कव्हर पेज का प्रारूप
(संशोधन/विलोपन पश्चात
निर्मित पाठ्यक्रम हेतु)

Pt. Ravishankar Shukla University,
Raipur (C.G.), India 492010

CURRICULUM & Syllabus
(Based on CBCS & LOCF)

M.Sc.- Computer Science
(Semester System)

Semester: I-IV

Session: 2025-27

Approved by:

Board of Studies : **Subject- COMPUTER SCIENCE**

Dates: **05-05-2025**

Name of Chairmen : **DR. SANJAY KUMAR**

Name of Member's : DR. ANIL KUMAR TIWARI, DR. VIBHA DUBEY, DR. SANJAY GUPTA
DR. PRANJLI DEWANGAN, DR. POOJA RATHI, DR. SANTOSH VISHWAS
DR. VINOD KUMAR PATLE DR. VARTIKA SHIRVASTHAV,
SHREE MANNU RAVANI, DR. PRAMOD MISHRA,
DR. SAMEEK BHATTACHARYA

Pt. Ravishankar Shukla University
Raipur

CURRICULUM & SYLLABI

(Based on CBCS & LOCF)

M.Sc. Computer Science

Semester System

Session: 2025-27 & onwards

Approved by:	Board of Studies	Academic Council
Date:	05 MAY 2025	

M.Sc. Computer Science

Master of Science in Computer Science is a two-year professional post-graduate program designed to meet the shortage of qualified professionals in the IT (Information Technology) industry. This program helps students wanting to delve deeper into the world of Application development with the help of learning modern programming languages. The program is a combination of both theoretical and practical knowledge. **M.Sc.(CS)** endows students an opportunity to work with tools meant to develop better and faster applications. Technological issues require specialized solutions and **M.Sc. CS** provides hands-on training and skills to address to complex issues arising in the domains such as operating systems, computer languages and System Development. Students learn about the advanced applications of computer hardware and software and its application in various fields such as operating systems, web designing and computer languages such as .NET, Java, HTML, C++, RDBMS etc.

Program Outcomes:

Upon successful completion of the Master of Science in Computer Science program, students will be able to:

PO-1	**Knowledge:** Demonstrate a deep understanding of advanced computing concepts, theories, and techniques in various subfields of Computer Science.
PO-2	**Advanced Analytical and Computational Skills:** Possess advanced skills in system analysis and computation, including proficiency in using software, programming languages, and computational tools for simulations and data analysis.
PO-3	**Self-directed and Life-long Learning**: Recognize the importance of ongoing professional development and lifelong learning in the rapidly evolving field of computer applications& IT/ Computer Science, and will exhibit the ability to continue learning independently or in formal educational settings.
PO-4	**Critical Thinking and Reasoning:** Exhibit advanced critical thinking skills by analyzing and evaluating by theories, practical and projects, and by making reasoned judgments about complex computing problems.
PO-5	**Effective Communication**: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions
PO-6	**Further Education or Employment:** Engage for further academic pursuits, including Ph.D.. Get employment in academia, research institutions, industry, government, and other public sectors.
PO-7	**Problem Solving:** Formulate abstract programming problems and derive solutions using logical reasoning and programming.
PO-8	**Effective Citizenship**: **Leadership and Innovation:** Lead and innovate in various computer applications & IT/ Computer Science, contributing to advancements in the field and applying computer applications and IT insights to emerging challenges.
PO-9	**Ethics**: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.
PO-10	**Social/ Interdisciplinary Interaction**: Integrate programming concepts and techniques into inter disciplinary contexts, collaborating effectively with professionals from other fields to address complex problems.
PO-11	**Global Perspective**: Recognize the global nature of Computer Science and its impact.

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(Mr. Mannu Rawani) (Miss. Vartika Shrivastav) (Dr.Pranjal Dewangan) (Mr. Samik Bhattacharya)

PROGRAMME SPECIFIC OUTCOMES (PSOs) : At the end of the program, the student will be able to:

PSO1	Understand the nature of Computer Science and explore the concepts in further details.
PSO2	Apply the knowledge of Computer Science concepts in interdisciplinary fields and draw the inferences by finding appropriate solutions.
PSO3	Pursue research in challenging areas of Computer Applications/Computer Science & IT
PSO4	Employ confidently the knowledge of Computer software and tools for treating the complex problems and scientific investigations.
PSO5	Qualify national level tests like NET/GATE etc.

M.Sc. Computer Science

Specification of Course	Semester	No. of Courses	Credits
Core	I-IV	25	84
Elective	II-III	04	16
Total		29	100

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SCHEME OF TEACHING AND EXAMINATIONS
MASTER OF COMPUTER SCIENCE (2 Years)

FIRST SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
MSc(CS)101	Web Development using Open Source Scripting Language	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)102	Advanced Operating System	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)103	Data Structure through algorithms using 'C'	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)104 400	Programming in Java	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)105	Computer System Architecture	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)106	**Lab-I**: Programming in Web Development	-	-	2x2	2	-	50	100	150	-	30	50	80
MSc(CS)107	**Lab-II:** Programming in Data Structure through C	-	-	2x2	2	-	50	50	100	-	30	25	55
MSc(CS)108	**Lab-III:** Programming in Java	-	-	2x2	2	-	50	50	100	-	30	25	55
MSc(CS)109	Indian Knowledge System	-	-	2x2	2	-	25	-	25	-	15	-	15
	TOTAL	15	5	16	28	500	300	200	**1000**	200	180	100	**480**

SECOND SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
MSc(CS)201	Advanced RDBMS & PL/SQL	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)202	Advanced Computer Networks	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)203	.Net Technology	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)204	Elective – I	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)205	Elective – II	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS)206	**Lab-IV**: Programming in RDBMS & PL/SQL	-	-	2x2	2	-	50	100	150	-	30	50	80
MSc(CS)207	**Lab-V**: Programming based on MSc(CS)203	-	-	2x2	2	-	50	50	100	-	30	25	55
MSc(CS)208	**Lab-VI:** Programming Lab in Network	-	-	2x2	2	-	50	50	100	-	30	25	55
MSc(CS)209	Personality development	-	-	2x2	2	-	25	-	25	-	15	-	15
	TOTAL	15	5	16	28	500	300	200	**1000**	200	180	100	**480**

* **L+T+(P/2)**

S.No	Elective -I	Elective -II
I.	Formal Automata Theory	AI & Expert System
II.	Big Data Analytics	Digital Signal Processing
III.	Software Engineering	Soft Computing
IV.	MOOC	MOOC

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THIRD SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
MSc(CS) 301	Data Science using Python	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS) 302	Open Source Software with Case Study of Linux	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS) 303	Advanced Computer System Architecture	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS) 304	Elective – III	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS) 305	Elective – IV	3	1	-	4	100	25	-	125	40	15	-	55
MSc(CS) 306	**Lab-VII:** Practical Based on Python	-	-	2x2	2	-	50	100	150	-	30	50	80
MSc(CS) 307	**Lab-VIII:** Programming in Linux	-	-	2x2	2	-	50	50	100	-	30	25	55
MSc(CS) 308	**Lab-IX**: Mini-Project	-	-	2x2	2	-	50	50	100	-	30	25	55
MSc(CS) 309	Internship	-	-	2x2	2	-	25	-	25	-	15	-	15
	TOTAL	15	5	16	28	500	300	200	**1000**	200	180	100	**480**

* **Note – Student should join Summer Internship of 4 to 6 weeks, after Second Semester Examination.**

S.No	Elective –III	Elective -IV
I.	Data Mining and Data Warehousing	Mobile Communication
II.	Network Security and Cryptography	Internet of Things
III.	Compiler Design	Cloud Computing
IV.	MOOC	MOOC

FOURTH SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
M.Sc.(CS) 401	Internship: System Development Project & Implementation / Research Project (Dissertation)	-	-	32	16	200	200	-	400	120	100	-	220
M.Sc.(CS) 402	MOOC	**Non Credit but mandatory course**											
	TOTAL	-	-	32	16	200	200	-	400	120	100	-	220

* **L+T+(P/2)**

* **The work done by the students should be enough to justify the duration of project as 6 to 8 weeks.**
* **The certificate of Company/institute must specify the duration of at least 6 weeks.**
* **Students having undergoing Project will have to send the confirmation letter from the company/institute within 1 week of joining. This letter will have to consist of the information regarding Company/institute name, Guide Name, Project Title, Project Starting Date etc.**
* **The student will have to deliver Seminar and will have to submit two copies of Project Reports after completion of Project Work.**
* **Preferably, independent work should be carried out by each student.**
* **Participating in Workshops, Conferences and Seminars or publishing Research Papers will be given weightage in the Research Project.**
* **Students should register for any one MOOC course from SWAYAM/NPTEL/RSU LMS. under the guidance of a mentor and a certificate of completion must be submitted to the mentor.**

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Note:

- In place of Elective Course of II and III semester, Student can choose paper(s) from **any one MOOC course from SWAYAM/NPTEL/RSU LMS** subject to the following conditions:
  a. The chosen paper from **any one MOOC course from SWAYAM/NPTEL/RSU LMS** will be other than the papers offered in the current course structure.
  b. The paper will be of PG level with a minimum of 12 weeks' duration of 5 credits and 100 marks.
  c. The list of courses on SWAYAM keeps changing; the departmental committee will finalize the list of MOOC courses for each semester.
  d. The paper(s) may be chosen from **any one MOOC course from SWAYAM/NPTEL/RSU LMS** on the recommendation of Head of the Department.
- The candidates who have joined the PG Program in School of Studies (University Teaching Department), shall undergo Generic Elective Courses (only qualifying in nature) offered by other departments/SoS in Semester II and Semester III.
- The candidates who have joined the PG Program in School of Studies in Computer Science & IT Studies (University Teaching Department), shall undergo Skill Enhancement Course/Value Added Course (only qualifying in nature) in Semester II and Semester III.

Generic Elective Courses: (Offered to PG students of other Departments/SoS only)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	CS-CBCS-01	Essential of Information Technology	T	2	2	25	75	100
III	CS-CBCS-02	Computer Networking & HTML	T	2	2	25	75	100

Skill Enhancement/Value Added Courses: (Offered to the PG students of SoS in Computer Science & IT)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	CS-VAC-01	Cyber Crimes and Law	T	2	2	25	75	100
III	CS-VAC-02	Green Computing	T	2	2	25	75	100

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Program Articulation Matrix:

Following matrix depicts the correlation between all the courses of the program and Program Outcomes

CourseCode	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
MSc(CS) 101	√	√	√	√	√	√	√	×	√	√	√	√	√	√	×	√
MSc(CS) 102	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MSc(CS) 103	√	√	√	√	√	×	√	√	×	√	√	√	×	√	×	√
MSc(CS) 104	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MSc(CS) 105	√	√	√	√	√	√	√	×	×	√	√	√	√	√	×	×
MSc(CS) 106	√	√	√	√	√	√	√	×	×	√	√	√	√	√	×	√
MSc(CS) 107	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MSc(CS) 108	√	√	√	√	√	×	√	√	×	√	√	√	×	√	×	×
MSc(CS) 109	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MSc(CS) 201	√	√	√	√	√	√	√	×	×	√	√	√	√	√	×	×
MSc(CS) 202	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MSc(CS) 203	√	√	√	√	√	√	×	√	×	√	√	√	√	√	×	√
MSc(CS) 204-I	×	√	×	√	√	√	×	×	√	×	×	×	×	×	√	×
MSc(CS) 204-II	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MSc(CS) 204-III	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MSc(CS) 205-I	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MSc(CS) 205-II	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MSc(CS) 205-III	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MSc(CS) 206	√	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√
MSc(CS) 207	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
MSc(CS) 208	√	√	√	×	√	×	√	√	√	√	√	√	√	√	×	×
MSc(CS) 209	√	√	√	√	√	√	√	√	√	√	√	√	√	×	√	×
MSc(CS) 301	√	×	√	×	√	×	√	√	×	√	√	√	√	√	×	×
MSc(CS) 302	√	√	√	×	√	√	√	√	×	√	√	√	√	√	×	√
MSc(CS) 303	√	√	√	√	√	√	√	√	√	√	√	√	√	√	×	√
MSc(CS) 304-I	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MSc(CS) 304-II	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MSc(CS) 304-III	√	×	√	√	√	√	×	√	×	√	√	√	√	√	×	√
MSc(CS) 305-I	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MSc(CS) 305-II	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MSc(CS) 305-III	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MSc(CS) 306	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MSc(CS) 307	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	×
MSc(CS) 308	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
MSc(CS) 309	√	√	√	×	√	×	√	√	×	√	√	√	√	√	×	×
MSc(CS) 401	×	√	×	√	×	√	×	√	√	√	√	√	√	√	√	√
MSc(CS) 402	×	×	×	√	√	√	√	×	√	×	×	×	×	×	√	√
MSc(CS) 403	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	√
MSc(CS) 404	×	√	×	√	√	√	√	×	√	×	√	×	√	√	√	√
MSc(CS) 405	√	√	√	√	√	×	√	×	√	×	√	×	√	×	√	√
MSc(CS) 406	√	√	√	×	√	×	√	√	×	√	√	√	√	×	√	×
No. of courses mapping the PO/PSO	31	38	31	36	39	34	37	27	23	31	33	31	31	30	17	20

