels for Non-Linear Spaces – #Finding Groups of Data# –clustering with K-Means: Understanding Clustering – K-Means algorithm for Clustering.	15
V	Using R for Machine Learning : Managing and Understanding Data: R Data Structures – Vectors – Factors: Lists – Data Frames – Matrices and Arrays – Managing Data with R: Saving and Loading R Data structures – Importing and Saving data from CSV files – Importing Data from SQL databases – Exploring and Understanding Data: Exploring the structure of data – Exploring numeric variables #Exploring Categorical Variables# – Exploring relationships between variables.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Reference Book:

1. Shai Shalev-Shwartz, Understanding Machine Learning: From Theory to Algorithms, Cambridge UniversityPress, 2014.
2. Alex Smola and SVN Vishwanathan, Introduction to Machine Learning,- Cambridge University Press.- ISBN: 0521 82583 0, 2010.
3. Jason Bell , Machine Learning – Hands-on for Developers and Technical Professionals, Wiley Publications.

Web-Resources:

https://www.datacamp.com/community/tutorials/machine-learning-in-r

https://www.geeksforgeeks.org/introduction-to-machine-learning-in-r/

https://www.kaggle.com/camnugent/introduction-to-machine-learning-in-r-tutorial

Course Outcomes:

On completion of this lab course the students will be able to

CO1: Statistical Learning: Understand the behavior of data as you build significant models

CO2: R for Machine Learning: Learn about the various libraries offered by R to manipulate, preprocess and visualize data

CO3: Optimization Techniques: Learn to use optimization techniques to find the minimum error in your machine learning model

CO4: Fundamentals of Machine Learning: Supervised, Unsupervised Machine Learning and relation of statistical modeling to machine learning

CO5: Machine Learning Algorithms: Learn various machine learning algorithms like KNN, Decision Trees, SVM, Clustering in detail

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Course-XV(CC)	**EMBEDDED LAB**	**Course Code: PGXPY**
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks : 40	**External Marks:60**	**Total Marks: 100**

Course Objectives:

- Introduction to embedded systems design tools and hardware programmers.
- Students are able to understand and acquire basic fundamental knowledge of electronics components and circuits.
- Experiments using both simulation and practical implementation of the basic building blocks of a microcontroller including timers, counters, PWM generation, I/O techniques and requirements, A/D conversion, serial communications.
- Experiments to explore the system design process using hardware-software co design process. Design project.
- Students are able to effectively evaluate basic electronics circuits

List of Practical's:

1. I/O Port Programming-LED Blinking
2. LCD Interfacing
3. Counter Programming
4. PWM Programming
5. Study Of Analog To Digital Converter Programming
6. Compare Mode Programming
7. Capture Mode Programming
8. Serial Communication- USART- Polling and Interrupts
9. Keypad Interfacing
10. Interfacing Of Digital to Analog Converter

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Experience with a set of tools for embedded systems programming and debugging.

CO2: Experience with implementing several embedded systems with particular focus on the interaction between multiple devices.

CO3: Design products using microcontrollers and various analog and digital ICs.

CO4: Can read the datasheet for any embedded system, understand how it works.

CO5: Develop existing embedded systems by formulating the system design problem including the design constraints, create a design that satisfies the constraints, implement the design in hardware and software, and measure performance against the design constraints.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-I / Core Elective –I (EC)	ARTIFICIAL INTELLIGENCE	Course Code: PGXE1
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Understood the AI &Expert Systems - Learnt the Heuristic techniques and reasoning. • An ability to apply knowledge of computing and mathematics appropriate to the discipline. • An ability to analyze a problem and identify and define the computing requirements appropriate to its solution. • An ability to use current techniques, skills, and tools necessary for computing practice. • An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION **AI Problems**: Underlying Assumptions. **Al Techniques:** Tic-Tac-Toe - Criteria for Success Problems, Problem Spaces and Search: Defining a problem as a State space search - **Production Systems**: Control Strategies –Heuristics.	12
II	HEURISTIC SEARCH TECHNIQUES:Generate and Test - Hill Climbing- Best-First - Means-end analysis. **Knowledge representation issues**: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.	12
III	USING PREDICATE LOGIC:Representing simple facts in logic Representing Instance and Is a relationships - Computable functions an predicates – **Resolution:** Conversion to clause form –The basis of resolution	12

	Resolution in propositional logic-Unification algorithm-Resolution in Predicat logic- Need to try several substitutions.	
IV	REPRESENTING KNOWLEDGE USING RULES:Procedural Vs Declarative knowledge – Logic Programming. **Forward Vs Backward Reasoning:** Backward –Chaining Rule systems-Forward –Chaining Rule Systems-Combining Forward and Backward reasoning - Matching :Indexing-Matching with variables-Complex and Approximate matching-conflict matching – Control knowledge.	12
V	GAME PLAYING **Overview**: The minimax search procedure. **Expert System**: Representing and using Domain Knowledge–Expert system shells –Explanation. **Perception and Action**: Real time Search. Perception–Vision-Speech Recognition. **Action**-Navigation-Manipulation-Robot Architectures.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

Elaine Rich and Kevin Knight," Artificial Intelligence", Tata McGraw Hill Publisherscompany Pvt Ltd, Second Edition, 1991.

Unit1: Chapter 1(1.1,1.3.1.5), Chapter 2(2.1,2.2)
Unit2: Chapter 3(3.1,3.2,3.3,3.6), Chapter 4(4.1,4.2,4.3,4.4).
Unit3: Chapter 5(5.1,5.2,5.3,5.4).
Unit4: Chapter 6.
Unit5: Chapter 12(12.1,12.2),Chapter 20 and Chapter 21.