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	I
Course Code	**Course Title**		**Course Type**
MSc(CS)101	Web Development using Open Source Scripting Language		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

This course aims to make student learn Web Development concepts using scripting Language. It also helps to develop an understating of WWW and web hosting etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about WEB pages and its execution.	U
2	Design web pages and hosting concepts.	U
3	Run DBMS query and link it with web Page.	AP
4	Learn DNS registration Process	U
5	Learn Website Publishing.	E

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	1	-	1	-	3	1	-	1	-	3	1	-	-	-
CO2	2	2	3	1	1	1	2	-	-	-	-	2	2	-	-	3
CO3	1	3	3	1	1	1	1	-	2	2	-	3	1	-	-	2
CO4	3	2	2	1	1	2	3	1	-	2	1	1	2	-	-	-
CO5	3	3	3	1	1	2	2	-	-	3	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus

MSc(CS)101 - Web Development using Open Source Scripting Language

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I Webpage designing** HTML: Introduction to HTML, historical context and justification for HTML, Basic structure of an HTML document, Elements of HTML, HTML Tag and attributes, working with Text, Lists, tables and frames, Hyperlinks, Images and multimedia, working with forms and controls static V/S Dynamic websites, introduction to DHTML, CSS: concept of CSS , Creating style sheet, way of implementing CSS, CSS properties, Selector, CSS Id and class, CSS styling-Background, Text Format, Controlling fonts, Working with block elements and objects , working with lists and tables Box Model(Introduction, Border properties, padding properties, Margin properties).	10	1
II	**UNIT – II Event Handling and validation** Java Script:- what is java script, comparison between java, java script and VB script, The document Object model(DOM), Introduction to objects and methods, The hierarchy of JavaScript objects, window object, document object, outputting Text with JavaScript, JavaScript HTMl events and event listeners, JavaScript Validation: JavaScript from validation, Validate Numerical Input, Automatic HTML from Validation, Data Validation, HTML constant validation.	10	2
III	**UNIT – III Introduction to PHP** PHP evalution of PHP, Basic syntax, Defining variable and constant, datatype, Operator, Expression, Global Variables, Conditional Statement & looping statement: If-else, switch, while, for, for each loop Function: Function, call by value and call by reference, Recursion function, inbuilt functions, string: creatibg and accessing String, searching and replacing string, Formatting string, string library function arrays: Types of Array, Enumerated Arrays, Associative Array, Iteration, Multi dimensional Array, Array Function and SPL.	10	3
IV	**UNIT – IV Advanced PHP** Handling HTML from data, Hidden Field, Dealing with Multi-value field, File Uploaded form, Redirecting a form after submission, PHP file Include, PHP file require, Difference between include and require, Session Management, Cookies, PHP FTP, PHP HTTP, Exception Handling : PHP Exception and Errror, Difference between Fatal error and Warning, TRY, CATCH, THROW.	10	4
V	**UNIT – V Database Connectivity & Website Hosting** **Database Connectivity with My SQL:**Introduction to RDBMS, Connection PHP with MySQL Database, Performing basic database operation (DML), (insert, delete, update, select) with PHP, Setting query parameter, Executing query in PHP, **Website Hosting:** Website Hosting Basics, Domain Name Registration, Configuring DNS, Website Uploading and Publishing, Web-Page Performance, Search Engins, Monitoring and Securiuty.	10	5

Books Recommended:

- **Headfirst PHP and MySQL** – lynn Beighley and Michael Morrison
- **Learning PHP, MySQL and Java Script With J-Query, CSS** – Robin Nixon
- **HTML 5 Black Book, Covers CSS3, Java Script, XML, XHTML, AJAX, PHP and Jquerry**- D T Editotial Services
- **Introduction to Object Oriented Programming:** K V Witt, Galgotia Publications.
- **Object Oriented Programming**: *G Blaschek*, Springer Verlag
- **Object Data Management**: *R Cattel*, Addison Wasley.

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	I
Course Code	**Course Title**		**Course Type**
MSc(CS)102	Advanced Operating System		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

The course learning objective is to develop an understanding of Operating System Concepts for relating the other subjects with the functions of OS.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basics of how does operating system work.	U
2	Inculcate knowledge of basic functions of operating system like memory management, disk scheduling etc.	U
3	Develop critical thinking to manage processes and learn managing hardware and software both.	U
4	Develop internal knowledge of system handling.	E
5	Process starts their execution and how it completes.(U)	E

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)102 - Advanced Operating System

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Introduction** Defining operating system, History and Evolution of operating system, Dual mode operation in operating system, **Basic Concepts**: batch processing, spooling, multiprogramming, multiprocessor system, time sharing, real time systems, Functions and Goals of operating system, Operating system as resource manager, Operating system as an abstract machine.	10	1
II	**UNIT – II: Processor Management** Process concept, Process Control Block, **Process State**: State Transition Diagram, **Scheduling Queues**: Queuing Diagram, Types of schedulers-context switching and dispatcher, various types of CPU scheduling algorithms and their evaluation, multilevel queues and multilevel feedback queues, Thread life cycle, multithreading,	10	2
III	**UNIT – III: IPC and Dead Locks** **Inter Process Communication**: competing and co-operating processes, Introduction to concurrent processing, Precedence graphs, Critical section problem, Semaphore concept, Study of classical process synchronization problems: Producer–Consumer, Dining Philosophers. **Deadlocks**: The dead lock problem, dead lock definition, **Deadlock Characterization**: necessary condition, resource allocation graph, **Deadlocks handling**: Deadlock prevention, Deadlock avoidance, Banker's algorithm, Deadlock detection, Recovery from Deadlock.	10	3
IV	**UNIT – IV: Memory Management** Preliminaries of memory management, Contiguous memory allocation, partitioned allocation MFT, fragmentation, MVT, partition allocation policies, compaction, Non-Contiguous memory allocation, Paging, Structure of page table, Segmentation, **Virtual Memory**: Concepts, demand paging, Swapping, **Page replacement policies**: FIFO, Optimal, LRU, MRU, Thrashing. **Secondary Storage**: Hierarchy, physical characteristics, evaluation of disk access time and data transfer rate, **Scheduling algorithms**: FCFS, SCAN etc.	10	4
V	**UNIT – V: File and Device Management** **File concept**: file types, file directory maintenance, file sharing, basic file system structure, access methods-sequential and direct access, free space management contiguous, linked allocation and indexed allocation and their performances. **Protection and Security**: principle of protection, domain structure, access matrix, access control, the security problems. **Distributed systems:** Introduction & Features, Types of distributed OS.	10	5

Books Recommended:

- **Operating System Concepts**, *Abraham Silberschatz, Peter B. Galvin and Greg Gagne,* Wiley India
- **Modern Operating System**, *Andrew .S. Tanenbaum,* PHI
- **Operating System Concepts**, *James L. Peterson and Abraham Silberschatz,* Addison-Wesley
- **Operating System Concepts & Design**, *Milan Milenkovic,* MGH
- **An Introduction to Operating Systems**, *Harvey M. Dietel,* Addison Wesley

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	I
Course Code	**Course Title**		**Course Type**
MSc(CS)103	Data Structure through Algorithms using 'C'		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Objective of this course is to make student think about real time data storage and its structure. After completion of this course student will be able to understand and write coding in efficient manner.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Design the appropriate data structures and algorithms for solving real world problems and enables them to gain knowledge in practical applications of data structures.	Ap
2	Choose efficient data structures and apply them to solve problems and analyze the efficiency of programs based on time complexity.	An
3	Create better design of computer applications.	An
4	Understand technique such as Searching, Sorting, Tree and Graph so that student gain the reasoning ability to implement these concept in development of live commercial applications	Ap
5	Understand about memory representation of different data structures.(U)	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus

MSc(CS)103 - Data Structure through Algorithms using 'C'

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I Array and Linked Lists** Algorithm: **Concept of Algorithm, definition, characteristics of algorithm,** algorithmic notation, analysis of algorithm, rate of growth, time, Basic time and space analysis of an algorithm, Asymtotic notation. **DataStructure: Definition, Types of Data Structure, Data Structure operation.** Array: Linear Array, Representations of Array in Memory, Traversing, Insertion and Deletion in Linear Array, Multidimensional Array. Linked list, Representation of linked lists in memory, Traversing a linked list, Searching a linked list, Memory Allocation, Insertion into a linked List, Deletion from a Linked List, Header Linked List, Two- Way Linked Lists, Circular Linked List.	10	1
II	**UNIT – II Stack and Queues** Stacks Definition, concepts, operation and application of Stacks, Recursion and Polish notations, Quick sort, tower of Hanoi, Queue, Priority Queue: definition concepts, operation and application of Queue, circular queue and Dequeue. Linked representation of stack and queue.	10	2
III	**UNIT – III Trees and Its Representation:** Terminologies related to trees, Binary Tree, complete binary tree, almost complete binary tree; Tree Traversals-preorder, in order and post order traversals, their recursive implementations, Expression tree-evaluation, Linked representations of binary tree, operations. header nodes; threads, **Binary Search Tree:** searching, Inserting and deleting in BST, Heap; Path Lengths; Huffman's Algorithms. Basic idea of AVL Tree.	10	3
IV	**UNIT – IV Graphs:** Related definitions; Graph representations- adjacency matrix, adjacency list, adjacency multi-list; Traversal schemes - depth first search, breadth first search; Minimum spanning tree; Shortest path algorithm; Kruskal and Dijkstra's algorithms.	10	4
V	**UNIT – V Searching, Hashing and Sorting:** Searching : Linear Search, Binary Search, Searching and data modification Hashing- Basics, methods, collision, resolution of collision, chaining; Internal Sorting, External sorting - Bubble Sort, Insertion Sort, Selection Sort, Merge sort, Radix sort, heap sort.	10	5

BOOKS RECOMMENDED:

- **Fundamental of Data Structures**, *Horowitz and Sahani*, Galgotia Publishers.
- **Data Structures and Program Design in C**, *Kruse R.L*, PHI.
- **Data Structures using C and C++**, *Tanenbaum*, PHI.
- **Data Structures**, Schaum Series.
- **Data Structures**, *Bhagat Singh.*
- **Data Structures** - *Trembley and Sorenson.*

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	I
Course Code	**Course Title**		**Course Type**
MSc(CS)104	Programming in JAVA		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The objective of this course is to make learn students high level object oriented programming like java which develops programming skills in students.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand fundamentals structure and model of Java programming language.	U
2	Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.	U
3	Understand the basic principles of creating Java applications with graphical user interface (GUI).	U
4	Write a computer program to solve specified problems as well as make Business and research applications.	Ap
5	Understanding all fundamentals of Java students can easily relate and solve the real problem.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	1	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	1	-	-	-	-	2	1	-	-	3
CO3	3	3	2	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)104 - Programming in JAVA

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Introduction to Java Programming** **An overview of Java:** Object Oriented Programming, Features of Java, Java Virtual Machine, Java Environment: Java Development Kit, Java Standard Library, Data Types, **Variables:** Declaring a variable, Dynamic Initialization, The scope and life time of variable, Type conversion and Casting: Narrowing and Widening Conversions, Numeric Promotions, Type Conversion Contexts; **Operators**: Arithmetic Operators, Relational Operators, Logical Operators, Bit wise Operators, Conditional Operators, new operator, [ ] and instance of operator. **Control Statements:** Java's Selection statement, Iteration Statement, Jump Statement. **Arrays**: Declaring Array variables, constructing an Array, Initializing an Array, Multidimensional Arrays, Anonymous Arrays.	10	1
II	**UNIT – II: Classes and Interface** **Introducing Classes:** Class Fundamentals, Declaring Object, Assigning Object Reference Variables, Defining **Methods**: method overloading and overriding, Using objects as parameter, Constructors, Garbage collection, finalize () method. **Inheritance**: Inheritance basic, method overloading, object reference this and super, Chaining constructor using this () and super (), Member accessibility modifier: public, protected, default accessibility of member, private protected, private, **Package:** Define package, CLASSPATH, importing package, Interface: Define an interface, implementing interface, extending interface, variable in interface, **Overview of Nested Class:** Top level nested class and interface, Non static inner class, Local class, Anonymous class.	10	2
III	**UNIT – III: Exception handling and Multithreading** **Exception Handling:** Exception types, Uncaught Exception, Using try and catch, multiple catch, nested try block, throw, throws, and finally. **Multithreading:** Creating Thread, Thread Priority, Synchronization, Thread Scheduler, Running & Yielding, Sleeping & Waking Up, Waiting & Notifying, Suspending & Resuming; miscellaneous methods in thread class.	10	3
IV	**UNIT – IV: Fundamental Library Classes of Java and Input / Output** Object class, String class, String Buffer class, Wrapper class, Math class, Collection: Collection interface, List interface, Set interface sorted interface, Array List class, Liked List class, Tree Set, Comparator, Vector, Stack. **I/O Classes and Interfaces:** File, Buffer Stream, Character Stream, and Random Access for files, Object Sterilization.	10	4
V	**UNIT – V: Events, GUI and JDBC** **Event Handling:** Overview of Event Handling, Event Hierarchy, The Delegation Event Model, Event Classes, KeyEventClass, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model, Event Adapters. **GUI Programming:** Introduction to Swing, History, Features, Components and Containers, Swing Packages, Painting, Swing Component Classes; **JDBC:** Introduction to JDBC, JDBC Drivers Type, Connection, JDBC URLs, Driver Manager, Statement – Creating, Executing, Closing, Result Set – Data Types and Conversions. Prepared Statement.	10	5

Books Recommended:

- **Java: The Complete Reference,** *Herbert Schildt,* Oracle Press.
- **Core Java: Volume-I & Volume 2,** *Cay S. Horstmann & Gary Cornell,* PEARSON
- **Programming with Java,** *E. Balagurusamy,* McGraw Hill Education
- **Core Java,** *R. Nageshwara Rao,* Dreamtech Press

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	I
Course Code	**Course Title**		**Course Type**
MSc(CS)105	Computer System Architecture		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The course develops an understanding of Computer architecture and its detailed working. It inculcates the cognition of circuit design of internal parts of computers and its electronics basics.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develops an intuitive knowledge of circuitry design of electronic components.	R
2	Understand the overall internal architecture of computer in detail and also the digital representation of data in a computer system.	U
3	Understand the general concepts in digital logic design, including logic elements and their use in combinational and sequential logic circuit design.	An
4	Understand computer arithmetic formulate and solve problems, understand the performance requirements of systems.	E
5	Familiar with system hardware component.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	2	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)105 - Computer System Architecture

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I Representation of Information and H/w component** Number system (decimal, BCD, octal, hexadecimal) and conversions, r and r-1's complement, Fixed and Floating point representation, Binary codes: Excess-3, ASCII, EBCDIC, Error detection codes. Boolean Algebra, Map simplification K-Map, Logic Gates, **Combinational Circuit:** Half and Full Adder, Decoder and Multiplexer; **Sequential Circuit:** Flip-Flop (SR, D, JK, Master-Slave,T), 4 bit Register, Register with parallel load, Shift register, Binary ripple Counter, Binary synchronous counter.	10	1
II	**UNIT – II Register transfer language and micro operations** Register Transfer Language (RTL), Concepts of bus, Bus and Memory transfers, **Micro-operation:** Arithmetic, Logic and Shift micro operation, Instruction code, Computer registers, Computer instructions, Timing and control, Instruction Cycle and Interrupt Cycle, Memory reference instructions, Input-output and interrupt, Design of basic computer	10	2
III	**UNIT – III Programming Computers and CPU** Machine Language, Assembly Language, Assembler, Program Loops, Input /Output, Programming, General register organization, Stack organization, Instruction format, Addressing modes, Data transfer and manipulation language, Micro-programmed and Hardwired control, RISC Vs. CISC, **Pipelining in CPU design:** , Parallel Processing ,Arithmetic and RISC pipelining.	10	3
IV	**UNIT – IV Computer Arithmetic and I/O Techniques** Addition, Subtraction, Division and Multiplication Algorithm, Input-Output Interface, asynchronous data transfer; **Modes of transfer:** Programmed I/O, Interrupt Mechanism, Direct Memory Access (DMA), I/O Processor.	10	4
V	**UNIT – V Memory Organization** **Memory hierarchy:** Static and Dynamic RAM, ROM; Building large memory using chips, Associative Memory: associative mapping, Direct mapping, set associative mapping; Cache Memory Organization, Virtual Memory.	10	5

BOOKS RECOMMENDED:

- **Computer System Architecture**, *Morris Mano*, PHI, 3rd Edition)
- **Computer Organization and Architecture**, *William Stalling*, PHI
- **Computer organization and Architecture**, *J.P.Hayes*, TMH.
- **Digital Computer Logic Design**, *Morris Mano* ,PHI
- **Computer System Architecture and organization**, *Dr. M. Usha,and T. S. Shrikant*, Wiley publication.
- **Digital Computer Electronics**, *Malvino.*
- **Structured Computer Organization**, *Andrew S. Tanenbanm*, PHI
- **Modern Digital Electronics**, *R.P.Jain*, TMH
- **Fundamental of microprocessors**, *B. Ram*

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	I
Course Code	**Course Title**		**Course Type**
MSc(CS)106	Lab-I:Programming in Web Development		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	-	-	4
Maximum Marks	**Sessional**		**Practical**
150	50		100

Learning Objective (LO):

The learning objective of the course to make students learn basics of networking and development of web pages, CSS, Layouts and its publishing.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about WEB pages and its execution.	AP
2	Design web pages and hosting concepts.	AP
3	Run DBMS query and link it with web Page.	AP
4	Learn DNS registration Process	AP
5	Learn Website Publishing.	AP

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	1	-	1	-	3	1	-	1	-	3	1	-	-	-
CO2	2	2	3	1	1	1	2	-	-	-	-	2	2	-	-	3
CO3	1	3	3	1	1	1	1	-	2	2	-	3	1	-	-	2
CO4	3	2	2	1	1	2	3	1	-	2	1	1	2	-	-	-
CO5	3	3	3	1	1	2	2	-	-	3	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)106 - Lab-I:Programming in Web Development

Unit No.	Topics	No. of Hours	CO No.
I	HTML Basic concepts, Web designing issue, Structure of HTML documents.	10	1
II	HTML Elements: Core attributes, Language attributes, Linking Basics, Linking in HTML. Images and Anchors, Anchor Attributes, Image Maps, Semantic Linking Meta Information.	10	1
III	Introduction to PHP and its basic Concepts with programs	10	1
IV	Advanced Concept of PHP like event handling etc..	10	1
V	Fundamental programs of Database connectivity	10	1

Books Recommended:

- **Fundamentals of Computers**, V. Rajaraman, Prentice Hall of India.
- **HTML Complete Reference**, *Thomas A. Powell,* TMH

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	I
Course Code	**Course Title**		**Course Type**
MSc(CS)107	Lab-II: Programming in Data Structure Through 'C'		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	-	-	4
Maximum Marks	**Sessional**		**Practical**
100	50		50

Learning Objective (LO):

This course aims to student to learn how memory uses data structures for efficient management of memory for better programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn memory structures in programming.	Ap
2	Manage memory during programming.	Ap
3	Learn what data structure is used for better memory management.	Ap
4	Understand technique such as Searching, Sorting, Tree and Graph so that student gain the reasoning ability to implement these concept in development of live commercial applications	Ap
5	Understand about memory representation of different data structures.(U)	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO5	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)107 - Lab-II: Programming in Data Structure Through 'C'

Unit No.	Topics	No. of Hours	CO No.
I	Programs Related to Array and Linked Lists	10	1
II	Programs Related to Stack and Queues	10	2
III	Programs Related to Trees	10	3
IV	Programs related to Searching algorithms	10	4
V	Programs related to Sorting algorithms	10	5

Books Recommended:

- **Fundamental of Data Structures**, *Horowitz and Sahani*, Galgotia Publishers.
- **Data Structures and Program Design in C**, *Kruse R.L*, PHI.
- **Data Structures using C and C++**, *Tanenbaum*, PHI.
- **Data Structures**, Schaum Series.
- **Data Structures**, *Bhagat Singh*.
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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	I
Course Code	**Course Title**		**Course Type**
MSc(CS)108	Lab-III: Programming in Java		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	Sessional	Practical
100	50	50

Learning Objective (LO):

The objective of this course is to make students implement knowledge of java programming language into practical and observe the output and to make analysis of efficacy of the program.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand fundamentals structure and model of Java programming language.	Ap
2	Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.	Ap
3	Understand all fundamentals of Java students can easily relate and solve the real problem.	Ap
4	Understand the basic principles of creating Java applications with graphical user interface (GUI).	Ap
5	Write a computer program to solve specified problems as well as make Business and research application.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)108 - Lab-III : Programming in Java

Unit No.	Topics	No. of Hours	CO No.
I	**Programs related to Variables:** Declaring a variable, Dynamic Initialization, The scope and life time of variable, Type conversion and Casting **Operators, Control Statements, Arrays.**	10	1
II	Programs related to Classes and Interface	10	2
III	Programs related to Exception handling and Multithreading	10	3
IV	Programs related to Fundamental Library Classes of Java and Input / Output	10	4
V	Programs related to Events, GUI and JDBC	10	5

Books Recommended:

- **Java: The Complete Reference,** *Herbert Schildt,* Oracle Press.
- **Core Java: Volume-I & Volume 2,** *Cay S. Horstmann & Gary Cornell,* PEARSON
- **Programming with Java,** *E. Balagurusamy,* McGraw Hill Education
- **Core Java,** *R. Nageshwara Rao,* Dreamtech Press

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M.Sc. (CS) Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	**Course Title**		**Course Type**
MCA109	Indian Knowledge System		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	2	0	0
Maxin.um Marks	**Sessional**		-
25	25		00

Learning Objective (LO):

The course aims comprehensive understanding of the rich and diverse knowledge traditions of India.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Provide an overview of the concept of the Indian Knowledge System and its importance.	U
2	Appreciate the need and importance of protecting traditional knowledge.	U
3	Recognize the relevance of Traditional knowledge in different domains.	U
4	Establish the significance of Indian Knowledge systems in the contemporary world.	U
5	understand the traditional knowledge and analyse it and apply it to their day-to-day life	AnAp

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	2	2	2	-	2	1	-	2	1	3	-	2	-	3
CO2	1	3	3	1	2	-	2	1	-	2	3	1	1	1	1	1
CO3	2	3	3	3	2	-	2	1	-	3	2	3	-	2	2	-
CO4	1	3	3	1	3	1	1	1	1	2	2	3	-	2	-	-
CO5	3	2	3	1	2	-	2	1	-	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)109 - Indian Knowledge System

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Indian Knowledge System (IKS)** Definition, Concept and Scope of IKS, IKS-based Approaches on Knowledge Paradigms, IKS in Ancient India and in Modern India	6	1
II	**Metaphysical concepts in Indian thought** Exploration of Atman, Brahman, Maya, and their ontological implications, Understanding the Concept of Karma and its Role in Indian Philosophy, Analysis of the nature of reality and the concept of moksha (liberation).	6	2
III	**Indian scientific treatises and disciplines** Contributions to Ancient Indian Mathematics, Analysis of Ancient Indian Texts on Astronomy, cosmology, and Astrology, Understanding the concepts of energy (Prana), sound (Nada), and vibration (Spanda) in Indian sciences.	6	3
IV	**Traditional Indian sciences and technologies** Exploration of Vastu Shastra (Indian architecture) and its principles, Study of Jyotisha (Indian astrology) and its practical applications, Analysis of traditional Indian technologies in areas such as metallurgy and agriculture.	6	4
V	**Indian systems of medicine and Well-being** Study of Ayurveda, Yoga, and Naturopathy as holistic approaches to Health, Understanding the Principles and Practices of Traditional Indian Medicine, Exploration of the Integration of Indian healing modalities with modern healthcare.	6	5

Reference Books

1. Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93 91818-21-0.
2. Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230.
3. Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334.

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)201	Advanced RDBMS & PL/SQL		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The course objective is to make students learn a understanding of DBMS concepts specifically SQL Concepts and PL- SQL programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Design a database based on the given requirement.	Ap
2	Make Database oriented application with knowledge of subject provided to them.	Ap
3	Get the knowledge about Standard Query Language statements, PL/SQL, Query processing and optimization.	U
4	Apply normalization techniques on given database.	Ap
5	Get the basic building blocks of data warehousing, mining, Big Data Analytics, cloud computing etc.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	1	3	3	3	1	-	2	1	1	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	1
CO3	1	2	2	1	1	1	2	-	-	2	-	3	2	-	1	2
CO4	3	3	2	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	2	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)201- Advanced RDBMS & PL/SQL

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT - I: Overview of Database Management** Data, Information and knowledge, Importance of database oriented approach to data management; data independence, database administration roles, DBMS architecture, different kinds of DBMS users, importance of data dictionary, contents of data dictionary, types of database languages. Data models: network, hierarchical, relational. Introduction to distributed databases, Client/Server databases, Object-oriented databases, Object-relational databases, Introduction to ODBC concept.	10	1
II	**UNIT - II: ER Model & Relational Algebra** Entity - Relationship model as a tool for conceptual design-entities, attributes and relationships. ER diagrams; Concept of keys; Case studies of ER modeling Generalization; specialization and aggregation. Converting an ER model into relational Schema. Extended ER features. **Relational Algebra:** select, project, cross product different types of joins (inner join, outer joins, self-join); set operations, Tuple relational calculus, Domain relational calculus, Simple and complex queries using relational algebra, stand alone and embedded query languages.	10	2
III	**UNIT – III : Normalization** Introduction, Pitfalls in database design, update anomalies: Functional dependencies, Join dependencies, Normal forms (1NF, 2NF, 3NF). Boyce-Codd Normal form, Decomposition, Multi-Valued Dependencies, 4NF, 5NF.Issues in physical design; Concepts of indexes, Denormalization. Protecting the Data Base - Integrity, Security and Recovery. Domain Constraints, Referential Integrity, Assertion, Security & Authorization in SQL.	10	3
IV	**UNIT - IV: SQL and Relational Database Design** Introduction to SQL constructs (SELECT...FROM, WHERE... GROUP BY... HAVING... ORDERBY....), CREATE, INSERT, DELETE, UPDATE, ALTER, LIKE, DROP, VIEW definition and use, Temporary tables, Nested queries, and correlated nested queries, Integrity constraints: Not null, unique, check, primary key, foreign key, references. Transaction control commands –grant, privileges, commit, Rollback, Savepoint.	10	4
V	**UNIT - V: PL/SQL** Introduction to PL/SQL variables – literals – data types – advantages of PL/SQL; Control statements : if ; iterative control – loop, while, for, goto ; exit when; Cursors : Types –implicit, explicit – parameterized cursors – cursor attributes; Exceptions: Types – internal , user-defined , handling exceptions – raise statement; Triggers; PL/SQL tables and records: Declaring PL/SQL tables - referring PL/SQL tables, inserting and fetching rows using PL/SQL table, deleting rows; records - declaration of records - deleting records; Sub programs: Functions -procedures - in, out, inout parameters; purity functions - packages - package specification -advantages of packages - private and public items - cursors in packages.	10	5