Web Resources:

https://eecs.wsu.edu/~cook/ai/lectures/p.hltm
http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: To understand the basics of Artificial Intelligence , Intelligent Agents and its structure
CO2: To understand the problem solving by various searching techniques
CO3: To understand the concept of informed search and Exploration
CO4: To understand the concept of constraint satisfaction Problems and Adversarial Search
CO5: To Understand what is Reasoning and Knowledge Representation and to understand the concept of Reasoning with Uncertainty & Probabilistic Reasoning

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	M	S	S	S	S	S	S

S - Strongly Correlated
M - Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / Core Elective –I (EC)	HIGH PERFORMANCE COMPUTING	Course Code: PGXE1
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Provide systematic and comprehensive treatment of the hardware and the software high performance techniques involved in current day computing. • Introduce the fundamentals of high performance computing with the graphics processing units and many integrated cores using their architectures and corresponding programming environments. • Introduce the learner to fundamental and advanced parallel algorithms through the GPU and MIC programming environments • Provide a strong foundation on memory hierarchy design and tradeoffs in both uniprocessor and multiprocessors. • Illustrate the cache coherence and consistency problems in multiprocessors, and their existing solutions.	
UNIT	**CONTENT**	**HOURS**
I	Modern Processors: Stored-program computer architecture – General- purpose cache- based microprocessor architecture – Memory hierarchies – Multi core processors - Multithread processors - Vector processors - Basic optimization techniques for serial code - Common sense optimizations - Simple measures - large impact - Role of compilers.	12
II	Parallel Computers: Data access optimization - Balance analysis and light speed estimates - Storage order - Taxonomy of parallel computing paradigms Shared memory computers - Distributed memory	12

	computers - Hierarchical systems –Networks - Basics of parallelization- Parallelism – Parallel scalability.	
III	Principles of Parallel Algorithm Design: Preliminaries - Decomposition techniques - Characteristics of tasks and interactions - Mapping techniques for load balancing - Methods for containing interaction overheads - Parallel algorithm models – Basic communication operations.	12
IV	Sorting and Graph Algorithms: Dense matrix Algorithm: Matrix-vector multiplication - Martix- matrix multiplication- Sorting: Issues in sorting on parallel computing - Sorting networks - Bubble sorts and its variants - Quick sort - Graph algorithms - Definition and representation - Prims algorithm - Dijkstra's algorithm - All pairs shortest path - Transitive closure – Connected components.	12
V	Shared-Memory Parallel Programming with OpenMP: Short introduction to OpenMP, Advanced OpenMP: Wavefront parallelization, Profiling OpenMP programs Performance pitfalls, Case study : OpenMP-parallel Jacobi algorithm & Parallel sparse matrix-vector multiply.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

1. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall, 2010.
2. Ananth Grama and George Karypis, Introduction to parallel computing, Addison-Wesley2009.

Reference Book

John Levesque and Gene Wagenbreth, High Performance Computing: Programming andApplications, Chapman & Hall, 2010.

Web-Resources:

https://www.tutorialspoint.com/parallel_computer_architecture/parallel_computer_architecture_ introduction.html
http://homepage.physics.uiowa.edu/~ghowes/teach/ihpc10/lec/ihpc10Lec_IntroHPC10.pdf
http://phycomp.technion.ac.il/~nanco/nan2/main.pdf
https://tutorialspoint.dev/computer-science/computer-organization-and-architecture/introduction-to-parallel-computing

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: To understand fundamental concepts and techniques in parallel computation structuring and design.

CO2: To Study various architectures of high - performance computing systems.

CO3: To demonstrate the principles of Parallel Algorithm Design.

CO4: Investigate modern design structures of pipelined and multiprocessors systems.

CO5: Understand the algorithms using parallel programming principle and to study about Parallel sparse matrix and vector multiplication

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	M	S	M	S	S	S	S	S	S	S

S - Strongly Correlated

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W-Weakly Correlated

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Semester-I / Core Elective –I (EC)	PARALLEL AND DISTRIBUTED COMPUTING	Course Code: PGXE1
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Understand the requirements for programming parallel systems and how they can be used to facilitate the programming of concurrent systems. • To learn the architecture and parallel programming in graphics processing units (GPUs). • Understand the memory hierarchy and cost-performance tradeoffs. • Analytical modeling and performance of parallel programs.	
UNIT	**CONTENT**	**HOURS**
I	**Introduction:** Computer Organization for Parallel and Distributed Computing- Communications and Computer networks-OS for distributed and parallel computing- Client/Server Model-Distributed database Systems-Parallel programming languages and algorithms. **Computer Organization for Parallel and Distributed Computing:** Pipeline and vector processors-Multicomputer and computer networks-Multiprocessors-Massively Parallel Architecture-Non-von Neumann-type computers-Cache architectures in Multiprocessors.	12
II	**Operating System for Distributed and Parallel Computing:** Network Operating Systems-Distributed Operating Systems-Operating systems for parallel computing-Distributed and parallel system modeling-Example Systems.	12
III	**Client Server Model:** File Servers-Name and directory Servers-Printer Servers- Electronic Mail Server-Move to Client/Server Systems.	12

IV	**Distributed Database Systems:** Introductory Concepts-Case for Distribution- Distribution problem and pattern-Queries and updates in DDBS-Failures-Example Patterns.	12
V	**Parallel Programming Languages and Algorithms:** Parallel language and algorithm design for the array processor-Von Neumann-type languages-C, C++ and Parallel C++-Non-von Neumann-type languages.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

An Introduction to Distributed and Parallel Computing (Second Edition) by JOEL .CRICHLOW, PHI Publications.