Books Recommended:

- **Database System Concept**: *A. Silberschatz , H.F. Korth and S. Sudarshan*, TMH
- **Fundamentals of Database Systems**: *Elmasri & Nawathe*, Pearson Education
- **An Introduction to Database Systems**: *C. J. Date*, AWL Publishing Company
- **SQL, PL/SQL**: *Ivan Bayross*, BPB Publication
- **An Introduction to database systems**: *Bipin Desai*, Galgotia Publication.
- **Database Management System**: *A. K. Majumdar & P. Bhattacharya*, TMH

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)202	Advanced Computer Network		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

The course aims to develop understanding about security in network communication. It introduces the real time threats and its causes so that student will be able to do secure programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand of computer network.	U
2	Know the basic concepts of bandwidth, data communication etc.	U
3	Make more employable.	An
4	Open up new areas in the field of research and development in the area of computer networking.	An
5	Learn the ideas about cyber security and networking technologies.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)202 - Advanced Computer Network

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I** **Introduction to Computer Networking:** The Concept of Networking, Data Communication, Required network elements, The role of Standards Organization. Line Configuration, Various Topologies, Transmission Mode, Categories of Networks- LAN, MAN, WAN. The benefits of a Computer Networks. The OSI and TCP/IP Reference Model: The Concept of Layered Architecture, Design Issues for the Layers. Interfaces and services, Detailed Functions of the Layers. Comparison between OSI and TCP/IP Reference model.	10	1
II	**UNIT – II** **Transmission of Digital Data:** Bandwidth, Nyquist and Shannon's theorems for maximum data rate of a channel. Transmission media- Co-axial, UTP, Fiber optic and wireless. Analog and digital data Transmission- Serial and Parallel transmission. Modulation Techniques – AM, FM, PM. ADSL Modem. Multiplexing and Switching: The Concept of Multiplexing- FDM, TDM, WDM, CDM. The Concept of Switching- Circuiting, Message switching, Packet switching. Virtual Circuit and Datagram.	10	2
III	**UNIT – III** **Data Link Layer :** Line Discipline, Flow Control- stop and wait, sliding window, Go back N, Selective Repeat. Error Detection and Correction – Parity, CRC, Hamming Code. ALOHA, Slotted ALOHA, CSMA/CD, HDLC. IEEE standards for LAN's and MAN's – Ethernet, DQDB,The concept of ICMP, ARP, RARP, SNMP, SMTP, MIME, POP3 Protocols.	10	3
IV	**UNIT – IV** **Network Layer and Transport Layer:** IP Addressing, Classes of IP Adresses, Subnet Mask. IPv4 and IPv6 Header Formats. Routing algorithms - Distance Vector, Link State. TCP Header Format, UDP Header Format. Congestion Control Algorithms – Leaky Bucket and Token Bucket. Internetwork, Networking Devices – Repeater, Bridge, Router, Gateway, Switch, Hub	10	4
V	**UNIT – V** **Cyber Security and Networking Technologies:** The Importance of Security in Networking. Confidentiality, Authentication, Integrity, Non Repudiation. Traditional Cryptography - Data Encryption Standards, RSA algorithm. Deffie Hellman Algorithm. Virus, Worm, Trojan Horse, DoS, Spoofing, Phishing. X.25, Frame Relay, Cell Relay -ATM, ATM Cell, ATM Switch – Multistage Switch. Banyan Network. DSL, ADSL, SONET, SMDS.	10	5

Books Recommended:

- Computer Networks - A. S. Tanenbaum
- Data Communication and Networking - B. A. Forouzan

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)203	.Net Technology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The course aims to develop programming skills based on .NET frame work. Programming skills leads student to have critical thinking for solving any technical issues using software.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand .NET Framework	U
2	Practice Console based C# application	U
3	Create applications using Microsoft Windows Forms and also ADO .NET.	AP
4	Design web applications using ASP.NET.	U
5	Understand the OOP and Exception handling in .NET(U)	E

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)203 - .Net Technology

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT-I** **Introduction:** architecture and components of .NET framework 4.5, managed code, intermediate language, metadata and JIT compiler, common language runtime, automatic memory management, private and shared assemblies, exploring Visual Studio .NET IDE.	10	1
II	**UNIT – II** **Introduction to C#:** Identifiers, keywords, data types, variables, constants, operators, precedence, associatively, type conversion, decision and loop statements, enumerations, namespaces. Object Oriented Programming: encapsulation, inheritance, polymorphism, abstraction, interfaces.	10	2
III	**UNIT – III** **Introduction to Windows Programming**: Creating windows forms, windows controls, menus and dialogue boxes. MDI application. **Overview of xml**. Window programming vs. Window presentation foundation, main features of WPF 4.5, WPF 4.5 architecture, types of WPF applications, , WPF properties.	10	3
IV	**UNIT – IV** **Introduction to ADO.NET:** Introduction to SQL, architecture of ADO.NET, Data Provider, Data set components, creating a connection to a database through ADO.Net , OLEDB database, ODBC data source, ADO.NET commands, data adapters, creating data view.	10	4
V	**UNIT –** **Introduction to ASP.NET:** ASP.NET life cycle, exploring ASP.NET 4.5 web application, creating a sample ASP.NET 4.5 website, application structure and state, global. asax application file, web forms – standard controls, validation controls, master pages, web services.	10	5

Books Recommended:

Textbook: 1. Kogent Learning Solutions Inc., .NET 4.5 Programming – Black Book (dreamtech)

References:

- Joseph Albahari, Ben Albahari, C# 6.0 in a Nutshell
- Christian Nagel, Professional C# 6 and .NET Core 1.0
- Andrew Troelsen, Philip Japikse, C# 6.0 and the .NET 4.6

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)204	Elective – I Formal Automata Theory		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Student will learn mathematical relation of computing model. It helps to design and enhance new computing model and its operation.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Construct finite state machines and the equivalent regular expressions.	Ap
2	Prove the equivalence of languages described by finite state machines and regular expressions.	U
3	Construct pushdown automata and the equivalent context free grammars.	E
4	Prove the equivalence of languages described by pushdown automata and context free grammars. Be able to construct Turing machines and Post machines	Ap
5	Understand undecidability.	R

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)204 – I - Formal Automata Theory

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I** Alphabet, String and language, Finite state Machines, finite automata with Є-moves, Conversion of NDFA to DFA, Removal of Є-transition from NDFA, Two way finite automata, finite automata with output, Mealy & Moore machines, Applications of finite automata, minimization of finite automata.	10	1
II	**UNIT – II** Chomsky classification of Languages, Regular Expression and Language, Properties of Regular languages, Pumping lemma for regular sets, Closure properties of regular sets, Decision algorithms for Regular sets, Myhill-Nerode theorem.	10	2
III	**UNIT – III** Context free grammars and their properties, derivation tree, simplifying CFG, ambiguity in CFG, Chomsky Normal form, Greibach Normal form, Pumping lemma for CFL, Closure properties of CFL.	10	3
IV	**UNIT – IV** Pushdown automata: Informal description, Definition, Determinism and Non determinism in PDA, Equivalence of PDA's and CFL's. Two way PDA, Concept of Linear Bounded Automata, context sensitive grammars and their equivalence, Turning machine construction, determinism and non-determinism in TM, Multi tape, multi-track TM.	10	4
V	**UNIT – V** Decidability, Universal turning machine and decidable problem, recursive function theory, Recursively enumerable sets, recursive sets, partial recursive sets, Church's hypothesis, post correspondence problem, Russell's paradox.	10	5

Books Recommended:

- **Theory of Computer Science, Automata Languages & computation,** *K.L.P. Mishra, N. Chandrashekharan,* PHI.
- **Introduction to Automata Theory Language and Computation,** *John E. HopcraftandJeffary D. Ullman,* Narosa Publication house.
- **Introduction to Formal Languages, Automata Theory and Computation,** *Kamala Krithivasan and Rama. R,*Pearson.
- **Introduction to Automata Theory Languages and Computation,** *John E. Hopcraft, Jeffary, D. Ullman and Rajeev Motwani.*

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)204	Elective – I Big Data Analytics		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Student will learn concepts of BigData, MongoDB, Spark, Zookeeper, etc and it also develops how Bigdata is maintained and managed.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the building blocks of Big Data.	U
2	Articulate the programming aspects of cloud computing (map Reduce etc). Also get the knowledge about the big data programming languages apache, pig, hive and spark.	Ap
3	Understand the specialized aspects of big data with the help of different big data applications.	U
4	Represent the analytical aspects of Big Data along with the knowledge of big data database such as mongodb and nosql.	An
5	Know the recent research trends related to Hadoop File System, MapReduce and Google File.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply, **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

(Dr. Sanjay Kumar) (Dr. V.K. Patle) (Dr. A.K. Tiwari) (Dr. Vibha Dubey) (Dr. Pooja Rathi)

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Detailed Syllabus
MSc(CS)204 – II - Big Data Analytics

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Introduction to Data Warehousing and OLAP Technology for Data Mining** What is Data Mining?, KDD(Knowledge Discovery from Databases) Process, What Kinds of Data Can Be Mined?, Data Mining Functionality, Are all the patterns interesting?, Attribute Types, What is Data Warehouse?, Data Warehouse Architecture, Data Cube: A multi-dimensional data model, Schemas for Multidimensional Data Models, OLAP Operations, Data Warehouse Usage(Applications). , Data Mining Primitive, Architecture of Data Mining System.	10	1
II	**UNIT – II: Introduction Concept of Big Data** Big Data- Define Data, Web Data, Classification of Data- Structured, Semi-Structured, and Unstructured. Big Data Definitions, Challenges of Conventional system, Why We Need Big Data, Difference between Big Data and Small Data, Importance of Big Data. Big Data Characteristics (4V's Volume, Velocity, Variety, and Veracity), Big Data Types, Big Data Handling Techniques. Complexity of Big Data, Big Data Processing Architectures, Big Data Technologies, Big Data Business Value. Big Data Analytics Application. Big Data Challenges and Future Scope.	10	2
III	**UNIT – III: INTRODUCTION TO HADOOP AND HADOOP ARCHITECTURE** **Big Data –** Apache Hadoop & Hadoop EcoSystem: Hadoop Core Component, Features of Hadoop, The Hadoop Distributed File System: HDFS data Storage, Hadoop Physical Organization, HDFS Commands, MapReduce Framework, MapReduce Programming Model, MapReduce Map task,Reduce Task and MapReduce Execution, Hadoop YARN, Hadoop2 Execution Model, Hadoop Ecosystem Tools, Hadoop Ecosystem.	10	3
IV	**UNIT – IV: NoSQL Big Data Management, Mongo DB** **NoSQL:** What is it?, Where It is Used Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL, Use of NoSQL in Industry, SQL vs NoSQL, NoSQL DataStore, NoSQL Data Architecture pattern, NOSQL to Manage Big Data. **Data Base for the Modern Web:** Introduction to MongoDB, features of MongoDB, Data Types,Mongo DB Query Language and Database Command.	10	4
V	**UNIT – V: Hive and Pig:** **Pig**: Apache Pig, Application of Apache Pig, Feature, Pig Architecture, Pig-Grunt Shell, Installing Pig, Pig Latin Data Model, Pig Latin and Developing Pig Latin Scripts: Apache Pig Execution, Commands. **HIVE AND HIVEQL.** **Hive:** Introduction, Characteristics, limitation, Hive Architecture and Installation, Comparison with Traditional Database (RDBMS), Hive Datatype and File Formats, Hive Data Model, Hive Integration and Workflow Steps, Hive Built-in Functions, HiveQL.	10	5

Books Recommended:

- **Big Data Analytics**, *Raj Kamal and Preeti Saxena*, McGraw Hill Education
- **Big Data: Black Book**, *DT Educational Services*, Dreamtech Press
- **Big Data Analytics**, *Seema Acharya & Shubhashini Chellappan*, Wiley India
- **Big Data Analytics**, *M. Vijayalakshmi & Radha Shankarmani*, Wiley India

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	Course Title		Course Type
MSc(CS)204	Elective – I Software Engineering		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Objective of this course is to develop a skill to analysis the software requirement and students will be able to know about SDLC and how that phases can be used for designing and implementation of software.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn idea about the importance of using software engineering principles in real life projects and also be able to pick an appropriate software development model for developing systems.	U
2	Prepare software requirement sheet for a real life project, keeping in mind the properties of an SRS document.	Ap
3	Use mathematical models for calculating the size, cost and duration of real life projects.	An
4	Test the developed system using different testing techniques.	E
5	Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.	E