Web-Resources:

https://sites.engineering.ucsb.edu/~hpscicom/p1.pdfhttps://www.gacbe.ac.in/pdf/ematerial/18MCS35E-U1.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Develop and apply knowledge of parallel and distributed computing techniques and methodologies.
CO2: Apply design, development, and performance analysis of parallel and distributed applications.
CO3: Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.
CO4: Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.

Mapping of COs with POs& PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

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W-Weakly Correlated

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Semester-II / Core Elective –II (EC)	ETHICAL HACKING	Course Code: PGXE2
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Use new career opportunities available in IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services. • Introduces the concepts of Ethical Hacking • Gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security • Practically apply Ethical hacking tools to perform various activities	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION TO HACKING: Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Foot printing – Information Gathering Methodology – Foot printing Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines	12
II	INTRODUCTION TO SCANNING: Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools	12
III	CRACKING PASSWORDS: Password Cracking Websites – Password Guessing – Password - Cracking Tools – Password Cracking – Counter measures – Escalating Privileges – Executing Applications – Keyloggers and	12

	Spyware.	
IV	PROGRAMMING FUNDAMENTALS C Language – Html – Perl – Windows OS Vulnerabilities – Tools For Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools For Identifying Vulnerabilities – Countermeasures.	12
V	SECURITY ASSESSMENTS: Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

Ec-Council, "Ethical Hacking and Countermeasures: Attack Phases", Delmar Cengage Learning,2009.

Reference Book

1. Michael T. Simpson, Kent Backman, James E. Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning, 2012.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy", Syngress Media, Second Revised Edition, 2013.

Web-Resources:

https://www.tutorialspoint.com/ethical_hacking/ethical_hacking_tutorial.pdf

https://www.uio.no/studier/emner/matnat/ifi/IN5290/h18/lectures/inf5290-2018-l01-introductionhical_hacking.pdf

http://cdn.ttgtmedia.com/searchNetworking/downloads/hacking_for_dummies.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Develop and apply knowledge of ethical IT assets
CO2: Apply difference tools and techniques and security
CO3: Use the audits and other special skills in ethical for IT profession.
CO4: Explain the design, testing, and performance various ethical hacking tools.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

S - Strongly Correlated

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W-Weakly Correlated

N – No Correlation

Semester-II / Core Elective –II (EC)	**CRYPTOGRAPHY AND NETWORK SECURITY**	**Course Code: PGXE2**
Instruction Hours: 4	**Credits: 3**	**Exam Hours: 3**
Internal Marks : 25	**External Marks:75**	**Total Marks: 100**

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To impart knowledge related to the various concepts, methods of Network Security using cryptography basics, program security, database security and security in networks. • The concepts of classical encryption techniques and concepts of finite fields and numbertheory. • And explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms. • The concepts of cryptographic utilities and authentication mechanisms to design secureapplications. • The ability to use existing cryptographic utilities to build programs for secure communication.	
UNIT	**CONTENT**	**HOURS**
I	NETWORK SECURITY: Security Trends - The OSI Architecture – Security Attacks – Security Services - Security Mechanisms - A model for Network Security. **CLASSIC ENCRYPTION TECHNIQUES:** Symmetric Cipher Model - Substitution Techniques – Transposition techniques - Rotor Machines - Steganography.	12
II	BLOCK CIPHERS AND DATA ENCRYPTION STANDARDS: Block Cipher- Principles – Data Encryption Standard - The strength of DES –Differential and Linear Cryptanalysis – Block Cipher design	12

	principles – **ADVANCED ENCRYPTION STANDARD:** The AES Cipher.	
III	PUBLIC KEY ENCRYPTION AND DIGITAL SIGNATURES: Principles of Public Key Crypto Systems -The RSA algorithm. Message Authentication: Authentication Requirements -Authentication Functions – Message Authentication codes – Hash Functions - Security of Hash Functions and MAC. Digital Signatures**:** Authentication Protocols.	12
IV	AUTHENTICATION APPLICATIONS Kerberos - X.509 Authentication Service – **PKI.** Electronic Mail Security**:** Pretty Good Piracy - S/ MIME. **WEB SECURITY:** Web Security Considerations- - SSL and Transport Layer Security.	12
V	SYSTEM SECURITY: Intruders - Intrusion Detection – Password Management. **Firewalls:** Firewall Design Principles - Trusted Systems.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

William Stallings, "Cryptography and network Security - Principles and Practices",Prentice Hall (Pearson Education), 7th Ed., 2016.

Reference Book:

AtulKahate, "Cryptography and Network Security", Tata McGraw Hill Publications, New Delhi, 20Charles P. Pfleeger, Shari L. Pfleeger, "Security in Computing", Prentice Hall, 5th Ed., 2015.