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)204 - Software Engineering

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Software Engineering Fundamentals:** Introduction to Software Engineering; Software Engineering Principles(Layers); Software Process – Process Framework, Umbrella Activities, Process Adaptation; Software Crisis; Process Models-Waterfall Model, Prototype Model, Incremental Model, Spiral Model, RAD Model; Agile Process.	10	1
II	**UNIT – II: Software Analysis and Design:** Requirement Engineering; Analysis Model-Data Flow Diagram, Data Dictionary, E-R Diagram, Decision Table; Software Requirements Specification(SRS), Structure of SRS; Pseudo code; Software Design; Design Process; Design Concepts-Abstraction, Partitioning, Modularity, Information Hiding, Refinement, Refactoring; Function Oriented Design; Object Oriented Design; Cohesion and Coupling.	10	2
III	**UNIT – III: Software Quality and Case Tools:** Software Metrics, Categories of Metrics, Function Point Metric; Software Quality; McCall's Quality Factors; Software Maturity Model-CMM,CMMI; Software Quality Assurance; ISO Standards-9000, 9001 and 9126; Software Reliability; Case Tools and its Scope; Case Objectives; Architecture of Case Tools; Case Classification.	10	3
IV	**UNIT – IV: Coding and Testing:** Programming Style; Structured Programming; Coding Standard; Internal Documentation; Software Testing-Verification and Validation; Alpha and Beta Testing; Levels of Testing-Unit, Integration and System Testing; Testing Techniques- White Box, Black Box; Cyclomatic Complexity; Test Plan; Debugging-Debugging Process, Debugging Strategies(Approaches).	10	4
V	**UNIT – V: Software Maintenance and Project Management:** Risk Management – Software Risk, Risk Identification; Introduction to Software Maintenance, Categories of Maintenance; Belady and Lehman Model; Boehm Model; Project Management Concept – People, Product, Process, Project; Software Team; Software Project Planning; Software Project Estimation; Cost Estimation Model(COCOMO, COCOMO II, Putnam-SLIM, Walston and Felix); Software Reengineering.	10	5

Books Recommended:

- **Software Engineering: A Practitioner's Approach,** *Roger S. Pressman*, TMH
- **An Integrated approach to Software Engineering,** *Pankaj Jalote*, Narosa Publications
- **Software Engineering,** *Bharat Bhushan Agarwal.*

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	Course Title		Course Type
MSc(CS)205	Elective – II(AI and Expert System)		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Students will learn about the basics of various AI concepts such as problem solving, logic, reasoning, learning and various algorithm related to these concepts.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Define the heuristics and apply them for solving complex problem with understanding of different heuristic based search techniques.	E
2	Understand of different knowledge structure and inference mechanism with ability to apply them in intelligent solutions of complex problem.	Ap
3	Understand the existence of uncertainty in problem solving and how mathematical /statistical models are used to overcome these problems.	E
4	Understand planning system and different types of planning required for problem solving process	U
5	Understand expert system and their various field.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)205 - AI and Expert System

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I** **Introduction to AI:** Foundations of AI, Philosophy and History; AI problems, AI technique; The Turing Test. **Intelligent Agents:** Agents and Environments, the Concept of Rationality, the Nature of Environments and the Structure of Agents. **Problem solving & State Space Search:** General problem solving: defining problems as State Space Search, Problem Characteristics; Production Systems & their characteristics.	10	1
II	**UNIT – II** **Exhaustive Searches:** Generate and Test, Breadth First Search, Depth First Search and DFID **Heuristic Search Techniques:** Branch and Bound technique; Best first search; A* algorithm; Problem Reduction AND/OR Graphs and AO* algorithm. **Local Searches & Optimizations:** Hill climbing and its variants. **Constraint Satisfaction Problems:** Definition; Constraint Propagation and Backtracking. **Game Playing:** Mini-Max Search Procedure; Alpha-Beta Cutoffs; Additional Refinements.	10	2
III	**UNIT – III** **Knowledge Representation:** Types of Knowledge; Knowledge Representation Issues; **Logic:** First order Predicate Logic; Representation of facts in FOL; Inference in FOL; Resolution Principle, Clausal Form and Unification; **Inference Mechanisms:** Forward and Backward Chaining; **Slot and Filler Structures:** Semantic Networks; Frame Systems and value inheritance; Conceptual Dependency; Scripts;	10	3
IV	**UNIT – IV** **Reasoning under Uncertainty:** Non-monotonic Reasoning, Logics for Non-monotonic Reasoning, Default Reasoning, Minimalistic Reasoning Implementation Issues, Truth Maintenance Systems; Probabilistic Reasoning and Uncertainty; Statistical Reasoning; Probability Theory; Bayes Theorem and Bayesian networks; Certainty Factor; Dempster-Shafer Theory. **Planning:** Overview; The Blocks Word; Component of a Planning System: Goal Stack Planning; Nonlinear Planning;	10	4
V	**UNIT – V** **Expert Systems:** Introduction, Characteristics, History and Applications of expert systems; Expert System Shells; Rule Based Systems Architectures, Non Production System Architectures; Knowledge Acquisition and Validation; Case Studies: MYCIN & DENDRAL. **Learning:** Rote learning; Learning by Taking Advise; Induction; Explanation based learning; Discovery; Analogy.	10	5

Books Recommended:

- **Artificial Intelligence**, *Rich E., Knight K. and Nair S. B.*, McGraw Hill Education
- **Artificial Intelligence: A Modern Approach**, *Russell S. J. and Norvig P.*, Pearson Education
- **Introduction to Artificial Intelligence and Expert Systems**, *Patterson D. W.*, PHI
- **Principles Of Artificial Intelligence**, *Nilson N. J.*, Narosa Publications

Artificial Intelligence, *Winston P. H.*, Pearson Education

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)205	Elective – II (Digital Signal Processing)		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Students will be able understand how does digital signal propagate. He/She is able to know working of digital communication devices through and its process of exchanging data.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand Digital Signals and its propagation.	U
2	Know the sampling of digital Signals.	U
3	Understand the process of conversion of digital signals into analog and vice versa.	R
4	Know the required devices for digital Signal Processing.	An
5	Know the application of digital Signal Processing.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)205 - Digital Signal Processing

Unit No.	Topics	No. of Hours	CO No.
I	UNIT – I Realization of Systems: Realization of digital linear system, Signal flow graph. IIR & FIR Structure. MATLAB Programming for realization of IIR & FIR Structure Only.	10	1
II	UNIT – II Infinite Impulse Response Filter design (IIR): Analog & Digital Frequency transformation. Designing by impulse invariance & Bilinear method. Butterworth and Chebyshev Design Method.	10	2
III	UNIT – III Finite Impulse Response (FIR) Filter Design: Rectangular, Triangular, Hamming, Blackman & Kaiser window. Linear Phase and Optimal Filter.	10	3
IV	UNIT – IV Multirate DSP: Introduction, Sampling Rate Conversion, Decimation of Sampling rate by an Integer factor, Interpolation of sampling rate by an Integer Factor, Sampling rate alteration or conversion by a rational factor. Filter design and implementation for sampling rate alteration or conversion: Direct form FIR digital filter structures, Polyphase filter structure, Time varying digital filter structures. Sampling rate conversion by an arbitrary factor: First order approximation & Second order approximation method. Applications of Multirate Digital Signal Processing (MDSP)	10	4
V	UNIT – V Applications of Digital Signal Processing: Introduction, Applications of DSP: Digital Sinusoidal Oscillators, Digital Time Control Circuits, Digital Comb Filters. Applications in broader sense: Removal of noise from pictures.	10	5

Books Recommended:

- Digital Signal Processing, J. Johnson, Pearson – PHI
- Digital Signal Processing, Proakis, Manolakis & Sharma, Pearson Education
- Digital Signal Processing, Nair, PHI
- Discrete Time Signal Processing, Oppenheim & Schafer, Pearson - PHI
- Digital Signal Processing, Vallavaraj, Salivahanan, Gnanapriya, TMH
- Digital Signal Processing by Hussain, Umesh Publications.

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)205	Elective – II (Soft Computing)		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Student will be able to apply various computational techniques such as fuzzy logic, neural network, genetic algorithms and probabilistic reasoning. These techniques are used to solve complex problems that may involve uncertainty, imprecision, or incomplete information.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand Artificial Neural Network concept with the help of Biological Neural Network.	U
2	Implement algorithms to train ANN by using learning algorithms.	Ap
3	Test fuzzy set operations and binary relations.	E
4	Understand Genetic algorithms.(CL)	An
5	Understand programming in MATLAB.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)205 - Soft Computing

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT - I: Introduction to Fuzzy Logic System** Fuzzy Sets Operation Of Fuzzy Sets, Properties Of Fuzzy Sets, Fuzzy Relations, Fuzzy Arithmetic, Membership Functions, Fuzzy To Crisp Conversion. Fuzzy Logic, Fuzzy Rule Based Systems, Fuzzy Decision Making, Fuzzy Database, Fuzzy Intelligent System.	10	1
II	**UNIT - II: Introduction to Artificial Neural Networks** Introduction to Artificial Neural Network, Artificial Neuron, Classification of Artificial NeuralNetwork, Architecture of a Artificial Neural Network, Activation Function, Training an Artificial Neural Network, Application of Artificial Neural Network.	10	2
III	**UNIT - III: Perceptron and Associative Memories** Amari General Learning Rule, HEBB Learning Rule, ADLINE, Perceptron Layer Network, Associative memory: Auto associative Memory, Bi-directional memory, Back-propagation Network: Architecture, Training Algorithm Application of Back-propagation algorithm	10	3
IV	**UNIT - IV: Evolutionary Computing** Introduction, overview of evolutionary computing, Genetic algorithms and optimization, The schema theorem: the fundamental theorem of genetic algorithms, Genetic algorithm operators, Integration of genetic algorithms with neural networks, Integration of genetic algorithms with fuzzy logic, Known issues in GAs.	10	4
V	**UNIT - V: Soft Computing Tools** Introduction to MATLAB, Features, Using MATLAB as a Calculator, Creating MATLAB Variables, Basic Plotting: Creating simple plots, adding titles, axis labels and annotations, specify line style and color, Matrix Genertaion : vector, matrix, matrix indexing,creating submatrix, transposing matrix, concatenation, generation of matrix, Programing in MATLAB: M-File scripts, Control flow and operators. Toolbox Introduction, Introduction to Simulink.	10	5

Books Recommended:

- **Soft Computing**, SarojKaushik, TMH Publications.
- **Fuzzy systems and Fuzzy Logic**, *Klir and Uuna*, PHI Publications.
- **Introduction to Artificial Neural Networks**, *S. N. Sivanandam and M. Paulraj*, Vikas publication.
- **Soft Computing and Intelligent systems Design**, *Fakhreddine O. Karry and Clarence de Silva*
- **Neural Network Design**, *Hagan & Demuth*, Vikas Pub. Comp.
- **Fundamentals of Artificial Neural Networks**, *M.A.Hassaoun.*

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)206	Lab-IV: Programming in RDBMS & PL-SQL		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4
Maximum Marks	**Sessional**		**Practical**
150	50		100

Learning Objective (LO):

The learning objective of the course is know how Database is managed by developing SQL queries and PL- SQL triggers etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develop programming skills by implementing theoretical concepts into practical in DBMS Lab.	Ap
2	Inculcate knowledge of SQL query and running it.	Ap
3	Design PL- SQL programs and running it in machine and evaluation of its efficacy.	Ap
4	Analysis Query Execution time.	Ap
5	Analysis Query Execution Efficacy.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO5	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)206 - Lab-IV: Programming in RDBMS & PL-SQL

Unit No.	Topics	No. of Hours	CO No.
I	Introduction to SQL constructs (SELECT...FROM, WHERE... GROUP BY... HAVING... ORDERBY....), CREATE, INSERT, DELETE, UPDATE, ALTER, LIKE, DROP, VIEW definition and use, Temporary tables,	10	1
II	Nested queries, and correlated nested queries, Integrity constraints: Not null, unique, check, primary key, foreign key, references	10	2
III	Transaction control commands –grant, privileges, commit, Rollback, Savepoint. Introduction to PL/SQL variables – literals – data types – advantages of PL/SQL; Control statements : if ; iterative control – loop, while, for, goto ; exit when;	10	3
IV	Cursors : Types –implicit, explicit – parameterized cursors – cursor attributes; Exceptions: Types – internal , user-defined , handling exceptions – raise statement; Triggers; PL/SQL tables and records: Declaring PL/SQL tables - referring PL/SQL tables, inserting and fetching rows using PL/SQL table, deleting rows; records - declaration of records - deleting records;	10	1
V	Sub programs: Functions -procedures - in, out, inout parameters; purity functions - packages - package specification -advantages of packages - private and public items - cursors in packages.	10	3

Books Recommended:

- **Database System Concept**: *A. Silberschatz , H.F. Korth and S. Sudarshan*, TMH
- **Fundamentals of Database Systems**: *Elmasri & Nawathe*, Pearson Education
- **SQL, PL/SQL**: *Ivan Bayross*, BPB Publication

M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)207	Lab-V: Programming based on paper-III		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	Sessional	Practical
100	50	50

Learning Objective (LO):

The course aims to develop programming skills based on .NET frame work. Programming skills leads student to have critical thinking for solving any technical issues using software.**Course Outcomes (CO):**