Web-Resources:

http://williamstallings.com/Extras/SecuryNotes/
http://www.vssut.ac.in/lecture_notes/lecture1428550736.pdf http://www.sasurieengg.com/e-course-material/It-MCA/III- IT/3.IT2352Cryptography%20and%20Network%20Security.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Explain the basics of number theory and compare various encryption techniques.
CO2: Understand the manner in which message Authentication code and hash function work and the functionality of public key cryptography.
CO3: Familiarize in intrusion detection and firewall design
CO4: Examine the different types of security systems and applications.
CO5: Discuss different levels of security and services and recognize various security policies

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Elective –II (EC)	ADHOC AND SENSOR NETWORKS	Course Code: PGXE2
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Understands the fundamentals of ADHOC network protocols and standards. • Applies and analyze the different approaches and routing strategies on AdHoc Protocols. • Understands and comprehends the wireless networking protocols. • Evaluates the Sensor networking management schemes. • Comprehends the security techniques with various ADHOC and Sensor Networks	
UNIT	**CONTENT**	**HOURS**
I	ADHOC NETWORKS Fundamentals Of WLANs – IEEE 802.11 Architecture – Self Configuration and Auto Configuration – Issues in Ad – Hoc Wireless Networks – MAC Protocols for Ad – Hoc Wireless Networks – Contention Based Protocols – TCP Over Ad – Hoc Networks – TCP Protocol Overview – TCP and MANETs – Solutions for TCP Over Ad – Hoc Networks.	12
II	ADHOC NETWORK ROUTING AND MANAGEMENT : Routing in Ad – Hoc Networks – Introduction – Topology based versus Position based Approaches – Proactive Routing – DSDV, WRP, TBRPF Reactive Routing – DSR,AODV, Hybrid Routing Approach ZRP, CBRP – Location services – DREAM – Quorums based Location Service – Forwarding Strategies – Greedy Packet Forwarding, LAR.	12
III	SENSOR NETWORK COMMUNICATION PROTOCOLS : Introduction – Architecture– Single Node Architecture – Sensor Network Design Considerations – Energy Efficient DesignPrinciples for WSN‟s – Protocols for WSN –	12

	Physical Layer– Transceiver Design Considerations – MAC Protocols for Wireless Sensor Network – IEEE 802.15.4 Zigbee – Link Layer and Error Control Issues – Routing Protocols – Gossiping and agent based unicast forwarding, Energy efficient unicast – Transport Protocols &QoS – Congestion Control Issues –Application specific Support – Target Detection and Tracking.	
IV	SENSOR NETWORK MANAGEMENT AND PROGRAMMING :Sensor Management–Topology Control Protocols and Sensing Mode Selection Protocols – Time Synchronization – Localization and Positioning – Operating Systems and Sensor Network Programming – Sensor Network Simulators.	12
V	ADHOC AND SENSOR NETWORK SECURITY : Security in Ad – Hoc and Sensc Networks – Key Distribution and Management – Software based Anti – tampe Techniques – Water Marking techniques – Defense against Routing Attacks – Secure A Hoc Routing Protocols – Broadcast Authentication WSN Protocols – TESLA – Biba Sensor Network Security Protocols – SPINS.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks: Theory and Applications", Second Edition, World Scientific Publishing, 2011.

Reference Book:

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.
2. Amiya Nayak, Ivan Stojmenovic,, "Wireless Sensor and Actuator Networks : Algorithm and Protocols for Scalable Coordination and Data communication", John Wiley & Sons 2010
3. C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2011.
4. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2007
5. ErdalÇayırcı , ChunmingRong, "Security in Wireless Ad Hoc and Sensor Networks", John Wiley and Sons, 2009.

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: To understand the basics of AdHoc & Sensor Networks.

CO2: To learn various fundamental and emerging protocols of alllayers in AdHoc Network.

CO3: To study about the issues pertaining to major obstacles in establishment and efficient management of AdHoc andSensor Networks.

CO4: To understand the nature and applications of AdHoc and SensorNetworks.

CO5: To understand various security practices and protocols ofAdHoc and Sensor Networks and to build sensor networks in various fields.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Elective –III (EC)	COMPILER DESIGN	Course Code: PGXE3
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To introduce the major concept areas of language translation and compiler design. • To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table. • To extend the knowledge of parser by parsing LL parser and LR parser. • To provide practical programming skills necessary for constructing a compiler.	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION: Different Phases of Compiler - Finite State Automation and Lexical analysis - A Simple Approach to the Design of Lexical Analyzers - Regular Expressions - A Language for SpecifyingLexical Analyzers.	12
II	SYNTAX SPECIFICATION: Context Free Grammars - Parsers – Derivation and Parse trees - Shift Reduce Parsing - Operator Precedence Parsing - Top-Down Parsing - Predictive Parsers.	12
III	CODE GENERATION :Intermediate Code Generation - Translation - Implementation of Syntax - DirectedTranslators - Intermediate Code – Postfix Notation - Parse Trees and Syntax Trees - Three Address Codes, Quadruples and Triples.	12
IV	SYMBOL TABLES: Contents of a Symbol Table - Data Structures for Symbol Tables - Implementation of a Simple Stack Allocation Scheme - Implementation of Block Structured Languages - Storage Allocation in	12

	Block Structured Languages - Errors - Lexical Phase Error.	
V	CODE OPTIMIZATION AND CODE GENERATION: Elementary Code Optimization technique - Loop Optimization - DAG Representation of Basic Blocks - Value Numbers and Algebraic Laws - Object Programs - Problems in Code Generation - A Machine Model - A Simple Code Generator.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	2 Hours

Text Books

1. Alfred V. Aho, Jeffery D.Ullman, "Principles of Compiler Design", Narosa, New Delhi,2002.

(Ch:1.1-1.11,3.1-3.7,4.1,4.2,5.1-5.5,7.1-7.6,9.1,9.2,10.1, 10.2,11.1,11.2,12.1- 2.4,15.1-15.4)

Reference Book

1. Dick Grune, Henri E. Bal, CerielJ.H.Jacobs, Koen G. Langondeon, "Modern Compiler Design", Wiley, Singapore, 2003.
2. Louden K., "Compiler Construction, Principles and Practice", Thomson, New Delhi, 2003.