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about .NET framework.	Ap
2	Understand website designing and its concepts.	Ap
3	Learn client-server paradigm.	Ap
4	Design web applications using ASP.NET.	Ap
5	Understand the OOP and Exception handling in .NET(U)	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	-	1	-	3	2	-	-	-	3	1	-	-	-
CO5	3	3	3	2	1	1	3	-	-	-	-	3	2	-	-	3

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)207 - Lab-V: Programming based on paper-III

Unit No.	Topics	No.of Hours	CO No.
I	**Program to explain following concepts:** Data Types, Variable, Constant, Control Structure: Conditional statements, Iteration, Type Conversion & OOP's Concept	10	1
II	**Programming based on Windows Programming :** working with windows form controls, creating custom dialog boxes, designing MDI application with menu, visual studio menu items.	10	2
III	**Programming based on XML:** WPF & It's controls, read an XML file in C#, `XmlDocument` & `XDocument`, Serialization and deserialization an object.	10	3
IV	**Programming based on Database:** Database Connectivity, OLEDB Connectivity, ODBC Connectivity, `SqlDataAdapter`, DataSet, Data Table, DataGridView, SqlDataReader, ExecuteNonQuery(), `using` blocks.	10	4
V	**Programming Based on ASP.NET:** Web Forms & It's Controls, Validations in Web Form, Connecting Multiple Web Pages, state management, Web Application development.	10	5

Books Recommended:

Textbook:

1. Kogent Learning Solutions Inc., .NET 4.5 Programming – Black Book (dreamtech)

References:

1. Joseph Albahari, Ben Albahari, C# 6.0 in a Nutshell
2. Christian Nagel, Professional C# 6 and .NET Core 1.0
3. Andrew Troelsen, Philip Japikse, C# 6.0 and the .NET 4.6

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)208	**Lab-VI:** Programming Lab in Network		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	-	-	4

Maximum Marks	Sessional	Practical
100	50	50

Learning Objective (LO):

Student will learn about data transmission in any computer network through simulation and develop a view that helps him to understand real time data transmission.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understanding for computer network concepts	Ap
2	Understand installation and configuration of server.	Ap
3	Learn simulation for any network.	Ap
4	Learn Analysis of transmission of packets.	Ap
5	Learn how does communication Protocols work.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO5	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)208 - Lab-VI: Programming Lab in Network

Unit No.	Topics	No. of Hours	CO No.
I	Basic Network Commands	10	1
II	Crimping of LAN Cable	10	2
III	Network Simulation in Cisco Packet Tracer	10	3
IV	Server Installation in Cisco Packet Tracer	10	4
V	Server Configuration in Cisco Packet Tracer	10	5

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M.Sc. (CS) Semester-II

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSc(CS)209	Personality Development		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	Sessional	-
25	25	00

Learning Objective (LO):

The objective of the course is to develop public speaking skills, team work, communication in group among students.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Achieve confidence in public speaking.	Ap
2	Know how to behave in group.	Ap
3	Observe how to work with team.	Ap
4	Be better equipped to resolve conflicts.	Ap
5	Be able to express themselves in a professional and diplomatic manner.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO5	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

MSc(CS)209 - Personality Development

UnitNo.	Topics	No. of Hours	CO No.
I	Group Discussion	50	1
II	Debate		2
III	Extempore		3
IV	Presentation		4
V	Leadership		5

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)301	Data Science using Python		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The course aims to understand concept of data science, machine learning algorithm and developed basic model using python.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	To Make students understand the fundamental of data science.	E
2	To make student understand mathematics behind data analysis.	U
3	To impart fundamentals of machine learning algorithms.	Ap
4	To introduce python based programming toolkit for developing basic model.	Ap
5	To design and develop Model.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)301 - Data Science using Python

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Data science in a big data world:** Why Data Science, Benefits and uses of data science; Facets of data. The data science process: Setting up goal, retrieving data, data preparation, data exploration, data modelling, Presentation and automation.	10	1
II	UNIT – II: Mathematical Foundations Mathematical Foundations Linear Algebra: Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem, Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, P-hacking, Bayesian Inference.	10	2
III	**UNIT – III: MachineLearning:**OverviewofMachinelearningconcepts–Overfittingandtrain/testsplits,Typesof Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, RuleInduction.	10	3
IV	**UNIT – IV: Introduction to Python :** Data science using python, IDEs, Sequence data: string, list, dictionary, array and tuple, Control Structure, Functions. Tools for Data Science- Toolkits using **Python**: Matplotlib, NumPy, Scikit-learn, NLTK 2.2 Visualizing Data: Bar Charts, Line Charts, Scatter plots.	10	4
V	**UNIT – V: Implementation with Python**: Working with data-Reading Files - Panda data frame: Reading data: txt, xlxs, csv files; indexing attributes of data, converting data types, Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction ,Developing a model-using scikit library(classification:Use Naïve bayes,SVM; Prediction Model: logistic Regression; Clustring K-mean clustering), Analyze performance.	10	5

BOOKS RECOMMENDED:

JoelGrus,"DataScience fromScratch:FirstPrinciplesswithPython",O'ReillyMedia
DavyCielen,Arno,D,BMeysmen,MohamedAli"IntroducingDataScience",Manning
Python Data Science Handbook: Essential Tools for Working with Data, by Jake VanderPlas, O'reilly Media, 2017.
Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniquesto Build Intelligent Systems", 1st Edition, O'Reilly Media

ReferenceBooks

1. JainV.K.,"DataSciences",KhannaPublishingHouse,Delhi.
2. JainV.K.,"BigDataandHadoop",KhannaPublishingHouse,Delhi.
3. JeevaJose,"MachineLearning",KhannaPublishingHouse, Delhi.
4. ChopraRajiv,"MachineLearning",KhannaPublishingHouse,Delhi.
5. IanGoodfellow,YoshuaBengioandAaronCourville,"DeepLearning",MITPresshttp://www.deeplearningbook.org
6. Hanand JianPei,"DataMiningConceptsand Techniques
7. NPTELcourseon"Datascienceusingpython"
8. **Web references**: 1. https://nptel.ac.in/courses/106/106/106106212/
   2. https://www.coursera.org/professional-certificates/ibm-data-science

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	1	II
Course Code	Course Title		Course Type
MSc(CS)302	Open Source Software with Case Study of Linux		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Objective of this course is to develop a skill to handle operating system and students will be able to know about commands of Linux and how to manage OS tasks.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about LINUX Commands.	U
2	Learn Vi editor commands.	U
3	Learn Shell Scripting	An
4	Manage administrative commands of LINUX	U
5	Handle security issues in LINUX environment.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus

MSc(CS)302 - Open Source Software with case study of LINUX

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Introduction :** Introduction to Multi-user System, Emergency and history of Unix, Feature and benefits, Versions of Unix. **System Structure:-** Hardware requirements, Kernel and its function, introduction to System calls and Shell. **File System :** Feature of Unix File System, Concept of i-node table, links, commonly used commands like who, pwd, cd, mkdir, rm, ls, mv, lp, chmod, cp, grep, sed, awk, pr, lex, yacc, make, etc. Getting started (login / logout), File system management, file operation, system calls, buffer cache. **Vi Editor:-**Intro to text processing, command and edit mode, invoking vi, command structure, deleting and inserting line, deleting and replacing character, searching strings, yanking, running shell command, command macros, set windows, set auto indent, set number, intro to exrc file.	10	1
II	**UNIT – II: Shell Programming :** Introduction to shell feature, wild card characters, i/out redirections, standard error redirection, system and user created shell variables, profile files, pipes/tee, background processing, command line arguments, command substitution, read statement, conditional execution of commands, special shell variables $ #, #?, $* etc. Shift commands, loops and decision making- for, while and until, choice making using case...esac, decision making if ....fi, using test, string comparison, numerical comparison, logical operation, using expr.	10	2
III	**UNIT – III: Introduction to Shell :** Features, changing the login shell, cshrc, login, logout files, setting environment, variables, history and alias mechanism, command line arguments, redirection/appending safely, noclobber, noglob, ignore eof, directory stacks (pushd, popd), feature of other shell (rsh, vsh). **Process Control :** Process management, process states and transition, regions and control of process, sleep and waking, process creation, process killing, signals, system boot and init process, traps, sitting process priorities	10	3
IV	**UNIT – IV: Inter-process Communication :** I/O Sub system, terminal drives, disk drives, messages, shared memory, semaphores, memory management, swapping, demand paging. **System Calls and Unix -C Interface :** File handling calls like - access (), open(), create(), read(), write(), close(), fseek(), process control system calls like kill(), exec(), fork(), wait(), signal(), exit(), comparing stdio library and calls.	10	4
V	**UNIT – V:** System Administration : Process and Scheduling, Security, Basic System Administration:- Adding a User, User Passwords, Delete of a User, Adding a Group, Deleting a Group, Super User, Startup and Shutdown. Advanced System Administration:-Managing Disk Space, Backup and Restore, Managing System Services. Xwindows:- Introduction to Xwindows concept.	10	5

Books Recommended:

- 1. Design of Unix Operating System - Maurice Bach
- 2. Advanced Unix - Stephan Prata
- 3. The Unix Programming Environment - Kennighan and Pike
- 4. Unix Programmers Guide - P. P. Selvester
- 5. Introduction to Unix System - Rachell Morgan
- 6. Complete Reference Red Hat Linux - Richard Peterson
- 7. Complete Reference Unix

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)303	Advanced Computer System Architecture		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Students will develop a cognitive understanding of parallel processing and hardware architecture of CPU for its implementation.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Make the students aware about Parallel Computing.	U
2	Learn the concepts of Multiprocessors, Multicomputer, Pipelining etc.	U
3	Increase the employability.	Ap
4	Make the students aware about advanced processor technology.	An
5	Open up new areas in the field of research and development in the area of computer architecture.	R

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)303 - Advanced Computer System Architecture

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT I:** Introduction - Feng's and Flynn's classification scheme-SISD, SIMD,MISD, MIMD Multiprocessor and Multicomputer, UMA, NUMA, COMA, NORMA, memory models, parallel computer and its type. Applications of Parallel Computers. Cache Coherence Protocols – Snoopy and Directory Protocols.	10	1
II	**UNIT II:** System Interconnect Architecture – Static and Dynamic, Hypercube Interconnection network, multistage interconnection networks-architecture and routing, design consideration, throughput delay. Architecture and routing of 3 stage and 4 stage Banyan Network. Routing and Addition in Hypercube Interconnection network. Performance Metrics and Benchmarks.	10	2
III	**UNIT III:** Principle of pipelining-overlapped parallelism, Linear and non-linear pipelining, reservation table, calculation of MAL.Types of Instruction Pipeline. Arithmetic pipeline designs example – Floating point adder, pipelined multiplier.	10	3
IV	**UNIT IV:** Advanced processor Technology – RISC, CISC, VLIW architectures, Hazard detection and resolution, functional organization of instruction in IBM 360/91. Numerical Problems based on CPI, IPC and MIPS.	10	4
V	**UNIT V:** Exploring parallelism in program- Parallel Algorithm for Matrix addition and subtraction. Bitonic sort, sorting on linear array processors or odd even sort, PRAM algorithm for addition of numbers or Parallel Reduction. Bernstein's condition, ISO efficiency concept.	10	5

Books Recommended:

- **Computer Architecture & Parallel Processing**, *Kai Hwang and F.A. Briggs*, McGraw Hill.
- **Advanced Computer Architecture**, *Kai Hwang*, McGraw Hill.
- **Parallel Computing**, *M.R. Bhujade*, New Age Publication.
- **Parallel Computing Theory and Practice**, *Michael J. Quinn*, Tata McGraw Hill

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)304-I	Elective–III Data Mining and Data Warehousing		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Data mining and Data Warehousing is a course used to inculcate skills like Critacal thinking to process data of large ammont and find patterns in it computationally.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the KDD process which leads to Data Mining processes.	An
2	Learn about mathematical details of data mining process.	E
3	Learn the algorithms which mines the data.	R
4	Learn Structures of multi dimensional data handling.	E
5	Learn Application of Data Mining in research.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

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Detailed Syllabus
MSc(CS)304 - Data Mining and Data Warehousing

Unit No.	Topics	No. of Hours	CO No.
I	**Unit1 :Introduction to Data Warehousing and OLAP Technology for Data Mining** What is Data Mining?, Data Mining: On what kind of data?, KDD Process, Data Mining Functionality, Are all the patterns interesting?, Attribute Types,What is Data Warehouse?, Data Cube: A multi-dimensional data model, Data Warehouse Architecture, Data Warehouse Implementation, Data Warehouse Usage(Applications), OLAP Operations, Concept of Transaction, Transactional Database, Distributed Database, Commit Protocols.	10	1
II	**Unit - II Data Preprocessing, Data Mining Primitive Languages and SystemArchitecture** Why preprocess the data?, Data Cleaning, Data Integration, Data Transformation, DataReduction, Concept Hierarchy Generation, Data Mining Primitive, Data Mining Query Language, Architecture of Data Mining System.	10	2
III	**Unit - III Mining Association Rules in Large Databases** Association Rule Mining, Mining Single-dimensional Boolean Association Rules from Transactional Databases(Apriori algorithm, FP-Tree growth algorithm), Mining Multilevel Association Rules from Transactional Databases, Mining Multi dimensional Association Rules from Transactional Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-based Association Mining..	10	3
IV	**Unit - IV Classification, Prediction and Cluster Analysis** What is Classification?, What is Prediction?, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back Propagation, Classification based on Association, Other Classification Methods, Prediction, Classification Accuracy What is Cluster Analysis?, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model Based Clustering Methods, Outlier Analysis.	10	4
V	**Unit - V Mining Complex Types of Data & Applications and Trends in Data Mining** Mining Time-series and Sequence Data, Mining Spatial Databases, Mining Multimedia Databases Mining Text Databases, Mining World Wide Web, Data Mining Applications, Social Impact of Data Mining, Trends in Data Mining.	10	5