Web-Resources

https://www.geeksforgeeks.org/last-minute-notes-compiler-design-gq/

https://www.tutorialspoint.com/compiler_design/compiler_design_tutorial.pdf

https://nptel.ac.in/downloads/106108113/

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Able to identify and understand different phases and passes of compiler and their functioning.
CO2: Able to understand the concept of syntax analysis and to solve the problems of predictive parsing.
CO3: Able to differentiate between top down and bottom up parsing and understand syntax directed translation techniques.
CO4: Able to apply code optimization and code generation techniques.
CO5: To learn & use the new tools and technologies used for designing a compiler.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Elective –III (EC)	**MANET**	**Course Code: PGXE3**
Instruction Hours: 4	**Credits: 3**	**Exam Hours: 3**
Internal Marks : 25	**External Marks:75**	**Total Marks: 100**

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• This course aims to build concepts regarding the fundamental principles of distributedsystems. • The design issues and distributed operating system concepts are covered. • To analyze the various design issues and challenges in the layered architecture of Ad hocwireless networks. • It starts with characteristics features, applications of ad hoc networks, Modulationtechniques and voice coding. • It also covers the IEEE 802.11 Wireless LAN and Bluetooth standards.	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION: Introduction to adhoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models:- Indoor and outdoor models. Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet.	12
II	AD HOC ROUTING PROTOCOLS :Introduction – Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing	12

	Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).	
III	MULTICASTROUTING IN ADHOC NETWORKS :Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols – Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application-Dependent Multicast Routing – Comparisons of Multicast Routing Protocols.	12
IV	END-END DELIVERY AND SECURITY Transport layer : Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.	12
V	CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary prespective. Intergration of adhoc with MobileIP networks.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text books:

1. C.Siva Ram Murthy and B.S.Manoj, Ad hoc Wireless Networks Architectures and protocols,2nd edition, Pearson Education. 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000

Reference Book:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad hocnetworking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of adhoc wireless networks, CRC press, 2002.

Web-Resources:

http://www.olsr.org/docs/wos3-olsr.pdf http://www.it.iitb.ac.in/~sri/talks/manet.pdf http://cwi.unik.no/images/Manet_Overview.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Appraise the importance of Adhoc networks such as MANET and VANET and WirelessSensor networks.

CO2: Understand design considerations for wireless networks.

CO3: Explain the design considerations for deploying the wireless network infrastructure.

CO4: Compare the differences between cellular and ad hoc networks and the analyse the challenges at various layers and applications

CO5: Summarize the protocols used at the MAC layer and scheduling mechanisms.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Core Elective –III (EC)	SOFTWARE PROJECT MANAGEMENT	Course Code: PGXE3
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Introducing the primary important concepts of project management related to managing software development projects. • They will also get familiar with the different activities involved in Software Project Management. • Further, they will also come to know how to successfully plan and implement a software project management activity, and to complete a specific project in time with the available budget.	
UNIT	**CONTENT**	**HOURS**
I	Introduction to Software Project Management: Introduction – Why is SPM important? – Project- Software projects Vs other types of project – Contract and technical project managementActivities – plan, methods and methodologies categorizing software projects- stakeholders- setting objectives- Business case – project success and failures- Management. Project Evaluation and Programme Management: Introduction – Business case – Project portfolio management – Evaluation of individual projects – cost benefit evaluation techniques – risk evaluation – Programme management – Managing the allocation of resources – Strategic programme management – Creating a programme and aids – benefits management	12
II	Overview Of Project Planning: Introduction - Step wise Project Planning – steps. Selection Of An Appropriate Project Approach :	12

	Introduction – Build or buy Choosing methodologies and technologies – Software processes and models – choice of process models – structure Vs speed of delivery – waterfall model – spiral model – software prototyping – Rapid application development – Agile methods- Extreme programming.	
III	Software Effort Estimation: Introduction- Where are estimates done? – Problems with over and under estimates – Basis for estimating and its techniques – Bottom up estimating – Top down approach and parametric models – Expert Judgment – Estimating by analogy - Function Point Analysis – FP mark II – COSMIC full FPCOCOMO II – Cost estimation and staffing patterns. Activity Planning: Introduction- objectives – When to plan? – Project schedules – Projects and Activities – Network Planning Models – Sequencing and Scheduling Activities – Formulating a Network Model – Adding the Time Dimension – Forward and Backward Pass – Critical Path- Activity Float – Shortening the Project Duration – Critical Activities – Activity on Arrow Networks.	12
IV	Risk Management: Introduction – Risk – Categories of risk – A framework for dealing with risk – Risk Identification – Risk assessment – Risk Planning – Risk Management – Evaluating risks to schedule – Applying the PERT Technique – MonteCarlo Simulation –Critical Chain Concepts. Resource allocation : Introduction – Nature of resources – Identifying Resource Requirements- Scheduling – Creating Critical Path – Counting the cost – being the specific – publishing the resource schedule - Cost Schedules – Scheduling sequence	12
V	Monitoring and Control: Introduction – Creating the framework – collecting the data – Review – Software Configuration Management. Managing Contracts: Introduction- Types of contracts – Contract Management - Managing people in software environments.	12
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

"Software project management" - Bob Hughes, Mike Cotterell and Rajib Mall - Fifth Edition.

Unit I: Chapter 1, 2
Unit II: Chapter 3, 4
Unit III: Chapter 5, 6
Unit IV: Chapter 7, 8
Unit V: Chapter 9, 10, 11

Reference Book

"Software Project Management" - Walker Royce - Pearson Education

Web-Resources:s

https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/SOFTWARE%20PROJECT%20M ANAGEMENT.pdf
https://www.smartzworld.com/downloads/download/spm-complete-pdf-notes/
https://www.srividyaengg.ac.in/coursematerial/CSE/104831.pdf
http://vemu.org/uploads/lecture_notes/20_12_2019_1305961524.pdf
https://ocw.mit.edu/courses/engineering-systems-division/esd-36-system-project-management- fall-2012/lecture-notes/

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Identify the different project contexts and suggest an appropriate management strategy.
CO2: Practice the role of professional ethics in successful software development.
CO3: Identify and describe the key phases of project management.
CO4: Determine an appropriate project management approach through an evaluation of the business context and scope of the project.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

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W-Weakly Correlated

N – No Correlation

Semester-III / Core Elective –IV (EC)	**EMBEDDED SYSTEM**	**Course Code: PGXE4**
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks : 25	**External Marks:75**	**Total Marks: 100**

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To provide fundamental concept of Embedded systems and real time operating systems. • The concepts and architecture of embedded systems • Basic of microcontroller 8051 • The concepts of microcontroller interface • The concepts of ARM architecture • The concepts of realtime operating system • Different design platforms used for an embedded systems application	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION TO EMBEDDED SYSTEMS:Processor in the system – software embedded into a system – structural units in a processor – processor, memory selection, Memory devices - Allocation of memory to program segments and blocks and memory map of a system.	15
II	DEVICE DRIVERS :Interrupt servicing mechanisms – context and periods for context switching -Programming concepts and Embedded programming in C and C++: Software programming in ALP and in high level language 'C' – 'C' program elements: Header source files and preprocessor directives – Macros and functions: Data types – data structures – modifiers – statements –	15

	loops and pointers – Embedded programming in C++ and Java.	
III	PROGRAM MODELING CONCEPTS :Program modeling concepts in single and multiprocessor systems – software – development process: modeling process for software analysis – programming model for event controlled or response time constrained real time program- modeling of multiprocessor systems. Multiple processes – sharing data by multiple tasks and routines – inter process communications.	15
IV	REAL TIME OPERATING SYSTEMS :OS services – IO sub systems – Real time and embedded operating systems – Interrupt routines in RTOS environment – RTOS task scheduling models, Interrupt latency and response times of the task as performance metrics – performance metrics in scheduling models.	15
V	HARDWARE SOFTWARE CODE DESIGN :Embedded system project management – Embedded system design and Co-design Issues –Design Cycle – uses of target system – use of software tools for development – use of scopes and logic analysers for system hardware tests – issues in embedded system design.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

Embedded systems – Architecture, Programming and Design By Raj Kamal – TMH, 2007

Reference Book:

Mohamed Ali Maszidi & Janice Gillispie Maszidi, "The 8051 Microcontroller and EmbeddedSystem", Pearson Publishers

Web-Resources:

https://www.iitg.ac.in/pbhaduri/cs52213/Introduction%20to%20Embedded%20Systems%20(ver%200.5,%20Aug%202010).pdf

https://drive.google.com/file/d/1n_wu9rjUyR-mzjhPuH4O67undtRTFeup/view__EE6602-SCAD-MSM- By EasyEngineering.net

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Learn fundamentals of designing embedded systems.
CO2: Different design platforms used for an embedded systems application.
CO3: Explain the embedded system concepts and architecture of embedded systems.
CO4: The concepts and architecture of embedded systems.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Elective –IV (EC)	SECURITY IN COMPUTING	Course Code: PGXE4
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks : 25	**External Marks:75**	**Total Marks: 100**

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To learn the importance of evidence handling and storage for various devices. • Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection. • This course focuses on the models, tools, and techniques for enforcement of security with some emphasis on the use of cryptography. • Students will learn security from multiple perspectives.	
UNIT	**CONTENT**	**HOURS**
I	SECURITY PROBLEM IN COMPUTING :Protecting variables - Characteristics of computer intrusion - Attacks - Security goals - Vulnerabilities- Computer criminals - methods of defense- Elements of cryptography : Terminology and background - Substitution ciphers - Transpositions – Encryption algorithms - Data encryption standard - AES encrypt ion algorithm - uses of encryption	15
II	PROGRAM SECURITY :Secure program - Non Malicious program errors – Virus and other malicious code - controls against program threads - - Protection in general purpose operating system: protected objects and methods of protection - Memory and address protection - control of access to general objects - file protection mechanism -user authentications	15

III	DESIGNING TRUSTED OPERATING SYSTEM :Security policy - Models of security - Trusted OS Design - Assurance in trusted OS - implementation – Database security	15
IV	SECURITY IN NETWORKS :NT concepts - Threads in NT - Network Security controls - firewalls - Intrusion detection system - Secure Email- Administering security: Security planning - Risk analysis - Organisation security policies - Physical security	15
V	LEGAL, PRIVACY AND ETHICAL ISSUES IN COMPUTER SECURITY :Protecting programs and data - Information of Computer objects -Rights of employees and Employeers- Software failure - Computer crime - Privacy - Ethical issues in Computer Security- Cryptography: Mathematics for Cryptography - Symmetric encryption - Public key encryption system – Quantum Cryptographic results.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

Charles P.Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", Second Edition,Pearson Education (Singapore) Pvt. Ltd, 2004.