Books Recommended:

- **Data Mining: Concepts and Techniques,** *Jiawei Han and MichelineKamber*
- **Data Mining Techniques,** *Arun K Pujari,*
- **Data Mining Introductory and Advanced Topics,***Margaret H Dunham,* Pearson

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)304-II	Elective–III Network Security and Cryptography		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Students will be able understand how to connect and control physical devices through the internet to gather and gather and exchange data. It involves learning about sensors, connectivity, data analysis, and the integration of devices to create smart and interconnected systems.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Acknowledge about the cybercrime, cyber-criminal, and intellectual property rights. Protection and resilience of Critical Information Infrastructure.	U
2	Enable effective prevention, investigation and prosecution of cybercrime and enhancement of law enforcement capabilities through appropriate legislative intervention.	U
3	Learn basics about computer, Network and Data Security, threats to any network and data security.	U
4	Know how to secure any network, computer and data in it, security goals to secure any network.	An
5	Learn internal details of security mechanism so that they could adopt it in their programming.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)304 - Network Security and Cryptography

Unit No.	Topics	No. of Hours	CO No.
I	**Unit - I Introduction & Symmetric Key Cryptography** Computer Security Concepts, The Challenges of Computer Security, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, A model for network Security, **Symmetric Encryption Principal:** Cryptography, Cryptanalysis, Feistel Cipher Structure, DES, Random and Pseudorandom Numbers, Symmetric Block Modes of Operation (ECB, CBC, CFB, CTR).	10	1
II	**Unit - II Public Key Cryptography** Approaches to Message Authentication, **Hash Functions**: Hash Functions Requirement, Security of Hash Functions, The SHA Secure Hash Function, **Public Key Cryptography:** Public -Key Encryption Structure, Applications for Public Key Cryptosystem, RSA, Attacks on RSA, OAEP.	10	2
III	**Unit - III Integrity and Authentication** **Message Integrity:** Document and Finger Printing, Message and Message Digest, Cryptographic Hash Function Criteria Random Oracle Model, Birthday Problems and Summery of solutions, **Message Authentication:** Modification Detection Code, Message Authentication Code, Introduction of HMAC & CMAC, **Digital Signature:** Comparison, Process, Services, Attacks on Digital Signature.	10	3
IV	**Unit - IV Malicious Software** **Intruders:** Intruder Behavior Patterns, Intrusion Techniques, Intrusion Detection by Audit Records, Statistical Intrusion Detection, Distributed Intrusion Detection, Honeypot Types of Malicious Software, Nature of Viruses, Virus Classification, Antivirus Approaches, Worms and its Propagation model, DDoS Attack.	10	4
V	**Unit - V FireWall and Security Softwares** **Firewall:** Need & Characteristics of Firewall, Types of Firewall, Firewall Basing, Firewall Location and Configuration, Introduction to Kali Linux ,Tools Available in Kali Linux and Its Usage. WireShark Packet Analyzer and Its Features. Cyber Security Policy, Domain of Cyber Security Policies.	10	5

Books Recommended:

- **Network Security Essentials**, *William Stallings*, PEARSON
- **Cryptography and Network Security**, *William Stallings*, PHI.
- **Cryptography and Network Security**, *AtulKahate*, Tata McGraw Hill
- **Cryptography and Network Security**, *B.A. FOROUZAN*, TMH
- **Cyber Security policy Guidebook**, *Jennifer Jason Paul, Marcus Jeffery Joseph*. Wiley Publication,2012.
- **Network Security: The Complete Reference**, Robertra Bragg, Tata McGraw Hill.
- **Cyber Security Essentials**, *James Graham, Richard Ryan*, CRC press

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)304-III	Elective – III Compiler Design		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Compiler design course aims to make students understand that how high level language is translated into low level languages. It also develops an insight for deep analysis of code optimization for the fast execution of the programming code.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Know about various phases of compiler design.	U
2	Aware of the function and complexity of modern compilers.	An
3	Aware of generation of intermediate code.	An
4	Concrete view on the theoretical and practical aspects of compiler design.	E
5	Apply ideas and techniques discussed to various software design.	R

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)304 - Compiler Design

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT - I** **Introduction to Compiling and one pass compiler:** Compilers & translators. Phases of compilers, Compiler writing tools, Bootstrapping; overview of one pass compiler. **Finite Automata and Lexical Analysis:** Role of Lexical Analyzer; specification of tokens, Recognition of tokens, Regular expression, Finite automata, from regular expression to finite automata, DFA and NFA, Implementation of lexical analyzer; tools for lexical analyzer -LEX.	10	1
II	**UNIT - II** **Syntax analysis & Parsing Technique:** Context free grammars; Bottom up parsing, Shift reduce parsing, Operator Precedence parsing, Top down parsing, elimination of left recursion; recursive descent parsing, Predictive parsing. **Automatic Construction of Efficient parsers:** LR parser, construction of SLR and canonical LR parser table, Using ambiguous grammar, An automatic parser the generator, YACC, Using YACC with ambiguous grammar, creating YACC lexical analyzer with LEX, Error recovery in YACC.	10	2
III	**UNIT - III** **Syntax Directed Translation:** Syntax directed schema, Construction of syntax tree, Translation with top down parser. **Run Time Environment:** Source Language issues, Storage organization and allocation strategies, Parameter passing, Implementation of block-structured language.	10	3
IV	**UNIT - IV** **Intermediate Code Generation:** Intermediate languages; Postfix notation, Three-address code, Quadruples and triples, Translation of assignment statements, Boolean expression, and Procedure call. **Error Detection & recover:** Lexical & syntactic phase error, semantics error.	10	4
V	**UNIT - V** **Code Optimization:** Optimization of basic block, Loop optimization global data flow analysis, Loop in variant computation. **Code Generation:** Issue and design of code generator, the target machine, a simple code generator.	10	5

Books Recommended:

- **Principles of Compiler Designing** - Alfred V. Aho and J.D. Ullman.
- **Principles of Compiler-Principles, Technique and Tools** - Alfred V. Aho, Ravi Sethi

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)305-I	Elective–IV Mobile Communication		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Mobile Communication course will develop and understanding among student how communication technology. They will also develop an insight view for networking technologies and devices.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the cellular concepts and infrastructure such as frequency reuse.	U
2	Understand the concept of Satellite systems.	U
3	Hand off and how interference between mobiles and base stations affects the capacity of cellular systems.	An
4	Identify the technical aspects of wireless and mobile communications along with the knowledge about the wireless LAN, PAN, MANET and its routing protocol.	E
5	Mobile Computing plays important role in research in wireless communication.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)305 - Mobile Communication

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I: Introduction.** Introduction to Mobile Communication, Short history of wireless communication, Applications, Vehicles, Emergency, Business, Replacement of wired network, Location dependent services, infotainment, Mobile and Wireless devices, A Simplified reference model, some open research topics in mobile communication.	10	1
II	**UNIT – II: Satellite Systems** History of satellite system, Applications of satellite systems, Type of satellite systems, characteristics of satellite systems, satellite system infrastructure, satellite system architecture, Global Positioning system (GPS), Limitations of GPS. Beneficiaries of GPS, Applications of GPS	10	2
III	**UNIT – III: Mobile Communication Systems** Introduction, Cellular System Infrastructure,, Registration, Handoff Parameters and Underlying support, Roaming Support Using System Backbone, to Mobile IP, Functions of Mobile IP, Mobile Node, Corresponding Node, Home Network, Foreign Network, Home Agent, Foreign Agent, Care-of Address, IP Packet Delivery, Agent Discovery, Agent Solicitation, Registration, Tunneling, Dynamic host configuration protocol.	10	3
IV	**UNIT – IV: Wireless LANs and PANs** Introduction to IEEE 802.11, Ricochet, Ricochet Wireless Modem, Services Provided by Ricochet , Home RF, Home RF Technology, Hiper LAN, Blue tooth , Advantages and disadvantages of Wireless LAN, Infra red vs radio transmission , introduction to MAC. Technologies influence WLANs / WPANs in future.	10	4
V	**UNIT – V: Mobile Adhoc Network** Introduction to Mobile Adhoc Network(MANET), Characteristics of MANET, Applications of MANET, Routing, Need for Routing, Routing Classification, Table-Driven Routing Protocol – Destination Sequenced Distance Vector Routing Protocol, Cluster-Head Gateway Switch Routing, Wireless Routing Protocol. Source initiated On-demand Routing- Adhoc on Demand Distance Vector Routing, Dynamic Source Routing, Temporarily Ordered Routing Algorithms, Hybrib Protocol – Zone Routing Protocol.	10	5

Books Recommended:

- **Mobile Communication**: *Jochen H. Schiller*, Pearson Education Publication
- **Introduction to Wireless and Mobile Systems**: *D.P. Agrawal, Qing-An Zing*, Vikas Publishing House

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)305-II	Elective–IV Internet of Things		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Students will be able understand how to connect and control physical devices through the internet to gather and gather and exchange data. It involves learning about sensors, connectivity, data analysis, and the integration of devices to create smart and interconnected systems.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Describe what IoT is and how it works today and recognise the factors that contributed to the emergence of IoT.	An
2	Design and program IoT devices and use real IoT protocols for communication.	Ap
3	Secure the elements of an IoT device.	Ap
4	Design an IoT device to work with a Cloud Computing infrastructure.	Ap
5	Transfer IoT data to the cloud and in between cloud providers.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)403 - Internet of Things

Unit No.	Topics	No. of Hours	CO. No.
I	**UNIT-I: Introduction of IOT:** Basics of IOT, Origin of Terminology, Definition, Characteristics,Evolution of Devices,Modern Day IOT Application, An IOT architectural outline,IOT Reference Architecture, Baseline Technologies: M2M,CPS,WOT,Device & gateway.	10	1
II	**UNIT-II: Basics of IOT Networking:** Convergence of Domain,Connectivity Terminologies,IPv4 vs IPv6, IOT Component,IOT & Associated Technologies.**Functionality Based IOT Protocol**: 6LowPAN, RPL, Wi-Fi, Bluetooth, LPWAN, MQTT,CoAP,AMQP.	10	2
III	**Unit-III: Transport Layer Protocol** Transmission Control Protocol, User Datagram Protocol, Datagram Congestion Control Protocol (DCCP)Stream Control Transmission Protocol (SCTP),Transport Layer Security(TLS), Datagram Transport Layer Security(DTLS)	10	3
IV	**Unit -IV: Sensing & Actuation:** Sensor,Features,Sensor Resolution,Sensor Classes,Sensor Types, Sensorial Deviation, Actuators, Actuator Types. **Sensor Networks**:WSNs,Basic Component of Sensor Node, Constrained on Sensor Node, Sensor Web,Co-operation Wireless Ad Hoc & Sensor Networks, Application of WSNs.	10	4
V	**UNIT- V: Elements of IoT** Hardware Components- Computing (Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.	10	5

Books Recommended:

- **Peter Waher,**" Learning InternetofThings", PACKT Publishing .
- **AdrianMcEwen,**"DesigningtheInternetofThings",Wiley
- **RajKamal,**"InternetofThings:ArchitectureandDesign",McGrawHill
- **Bernd Schloz-Reiter**,"GettingStartedwiththeInternetofThings",Florian Michahellas,Springer.
- **NPTEL,**" Internet of Things"

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)305-III	Elective–IV Cloud Computing		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Student will learn the concepts of cloud computing and develops analytical skills and critical thinking for better programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Perform cloud oriented analysis.	Ap
2	Model cloud candidate derived from existing business documentation.	Ap
3	Design the composition of a cloud services and also to design application services for technology abstraction.	Ap
4	Appreciate the cloud computing paradigm, recognize its various forms and able to implement some cloud computing features.	Ap
5	Design application services for technology abstraction	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)401 - Cloud Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Unit – I** **Introduction:** Cloud Computing: Vision, Definition, Reference Model, Characteristics, Benefits and Challenges, Historical Developments, Cloud Computing Environments, Cloud Platforms and Technologies; The Evolution of Cloud Computing: Parallel Computing vs. Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing, Introduction of Grid Computing.	10	1
II	**Unit – II** **Virtualization:** Introduction, Characteristics, Taxonomy of Virtualization, Levels of Virtualization, Structure and Mechanism of Virtualization, Virtualization and Cloud Computing, Advantages and Disadvantages, Virtualization Technology Examples: Xen, VMware, Microsoft Hyper-V.	10	2
III	**Unit – III** **Cloud Computing Architecture:** Service Oriented Architecture, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), Data Storage as a Service (DSaaS). Types of Clouds; Economics of the Cloud and Open Challenges; **Security and Organizational aspects**: Host Security and Data Security.	10	3
IV	**Unit – IV** **Migration to the Cloud:** Adoption and use of Cloud by Businesses (Small and Enterprise), Pace of Adoption, Benefits and Phases of Adoption, Cloud Service Provider's Capabilities and Liabilities, Success factors and Issues. **Migrating Applications**: Key Aspects, Migration Techniques, Phases of Migration. **Service Level Agreement (SLA)**: Aspects and Requirements, Availability and Outages, Credit Calculations, SLA Samples.	10	4
V	**Unit – V** **Industry Platforms:** Amazon Web Services, Google AppEngine, Microsoft Azure; **Cloud Applications**: Scientific Applications, Business and Consumer Applications; Advanced Topics: Energy Efficiency in Clouds, Market Based Management, Federated Clouds / InterCloud, Third Party Cloud Services.	10	5

Books Recommended:

- **Mastering Cloud Computing**, *Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi*, McGraw Hill Education
- **Cloud Computing: Black Book**, *Kailash Jayaswal et al.*, Kogent Learning Solutions, Dreamtech Press
- **Cloud Computing: Principals and Paradigms**, *Rajkumar Buyya et al.*, Wiley India
- **Cloud Computing: Concepts, Technology & Architecture**, *Erl*, Pearson Education India
- **Cloud Computing Bible**, *Barrie Sosinsky*, O'Reilly Media
- **Cloud Computing: A Practical Approach**, *Toby Velte, Anthony Vote and Robert Elsenpeter*, McGraw Hill
- **Cloud Application Architectures: Building Applications and Infrastructures in the Cloud**, *George Reese*, O'Reilly Media.
- **Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance**, *Tim Matherm Subra Kumaraswamy and Shahed Latif*, O'Reilly Media.

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)306	Lab-VII: Data Science using python		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	Sessional	Practical
150	50	100

Learning Objective (LO):

This course introduces students to the basic concepts and techniques of Data Science. And this course also contains Basic of Python Programming to contain control structure, conditional statement, function Sequence Data type and toolkits

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn Python Programming.	Ap
2	Understand the concept of toolkits.	Ap
3	Learn to build data science model.	AP
4	Visualizing and understand the data semantics.	Ap
5	Build data science application using Python based toolkits.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO5	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)306 - Lab-VII: Data Science using python

Unit No.	Topics	No. of Hours	CO No.
I	Learn basics of python –Variable, Data type , Control Statement Array	10	1
II	Understand toolkits using Python :Matplotlib,Numpy,Scikit-Learn	10	2
III	Visualizing and understand the data semantic.	10	3
IV	Learn working with data files.	10	4
V	Developing a model-using scikit library(classification:Use Naïve bayes,SVM; Prediction Model: logistic Regression; Clustring K-mean clustering), Analyze performance.	10	5

Books Recommended:

1. Python Programming- A modular Approach (with Graphics, database, Mobile and Web Applications by Sheetal Taneja and Naveen Kumar, Pearson.

2. Beginning Programming with Python Dummies by John Paul Meuller.

Web references:

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.coursera.org/professional-certificates/ibm-data-science

M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)307	Lab-VIII: Programming in LINUX		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	-	-	4

Maximum Marks	Sessional	Practical
100	50	50

Learning Objective (LO):

Students are going to be able to learn Shell Scripting paradigm in LINUX and its commands.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about LINUX Commands.	Ap
2	Learn Vi editor commands.	Ap
3	Learn Shell Scripting	Ap
4	Manage administrative commands of LINUX	Ap
5	Handle security issues in LINUX environment.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	2	3	1	1	1	1	3	-	-	-	-	1	2	-	-	3
CO5	3	2	3	1	1	1	3	-	-	2	-	3	2	-	-	2

"3" – Strong; "2" – Moderate "1"- Low; "-" No Correlation

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Detailed Syllabus
MSc(CS)307 - Lab-VIII: Programming in LINUX

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT-1 Commands** :commonly used commands like who, pwd, cd, mkdir, rm, ls, mv, lp, chmod, cp, grep, sed, awk, pr, lex, yacc, make, etc. Getting started (login / logout), File system management, file operation, system calls, buffer cach .	10	1
II	**UNIT 2 Vi Editor**:-Intro to text processing, command and edit mode, invoking vi, command structure, deleting and inserting line, deleting and replacing character, searching strings, yanking, running shell command, command macros, set windows, set auto indent, set number, intro to exrc file.	10	2
III	**UNIT 3 Shell Script** : command line arguments, command substitution, read statement, conditional execution of commands, special shell variables $ #, #?, $* etc.	10	3
IV	**UNIT 4 Shell Script** : Shift commands, loops and decision making-for, while and until, choice making using case...esac, decision making if ....fi, using test, string comparison, numerical comparison, logical operation	10	4
V	**UNIT 5 Administrative Commands** :Process and Scheduling, Security, Basic System Administration:- Adding a User, User Passwords, Delete of a User, Adding a Group, Deleting a Group, Super User, Startup and Shutdown.	10	5

Books Recommended:

- Advanced Unix - Stephan Prata
- The Unix Programming Environment - Kennighan and Pike
- Unix Programmers Guide - P. P. Selvester
- Complete Reference Unix

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	Course Title		Course Type
MSc(CS)308	Lab-IX: Mini-Project		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	-	-	4
Maximum Marks	Sessional		Practical
100	50		50

Learning Objective (LO):

Objective of minor project is to make student capable of implementing learnt programming concepts into practical by creating small software by applying SDLC concepts.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Enhance coding skills.	Ap
2	Enable to analyze system.	Ap
3	Learn about problem solving in software.	Ap
4	Learn about logic building in software.	Ap
5	Create small software using programming language.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO5	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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M.Sc. (CS) Semester-III

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	III
Course Code	**Course Title**		**Course Type**
MSc(CS)309	Internship		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	-	-	4
Maximum Marks	**Sessional**		-
25	25		00

Learning Objective (LO):

Students will be able to polish their communication skill and presentation skills.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn how to make presentation PPT.	U
2	Learn how to present effectively.	U
3	Becomes Confident for their knowledge expression.	U
4	Improve their public speaking skills.	Ap
5	Learn novel topics and develop a more holistic perspective.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO5	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus

MSc(CS)309 - Internship

Unit No.	Topics	No. of Hours	CO No.
I	Internship	50	1
II	Internship Seminar		2
III	Internship Report		3
IV	Internship Presentation		4
V	Internship Viva		5

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M.Sc. (CS) Semester-IV

Program	Subject	Year	Semester
M.Sc.	Computer Science	2	IV
Course Code	**Course Title**		**Course Type**
MSc(CS)401	Internship: System Development Project & Implementation / Research Project (Dissertation)		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
16	0	0	32

Maximum Marks	Sessional	Project
400	200	200

Learning Objective (LO):

To make students skilled and employable for industry requirement and to make them understand latest knowledge in their domain.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develop software for organizations..	C
2	Analyse and design a system	C
3	Relate their knowledge and its implementation.	C
4	Find practical exposure to industry.	C
5	Understand current trends in technology.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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M.Sc.(CS)

Skill Enhancement/Value Added Courses

Program	Subject	Year	Semester
M.Sc.(CS)	Computer Science	1	II
Course Code	**Course Title**		**Course Type**
MSCCS-VAC-01	Cyber Crimes and Law		Skill Enhancement
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	2	0	0
Maximum Marks	**Sessional**		**Theory**
100	25		75

Learning Objective (LO):

- The course objective is to make Understand and describe the major types of cybercrime. Identify cybercrime vulnerabilities and exploitations of the Internet.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand and describe the major types of cybercrime.	**Ap**
2	Identify cybercrime vulnerabilities and exploitations of the Internet.	**Ap**
3	Understand tools and methods used by Cybercriminals.	**U**
4	Understand the law with regards to the investigation and prosecution of cyber criminals.	**Ap**
5	Understand the law with regards to the investigation and prosecution of cyber criminals	**U**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	2	2	1	2	1	-	2	2	3	1	2	-	1
CO2	3	1	3	2	3	2	2	1	-	2	1	1	1	2	2	3
CO3	2	3	3	2	2	1	1	-	-	3	2	3	1	2	-	2
CO4	3	2	3	3	2	3	2	1	-	2	1	2	2	2	1	2
CO5	1	3	3	1	2	1	2	1	-	2	2	3	1	2	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus

M.Sc.(CS) - Skill Enhancement (Value Added Courses)

Cyber Crimes and Law

Unit No.	Topics	No. of Hours	CO No.
I	**Cyber Crime:** Definition and Origin of the Word, Cyber Crime and Security, E-mail Spoofing, Spamming, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Forgery, Web Jacking, Newsgroup Spam, Industrial Spying, Hacking, Online Frauds, Pornographic Offenders, Software Piracy, Computer Sabotage Email Bombing, Computer Network Intrusion, Password Sniffing, Credit Card Frauds.	6	1
II	**Cyber Offenders:** Who are cyber criminals?, Categories of Cyber Crimes, How Criminal Plans to Attack: Active Attacks, Passive Attacks, Social Engineering, Classification of Social Engineering, Cyber Stalking: types of Stalkers, Hackers and types of hackers, Cyber Cafe and Cyber Crimes, Botnets, Cyber Crime and Cloud Computing	6	2
III	**Tools and Methods used by Cybercriminals:** Proxy server and Anonymizers, phishing: How Phishing works? How password cracking works? Keyloggers and Spywares, Reconnaissance, Virus and Worms, Trojan Horses and Backdoors, Dos and DDOS Attacks, SQL Injection, Buffer Overflow, An Attacks on Wireless Networks. What is Nmap tool	6	3
IV	**Phishing, Identity Theft and Cyber Act**: Phishing: Methods of Phishing, Phishing Techniques, Types of Phishing Scams, Phishing countermeasures, Identity theft, Types and Techniques of identity thefts and its counter measures. **IT ACT, Offenses and Penalties:** Offences under the Information and Technology Act 2000 - Penalty and adjudication - Punishments for contraventions under the Information Technology Act 2000 (Case Laws, Rules and recent judicial pronouncements to be discussed) - Limitations of Cyber Law	6	4
V	**Cyber Laws:** The legal perspectives Cybercrimes and the legal Landscape around the world, why do we need cyber laws: The Indian context, The Indian IT ACT: Admissibility of Electronic records, Amendments made in Indian ITA 2000, Positive Aspects and weak areas of ITA 2000, Challenges to Indian law and cybercrime scenario in India, Digital signatures and the Indian ITA act, Cybercrime and punishment, Cyber law Technology and students: Indian Scenario	6	5

BOOKS RECOMMENDED:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives By Nina Godbole, Sunit Belapur, Wiley.
2. Understanding Cybercrime: Phenomena, and Legal Challenges Response, ITU 2012

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M.Sc.(CS)

Skill Enhancement (Value Added Courses)

Program	Subject	Year	Semester
M.Sc.(CS)	Computer Science	1	III
Course Code	Course Title		Course Type
MSCCS-VAC-02	Green Computing		Skill Enhancement
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	0	0
Maximum Marks	Sessional		Theory
100	25		75

Learning Objective (LO):

- The course objective is to learn the fundamentals of Green Computing and to analyze the Green computing Grid Framework. To understand the issues related with Green compliance and study and develop various case studies.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.	**Ap**
2	Enhance the skill in energy saving practices in their use of hardware.	**Ap**
3	Understand the issues related with Green compliance.	**U**
4	Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.	**Ap**
5	Understand the ways to minimize equipment disposal requirements.	**U**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	2	2	1	2	1	-	2	2	3	1	2	-	1
CO2	3	1	3	2	3	2	2	1	-	2	1	1	1	2	2	3
CO3	2	3	3	2	2	1	1	-	-	3	2	3	1	2	-	2
CO4	3	2	3	3	2	3	2	1	-	2	1	2	2	2	1	2
CO5	1	3	3	1	2	1	2	1	-	2	2	3	1	2	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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Detailed Syllabus

M.Sc.(CS) - Skill Enhancement (Value Added Courses)

Green Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Green Fundamentals:** Introduction, Green Computing: Benefits And Important, Growth Statistics Of Internet Usages, Formal Approach To Green Computing: Green Design, Green Manufacturing, Green Management, Green Purchasing, Green Use, Green Disposal And Recycle. Environmentally Sound Practices For Computing, Green Computing Standardizations And Compliances.	6	1
II	**GREEN ASSETS AND MODELING** : Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.	6	2
III	**GRID FRAMEWORK** :Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.	6	3
IV	**GREEN COMPLIANCE** :Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.	6	4
V	**CASE STUDIES:** The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.	6	5

BOOKS RECOMMENDED:

TEXT BOOKS: 1. Bhuvan Unhelkar, —Green IT Strategies and Applications-Using Environmental Intelligence‖, CRC Press, June 2014.

3. Woody Leonhard, Katherine Murray, —Green Home computing for dummies‖, August 2012.
4. **REFERENCES**

1. Alin Gales, Michael Schaefer, Mike Ebbers, —Green Data Center: steps for the Journey‖, Shroff/IBM rebook, 2011.
2. John Lamb, —The Greening of IT‖, Pearson Education, 2009.
3. Jason Harris, —Green Computing and Green IT- Best Practices on regulations & industry‖, Lulu.com, 2008
4. Carl speshocky, —Empowering Green Initiatives with IT‖, John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), —Green computing: Large Scale energy efficiency‖, CRC Press

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