Reference Book:

1. Eric Maiwald, "Network Security a Beginner's Guide", Second Edition, Tata-Mcgraw Hill Publication Ltd., New Delhi, 2003.
2. AtulKahate, "Cryptography and Network Security", Tata-Mcgraw Hill Publication Ltd., New Delhi, 2003

Web-Resources:

https://www.cs.vu.nl/~ast/CN5/#Auth
http://williamstallings.com/ComputerSecurity/
https://www.nap.edu/read/1581/chapter/4

Course Outcomes

On completion of the Course, Students should be able to do

CO1: Identify some of the factors driving the need for network security
CO2: Identify and classify particular examples of attacks
CO3: Define the terms vulnerability, threat and attack
CO4: Identify physical points of vulnerability in simple networks
CO5: Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Elective –IV (EC)	GRID COMPUTING	Course Code: PGXE4
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Identify the technical foundations of cloud systems architectures. • Analyze the problems and solutions to cloud application problems. • Apply principles of best practice in cloud application design and management. • Identify and define technical challenges for cloud applications and assess their importance.	
UNIT	**CONTENT**	**HOURS**
I	Introduction: Early and Current Grid Activities – An Overview of Grid Business Areas – Applications – Infrastructure. Grid Computing Organization and their Roles: Standards and Guidelines – Tool Kids and Framework – Grid-Based Solution to Solve Computing, Data and Network Requirements.	15
II	The Grid Computing Anatomy: The Grid Problem – Concept of Virtual Organizations – Architecture. The Grid Computing Road Map: Autonomic Computing – Business on Demand and Infrastructure Virtualization – Service oriented Architecture and Grid – Semantic Grid.	15
III	Merging Grid Services Architecture with the Web Services Architecture: Service-Oriented Architecture – Web Service	15

	Architecture – XML, Related Technologies –XML Messages and Enveloping – Service Message Description Mechanisms – Relationship between Web Service and Grid Service – Open Grid Services Architecture (OGSA): Architecture.	
IV	OGSA Use Cases: Commercial Data Center – National Fusion Collaboratory –Online Media and Entertainment - OGSA Platform Components – OGSI: Grid Services – Specification – Service Data Concepts – Naming and Change Management Recommendations.	15
V	OGSA Basic Services: Common Management Model – Service Domains – Policy Architecture – Security Architecture – Metering and Accounting – Common Distributed Logging - Distributed Data Access and Replication.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

"Grid Computing ", Joshy Joseph and Craig Fellenstein, Pearson Education, 2005.

Reference Books :

"Grid Computing "S. Jaya Krishna, ICFAI University Press, 2006.

Web-Resources:

https://www.imsc.res.in/~kabru/parapp/Grid-2004-workshop/presentations/day1-au-cdac-intro.pdf
https://www.vidyarthiplus.com/vp/Thread-CS2063-Grid-Computing-Lecture-Notes
http://www.cs.kent.edu/~farrell/grid06/lectures/index.html

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
CO2: Analyze the performance of Cloud Computing.
CO3: Understand the concept of Cloud Security.
CO4: Learn the Concept of Cloud Infrastructure Model.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Elective –V (EC)	**INTERNET OF THINGS**	**Course Code: PGXE5**
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks : 25	**External Marks:75**	**Total Marks: 100**

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To assess the vision and introduction of IoT. • To Understand IoT Market perspective. • To Implement Data and Knowledge Management and use of Devices in IoT Technology. • To Understand State of the Art - IoT Architecture. • To classify Real World IoT Design Constraints, Industrial Automation in IoT.	
UNIT	**CONTENT**	**HOURS**
I	INTRODUCTION TO INTERNET OF THINGS Introduction - Physical design of IoT – Logical design of IoT – IoT Enabling Technologies – IoT levels & Deployment technologies. DEMYSTIFYING THE IoT PARADIGM: The Emerging IoT flavors-The Industrial Internet of Things – Consumer Internet of Things - Social Internet of things - Semantics for The Interoperable IoT- Cognitive IoT.	15
II	REALIZATION OF IoT ECOSYSTEM USING WIRELESS TECHNOLOGIES: Introduction- Architecture for IoT Using Mobile Devices- Mobile Technologies for Supporting IoT Ecosystem- Mobile Use Cases for IoT – Low Power Wide Area Networking Topologies – Sigfox- Weightless – Nwave- Ingenu- Lora.	15

III	INFRASTRUCTURE AND SERVICE DISCOVERY PROTOCOLS FOR THE IOT ECOSYSTEM: Introduction- Layered Architecture for IoT – Protocol Architecture of IoT – Infrastructure Protocols-Device or Service Discovery for IoT – Protocols for IoT service Discovery. INTEGRATION TECHNOLOGIES AND TOOLS FOR IOT ENVIRONMENTS:Sensor and actuator networks.	15
IV	IOT AND M2M :INTRODUCTION – M2M – Difference Between IoT and M2M – SDN and NFV for IoT. DEVELOPING IOT: IoT Design Methodology.	15
V	SECURITY MANAGEMENT OF AN IOT ECOSYSTEM Introduction- Security Requirements of an IOT Infrastructure-Authentication - Authorization And Audit Trail (AAA) Framework-Defense In Depth-Security Concerns of Cloud Platforms-Security Threats of Big Data –Security Threats In Smartphones-Security Solutions For Mobile Devices-Security Concerns In IoT Components-Security Measures for IoT Platforms/Devices.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things Enabling Technologies, Platforms, and Use Cases", Taylor & Francis, CRC Press, 1st Edition, 2017.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands-On Approach", Universities Press (INDIA) Private Limited, 1st Edition, 2015.

Reference Books

Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

Web Resources:

https://lecturenotes.in/notes/21082-note-for-internet-of-things-iot-by-srikant-vas
https://ocw.cs.pub.ro/courses/iot/courses/01
https://nptel.ac.in/courses/106105166/
http://www.cs.ust.hk/~qianzh/FYTGS5100/spr2013/notes/Chapter1-IoT.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: Understand the Architectural Overview of IoT.
CO2: Realize the concepts of IoT using Wireless Technologies.
CO3: Understand the various IoT Protocols.
CO4: Impart the knowledge on the devices of IoT.
CO5: Comprehend the idea of M2M, and Learn the IoT security in various domains

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Elective –V (EC)	HUMAN COMPUTER INTERACTION	Course Code: PGXE5
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable. • Understand the theoretical dimensions of human factors involved in the acceptance ofcomputer interfaces. • Understand the important aspects of implementation of human-computer interfaces. • Identify the various tools and techniques for interface analysis, design, and evaluation. • Identify the impact of usable interfaces in the acceptance and performance utilization ofinformation systems.	
UNIT	**CONTENT**	**HOURS**
I	**The Interaction:** Introduction – Models of interaction – Frameworks and HCI Ergonomics– Interaction styles – Elements of the WIMP interface – Interactivity – The context of the interactions. Paradigms : Introduction – Paradigms for interaction.	15
II	**Interaction, Design basics:** Introduction – What is design? – User focus – Scenarios – Navigation design – Screen design and layout – Interaction and prototyping. HCL in the Software Process : Introduction – The software lifecycle – Usability engineering – interactive design and prototyping – Design rationate.	15
III	**Design Rules:** Introduction – Principles to support usability – Standards – Guidelines – Golden rules and heuristics – HCI patterns.	15

	Implementation Support : Introduction – Elements of windowing systems – Programming the application Using toolkits – User interface management systems.	
IV	**Evaluation Techniques:** What is evaluation – Goals of evaluation – Evaluation through expert analysis – Evaluation through user participation – Choosing an evaluation method. Universal Design : Introduction – Universal design principles – Multi-modal interaction – Designing for diversity – Summary.	15
V	**User Support:** Introduction Requirements of user support – Approaches to; user support – Adaptive help systems designing user support systems.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books

Human - Computer Interaction, Third Edition, "Alan Dix, Janet Finlay, Gregory D. Abowd and Russell Beale", Pearson Education, 2004.

Reference Books

Human – Computer Interaction in the New Millennium, "John C. Carroll", Pearson Education"2002.

Web-Resources:

https://www.iare.ac.in/sites/default/files/lecture_notes/HCI%20LECTURE%20NOTES.pdf

http://www.cs.bham.ac.uk/~rxb/Teaching/SSC%20HCI%202008-9/HCIlecturenotes.pdf

Course Outcomes:

On completion of the Course, Students should be able to do

CO1: To stress the importance of good interface design
CO2: To predict good features of interface designs.
CO3: To evaluate designs based on theoretical frameworks and methodological approaches.
CO4: To identify and criticize bad features of interface designs.
CO5: To learn the techniques for prototyping and evaluating user experiences.

Mapping of COs with POs & PSOs:

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Elective –V (EC)	WEB SERVICES	Course Code: PGXE5
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks : 25	External Marks:75	Total Marks: 100

Knowledge Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To Understand Web Services and implementation model for SOA • To Understand the SOA, its Principles and Benefits • To Understand XML concepts • To Understand paradigms needed for testing Web Services • To explore different Test Strategies for SOA-based applications	
UNIT	**CONTENT**	**HOURS**
I	**Introduction:** What are Web Services?-SOAP WSDL UDDI-Why Web Services are important?-The evolution of web applications Not just another distributed computing platform- Web Services and enterprises	15
II	**XML Fundamentals:** The Lingua Franca of Web Services-XML Documents-XML Namespaces Explicit and Default namespaces-Inheriting namespaces and not inheriting namespaces-Attributes and namespaces. **XML Schema:** XML Schema and namespaces-First Schema-Implementing XML Schema types- The any element-Inheritance-Substitution groups- Global and local type declarations-Managing Schemas-Schemas and instance documents-XML schema best practices.	15
III	**SOAP:** Overview of SOAP-HTTP-XML-RPC-SOAP Protocol-	15

	Message Structure-Intermediaries-Actors-Design Patterns and Faults-SOAP with Attachments.	
IV	**UDDI:** UDDI at glance-The UDDI Business registry-UDDI under the covers-Accessing UDDI-How UDDI is playing out.	15
V	**Conversations:** Overview- Web Services-Web Services Conversation Language-W3CL Interface components – The Bar Scenario Conversations – Relationship between WSCL and WSDL.	15
VI	Contemporary Issues: Expert lectures, online seminars – webinars.	-

Text Books:

1. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services", Pearson Education, 2004.
2. Frank.P.Coyle, XML, Web Services and the Data Revolution, "Pearson Education, 2002.
3. Ramesh Nagappan, Robert Skoczylas and Rima Patel Sriganesh, "Developing Java Web Services", Willey Publishing I McGovern, et al.,
4. "Java Web Services Architecture", Morgan Kaufmann Publishers, 2005

Web-Resources:

https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/WEB%20SERVICES%20NOTES. pdf
https://www.jbiet.edu.in/pdffls/csecoursefile2020/WS_notes_IV_CSE.pdf
https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-264j-database-internet-and- systems-integration-technologies-fall-2013/lecture-notes-exercises/MIT1_264JF13_lect_22.pdf
https://www.cl.cam.ac.uk/~ib249/teaching/Lecture1.handout.pdf

Course Outcomes

On completion of the Course, Students should be able to do

CO1: Understand the principles of SOA
CO2: Efficiently use market leading environment tools to create and consume web services
CO3: Identify and select the appropriate framework components in creation of web service solution
CO4: Apply OOP principles to creation of web service solutions

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation