

**Master of Science (M.Sc. Computer Science ) Full Time Two Years Degree Programme :-**

- 1) A Student shall have to be admitted every year in the respective Institute/ College/University Department for completion of an academic year of this two year Degree program.
- 2) The M.Sc. Degree shall consist of four semesters i.e. Semester I & II in the first academic year, Semester III & IV in the second academic year.
- 3) Student has to complete all four Semesters successfully for the award of Degree of Master of Science and fulfill conditions as per Ordinance No. 19.
- 4) Every Semester of M.Sc. Computer Science Program shall be of at least 90 teaching days in a semester and shall be of at least 180 teaching days in an academic year.
- 5) The Examinations shall consist of the subjects as indicated in the Scheme of Examinations as per **Appendix – 'A1 to A4'**.
- 6) The Semester wise structure of the program is as follows.

**Sant Gadge Baba Amravati University Amravati**  
**Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Computer Science)**  
**(Two Years- Four Semesters Degree Programme- C.B.C.S)**  
**(M. Sc. Part-I) Semester- I**

S. N.	Subject Code	Type	Subject	Teaching & Learning Scheme						Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits			Maximum Marks				Minimum Passing			
				L	T	P	Total	L/T	Practical		Total	Theory		Practical		Total Marks	Marks	Grade
												Theory+MCQ External	Theory Internal	Internal	External			
<b>Core Subject</b>																		
1	2022-1MCS1	DSC1	1 Computer System Design	4	-	-	4	4	-	4	3	80	20			100	40	P
2	2022-1MCS2	DSC2	2 Data Structure with OOP	4	-	-	4	4	-	4	3	80	20			100	40	P
3	2022-1MCS3	DSC3	3 Data Base Management Technologies	4	-	-	4	4	-	4	3	80	20			100	40	P
4	2022-1MCS4	DSC4	4 Computer Network & Wireless Technology	4	-	-	4	4	-	4	3	80	20			100	40	P
<b>Skill-1</b>																		
5	2022-1MCS5	SEC1	4-Advanced Java/ NS2/ tools	-	2	2	4	4	-	4	3	-	-	25	25	50	25	P
<b>Elective-1</b>																		
6.	2022-1MCS6(1)	DSE1	(1) Discrete Mathematical Structure	4	-	-	4	4	-	4	3	80	20			100	40	P
7.	2022-1MCS6(2)	DSE2	(2) Entrepreneurship Development															
8.	2022-1MCS6(3)	DSE3	(3)Research Methodology															
9.	2022-1MCS6(4)	DSE4	(4)Management Information System															
10.	2022-1MCS6(5)	DSE5	(5)Data Science and Analytics															
<b>Laboratories</b>																		
11	2022-1MCS7	Lab-I	1,2 - Programming(C/C++/Java/ALP)	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
12	2022-1MCS8	Lab-II	3-SQL/ DBMS tools, MSsql, My Sql	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
<b>Internship</b>																		
13	2022-1MCS9		#Internship/Field Work/Work Experience@															
			TOTAL	20	2	10	32											
<b>Open Elective(Appendix-5)</b>																		
14	2022-1MCS10	OE1	Open elective (OE) /GIC/Open skill/MOOC*	-	2	-	2	-	1	1	-			25	25	50	25	P
			TOTAL	20	4	10	34	24	5	29								
<b>GIC</b>																		
		GIC1	User Experience Deign															
		GIC2	Effective Email Communication															

**L: Lecture, T: Tutorial, P: Practical**

# Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Computer Science) according to their convenience; @ denotes Ancillary Credit

**Note : Internship /Apprenticeship/Field Work / Work Experience (During vacations of Semester I to Semester III) for duration of minimum 60 hours to maximum 90 hours mandatory to all the students, to be completed during vacations of Semester I to III. This will carry 2 Credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.**

- OEC can be studied during semester I to IV-As per Appendix 5

**Sant Gadge Baba Amravati University Amravati**  
**Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Computer Science)**  
**(Two Years- Four Semesters Degree Programme- C.B.C.S)**  
**(M. Sc. Part-I) Semester- II**

S. N.	Subject Code	Type	Subject	Teaching & Learning Scheme						Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits			Maximum Marks				Minimum Passing			
				L	T	P	Total	L/T	Practical		Total	Theory		Practical		Total Marks	Marks	Grade
												Theory+ MCQ External	Theory Internal	Internal	External			
<b>Core Subject</b>																		
1	2022-2MCS1	DSC1	1 Operating System Algorithms	4	-	-	4	4	-	4	3	80	20			100	40	P
2	2022-2MCS2	DSC2	2 Graphics Application programming	4	-	-	4	4	-	4	3	80	20			100	40	P
3	2022-2MCS3	DSC3	3 Software Engineering	4	-	-	4	4	-	4	3	80	20			100	40	P
4	2022-2MCS4	DSC4	4 Data Mining and Data Warehousing	4	-	-	4	4	-	4	3	80	20			100	40	P
<b>Skill-2</b>																		
5	2022-2MCS5	SEC2	1 -OS (Windows / Android /Linux)	-	2	2	4	4	-	4	3	-	-	25	25	50	25	P
<b>Elective-2</b>																		
6.	2022-2MCS6(1)	DSE1	(1)Theory of Computation	4	-	-	4	4	-	4	3	80	20			100	40	P
7.	2022-2MCS6(2)	DSE2	(2)Computer System Architecture															
8.	2022-2MCS6(3)	DSE3	(3)Enterprise Resource Management															
9.	2022-2MCS6(4)	DSE4	(4)Mobile Computing															
10.	2022-2MCS6(5)	DSE5	(5)Compiler Construction															
<b>Laboratories</b>																		
11	2022-2MCS7	Lab-III	3,4 -SE tools/ DM tools	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
12	2022-2MCS8	Lab-IV	2- Graphics programming and tools	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
<b>Internship</b>																		
13	2022-2MCS9		#Internship/Field Work/Work Experience@															
			TOTAL	20	2	10	32											
<b>Open Elective(Appendix 5)</b>																		
14	2022-2MCS10	OE2	Openelective (OE) /GIC/Openskill/MOOC*	-	2	-	2	-	1	1	-			25	25	50	25	P
			TOTAL	20	4	10	34	24	5	29								
<b>GIC</b>																		
		GIC3	Web Page Design Techniques															
		GIC4	Automation With Robotics															

**L: Lecture, T: Tutorial, P: Practical**

# Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Computer Science) according to their convenience; @ denotes Ancillary Credit

**Note : Internship /Apprenticeship/Field Work / Work Experience (During vacations of Semester I to Semester III) for duration of minimum 60 hours to maximum 90 hours mandatory to all the students, to be completed during vacations of Semester I to III. This will carry 2 Credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.**

Page 4  
 Sant Gadge Baba Amravati University Amravati  
Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Computer Science)  
(Two Years- Four Semesters Degree Programme- C.B.C.S)  
 (M. Sc. Part-II) Semester- III

S. N.	Subject Code	Type	Subject	Teaching & Learning Scheme						Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits			Maximum Marks					Minimum Passing		
				L	T	P	Total	L/T	Practical		Total	Theory		Practical		Total Marks	Marks	Grade
				Theory+MCQ External	Theory Internal	Internal	External											
<b>Core Subject</b>																		
1	2022-3MCS1	DSC1	1 Algorithms and Design	4	-	-	4	4	-	4	3	80	20			100	40	P
2	2022-3MCS2	DSC2	2 Web Computing	4	-	-	4	4	-	4	3	80	20			100	40	P
3	2022-3MCS3	DSC3	3 Artificial Intelligence and Machine Learning	4	-	-	4	4	-	4	3	80	20			100	40	P
4	2022-3MCS4	DSC4	4 Distributed Computing	4	-	-	4	4	-	4	3	80	20			100	40	P
<b>Skill-3</b>																		
5	2022-3MCS5	SEC3	1 Programming on algorithms and Design	-	2	2	4	4	-	4	3	-	-	25	25	50	25	P
<b>Elective-3</b>																		
6.	2022-3MCS6(1)	DSE1	(1) Network Security															
7.	2022-3MCS6(2)	DSE2	(2) Software Project Management															
8.	2022-3MCS6(3)	DSE3	(3) Digital Forensics	4	-	-	4	4	-	4	3	80	20			100	40	P
<b>Laboratories</b>																		
11	2022-3MCS7	Lab-V	2 HTM/ JS/ CSS/ .net/ PHP	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
12	2022-3MCS8	Lab-VI	3 AI programming. Tools/ Python	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
<b>Internship</b>																		
13	2022-3MCS9		#Internship/Field Work/Work Experience@															
			<b>TOTAL</b>	20	2	10	32											
<b>Open Elective</b>																		
14	2022-3MCS10	OE3	Openelective (OE) /GIC/Openskill/MOOC*	-	2	-	2	-	1	1	-			25	25	50	25	P
			<b>TOTAL</b>	20	4	10	34	24	5	29								
<b>GIC</b>																		
		GIC5	<b>Digital Marketing</b>															
		GIC6	<b>Game Development-: Gamification</b>															

**L: Lecture, T: Tutorial, P: Practical**

# Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Computer Science ) according to their convenience; @ denotes Ancillary Credit

**Note : Internship /Apprenticeship/Field Work / Work Experience (During vacations of Semester I to Semester III) for duration of minimum 60 hours to maximum 90 hours mandatory to all the students, to be completed during vacations of Semester I to III. This will carry 2 Credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.**

- OEC can be studied during semester I to IV- As per Appendix 5

**Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Computer Science)**  
**(Two Years- Four Semesters Degree Programme- C.B.C.S)**  
**(M. Sc. Part-II) Semester- IV**

S. N.	Subject Code	Type	Subject	Teaching & Learning Scheme						Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits			Maximum Marks			Minimum Passing				
				L	T	P	Total	L/T	Practical		Total	Theory		Practical		Total Marks	Marks	Grade
												Theory+ MCQ External	Theory Internal	Internal	External			
<b>Core Subject</b>																		
1	2022-4MCS1	DSC1	1 Cloud Computing	4	-	-	4	4	-	4	3	80	20			100	40	P
2	2022-4MCS2	DSC2	2 Big Data	4	-	-	4	4	-	4	3	80	20			100	40	P
3	2022-4MCS3	DSC3	3 Cyber Security	4	-	-	4	4	-	4	3	80	20			100	40	P
4	2022-4MCS4	DSC4	4 Block Chain Technology	4	-	-	4	4	-	4	3	80	20			100	40	P
<b>Skill-4</b>																		
5	2022-4MCS5	SEC4	Android Programming	-	2	2	4	4	-	4	3	-	-	25	25	50	25	P
<b>Elective-4</b>																		
6.	2022-4MCS6(1)	DSE1	(1) Software Testing															
7.	2022-4MCS6(2)	DSE2	(2) Internet of Things(IOT)															
8.	2022-4MCS6(3)	DSE3	(3) Human Computer Interaction	4	-	-	4	4	-	4	3	80	20			100	40	P
<b>Laboratories</b>																		
11	2022-4MCS7	Lab-VII	1,2 - Cloud Computing and Big Data	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
12	2022-4MCS8	Lab-VIII	3,4 – Block Chain Technology and Cyber Security	-	-	4	4	-	2	2	3	-	-	25	25	50	25	P
13	2022-4MCS9		Seminar	2				1		1				25	25	50	25	P
14	2022-4MCS10		Project			4			2	2				50	50	100	50	P
<b>Internship</b>																		
15	2022-4MCS11		#Internship/Field Work/Work Experience@															
			TOTAL	22	2	14	38	25	6	31								
<b>Open Elective</b>																		
16	2022-4MCS12	OE4	Openelective (OE) /GIC/Openskill/MOOC*	-	2	-	2	-	1	1	-			25	25	50	25	P
			TOTAL	22			40	25	7	32								
<b>GIC</b>																		
		GIC7	Ethics in Technology & Innovation															
		GIC8	Business Intelligence															

**L: Lecture, T: Tutorial, P: Practical**

# Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Computer Science) according to their convenience; @ denotes Ancillary Credit

**Note : Internship /Apprenticeship/Field Work / Work Experience (During vacations of Semester I to Semester III) for duration of minimum 60 hours to maximum 90 hours mandatory to all the students, to be completed during vacations of Semester I to III. This will carry 2 Credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.**

- OEC can be studied during semester I to IV-As per Appendix 5

**Total Credits: 119**

Page 6  
**Appendix- 5**

Common Instructions for all the Semesters regarding Choice Based Credits (CBC)/Open Electives (OE) are as under:

The titles of broad activity those can be undertaken by the students in every semester and their respective credits are listed in the table given below. Student has to undertake one or more activities out of these table so as to avail at least 2 credits per semester

The Subjects/Modules Activity to be undertaken by the Student under the Open Electives approved by the Department Institute. The schedule of approval will be declared by the Department/Institute at the beginning of the Semester (1 July) as per details given below:

One Faculty Member will work as a Coordinator for Open Electives for which 01 Hour of Theory period will be considered as a weekly work load against this work. All Coordinators has to do counselling of respective Open electives, do the Students Registration process and allot them to faculty members (will be working as a mentor). All these electives are internally accessed by respective Coordinators & Guides based on Minimum 03 Class Tests/ Final Objective Test/ Demo/ Report Submission/Certificate issued by competent authority Viva Voce and other methods as decided by the Department/Institute.

The Mentor shall conduct Tutorial Classes for Workload counting purpose, it should be noted that: 01 Tutorial hour is equal to 01 Theory Hour. For Tutorial, Batch of Maximum 20 Students will be considered and the Tutorial Batch should not be comprised of Less than 04 Students.

Coordinator shall take care that the students are not repetitively opting for same type of Electives in every Semester.

**Summary of conduction of Choice Based Credits (CBC)/Open Electives (OC) Electives for all Semesters**

- i. Electives Selection Process starts at beginning of the Semester,
- ii. Declare the names of Coordinator for Open Electives.
- iii. Counselling of Students by Coordinators for selection of Open Electives
- iv. Registration of Students by Coordinators under respective Open Electives
- v. Allotment of Registered Students to Mentor from Department.
- vi. Guidance/Counselling to Students by Mentor throughout the Semester
- vii. General Counselling by Coordinators over the Semester, whenever required.
- viii. Final Assessment of Students by Coordinators & Mentor for Allotment of Final Credits
- ix. Submission of Credits gained by Students to the Head of Department from Coordinators

<b>The Open Elective and Credit Assigned</b>	<b>Credit</b>
Successful completion of Online Course of 4 weeks	4
Project activity	4
Seminar Activity	1
Paper/poster presentation	1
Completion of soft skill programme of one week	1
Internship of 30 Hrs	2
Field Visit of 15 Hrs	1
Startup recognized and approved by the department	2

Participation in Unnat Bharat Abhiyan	1 for 15 days, maximum 4
Yoga Meditation camp of 1 week	1
Completion of course/activity of similar credits proposed by the department from among the available courses/activities from other department/faculty in the college/university	4

**Sant Gadge Baba Amravati University, Amravati**

**Faculty of Science and Technology**

**Programme: M Sc Computer Science (CBCS)**

**PROGRAMME OUTCOMES (POs)**

Upon completion of the programme successfully, students would be able to

**PO1: Problem Analysis**

Identify, formulate, review research literature and analyze complex engineering problems in Computer Science and Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

**PO2: Design / Development of Solutions**

Design solutions for complex engineering problems and design system components or processes of Computer Science and Engineering that meet the specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

**PO3: Conduct Investigations of Complex Problems**

Use research-based knowledge and research methods including design of experiments in Computer Science and Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO4: Modern tool usage**

Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex activities related to Computer Science with an understanding of the limitations.

**PO5: The services to the society**

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Computer Science and Engineering.

**PO6: Project Management**

Demonstrate knowledge and understanding of the computer science and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PROGRAMME SPECIFIC OUTCOMES (PSOs)**

Upon completion of the programme successfully, students would be able to

**PSO 1:** deliver efficient solutions for emerging challenges in the computation domain through continuous learning

**PSO2**

design, develop, implement computer programs and use knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovations.



## **Employability Potential in M.Sc. Computer Science**

If you've studied computer science, you will have gained many technical and non-technical skills which are highly valued by employers, from leadership to programming. The increasing scope of computer science means you have plenty of choice in a wide variety of highly specialized areas.

Computer technologies are integral to modern life, so you're likely to find your computer science skills in high demand across many different industries. These include financial organizations, management consultancy firms, software houses, communications companies, data warehouses, multinational companies, governmental agencies, universities and hospitals.

As always, it's extremely beneficial to have completed relevant work experience. You should also consider compiling a portfolio of your own independent projects outside of your degree, which could be in the form of programming, moderating online or even building an app. This will demonstrate to employers your interest in the subject and your problem-solving skills, creativity and initiative.

- Application analyst.
- Applications developer.
- Cyber security analyst.
- Data analyst.
- Forensic computer analyst.
- Game designer.
- Games developer.
- Machine learning engineer
  
- Cyber security analyst
  - Data analyst
  - Forensic computer analyst
  - Game designer
  - Games developer
  - Machine learning engineer
  - Penetration tester
  - Software engineer
  - Systems analyst
  - UX designer
  - Web designer & Developer
  - Business analyst
  - IT sales professional
  - IT trainer
  - Nanotechnologist
  - Network Engineer
  - Telecommunications researcher
  - Database Manager/ Administrator

Common employers are IT consultancies and IT service providers. However, as most businesses rely on computers to function effectively, there are also opportunities within the IT departments of major organisations in sectors such as:

- Aerospace and Defence
- Agricultural
- Financial Services
- Healthcare
- Manufacturing
- Public And Third Sectors
- Telecommunications
  - Banking
  - E-Commerce
  - Medical
  - Defence
  - Education
  - Communication
  - Automobile Industry
  - Printing Industry
  - Film Industry
  - Entertainment Industry
  - E- Governance
  - Satellite Launching
  - Simulators
  - Research & Development
  - And Lot More...

You can also find opportunities with a range of small to medium-sized enterprises (SMEs).

Another option is to set up your own business, providing IT services such as web design and consultancy.

Computing degrees combine theoretical study and practical projects, teaching you subject-specific skills including:

- Programming Languages
- Hardware Architecture And Construction
- Network Design and Engineering
- Software Engineering
- Multimedia Design
- Software Tools and Packages.

You'll learn how to specify, design and construct computer-based systems, evaluate and recognize potential risks and design creative solutions.

You'll also get more generic skills from your computing degree including:

- Teamwork and Leadership
- Communication
- Problem Solving
- Negotiation

- Time Management and Organisation
- Report Writing
- Numeracy
- Commercial Awareness.

Continuing professional development (CPD) is especially important when you're working with computers as technology and software develops at such a rapid pace.

**Syllabus PG Programme: M.Sc. (Computer Science) (CBCS)**  
**Second Year Semester: III**

<b>Course Code</b>	<b>2022-3MCSI/DSC 1</b>
<b>Course Name</b>	<b>1. Algorithm &amp; Design</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: 1. Analyze the running time proved the correctness basic algorithms. 2. Design efficient algorithms for computational problems using divide and conquer 3. Design optimal solutions using greedy algorithm. 4. Able to apply searching and traversing efficiently 5. Prove the hardness of NP hard problems using simple reduction. 6. Do performance analysis of simple approximation algorithm

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<b>Introduction:</b> Introduction to Algorithms, Algorithm Specification, Space Complexity and Time Complexity, Basics of Probability Theory, Advantages & Disadvantages of Randomized Algorithms. <b>Elementary Data Structures:</b> Stacks and Queues, Trees, Heaps, Graphs & Graphs Representation.	10
II	<b>Divide-and-conquer:</b> Growth of functions, solving recurrence equations: Substitution method, Iteration method and Master method, Binary search, Finding Maximum and Minimum, merge sort, quick sort, heap sort, selection sort, Selection Strassen's Matrix Multiplication.	10
III	<b>Greedy Approach:</b> General Method, Optimal storage on tapes, Knapsack problem, job sequencing with deadlines, optimal merge patterns, Minimum cost spanning trees, Single source shortest path problem, <b>Dynamic Programming:</b> General method, multi stage graph, optimal binary search trees, Principle of optimality, All pairs shortest path problem, Longest common subsequence, Traveling salesperson problem.	10
IV	<b>Search &amp; Traversal Technique:</b> AND/OR graph, biconnected components, Breadth first search & depth first search. <b>Backtracking:</b> General method, 8 Queens Problem, Graph colouring, Sum of subset problem, Hamiltonian cycle. <b>Branch and Bound:</b> 0/1 Knapsack problem, Traveling salesman problem.	10
V	<b>Algebraic Problems:</b> Evaluation & Interpolation, The Fast Fourier Transform, Modular arithmetic <b>Lower bound theory:</b> Comparison trees for sorting and searching, techniques for algebraic problems, some lower bounds and parallel computation. <b>NP Hard &amp; NP Complete Problems:</b> Basic Concept, Cook's Theorem, NP- Hard Graph Problems, AND/OR Graph Decision Problem, Chromatic number decision problem, Clique decision problem, Vertex cover problem.	10
VI	<b>Mesh Algorithm:</b> Computational Model, Packet Routing, Fundamental Algorithms, Selection, Odd-Even Merge. Sorting on Mesh, Preparata's Sorting Algorithm, Graph Problems., Computational Model of Hypercube Algorithms, prefix computation.	10
<b>Text books:</b> 1. Introduction to Algorithms, Corman , Leiserson and others , 2nd edition , PHI 2. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni and		

<p>Sanguthevar Rajasekaran, Second Edition, Universities Press, Hyderabad, 2008.</p> <ol style="list-style-type: none"> <li>Design and Analysis of Algorithms , Dave and Dave , Pearson Education Inc</li> <li>Introduction to Algorithms, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Second Edition, Prentice Hall of India, New Delhi, 2007</li> <li>Computer Algorithm, Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Galgotia Publications Pvt. Ltd., 1999</li> </ol>	
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>Data Structures, Lipschutz , Tata McGraw Hills</li> <li>Design Methods and Analysis of Algorithms , S.K.Basu , PHI.</li> <li>The Art of Computer Programming, Vol 1,2,3 , Dr.Kunth , Addison Wesley</li> <li>The Design and Analysis of Computer Algorithms, Aho , Hopcroft and Ullman, Addison Wesley</li> <li>Computer Algorithms, Kenneth A. Berman and Jerome L. Paul,</li> <li>Algorithms, Cengage learning India Edition, Sara Baase and Allen Van Gelder,</li> <li>Introduction to Design &amp; Analysis, Third Edition, Pearson Education, New Delhi, 2000.</li> </ol>	
<p><b>Video Links</b></p> <ol style="list-style-type: none"> <li><a href="https://www.udemy.com/share/102ari/">https://www.udemy.com/share/102ari/</a></li> <li><a href="https://youtu.be/GQNT0v5zKhE">https://youtu.be/GQNT0v5zKhE</a></li> <li><a href="https://youtu.be/3udyFh_Dbbc">https://youtu.be/3udyFh_Dbbc</a></li> <li><a href="https://youtu.be/XqWYatsgwfU">https://youtu.be/XqWYatsgwfU</a></li> <li><a href="https://onlinecourses.nptel.ac.in/noc23_cs96/preview">https://onlinecourses.nptel.ac.in/noc23_cs96/preview</a></li> </ol>	

<b>Course Code</b>	<b>2022-3MCS2/DSC 2</b>
<b>Course Name</b>	<b>2. Web Computing</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>Describe the basic concept PHP, Server-Side Scripting Language.</li> <li>Design applications using Arrays and Function.</li> <li>Understand OOP concepts for application development.</li> <li>Implement the knowledge of PHP-Database handling.</li> <li>Develop PHP framework for effective design of web application.</li> <li>Implement JavaScript to develop dynamic web pages.</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<p><b>Introduction to Web Techniques:</b> HTTP basics, Introduction to Web server and Web browser, Introduction to PHP, features of PHP, Lexical structure- keywords, comments, variables, type casting, Type Juggling, Variable Variables, Variable references, Scope of variable, Literals, Operators, Language Basics-Data types, Flow control Statements (if, switch, for, foreach, declare, exit and return)</p>	10
II	<p><b>Function, String and Arrays:</b> Defining and calling a function, Default parameters, Variable parameters, Variable function ,Types of strings in PHP, Printing functions-echo(), print(), printf(), print_r() ,Encoding and escaping, Comparing strings-strcmp(), strcmp(), strncmp(), soundex(), metaphone(), Manipulating and searching string functions, Regular expressions</p> <p><b>Arrays:</b> Indexed Vs. Associative arrays, Identifying elements of an array, Storing data in arrays,range(), count(), sizeof(), array_pad(), Multidimensional arrays,</p>	10

	<b>Extracting Multiple Values from array-list(), array_slice(), array_chunk(), array_splice(),</b> Converting between arrays and variables-extract(), Traversing arrays using iterator functions and using array_walk(), array_reduce(), <b>Array Sorting-sort(), assort(), ksort()</b> .	
III	<b>Introduction to Object Oriented Programming</b> Classes, Objects, adding a method, adding a property, visibility, Introspection, constructor and destructors Serialization, Inheritance, overriding, Interfaces, Encapsulation	10
IV	<b>Databases:</b> Relational databases and SQL, basics-connectivity to databases-Making a Connection of PHP with Database, Handling errors, Reading data through query, Advanced databasetechniques-placeholders, prepare/execute, sequences, metadata	10
V	<b>Web Techniques:</b> Introduction, Variables, Server information, Processing Forms-GET Method,POST Method, Sticky Forms, Multivalued parameters, File Upload, Validating Forms, Setting response headers. Maintaining state-Cookies, Sessions.	10
VI	<b>Web Designing Technologies (JavaScript-DHTML)</b> Overview of JavaScript, DHTML, Object Orientation and JavaScript, Basic Syntax (JS data types, JS variables), Primitives, Operations and Expressions, Screen Output and keyboard input (Verification and Validation), JS Control statements, JS Functions, JavaScript HTML DOM Events (onmouseup, onmousedown, onclick, onload, onmouseover, onmouseout). JS Strings.JS String methods JS popup boxes (alert, confirm, prompt). Changing property value of different tags using DHTML	10
<b>Text books:</b> 1. Beginning PHP 5.3 , Matt Doyle, Wiley Publication 2. Programming PHP By Rasmus Lerdorf and Kevin Tatroe, O'Reilly Publication 3. Beginning PHP 5, Dave W. Mercer, Wrox Publication 4. PHP Web Services, Lorna Jane Mitchell, O'Reilly Publication 5. Learning PHP 5, David Sklar, O'Reilly Publication 6. PHP, MySQL, & JavaScript All-in-One For Dummies, Richard Blum, Wiley Publication 7. PHP cookbook, David Sklar, Adam Trachtenberg, O'Reilly publication		
<b>Reference Books:</b> 1. PHP for Beginners, SPD publication 2. Programming the World Wide Web , Robert W Sebesta(3rd Edition) 3. PHP 5 for Dummies, Janet Valade, Wiley Publication 4. PHP: The Complete Reference, Steven Holzner, McGraw-Hill Education 5.		
<b>Online References: Weblinks</b> 1. <a href="http://www.coursera.org">www.coursera.org</a> 2. <a href="http://www.php.net.in">www.php.net.in</a> 3. <a href="http://www.W3schools.com">www.W3schools.com</a> 4. <a href="http://www.wrox.com">www.wrox.com</a> 5. <a href="https://youtu.be/JsxB217QGY">https://youtu.be/JsxB217QGY</a> 6. <a href="https://youtu.be/3-2Pj5hxwrw">https://youtu.be/3-2Pj5hxwrw</a> 7. <a href="https://www.youtube.com/live/s-iza7kAXME?feature=share">https://www.youtube.com/live/s-iza7kAXME?feature=share</a> 8.		

<b>Course Code</b>	<b>2022-3MCS3/DSC 3</b>
<b>Course Name</b>	<b>3. Artificial Intelligence and Machine Learning</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Analyze artificial intelligence (AI) techniques and describe their principles.</li> <li>2. Examine and demonstrate the important role that search algorithms play in problem-solving, inference, perception, knowledge representation, and learning.</li> <li>3. Use the concepts of logic and knowledge representation to solve challenges in the real world.</li> <li>4. Recognize the features of machine learning that allow it to be used in solving a real-world problem.</li> <li>5. Implement the various supervised learning techniques for tree-based and support vector machine models.</li> <li>6. Use several linear approaches for classification and regression, then optimize them using various regularization strategies.</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<p><b>Introduction to AI:</b> Basic Definitions and terminology, Foundation and History of AI, Overview of AI problems, Evolution of AI - Applications of AI, Classification/Types of AI. Artificial Intelligence vs Machine learning.</p> <p><b>Intelligent Agent:</b> Types of AI Agent, Concept of Rationality, nature of environment, structure of agents. Turing Test in AI.</p>	10
II	<p><b>Problem Solving:</b> <b>Search Algorithms in Artificial Intelligence:</b> Terminologies, Properties of search Algorithms, Types of search algorithms: uninformed search and informed search, State Space search. <b>Heuristic Search Techniques:</b> Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best-first Search; Problem Reduction.</p> <p><b>Constraint Satisfaction problem:</b> Interference in CSPs; Back tracking search for CSPs; Local Search for CSPs; structure of CSP Problem.. <b>Beyond Classical Search:</b> Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action and partial observation, online search agent and unknown environments.</p>	10
III	<p><b>Knowledge and Reasoning:</b> <b>Knowledge-Based Agent in Artificial intelligence:</b> Architecture, Approaches to designing a knowledge-based agent, knowledge representation: Techniques of knowledge representation, Propositional logic, Rules of Inference, First-Order Logic, Forward Chaining and backward chaining in AI</p> <p><b>Reasoning in Artificial intelligence:</b> Types of Reasoning and Probabilistic reasoning, Uncertainty.</p>	10
IV	<p><b>Introduction to ML:</b> <b>Introduction to Machine Learning:</b> History of ML Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI &amp; ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation.</p>	10

V	<p><b>Learning:</b>  <b>Types of Learning:</b> Supervised, Unsupervised and Semi-Supervised Learning.  <b>Supervised:</b> Learning a Class from Examples, Types of supervised Machine learning Algorithms,  <b>Unsupervised:</b> Types of Unsupervised Learning Algorithm, Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis.</p>	10
VI	<p><b>Classification &amp; Regression Classification: Binary and Multiclass</b>  <b>Classification:</b> Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest.  <b>Regression:</b> Assessing performance of Regression – Error measures, Overfitting and Underfitting,</p>	10
<p><b>Text books:</b></p> <ol style="list-style-type: none"> <li>1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall</li> <li>2. J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016</li> <li>3. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.</li> </ol> <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Introduction to Artificial Intelligence &amp; Expert Systems, Dan W Patterson, PHI, 2010</li> <li>2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011.</li> <li>2. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.</li> <li>3. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.</li> <li>4. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT.</li> <li>5. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.</li> <li>6. Nilsson Nils J, “Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, and ISBN: 978-1-55-860467-4.</li> </ol>		
<p><b>Weblinks :</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=wnqkfpCpK1g">https://www.youtube.com/watch?v=wnqkfpCpK1g</a></li> <li>2. <a href="https://youtu.be/GwIo3gDZCVQ">https://youtu.be/GwIo3gDZCVQ</a></li> <li>3. <a href="https://youtu.be/Pj0neYUp9Tc">https://youtu.be/Pj0neYUp9Tc</a></li> </ol>		

<b>Course Code</b>	<b>2022-3MCS4/DSC 4</b>
<b>Course Name</b>	<b>4. Distributed Computing</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Learn the fundamental concepts of distributed computing systems.</li> <li>2. Learn the concepts of message passing in distributed systems with inter Process Communication.</li> <li>3. Learn and understand Remote Procedure Call-RPC</li> <li>4. Learn and understand the concept of Synchronization</li> <li>5. Learn and understand Deadlock in distributed computing systems</li> </ol>



	<p>with solutions</p> <p>6. Learn and understand resource management and process management and also learn the concept of threads with issues in designing threads packages.</p>
--	--

Unit	Contents	Periods
I	<b>Distributed Operating System:</b> Introduction, <b>distributed computing models:</b> Workstation model, Workstation server Model, processor pool model, Comparison of models, advantages and disadvantages of distributed system. <b>Issues in designing Distributed system:</b> Transparency, Reliability, Flexibility, Performance, Scalability, Security, fault tolerance, client server model.	10
II	<b>Network Communication:</b> ISO/OSI reference model, ATM protocol reference model. <b>Message Passing:</b> Introduction, Features of Message-Passing Systems, inter process message format, IPC Synchronization, Message buffering strategies, Multi datagram Messaging, Process Addressing, Failure Handling, group communication.	10
III	<b>Remote Procedure Calls-RPC:</b> Introduction, RPC basics, <b>Implementing RPC:</b> RPC messages, Parameter Passing Semantics, Server management <b>RPC communication:</b> Call semantics, Communication protocol, Client-Server Binding, <b>Other RPC issues:</b> Exception Handling & Security Heterogeneous Environments, Failure handling, RPC optimization. <b>RMI Basics &amp; Implementation</b>	10
IV	<b>Synchronization:</b> Introduction, Clock Synchronization, Logical clocks, Mutual Exclusion, <b>Deadlock:</b> Necessary Conditions for Deadlock, Deadlock Modeling, <b>Handling Deadlocks in Distributed Systems:</b> Deadlock Avoidance, Deadlock Prevention, Deadlock Detection, Ways for Recovery from Deadlock, Issues in Recovery from Deadlock, <b>Election Algorithms:</b> The Bully Algorithm, A Ring Algorithm	10
V	<b>Distributed Shared Memory:</b> Introduction, Basic concepts of DSM, Hardware DSM, Design issues in DSM, Issues in implementing DSM system, Granularity, Heterogeneous & other DSM system. <b>Distributed File System:</b> Introduction, File Models, Distributed File system design, Semantics of file sharing, DFS implementation, file caching in DFS, Replication in DFS	10
VI	<b>Resource and Process Management:</b> Introduction, Desirable Features of a global scheduling algorithm, Task assignment approach, Load Balancing approach, Load balancing approach, <b>Process Management:</b> Functions, Desirable features, Process Migration, <b>Threads:</b> Introduction, <b>Issues In Designing Threads Package:</b> Creation, Termination, Synchronization, Scheduling	10
<b>Text books:</b> <ol style="list-style-type: none"> <li>1. Distributed Computing (Oxford Higher Education)– Sunita Mahajan &amp; Seema Shah</li> <li>2. Distributed Operating Systems - Tanenbaum S., Pearson Education</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Distributed Systems Principles and Paradigms - Tanenbaum S. and Maarten V.S., Pearson Education</li> <li>2. Distributed Operating Systems -Concepts and Design - Pradeep K. Sinha (PHI)</li> <li>3.</li> </ol>		

<b>Web Resources :</b> 1. <a href="https://archive.nptel.ac.in/courses/106/106/106106168/">https://archive.nptel.ac.in/courses/106/106/106106168/</a> 2. <a href="https://onlinecourses.nptel.ac.in/noc21_cs87/preview">https://onlinecourses.nptel.ac.in/noc21_cs87/preview</a> 3. <a href="https://www.digimat.in/nptel/courses/video/106106168/L01.html">https://www.digimat.in/nptel/courses/video/106106168/L01.html</a>	
--	--

### Skill -III

<b>Course Code</b>	<b>2022-3MCS5 SEC3</b>
<b>Course Name</b>	<b>1. Programming on algorithms and Design</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Implement the various data structure used for the different application in the industry.</li> <li>2. Simulate and demonstrate the various mechanism involved.</li> <li>3. Demonstrate the loopholes in the system to resolve the problem divide and conquer.</li> <li>4. Simulate and demonstrate the performance of the greedy method simulate and demonstrate advanced problems of backtracking.</li> </ol>
	<p>The following information can be used as guidelines for basic understanding of Programming on algorithms and Design.</p> <p><b>Topics Cover:</b> - Divide and conquer, Searching and Sorting techniques, Strassen's matrix multiplication, Greedy method, minimum spanning trees, optimal merge patterns, Single source shortest path problem, all pair shortest path, AND/OR graph, biconnected components, 4-queens problem, Graph coloring, Knapsack problems, Branch and bound technique, travelling salesperson problem</p> <ol style="list-style-type: none"> <li>1. Write a program to demonstrate the use of Binary search algorithm.</li> <li>2. Write a program to demonstrate the use of Strassen's matrix multiplication algorithm.</li> <li>3. Write a program to demonstrate the use of Optimal storage on tapes Algorithm.</li> <li>4. Write a program to demonstrate the use of Knapsack Problem.</li> <li>5. Write a program to demonstrate the use of Job sequencing with deadlines algorithm.</li> <li>6. Write a program to demonstrate the use of Minimum spanning trees algorithm.</li> <li>7. Write a program to demonstrate the use of all pair shortest path algorithm.</li> <li>8. Write a program to demonstrate the use of Multistage graph algorithm.</li> <li>9. Write a program to demonstrate the use of Travelling salesperson problem algorithm.</li> <li>10. Write a program to demonstrate the use of Graph coloring algorithm.</li> </ol>

## Elective 3

<b>Course Code</b>	<b>2022-3MCS6(1)/DSE 1</b>
<b>Course Name</b>	<b>1. Network Security</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: 1. Study the introduction about security over the network. 2. Learn the cryptographic algorithm. 3. Learn and understand the types of authentication application and protocol. 4. Learn the Protocol used to provide authenticity to the client and data. 5. Understand the concept of network security and prevention from intruders. 6. Learn and understand Types of viruses.

-

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<b>Introduction:</b> Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for network Security, Internet Standards and the Internet Society. <b>Symmetric Encryption and Message Confidentiality:</b> Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Stream Ciphers and RC4, Cipher Block Modes of Operation.	10
II	<b>Public-Key Cryptography and Message Authentication:</b> Approaches to Message Authentication, Secure Hash Functions and HMAC, Public Key Cryptography Principles, Public Key Cryptography Algorithms, Digital Signatures, Key Management.	10
III	<b>Authentication Applications &amp; Key Distribution:</b> Kerberos, X.509 Authentication Service, Public-Key Infrastructure, Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.	10
IV	<b>IP Security:</b> IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management, <b>Web Security:</b> Web Security Considerations, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).	10
V	<b>Network Management Security:</b> Basic Concepts of SNMP, SNMPv1 Community Facility, SNMPv3, <b>Intruders:</b> Intruders, Intrusion Detection, Password Management.	10
VI	<b>Malicious Software:</b> Viruses and Related Threats, Virus Countermeasures, Distributed Denial of Service Attacks, <b>Firewalls:</b> Firewall Design Principles, Trusted Systems, Common Criteria for Information Technology Security Evaluation.	10
<b>Text books:</b> 1. William Stallings: "Network Security Essentials Applications and Standards" Pearson Education, Third Edition.		

<p><b>Reference Books: format (Title ,Author, Publisher, Edition)</b></p> <ol style="list-style-type: none"> <li>1. Network Security: Private Communication in a Public World, Second Edition : Charlie Kaufman; Radia Perlman; Mike Speciner (Prentice Hall)</li> <li>2. Atul Kahate: “Cryptography and Network Security” Mc Graw Hill.</li> <li>3. Forouzan and Mukhopahyay: “Cryptography and Network Security” Mc Graw Hill.</li> <li>4. Matt Bishop: “Computer Security: Art &amp; Science” Pearson Education.</li> <li>4. Brijendra Singh: “ Network Security &amp; Management” PHI.</li> </ol>	
<p><b>Online References</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://youtu.be/IkfggBVUJxY">https://youtu.be/IkfggBVUJxY</a></li> <li>2. <a href="https://www.youtube.com/live/k-k1cfIOLnQ?feature=share">https://www.youtube.com/live/k-k1cfIOLnQ?feature=share</a></li> <li>3. <a href="https://youtu.be/6Jub11UnJTE">https://youtu.be/6Jub11UnJTE</a></li> <li>4. <a href="https://youtu.be/VJelZrYc49c">https://youtu.be/VJelZrYc49c</a></li> </ol>	

<b>Course Code</b>	<b>2022-3MCS6(2)/DSE 2</b>
<b>Course Name</b>	<b>2. Software Project Management</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Understand and estimate cost for software project.</li> <li>2. Identify &amp; analyse aspect in s/w to manage time, process &amp; recourses effectively with quality concept.</li> <li>3. Estimate software productivity using metrics and indicator &amp; identify important issues for planning a project</li> <li>4. Judge different testing techniques used to test software.</li> <li>5. Evaluate the role of user and software teams.</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	Introduction to Software Project Management: Define Project Management, Significance of Software Project Management, and Issues in Project Management Practices. Stages in Software Project: Request For Proposal (RFP), Feasibility Study, Planning, Project Execution, Project Life Cycles Models. Stakeholders of a Project: Role of Project Manager, and Other Key Members and Parties (stake holders) Involved in Project.	10
II	Project Planning: Steps In Project Plan Development, Project Plan Execution Activities, Human Resource Planning, Staff Acquisition And Team Development, Work Breakdown Structure (WBS). Risk Management: Identification of Risks Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Risk Closure	10
III	Project Scheduling: Time Management, Project Network Diagrams - Critical Path Analysis (CPA), Program Evaluation & Review Techniques (PERT). Project Cost Estimation: Cost Estimation Principles, Types of Estimation Techniques and Metrics -COCOMO, Function Point, Delphi Technique.	10
IV	Software Quality Management & Control Quality Assurance & Standards :The SEI Capability Maturity Model CMM; Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, Quality assurance & Validation plan (SQA Activities , reviews, walkthroughs, inspection, testing) Automation to improve Quality in testing Defect Management	10

V	Software testing: Test case design, White box testing, Basis path, control structure- Black box testing and for specialized environments, Strategic approach to S/W testing, Unit testing, integration testing, validation testing, system testing. Debugging with life cycle.	10
VI	Software Team Management: Team Structure & Staff development plan Characteristics of Performance management High performance Directive and collaborative styles Team Communication Group Behavior Managing customer expectations	10
<b>Text books:</b>		
<ol style="list-style-type: none"> <li>1. Bob Hughes and Mike Cotterell, "Software Project Management", Third Edition, Tata McGraw-Hill.</li> <li>2. McGraw-Hill, Waman S. Javadekar, "Software engineering principles and practice".</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Pressman Roger.S, "Software Engineering, A Practitioner's Approach", TMH.</li> <li>2. Pankaj Jalote, "Software Project Management in Practice", Pearson Edn., 2002.</li> <li>3. Robert K. Wysocki, "Effective software project management", Willy India edition.</li> </ol>		
<b>Online References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://youtu.be/tMZrra-5jS4">https://youtu.be/tMZrra-5jS4</a></li> <li>2. <a href="https://youtu.be/hCmf20BUWUg">https://youtu.be/hCmf20BUWUg</a></li> <li>3. <a href="https://youtu.be/M29ZMmQXbqU">https://youtu.be/M29ZMmQXbqU</a></li> <li>4. <a href="https://youtu.be/UKPcdJz1k40">https://youtu.be/UKPcdJz1k40</a></li> </ol>		

<b>Course Code</b>	<b>2022-3MCS6(3)/DSE 3</b>
<b>Course Name</b>	<b>3. Digital Forensics</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Describe Forensic science and Digital Forensic concepts</li> <li>2. Determine various digital forensic Operandi and motive behind cyber-attacks</li> <li>3. Interpret the cyber pieces of evidence, Digital forensic process model and their legal perspective.</li> <li>4. Demonstrate various forensic tools to investigate the cybercrime and to identify the digital pieces of evidence</li> <li>5. Explain how to apply digital forensics methods to investigating email and social media communications</li> <li>6. Describe procedures for acquiring data from mobile devices</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<b>Introduction: Digital Forensics</b> Digital Forensics, Digital Forensics Goals, Cybercrime, Cybercrime Attack Mode, How Are Computers Used in Cybercrimes?, Example of Cybercrime, Types of Digital Forensics, Computer Forensics, Mobile Forensics Network Forensics, Database Forensics, Forensics Data Analysis, Digital Forensics Users	10

II	<p><b>Essential Technical Concepts</b> Data Representation, Decimal (Base-10), Binary, Hexadecimal (Base-16), Computer Character Encoding Schema, File Structure, Digital File Metadata, Timestamps Decoder (Tool), Hash Analysis, How to Calculate File Hash, Memory Types, Volatile Memory, Non-volatile Memory, Types of Computer Storage, Primary Storage, Secondary Storage, HPA and DCO, Data Recovery Considerations, File Systems</p>	10
III	<p><b>Initial Response and First Responder Tasks</b> Digital Evidence, Digital Evidence Types, Locations of Electronic Evidence, Challenge of Acquiring Digital Evidence, Who Should Collect Digital Evidence?, Chain of Custody, Cloning, and Live vs Dead System, Hashing, and Final Report Digital Forensics Examination Process, Seizure, Acquisition, Analysis, Reporting Digital Forensics vs. Other Computing Domain, Search and Seizure, Consent to Search, Subpoena, Search Warrant, First Responder Toolkit, First Responder Tasks, Order of Volatility, Documenting the Digital Crime Scene, Packaging and Transporting Electronic Devices, Conducting Interview, First Responder Questions When Contacted by a Client, Witness Interview Questions, Witness Signature</p>	10
IV	<p><b>Digital Forensics Tools</b> Evaluating Digital Forensics Tool Needs, Types of Digital Forensics Tools, Tasks Performed by Digital Forensics Tools, Tool Comparisons, Other Considerations for Tools, Digital Forensics Software Tools, Command-Line Forensics Tools , Linux Forensics Tools, Other GUI Forensics Tools, Digital Forensics Hardware Tools, Forensic Workstations, Using a Write-Blocker, Recommendations for a Forensic Workstation, Validating and Testing Forensics Software, Using National Institute of Standards and Technology Tools, Using Validation Protocols</p>	10
V	<p><b>E-Mail and Social Media Investigation</b> Exploring the role of email investigation, Exploring the role of client and server in email, Investigating E-mail crimes and violations, Examining E-mail Messages, Viewing E-mail headers, Examining E-mail headers, Examining additional E-mail files, Tracing an e-mail message, Using network E-mail logs , Understanding E- mail servers, Examining Unix and Microsoft email server logs, Applying Digital Forensics Methods to Social Media Communications, Social Media Forensics on Mobile Devices, Forensics Tools for Social Media</p>	10
VI	<p><b>Mobile Device Forensics</b> Need of mobile forensics, Challenges in mobile forensics, The mobile phone evidence extraction process, Understanding mobile device forensics, Mobile phone basics, Inside mobile devices, Mobile Forensics Equipment, Mobile Forensics Tools, The Android model, file system and hierarchy, Android Data Extraction Techniques, Manual data extraction, Logical data extraction: ADB pull data extraction , Using SQLite Browser to view the data, Extracting device information ,Extracting call logs, Recovering deleted data from external SD card, Recovering data deleted from internal memory, Recovering deleted files by parsing SQLite files, Recovering files using file carving techniques, Recovering contacts using your Google account</p>	10
<p><b>Text books:</b> 1. John Sammons, “The Basics of Digital Forensics - The Primer for Getting Started in Digital Forensics” Syngress is an imprint of Elsevier 2. Nihad A. Hassan, “Digital Forensics Basics - A Practical Guide Using Windows OS” Apress</p>		

<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Clint P Garrison “Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data, Syngress Publishing, Inc. 2010 9999</li> <li>2. Bill Nelson Amelia Phillips Christopher Steuart, Guide to Computer Forensics and Investigations: Processing Digital Evidence, Cengage Learning</li> <li>3. Cory Altheide, Harlan Carvey ”Digital forensics with open source tools “Syngress Publishing, Inc. 2011. Bill Nelson Amelia Phillips Christopher Steuart. Guide to Computer Forensics and Investigations: Processing Digital Evidence, Sixth Edition, Cengage Learning</li> <li>4. Heather Mahalik, Rohit Tamma, Satish Bommi setty, Practical Mobile Forensics, Second Edition, Packt Publishing.</li> </ol>	
<p><b>Online References:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://youtu.be/tMZrra-5jS4">https://youtu.be/tMZrra-5jS4</a></li> <li>2. <a href="https://youtu.be/hCmf20BUWUg">https://youtu.be/hCmf20BUWUg</a></li> <li>3. <a href="https://youtu.be/M29ZMmQXbqU">https://youtu.be/M29ZMmQXbqU</a></li> <li>4. <a href="https://youtu.be/UKPcdJz1k40">https://youtu.be/UKPcdJz1k40</a></li> </ol>	

## Laboratories

<b>Course Code</b>	<b>2022-3MCS7 Lab-V</b>
<b>Course Name</b>	<b>2. HTM/JS/CSS/.net/PHP</b>
<b>Total Credits</b>	<b>2</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. introduce the fundamentals of Internet, the principles of web design analyse a web page and identify its elements and attributes.</li> <li>2. Create or construct basic websites using XHTML and Cascading Style Sheets.</li> <li>3. Build dynamic web pages using JavaScript (Client-side programming) objects by applying different event handling mechanisms.</li> <li>4. Create XML documents and Schemas.</li> <li>5. Build interactive web applications using AJAX</li> <li>6. develop modern interactive web applications using PHP, XML and MySQL</li> </ol>
	<p><b>Practical List: Web Computing</b></p> <ol style="list-style-type: none"> <li>1. Write a PHP script to print prime numbers between 1-50</li> <li>2. HP script to <ul style="list-style-type: none"> <li>• Find the length of a string.</li> <li>• Count no of words in a string.</li> <li>• Reverse a string.</li> <li>• Search for a specific string.</li> </ul> </li> <li>3. Write a PHP script for the following: Design a form to accept a string. Write a function to count the total number of vowels (a,e,i,o,u) from the string. Show the occurrences of each vowel from the string. Check whether the given string is a palindrome or not, without using built-in function. (Use radio buttons and the concept of function. Use ‘include’ construct or require stmt.)</li> </ol>

4. Write a PHP script for the following: Design a form to accept two strings from the user. Find the first occurrence and the last occurrence of the small string in the large string. Also count the total number of occurrences of small string in the large string. Provide a text box to accept a string, which will replace the small string in the large string. (Use built-in functions)
5. Accept a string from the user and check whether it is a palindrome or not (Implement stack operations using array built-in functions).
6. Write a PHP script to merge two arrays and sort them as numbers, in descending order.
7. Define an interface which has methods area (), volume( ). Define constant PI. Create a class cylinder which implements this interface and calculate area and volume.
8. Write a Script to Create a database insert data in it and display all the contents.
9. Write class declarations and member function definitions for an employee (code, name, designation). Derive emp\_account (account\_no, joining\_date) from employee and emp\_sal(basic\_pay, earnings, deduction) from emp\_account. Write a menu driven program
  - To build a master table
  - To sort all entries
  - To search an entry
  - Display salary
10. Consider the following entities and their relationships Doctor (doc\_no, doc\_name, address, city, area) Hospital (hosp\_no, hosp\_name, hosp\_city) Doctor and Hospital are related with many- many relationships. Create a RDB in 3 NF for the above and solve following Using above database, write a PHP script which accepts hospital name and print information about doctors visiting / working in that hospital in tabular format.
11. Create a login form with a username and password. Once the user logs in, the second form should be displayed to accept user details (name, city, phoneno). If the user doesn't enter information within a specified time limit, expire his session and give a warning.
12. Write a javascript to display message 'Good Morning' using alert box.
13. Write a javascript to display message 'Good Afternoon' using function. (Hint: use Event 'Onload').
14. Write a javascript function to validate username and password for a membership form.
15. Using Javascript function, display the string in different formatting styles (Bold, italic, underline, strikethrough, hypertext etc)



<b>Course Code</b>	<b>2022-3MCS8 Lab-VI</b>
<b>Course Name</b>	<b>3. Based on AI Programming Tools /Python</b>
<b>Total Credits</b>	<b>2</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Apply various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction,)</li> <li>2. Understand the fundamentals of knowledge representation, inference.</li> <li>3. Understand the fundamentals of theorem proving using AI and ML tools.</li> <li>4. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information</li> </ol>
	<p><b>Practical List: Artificial Intelligence</b></p> <ol style="list-style-type: none"> <li>1. Implementation of uninformed search techniques like, <ol style="list-style-type: none"> <li>i) a. Breadth first Search</li> <li>ii) b. Depth First Search</li> </ol> </li> <li>2. Implementation of informed (Heuristic) search techniques like <ol style="list-style-type: none"> <li>i) Best first Search</li> <li>ii) Branch and Bound Search.</li> <li>iii) A* Search</li> <li>iv) Hill Climbing search</li> <li>v) AO* Search</li> </ol> </li> <li>3. Implementation of Water Jug problem.</li> <li>4. Implementation of Missionaries and Cannibals problem.</li> <li>5. Implementation of Tic-Tac-Toe game.</li> <li>6. Implementation of Tower of Hanoi Problem.</li> <li>7. Implementation of 8 queen problem.</li> </ol> <p><b>Practical List: Machine Learning</b></p> <ol style="list-style-type: none"> <li>1. The probability that it is Friday and that a student is absent is 3%. Since there are 5 school days in a week, the probability that it is Friday is 20%. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.(Ans: 15%)</li> <li>2. Extract the data from database using python</li> <li>3. Implement k-nearest neighbor's classification using python.</li> <li>4. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)</li> <li>5. The following training examples map descriptions of individuals onto high, medium and low credit-worthiness. Input attributes are (from left to right) income, recreation, job, status, age-group, home- owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset</li> <li>6. Implement linear regression using python</li> <li>7. Implementation of Python basic Libraries such as Math, Numpy and Scipy</li> </ol>

	<ol style="list-style-type: none"> <li>8. Implementation of Python Libraries for ML application such as Pandas and Matplotlib</li> <li>9. Creation AND Loading different datasets in Python.</li> <li>10. Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets</li> <li>11. Implementation of Find S Algorithm</li> <li>12. implementation of Candidate elimination Algorithm</li> <li>13. Write a program to implement simple Linear Regression and Plot the graph</li> <li>14. Implement naive bayes theorem to classify the English text</li> <li>15. Implement an algorithm to demonstrate the significance of genetic algorithm</li> <li>16. Implement the finite words classification system using Back-propagation algorithm</li> </ol>
--	--

### GIC

<b>Course Code</b>	2022-3MCS10 – GIC 5
<b>Course Name</b>	<b>GIC5- Digital marketing</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Understand the concept of digital marketing.</li> <li>2. Analyse online marketing environment &amp; Study impact of online marketing on the consumers.</li> <li>3. Explain the impact of social media and other macro environments on digital marketing</li> </ol>
<b>Unit 1</b>	<b>Introducing digital marketing</b>
	Introduction – how has digital marketing transformed marketing?
	Definitions – what are digital marketing and multichannel marketing?
	Introduction to digital marketing strategy
	Introduction to digital marketing communications
<b>Unit 2</b>	<b>Online marketplace analysis: micro-environment</b>
	Situation analysis for digital marketing
	The digital marketing environment
	Understanding how customers interact with digital markets
	Consumer choice and digital influence
	Customer characteristics
	Competitors
	Suppliers
	New channel structures
	Digital business models for e-commerce

<b>Unit 3</b>	<b>The digital macro-environment</b>
	The rate of environment change
	Technological forces
	Economic forces
	Political forces
	Legal forces
	Social forces: impact of social media on digital marketing
<b>Text book</b>	<b>Digital Marketing: Strategy, Implementation &amp; Practice – Dave Chaffey &amp; Fiona Ellis. Publisher- <u>Pearson</u>, Year-2019,ISBN-9781292241623</b>
<b>Course Code</b>	2022-3MCS10 – GIC 6
<b>Course Name</b>	<b>GIC6- Game Development : Gamification</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: <ol style="list-style-type: none"> <li>1. write survey on the gamification paradigms.</li> <li>2. write programs to solve problems using gamification and open source tools.</li> <li>3. solve problems for multi-core or distributed, concurrent/Parallel environments</li> </ol>
<b>UNIT 1</b>	<b>Gaming Foundations and Developing Thinking:</b>
	<b>Gaming Foundations:</b> Introduction, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins. <b>Developing Thinking:</b> Re-framing Context, Player Motivation, Case studies for Thinking: Tower of Hanoi.
<b>UNIT 2</b>	<b>Game Design and Moves in Gamification:</b>
	<b>Opponent Moves in Gamification:</b> Reclaiming Opposition, Gamed Agencies, Remodeling design, Game Mechanics, Case study of Maze Problem. <b>Game Design:</b> Game Mechanics and Dynamics: Feedback and Re-enforcement, Game Mechanics in depth, putting it together, Case study of 8 queens problem.
<b>Unit 3</b>	<b>Game Development Tools &amp; Techniques:</b>
	<b>Advanced tools, techniques and applications:</b> Gamification case Studies, Coding basic game Mechanics, Instant Gamification Platforms, Mambo.io(Ref: <a href="http://mambi.io">http://mambi.io</a> ), Installation and use of BigDoor (Open Source <a href="http://bigdoor.com">http://bigdoor.com</a> ), ngameoint/gamificationserver (ref: <a href="https://github.com/ngameoint/gamification-server">https://github.com/ngameoint/gamification-server</a> )
<b>Text book</b>	<ol style="list-style-type: none"> <li>1. Mathias Fuchs, Sonia Fizek, Paolo Ruffino, Niklas Schrape, <b>Rethinking Gamification</b>, Meson Press, ISBN (Print): 978-3-95796-000-9 , ISBN (PDF): 978-3-95796-001-6</li> <li>2. Gabe Zechermann, Christopher Cunningham, <b>Gamification Design</b>, Oreilly, ISBN: 978-1-449-39767-8</li> </ol>

**Syllabus PG Programme: M.Sc. (Computer Science) (CBCS)**  
**Second Year Semester: IV**

<b>Course Code</b>	<b>2022-4MCS1/DSC 1</b>
<b>Course Name</b>	<b>1. CLOUD COMPUTING</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: <ol style="list-style-type: none"> <li>1. Describe the basic concept of Cloud Computing and Its Models.</li> <li>2. Analyze the application and virtualization infrastructures for cloud computing.</li> <li>3. Exhibit in-depth understanding of key cloud-based services.</li> <li>4. Understand the necessity of management activity at cloud environment.</li> <li>5. Study different cloud deployment tools.</li> <li>6. Understand various security aspects related to cloud</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<b>Fundamentals of Cloud Computing:</b> Definition and History, Cloud Characteristics, Cloud Advantages and Disadvantages, Cloud Provider, Cloud Consumer <b>Distributed Computing:</b> Client Server, Multitier Architecture <b>Parallel Computing:</b> Flynn's Taxonomy, SIMD vs MIMD, <b>Cloud-based RESTful API:</b> Principle, Components, working, Authentication Method, Benefits.	10
II	<b>Cloud Architecture and Services:</b> NIST Cloud Computing Reference Architecture <b>Cloud Deployment Models:</b> Public Cloud, Private Cloud, Community Cloud, Hybrid Cloud. <b>Cloud Delivery Models:</b> Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS).	10
III	<b>Cloud Enabling Technology:</b> Internet Service Provider (ISP) <b>Web Technology:</b> Basic Concept, Fundamental Elements (URL, HTTP, HTML, XML), Web Application Architecture. <b>Data Center:</b> Concept and Challenges, <b>Data Center Virtualization:</b> Basic Model of Virtualization, Benefits of Virtualization, Para Virtualization (O.S. Based), Full Virtualization (Hardware Based). <b>Virtualization Platform:</b> Xen and Virtual Box: Terms, Need, Structure, Merits and Demerits.	10
IV	<b>Cloud Infrastructure and Management:</b> Virtual Server <b>Cloud Storage Device:</b> Cloud Storage Level, Cloud Storage Reference Model <b>Cloud Usage Monitor:</b> Monitoring Agent, Resource Agent, Polling Agent, Resource Replication <b>Cloud Management:</b> Need, Cloud Management Tasks, Features, Resource Provisioning, Resource Management, SLA Management.	10
V	<b>Cloud Building Platform: Eucalyptus:</b> Architecture Design, Components (Control Plane): Cloud Controller, Cluster Controller, Storage Controller, Node Controller, Client Interface, Features, Advantages, Installation Procedure <b>OpenStack:</b> Architecture, Components, OpenStack Landscape, Installation and manage instances process, Features, Advantages.	10
VI	<b>Cloud Security Essentials: Basic Terms:</b> Confidentiality, Integrity, Authenticity, Availability, Threats, Vulnerabilities, and Risks <b>Threat Agents:</b> Anonymous Attacker, Malicious Service Agent, Trusted Attacker, Malicious Insider <b>Cloud Security Threats:</b> Traffic Eavesdropping, Malicious Intermediary, Denial of Service, Insufficient Authorization, Virtualization Attack <b>Encryption:</b> Symmetric Encryption, Asymmetric Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), <b>Identify and Access Management (IAM):</b> Authentication and Authorization with	10

IAM.	
<b>Text books:</b> <ol style="list-style-type: none"> <li>1. “Cloud Computing: Methodology, System, and Application”, Lizhe Wang, CRC Press, 2017.</li> <li>2. “Cloud Computing a Practical Approach”, Toby Velte et.al., McGraw Hill, 2017.</li> <li>3. “Cloud Computing and Virtualization”, Dac-Nhuong Le et.al., Wiley, 2018.</li> <li>4. “Design and Use of Virtualization Technology in Cloud Computing”, P. Kumar Das, IGI Global, 2018.</li> </ol>	
<b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. “Cloud Computing: Concept, Technology and Architecture”, Thomas Erl et.al., Pearson, 2013.</li> <li>2. “Cloud Computing for Science and Engineering”, Ian Foster and Dennis, MIT Press, 2017.</li> <li>3. “Cloud Computing: From Beginning to End”, Ray Rafaels, 2018.</li> <li>4. “Virtualization Essentials”, Matthew Portnoy, Sybex, 2012.</li> <li>5. “The Value Of Virtualization And Cloud Computing”, Manny Vergara, 2013.</li> </ol>	
<b>Online References: Weblinks</b> <ol style="list-style-type: none"> <li>1. <a href="https://onlinecourses.nptel.ac.in/noc23_cs89/preview">https://onlinecourses.nptel.ac.in/noc23_cs89/preview</a></li> <li>2. <a href="https://onlinecourses.nptel.ac.in/noc23_cs90/preview">https://onlinecourses.nptel.ac.in/noc23_cs90/preview</a></li> <li>3. <a href="https://youtu.be/a6us8kaq0g">https://youtu.be/a6us8kaq0g</a></li> <li>4. <a href="https://youtu.be/RmuVkB3siYY">https://youtu.be/RmuVkB3siYY</a></li> <li>5. <a href="https://youtu.be/Dv0sjAYnVCY">https://youtu.be/Dv0sjAYnVCY</a></li> </ol>	

<b>Course Code</b>	<b>2022-4MCS2/DSC 2</b>
<b>Course Name</b>	<b>2. Big Data</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: <ol style="list-style-type: none"> <li>1. Identify current scenarios of big data and provide various facets of big data.</li> <li>2. Illustrate different types of big data technologies.</li> <li>3. Familiar with the big data technology framework and file systems.</li> <li>4. Describe the components of Map Reduce &amp; it’s working.</li> <li>5. Understand the use of Apache Spark in Distributed processing System</li> <li>6. Apply NoSQL to store big data and real time web application</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<b>Introduction to Big Data:</b> Big Data Overview, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, Traditional Business Intelligence (BI) versus Big Data. <b>Big data analytics:</b> Background of Data Analytics, Classification of Analytics, Role of Data Scientist, Importance and challenges facing big data, Terminologies Used in Big Data Environments, The Big Data Technology Landscape	10
II	<b>Introduction to Hadoop:</b> History and overview of Hadoop, RDBMS versus Hadoop, Distributed Computing Challenges, Hadoop Distributors, Processing Data with Hadoop. <b>Hadoop Ecosystem:</b> Introduction to Hadoop ecosystem technologies: Serialization: AVRO, Co-ordination: Zookeeper, <b>Databases:</b>	10

	HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm	
III	<b>Hadoop Framework:</b> Requirement of Hadoop Framework - Design principle of Hadoop, Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's. <b>Hadoop Distributed File System (HDFS):</b> The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Basic Filesystem Operations, Hadoop Filesystems. – HDFS Commands.	10
IV	<b>Map Reduce:</b> Anatomy of a Map Reduce, Map Reduce Types and Formats, Map Reduce Features, Working of Map Reduce, Exploring Map and Reduce Functions, Techniques to optimise Map Reduce jobs, Uses of Map Reduce. Controlling MapReduce Execution with InputFormat, Reading Data with custom Record Reader,-Reader, Writer, Combiner, Partitioners, Map Reduce Phases, Developing simple MapReduce Application.	10
V	<b>Apache Spark:</b> Introducing Apache Spark, Why Hadoop plus Spark?, Components of Spark, Apache Spark RDD, Apache Spark installation, Apache spark architecture, Introducing real time processing, Architecture of spark streaming, Spark Steaming transformation and action, Input sources and output stores, spark streaming with Kafka and HBase.	10
VI	<b>NoSQL:</b> Introduction to NoSQL, NoSQL Business Drivers, NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study, NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.	10
<b>Text books:</b>		
<ol style="list-style-type: none"> <li>1. Seema Acharya, Subhashini Chellappan, —Big Data and Analytics, Wiley Publications, 2nd Edition, 2014 DT Editorial Services, —Big Data, Dream Tech Press, 2nd Edition, 2015.</li> <li>2. Tom White , —Hadoop: The Definitive Guide, O'Reilly, 3rd Edition, 2012</li> <li>3. Black Book Big Data, dreamtech publications , 1st Edition, 2017</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Michael Minelli, Michele Chambers, Ambiga Dhiraj ,—Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Wiley CIO Series, 1st Edition, 2013.</li> <li>2. Arvind Sathi,—Big Data Analytics: Disruptive Technologies for Changing the Game , IBM Corporation, 1st Edition, 2012.</li> <li>3. Dan Mcary and Ann Kelly Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press</li> <li>4. Venkat Ankam, “Big Data Analytics” Published by Packt Publishing Ltd., 1st Edition, 2016</li> </ol>		
<b>Video Links:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=zez2Tv-bcXY">https://www.youtube.com/watch?v=zez2Tv-bcXY</a></li> <li>2. <a href="https://www.youtube.com/watch?v=1vbXmCrkT3Y">https://www.youtube.com/watch?v=1vbXmCrkT3Y</a></li> <li>3. <a href="https://www.youtube.com/watch?v=S2MUhGA3IEw">https://www.youtube.com/watch?v=S2MUhGA3IEw</a></li> <li>4. <a href="https://onlinecourses.nptel.ac.in/noc23_cs112/preview">https://onlinecourses.nptel.ac.in/noc23_cs112/preview</a></li> </ol>		

<b>Course Code</b>	<b>2022-4MCS3/DSC 3</b>
<b>Course Name</b>	<b>3. Cyber Security</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Analyse and evaluate the importance of personal data &amp; its privacy &amp; security.</li> <li>2. Recognize the importance of firewall in cyber-attacks from unauthorized access in network.</li> <li>3. Increase awareness about Cyber-attack vectors and safety against Cyber-frauds</li> <li>4. Take measures for self -Cyber protection as well as societal Cyber- Protection.</li> <li>5. Analyse and evaluate existing legal framework and laws on Cyber security</li> <li>6. Analyse and evaluate the digital payment system security and remedial measures against digital payment frauds</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Periods</b>
I	<p><b>Introduction to Cyber Security</b>            Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber Security, Issues and challenges of cyber security.</p>	10
II	<p><b>Network Defence tools</b>  <b>Firewalls and Packet Filters:</b> Firewall Basics, Packet Filter Vs Firewall, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address, Translation (NAT) and Port Forwarding. <b>VPN:</b> the basic of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System.</p>	10
III	<p><b>Digital Devices Security , Tools and Technologies for Cyber Security</b>            End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions</p>	10
IV	<p><b>Introduction to Cyber Crime, law and Investigation</b>            Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyber space and Criminal Behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. Internet crime and Act: A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000. Firewalls and Packet Filters, password Cracking,</p>	10

	Keyloggers and Spyware, Virus and Worms, Trojan and backdoors, attack, SQL injection, Buffer Overflow, Attack on wireless Networks.	
V	<p><b>Social Media Overview and Security</b></p> <p>Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media,</p>	10
VI	<p><b>E-Commerce and Digital Payments</b></p> <p>Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions.</p>	10
<p><b>Textbooks :</b></p> <ol style="list-style-type: none"> <li>1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press.</li> <li>2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.</li> <li>3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.</li> </ol> <p><b>Reference Books :</b></p> <ol style="list-style-type: none"> <li>1. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India.</li> <li>2. Fundamentals of Network Security by E. Maiwald, McGraw Hill.</li> <li>3. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.</li> <li>4. Cyber Laws: Intellectual Property &amp; E-Commerce Security by Kumar K, Dominant Publishers. Pvt. Ltd..</li> </ol>		
<p><b>Web Link :</b></p> <p>Web link to Equivalent MOOC on SWAYAM/NPTEL if relevant:</p> <ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=yr1Psapupsc">https://www.youtube.com/watch?v=yr1Psapupsc</a></li> <li>2. <a href="https://www.youtube.com/watch?v=PIHnamdwGmw">https://www.youtube.com/watch?v=PIHnamdwGmw</a></li> <li>3. <a href="https://www.youtube.com/watch?v=inWWhr5tnEA">https://www.youtube.com/watch?v=inWWhr5tnEA</a></li> <li>4. <a href="https://www.youtube.com/watch?v=mo3R-LDTdos">https://www.youtube.com/watch?v=mo3R-LDTdos</a></li> <li>5. <a href="https://www.youtube.com/watch?v=3pntAu95Phk">https://www.youtube.com/watch?v=3pntAu95Phk</a></li> </ol>		



<b>Course Code</b>	2022-4MCS4/DSC4
<b>Course Name</b>	4. BLOCKCHAIN TECHNOLOG
<b>Total Credits</b>	4
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Describe the basic concept of Blockchain and Distributed Ledger Technology.</li> <li>2. Interpret the knowledge of the Bitcoin network, nodes, keys, wallets and transactions.</li> <li>3. Implement smart contracts in Ethereum using different development frameworks.</li> <li>4. Develop applications in permissioned Hyperledger Fabric network.</li> <li>5. Understand different Crypto assets and Crypto currencies.</li> <li>6. Analyse the use of Blockchain in different use cases and with AI, IoT and Cyber Security using case studies.</li> <li>7.</li> </ol>

Unit	Contents	Periods
I	<p><b>Introduction to Blockchain:</b> Technical definition of Blockchain. Elements of a blockchain Features of Blockchain, Types of Blockchain, DLT. DLT V/S Blockchain CAP theorem Byzantine Generals Problem, Consensus Mechanism and its Type Cryptographic primitives and data structure used in blockchain, Block in a Blockchain: Structure of a Block, Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Blockchain, Merkle Tree.</p>	10
II	<p><b>Bitcoin:</b> Bitcoin and the history of Bitcoin, Bitcoin Transactions, Bitcoin Concepts: keys, addresses and wallets, Bitcoin Transactions, UTXO. validation of transactions, Bitcoin Mining and Difficulty levels, Structure of Blocks, Block header and Genesis Block, linking of Block.</p> <p><b>Bitcoin Network:</b> Bitcoin Core node and API, Peer-to-Peer Network Architecture, Node Types and Roles, Incentive based Engineering, The Extended Bitcoin Network, Network Discovery, Full Nodes, exchanging “Inventory”, Simplified Payment Verification (SPV) Nodes, Transaction Pools, Blockchain Forks,</p> <p><b>Basics of Bitcoin Forensics:</b> Analysis of Address and Wallet, Clustering of Addresses following Money.</p>	10
III	<p><b>Permissionless Blockchain: Ethereum:</b> Introduction to Ethereum, Ethereum 1.0 and 2.0, Turing completeness EVM and compare with bitcoin Basics of Ether Units, Ethereum Wallets Working with MetaMask EOA and Contracts Transaction: Structure of Transaction, Transaction Nonce, Transaction GAS, Recipient, Values and Data, Transmitting Values to EOA and Contracts.</p> <p><b>Smart Contracts and Solidity:</b> Development environment and client, Life cycle of Smart contract, Smart Contract programming using solidity, Setting up development environment, Use cases of Smart Contract, Smart Contracts: Opportunities and Risk.</p> <p><b>Smart Contract Deployment:</b> Introduction to Truffle, Use of Remix and test networks for deployment.</p>	10

IV	<p><b>Basic Solidity:</b> Introducing Solidity, Sample Code, Layout of Source File, Structure of a Contract, State Variables, Functions Types, Reference Types, Units, Special Variables and Functions, Expressions and Control Structures, Function Calls, Error Handling, Visibility for Functions and State Variables</p> <p><b>Advanced Solidity:</b> State Modifiers, Inheritance, Constructors, Libraries, Importing Smart Contracts, Events and Logging, Error Handling and Exceptions, Common Pitfalls, Gas Limit and Loops. Sending and Receiving Ether, Recommendations, Contract ABI, Setting up the development environment</p>	10
V	<p><b>Permissioned Blockchain: Hyperledger Fabric:</b> Introduction to Framework, Tools and Architecture of Hyperledger Fabric Blockchain. Components: Certificate Authority, Nodes, Chain codes, Channels, Consensus: Solo, Kafka, RAFT Designing Hyperledger Blockchain Other Challenges: Interoperability and Scalability of blockchain.</p>	10
VI	<p><b>MultiChain:</b> Introduction to MultiChain, Privacy and Permissions in MultiChain, Mining in MultiChain, Multiple configurable Blockchains using MultiChain, setting up a Private Blockchain.</p> <p><b>Crypto assets and Cryptocurrencies:</b> ERC20 and ERC721 Tokens, comparison between ERC20 &amp; ERC721, NFT, ICO, STO, Different Crypto currencies.</p> <p><b>Blockchain Use Cases:</b> Business Use Cases, Technology Use Cases, Legal and Governance Use Cases, Private block chain use cases, Blockchain in IoT, AI, Cyber Security</p>	10
<p><b>Text books:</b></p> <ol style="list-style-type: none"> <li>1. “Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN”, 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O’Reilly Media, Inc. ISBN: 9781491954386.</li> <li>2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O’reilly.</li> <li>3. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press.</li> <li>4. Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric, Ashwani Kumar, BPB publications.</li> <li>5. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Ritesh Modi, Packt publication.</li> <li>6. Cryptoassets: The Innovative Investor’s Guide to Bitcoin and Beyond, Chris Burniske &amp; Jack Tatar.</li> </ol>		
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Mastering Blockchain, Imran Bashir, Packt Publishing.</li> <li>2. Mastering Bitcoin Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O’Reilly Media.</li> <li>3. Blockchain Technology: Concepts and Applications, Kumar Saurabh and Ashutosh Saxena, Wiley.</li> <li>4. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them, Antony Lewis. for Ethereum and Blockchain, Ritesh Modi, Packt publication.</li> <li>5. Blockchain For Dummies, Tiana Laurence</li> </ol>		

**Online References:**

1. NPTEL courses:
  - a. Blockchain and its Applications,
  - b. Blockchain Architecture Design and Use Cases
2. [www.swayam.gov.in/](http://www.swayam.gov.in/)
3. [www.coursera.org](http://www.coursera.org)
4. <https://ethereum.org/en/>
5. <https://www.trufflesuite.com/tutorials>
6. <https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.h>
7. Blockchain demo: <https://andersbrownworth.com/blockchain/>
8. Blockchain Demo: Public / Private Keys & Signing: <https://andersbrownworth.com/blockchain/public-private-keys/>
9. <https://solidity.readthedocs.io/en/v0.6.2/>

**Skill -IV**

<b>Course Code</b>	<b>2022-4MCS5/SEC 4</b>
<b>Course Name</b>	<b>Android Programming</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Develop Android apps with proficiency in Java, UI design, and user interaction.</li> <li>2. Implement core Android components, including Activities, Fragments, Services, Broadcast Receivers, and Content Providers.</li> <li>3. Manage data storage and retrieval using SQLite, Shared Preferences, and file-based techniques.</li> <li>4. Integrate networking capabilities to handle HTTP requests, JSON/XML data, and RESTful APIs.</li> <li>5. Utilize multimedia features and device sensors for audio, video, camera, and location-based services</li> </ol>
	<p>The following information can be used as guidelines for basic understanding of <b>Android Programming</b></p> <p><b>Topics to Cover:</b></p> <p><b>Introduction to Android Development:</b> Overview of the Android platform, Setting up development environment (Android Studio, SDK, etc.), Basics of Java programming language (if necessary).</p> <p><b>2. Android Application Components:</b> Activities and their lifecycle, Fragments and their lifecycle, Services and Broadcast receivers, Content providers.</p> <p><b>3. User Interface (UI) Development:</b> Layouts and views, UI design principles and best practices, Handling user input and events, Working with menus and dialogs.</p> <p><b>4. Data Storage and Persistence:</b> SQLite database and CRUD operations, Shared Preferences for simple data storage, File-based data storage and retrieval.</p> <p><b>5. Networking and Web Services:</b> Working with HTTP requests and</p>

responses, Parsing and processing JSON/XML data, Consuming RESTful APIs, Handling network connectivity and errors.

**6. Multimedia and Sensors:** Playing audio and video, Accessing the camera and capturing media, Utilizing device sensors (e.g., accelerometer, gyroscope).

**7. Background Processing and Multithreading:** Async Task and Threads, Handlers and Loopers, Background services and Intent Service.

**8. App Deployment and Publishing:** Generating signed APKs, Google Play Store submission process, App monetization strategies and considerations

**9. Additional Topics:** Notifications and messaging, Location-based services and maps, Firebase integration (cloud messaging, authentication, etc.), App security and data privacy.

**Practicals based on the topics covered in Android programming:**

1. Introduction to Android Development:- Task: Create an app with two activities. On button click in the first activity, navigate to the second activity and display a message.

2. Android Application Components:- Task: Develop an app with a fragment that displays a list of items. On selecting an item, open a new fragment to show its details.

3. User Interface (UI) Development:- Task: Design a login screen with two input fields for username and password. On clicking a button, display a toast message with the entered credentials.

4. Data Storage and Persistence:- Task: Build a simple note-taking app. Implement functionality to add, edit, and delete notes using SQLite database.

5. Networking and Web Services:- Task: Create an app that fetches data from an API (e.g., weather API) and displays it in a RecyclerView.

6. Multimedia and Sensors:- Task: Develop a camera app that allows users to capture a photo and display it on the screen.

7. Background Processing and Multithreading:- Task: Build a stopwatch app with Start, Stop, and Reset buttons. Implement the functionality using a background thread.

8. App Deployment and Publishing:- Task: Generate a signed APK for your app and install it on a physical device or emulator for testing.

9. Additional Topics:- Task: Implement a chat app where users can send and receive text messages using Firebase Realtime Database.

10. Design a simple hands-on Android programming App that covers all the topics mentioned: App Name: "MyNotebook App"- Task: In this app, create a basic note-taking app called "MyNotebook." Users will be able to create, edit, and delete notes. The app will also allow users to record voice notes and attach images to their notes.

This task will cover various aspects of Android development, ranging from UI design, data storage, networking, multimedia handling, background processing, and deployment. It allows students to get hands-on experience in building a functional Android app while incorporating the mentioned topics. Remember to encourage creativity and exploration during the development process.

	<p><b>To perform the practicals in Android programming, the following tools, Front- end and Back-end technologies can be utilize:</b></p> <ol style="list-style-type: none"> <li>1. Android Studio</li> <li>2. Android Emulator</li> <li>3. Android Device Bridge (ADB)</li> <li>4. Android Asset Studio</li> <li>5. Stetho</li> <li>6. Git: GitHub, GitLab, or Bitbucket can be used for hosting repositories.</li> <li>7. Postman</li> <li>8. Android Profiler</li> <li>9. Crashlytics or Firebase Crashlytics</li> </ol> <p><b>Front-end Development:</b></p> <ol style="list-style-type: none"> <li>1. XML (Extensible Markup Language)</li> <li>2. Android Views and Layouts</li> <li>3. Material Design language</li> </ol> <p><b>Back-end Development:</b></p> <ol style="list-style-type: none"> <li>1. Java or Kotlin</li> <li>2. Android SDK (Software Development Kit)</li> <li>3. SQLite Database</li> <li>4. Retrofit or Volley</li> <li>5. Firebase</li> <li>6. RESTful APIs: Node.js, Python (Django/Flask), Ruby on Rails,etc</li> </ol>
--	--

#### Elective 4

<b>Course Code</b>	<b>2022-4MCS6 (1)/DSE1</b>
<b>Course Name</b>	<b>1. Software Testing</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Design test cases suitable for a software development for different domains.</li> <li>2. Apply various software testing techniques, such as black-box testing, white-box testing, gray-box testing, and regression testing, to identify defects and verify the functionality of software systems.</li> <li>3. Prepare test planning based on the document.</li> <li>4. Document test plans and test cases designed.</li> <li>5. Design test cases that adequately cover different aspects of software functionality, including boundary cases, error handling, and performance scenarios.</li> <li>6. Apply automated testing tools and frameworks to streamline the testing process and improve efficiency .</li> </ol>

Unit	Contents	Periods
------	----------	---------

I	Testing: Introduction and Outline - Introduction to testing and test outline, Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – The Tester’s Role in a Software Development Organization, sample application, incremental testing approach, outline approach steps, evaluation and schedule estimation.	10
II	TEST CASE DESIGN STRATEGIES: Introduction to test outline to test cases, creating test cases, documentation short cuts, Using Black Box Approach to Test Case Design -Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing - Random Testing – Requirements based testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing Documenting test cases.	10
III	LEVELS OF TESTING The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests –systems – Usability and Accessibility test Configuration testing –Compatibility testing – Testing the documentation – Website testing. Other types of tablets, State machines, test case table with multiple inputs, decision tables, applications with complex data, managing tests, testing object-oriented software, comparison, System testing example, Unit testing of Classes	10
IV	Testing Web Applications: Introduction, sample application, functional and usability issues, configuration and compatibility testing, reliability and availability, security testing, database testing, post implementation testing.	10
V	Reducing the No. of test cases: Introduction, prioritization guidelines, priority category scheme, Risk analysis, interviewing to identify problem areas, combination schemes, tracking selected test cases.	10
VI	Creating Quality Software: Introduction, development environmental infrastructure, software testing environment, software testing tools, applying software standards to test documentation. Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.	10
<b>Text books:</b> <ol style="list-style-type: none"> <li>1. Introducing Software Testing: Louise Tamres (PE)</li> <li>2. Software Testing in the Real World by Kit – Pearson</li> <li>3. Effective methods for software testing – William E. Perry</li> <li>4. Srinivasan Desikan and Gopala swamy Ramesh, —Software Testing – Principles and Practices, Pearson Education, 2006.</li> <li>5. Ron Patton, —Software Testing, Second Edition, Sams Publishing, Pearson Education, 2007. AU Library.com</li> </ol>		
<b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Ilene Burnstein, —Practical Software Testing, Springer International Edition, 2003.</li> <li>2. Edward Kit, Software Testing in the Real World – Improving the Process, Pearson Education, 1995.</li> <li>3. Boris Beizer, Software Testing Techniques – 2nd Edition, Van Nostrand Reinhold, New York, 1990.</li> <li>4. Aditya P. Mathur, —Foundations of Software Testing _ Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008</li> </ol>		

<b>Video Lecture</b> 1. <a href="https://youtu.be/zEgVjx85lWs">https://youtu.be/zEgVjx85lWs</a> 2. <a href="https://youtu.be/zEgVjx85lWs?t=89">https://youtu.be/zEgVjx85lWs?t=89</a> 3. <a href="https://youtu.be/OGImfxO2TEU">https://youtu.be/OGImfxO2TEU</a>	
--	--

<b>Course Code</b>	<b>2022-4MCS6 (2)/DSE2</b>
<b>Course Name</b>	<b>2. Internet of Things (IOT)</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: <ol style="list-style-type: none"> <li>1. Understood what Internet of Things are.</li> <li>2. Identify the use of IOT from the global market.</li> <li>3. Able to control home appliances from anywhere in the world.</li> <li>4. Analyze the IOT enabling technologies.</li> <li>5. Design applications using IOT.</li> <li>6. Determine the real-world problems and challenges in IOT.</li> </ol>

<b>Unit</b>	<b>Contents</b>	<b>Total Lectures</b>
I	<b>Introduction and Concepts:</b> Definition and Characteristics of Introduction to IoT, Physical design of IoT, Things in IoT, IoT protocols, Logical Design of IoT, IoT functional blocks, IoT communication Model, IoT Communication API, IoT Enabled Technologies.	10
II	<b>Developing IoT:</b> IoT platform and design methodology-Purpose & requirement specification, process specification, Domain Model specification, Information Model Specification, service specification, IoT level specification, functional view specification, Operational view specification, Device & Component Integration, Application Development.	10
III	IoT Physical Device Endpoints-Basic building blocks of an IoT Device, Exemplary Device Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python.	10
IV	IoT and M2M-Machine 2 Machine, Difference between IoT and M2M, Web of Things, Applications-- Remote Monitoring and Sensing, Remote Controlling, Performance Analysis. Security aspects of IoT.	10
V	Application of IoT with Domain Specific tools: Case studies on Intrusion Detection, Smart Parking, Smart Roads, Surveillance, and Emergency response, Air/Noise Pollution Monitoring Systems, Prognostics, Smart Irrigation, Green House Controls and Wearable Electronics.	10
VI	Data analytics for IOT: MapReduce Programming Model, Ozie workflow for IOT data analysis, setting up a strong, cluster, REST –based approach web socket-based approach, case studies	10

<b>Text books:</b> <ol style="list-style-type: none"> <li>1. Internet of Things (A Hands on Approach), Vijay Madiseti, Arshdeep Bahga</li> <li>2. Getting Started with Internet of Things: Connecting Sensors and Microcontrollers to the cloud by Cuno Pfister, O'RiellyPublications</li> </ol>	
<b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler VlasiosTsiatsis Catherine Mulligan Stefan Aves &amp; Stamatis Kamouskos</li> <li>2. Getting Started with the Internet of Things by Cuno Pfister.</li> <li>3. The Internet of Things: Connecting Objects by Hakima Chaouchi.</li> <li>4. Francisda Costa. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", I Edition, A press Publications, 2013.</li> <li>5. Raj Kamal" Internet of Things", 1<sup>st</sup> edition 2016,McGraw-Hill</li> </ol>	
<b>Weblinks:</b> <ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=LlhmzVL5bm8">https://www.youtube.com/watch?v=LlhmzVL5bm8</a></li> <li>2. <a href="https://www.youtube.com/watch?v=APH6Nrar27w">https://www.youtube.com/watch?v=APH6Nrar27w</a></li> <li>3. <a href="https://www.youtube.com/watch?v=Fj02iTrWUx0">https://www.youtube.com/watch?v=Fj02iTrWUx0</a></li> </ol>	
<b>MOOCS :</b> <ol style="list-style-type: none"> <li>1. <a href="https://onlinecourses.nptel.ac.in/noc23_cs89/preview">https://onlinecourses.nptel.ac.in/noc23_cs89/preview</a> (3 Credit)</li> <li>2. <a href="https://onlinecourses.nptel.ac.in/noc23_cs90/preview">https://onlinecourses.nptel.ac.in/noc23_cs90/preview</a> (2 Credit)</li> <li>3. <a href="https://onlinecourses.nptel.ac.in/noc21_cs14/preview">https://onlinecourses.nptel.ac.in/noc21_cs14/preview</a> (2 Credit)</li> <li>4. <a href="https://archive.nptel.ac.in/courses/106/105/106105167">https://archive.nptel.ac.in/courses/106/105/106105167</a> (4 Credit)</li> </ol>	

<b>Course Code</b>	<b>2022-4MCS6 (3)/DSE3</b>
<b>Course Name</b>	<b>3. HUMAN-COMPUTER INTERACTION</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. To explain importance of HCI study and principles of user-centred design (UCD) approach.</li> <li>2. To develop understanding of human factors in HCI design.</li> <li>3. To develop understanding of models, paradigms and context of interactions.</li> <li>4. To design effective user-interfaces following a structured and organized UCD process.</li> <li>5. To evaluate usability of a user-interface design.</li> <li>6. To apply cognitive models for predicting human-computer-interactions.</li> </ol>

<b>U nit</b>	<b>Contents</b>	<b>Periods</b>
I	<b>INTRODUCTION</b> What is HCI?, Disciplines involved in HCI, Why HCI study is important? The	10



	psychology of everyday things, Principles of HCI, User-centred Design.	
II	<b>UNDERSTANDING THE HUMAN</b> Input-output channels, Human memory, Thinking: Reasoning and Problem Solving, Human emotions, Individual differences, Psychology and Design.	10
III	<b>UNDERSTANDING THE INTERACTION</b> Models of interaction, Ergonomics, Interaction styles, WIMP Interface, Interactivity, Context of interaction, User experience, Paradigms of Interactions.	10
IV	<b>HCI - DESIGN PROCESS</b> What is interaction design?, The software design process, User focus, Scenarios, Navigation Design, Screen Design, Prototyping techniques, Wire-Framing, Understanding the UI Layer and Its Execution Framework, Model-View-Controller(MVC) Framework.	10
V	<b>HCI - DESIGN RULES , GUIDELINES AND EVALUATION TECHNIQUE</b> Principles that support usability, Design standards, Design Guidelines, Golden rules and heuristics, Using toolkits, User interface management system (UIMS), Goals of evaluation, Evaluation Criteria, Evaluation through expert analysis, Evaluation through user participation, Choosing an Evaluation Method.	8
VI	<b>HCI MODELS AND THEORIES</b> Goal and task hierarchy model, Linguistic model, Physical and device models, Cognitive architectures, Hierarchical task analysis (HTA), Uses of task analysis, Diagrammatic dialog design notations, Computer mediated communication, Ubiquitous Computing, Finding things on web Future of HCI.	7
<b>Text books:</b> Text Books: 1. Alan Dix (2008). Human Computer Interaction. Pearson Education. ISBN 978-81-317-1703-5. 2. Gerard Jounghyun Kim (20 March 2015). Human–Computer Interaction: Fundamentals and Practice. CRC Press. ISBN 978-1-4822-3390-2.		
<b>Reference Books: format (Title ,Author, Publisher, Edition)</b> 1. Ben Shneiderman; Catherine Plaisant; Maxine Cohen; Steven Jacobs (29 August 2013). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Pearson Education Limited. ISBN 978-1-292-03701-1. 2. Donald A. Norman (2013). The Design of Everyday Things Basic Books. ISBN 978-0-465-07299-6. 3. Jeff Johnson (17 December 2013). Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines. Elsevier. ISBN 978-0-12-4115569. 4. Alan Cooper; Robert Reimann; David Cronin; Christopher Noessel (13 August 2014). About Face: The Essentials of Interaction Design. Wiley. ISBN 978-1-118- 76658-3. 5. Alan Cooper (1 January 1999). The Inmates are running the Asylum, Sam’s. ISBN 978-0-672-31649-4. 6. John M. Carroll (21 May 2003). HCI Models, Theories, and Frameworks: Toward a Multidisciplinary Science. Morgan Kaufmann. ISBN 978-0-08-049141-7. 7. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, About Face: The Essentials of Interface Design,Wiley India, ISBN : 9788126559718,4th Edition. 8. Rogers, Sharp, Preece, Interaction Design: Beyond Human Computer Interaction,		

Wiley India, ISBN: 9788126544912, 3rd Edition. 9. Wilbert O. Galitz, The Essential Guide to user Interface Design, Wiley India, ISBN: 9788126502806.	
<b>Online References:</b> 1. . <a href="http://hcibib.org/">http://hcibib.org/</a> 2. Android Design Guidelines - <a href="https://developer.android.com/guide/practices/ui_guidelines/index.html">https://developer.android.com/guide/practices/ui_guidelines/index.html</a> 3. iOS Human Interface Guidelines - <a href="https://developer.apple.com/ios/human-interface-guidelines/overview/design-principles/">https://developer.apple.com/ios/human-interface-guidelines/overview/design-principles/</a> 4. MacOS Human Interface Guidelines - <a href="https://developer.apple.com/library/content/documentation/UserExperience/Conceptual/OSXHIGuidelines/">https://developer.apple.com/library/content/documentation/UserExperience/Conceptual/OSXHIGuidelines/</a>	

## Laboratories

<b>Course Code</b>	<b>2022-4MCS7 : Lab VII</b>
<b>Course Name</b>	<b>1,2 : Cloud Computing and Big Data</b>
<b>Total Credits</b>	<b>2</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: <ol style="list-style-type: none"> <li>1. Describe the basic concept of Cloud Computing and Its Models.</li> <li>2. Analyze and the application and virtualization infrastructures for cloud computing.</li> <li>3. Exhibit in-depth understanding of key cloud-based services.</li> <li>4. Understand the necessity of management activity at cloud environment.</li> <li>5. Create Virtual environment using hypervisor.</li> </ol> Develop own cloud with desired functions
	<b>Practical List: CLOUD COMPUTING</b> The Study of NIST model of cloud computing. <ol style="list-style-type: none"> <li>1. To Install Virtual Box used to create Virtual Environment.</li> <li>2. To Create Virtual Machine using Virtual Box and deploy Ubuntu operating System.</li> <li>3. Demonstration of Virtual Box Manager Tool.</li> <li>4. Demonstration of Capturing, Releasing Keyboard and Mouse with Resizing the Machine's Window in Virtual Box.</li> <li>5. To Find procedure to install storage controller and interact with it at Virtual Box</li> <li>6. To Install a 'C' Compiler in the Virtual Machine and Execute a Sample Program.</li> <li>7. To move the files between virtual machine using virtual box.</li> <li>8. To Install Google App Engine and Create hello world app.</li> <li>9. To use Google App Engine launcher to launch the web applications.</li> <li>10. Demonstration of IAM using Google App Engine.</li> <li>11. To installation of Openstack and creation of virtual a machine.</li> </ol>

	<p>12. To implementation of infrastructure as Service using Open Stack.</p> <p>13. To demonstrate and implement IAAS service using AWS EC2 Instance (Free Tier Account</p>
<b>Course Name</b>	<b>1,2: Cloud Computing and Big Data</b>
<b>Total Credits</b>	<b>2</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Able to work with HDFS Commands</li> <li>2. Able to implement Map Reduce programs</li> <li>3. Able to Work with the Mongo DB</li> <li>4. Able to use Spark in designing analytic solutions</li> </ol>
	<p><b>List of Practical's: BIG DATA</b></p> <ol style="list-style-type: none"> <li>1. HDFS Commands: <ol style="list-style-type: none"> <li>a. Starting and shutting down</li> <li>b. Operation to write in file</li> <li>c. Listing files</li> <li>d. Inserting Data into HDFS</li> <li>e. Retrieving Data from HDFS</li> </ol> </li> <li>2. Write a simple program for Word Count Using Map Reduce Programming.</li> <li>3. Write a program in Map Reduce for Union operation.</li> <li>4. Write a program in Map Reduce for Intersection operation.</li> <li>5. Write a program in Map Reduce for GroupSum operation.</li> <li>6. Write a program in Map Reduce for Matrix Multiplication.</li> <li>7. Program to Demonstrate spark operators.</li> <li>8. Program to Demonstrate Spark RDD Transformations methods.</li> <li>9. Program to Demonstrate Spark RDD Action methods.</li> <li>10. Practical using Mongo DB to demonstrate Create and Drop commands for Database</li> <li>11. Practical using Mongo DB to insert or add new documents to the collection</li> <li>12. Practical using Mongo DB to demonstrate read, update and delete operations.</li> </ol>

<b>Course Code</b>	<b>2022-4MCS7 /DSE2: Lab-VIII</b>
<b>Course Name</b>	<b>3. Block Chain Technology and Cyber Security</b>
<b>Total Credits</b>	<b>2</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Explain the fundamental characteristics of block chain using bitcoin.</li> <li>2. Demonstrate the application of hashing and public key cryptography in protecting the block chain</li> <li>3. Analyse the block chain applications in a structure manner</li> <li>4. Handle the crypto currency</li> <li>5. Perform a transaction in bitcoin testnets.</li> </ol>

	<p><b>Practical List: Block Chain Technology</b></p> <ol style="list-style-type: none"> <li>1. To study basic Hadoop commands</li> <li>2. To study and implement hash table using hash functions</li> <li>3. Create simple blockchain using any suitable tool</li> <li>4. Implementing proof of work</li> <li>5. Miner rewards and transactions</li> <li>6. Signing transactions</li> <li>7. Use Geth for Creating private blockchain using Ethereum</li> <li>8. Use Geth for Creating account using Ethereum blockchain</li> <li>9. Use Geth for mining</li> <li>10. Write a smart contract on solidity to store and get hello world</li> </ol> <p><b>Each student should perform sample practical list given below using listed tools. More practicals can be added to implement BCT more efficiently.</b></p> <p><b>List of Tools used for Block chain Technology Analysis Software:</b></p> <ol style="list-style-type: none"> <li>1. <b>AnChain.ai</b> : Based in Silicon Valley, AnChain.AI is a blockchain analytics company that specializes in AI-powered platforms. AnChain.AI provides around-the-clock protection, securing crypto exchanges, protocols, and DApps worldwide for several millions of dollars in weekly transaction amounts.</li> <li>2. <b>Coin base Tracer</b> : Coinbase Tracer (formerly Coinbase Analytics) supports crypto compliance for governments, financial institutions, and crypto businesses, and connects crypto currency transactions to real-world entities using public blockchain attribution data, enabling users to monitor risk on millions.</li> <li>3. <b>Crystal Blockchain</b> : Crystal is a blockchain investigative tool from the Bitfury Group headquartered in Amsterdam. Designed for law enforcement and financial institutions, Crystal provides a view of the public blockchain ecosystem and uses analytics and data scraping to map suspicious transactions.</li> <li>4. <b>Uppsala Security</b> :Uppsala Security headquartered in Singapore built a crowdsourced Threat Intelligence Platform known as the Sentinel Protocol, which is powered by blockchain technology. Supporting the framework is a team of security analysts and researchers, who aim to deliver a safely interconnected.</li> <li>5. <b>Coinfirm</b>: Founded in 2016, Coinfirm provides blockchain analytics and regulatory technology solutions. The company specializes in blockchain AML (‘Anti-Money laundering’) services and fraud investigations, whose blockchain coverage supports 1,500+ crypto assets including Bitcoin.</li> </ol>
<b>Course Code</b>	<b>2022-4MCS7 /DSE2: Lab-VIII</b>
<b>Course Name</b>	<b>3. Block Chain Technology and Cyber Security</b>
<b>Total Credits</b>	<b>2</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Understand the cyber security threat landscape.</li> <li>2. Develop a deeper understanding and familiarity with various types of cyber attacks, cybercrimes, vulnerabilities and remedies thereto.</li> <li>3. Analyse and evaluate existing legal framework and laws on cyber security.</li> <li>4. Analyse and evaluate the digital payment system security and</li> </ol>

	remedial measures against digital payment frauds. 5. Analyse and evaluate the importance of personal data its privacy and security.
	<p><b>Practical list - Cyber Security</b></p> <ol style="list-style-type: none"> <li>1. Study of different types Prepare password policy for computer and mobile device.</li> <li>2. Study of different types security controls for computer and implement technical security controls in the personal computer.</li> <li>3. Steps to Installation and configuration of computer Anti-virus.</li> <li>4. Study of different wireless network components and features of any one of the Mobile Security Apps.</li> <li>5. Study of the features of firewall in providing network security and to set Firewall Security in windows.</li> <li>6. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)</li> <li>7. Study of different types of vulnerabilities for hacking a websites / Web Applications.</li> <li>8. Analysis the Security Vulnerabilities of E-commerce services.</li> <li>9. Analysis the security vulnerabilities of E-Mail Application</li> <li>10. Study of different types cryptography</li> <li>11. Study of different types digital payments</li> <li>12. Steps to Installation and configuration of Computer Host Firewall</li> <li>13. Steps to Wi-Fi security management in computer.</li> <li>14. Steps to Setting privacy settings on social media platforms.</li> <li>15. Study of different Platforms for reporting cybercrimes.</li> <li>16. Steps to Configuring security settings in Mobile Wallets and UPIs.</li> <li>17. Study of secure net banking.</li> <li>18. Study of email phishing attack and preventive measures.</li> <li>19. Study of basic checklist, privacy and security settings for popular Social media platforms.</li> <li>20. Steps to log into computer system as an administrator and check the security policies in the system.</li> </ol>

## GIC

<b>Course Code</b>	2022-4MCS12
<b>Course Name</b>	<b>GIC7- Ethics in Technology and Innovation</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	On completion of this course, students would be able to: 1 Understand the ethics in technology. 2. Use ethics for Privacy and Data protection 3. Illustrate various issues related to AI/ML and hacking. 4. Analyse Ethical Implications of Emerging Technologies.
<b>Unit 1</b>	<b>Ethical Foundations of Technology</b>
	1. Introduction to Ethics in Technology - Understanding ethics and its importance in the context of technology

	<p>and innovation</p> <ul style="list-style-type: none"> <li>- Ethical theories and frameworks relevant to technology ethics</li> </ul> <p>2. Technological Determinism vs. Social Shaping of Technology</p> <ul style="list-style-type: none"> <li>- Exploring the debate between technological determinism and social shaping theories</li> <li>- Assessing the ethical implications of these perspectives on technology development and adoption</li> </ul> <p>3. Ethical Considerations in Technology Design and Development</p> <ul style="list-style-type: none"> <li>- Evaluating ethical issues in technology design, including bias, privacy, and security concerns</li> <li>- Incorporating ethics into the design process</li> </ul> <p>4. Privacy and Data Ethics</p> <ul style="list-style-type: none"> <li>- Understanding the ethical challenges related to data collection, use, and storage</li> <li>- Examining privacy laws and guidelines for data protection</li> </ul> <p>Introduction – how has digital marketing transformed marketing?</p>
<b>Unit 2</b>	<b>Ethical Issues in Digital Innovation</b>
	<p>1. Artificial Intelligence and Machine Ethics</p> <ul style="list-style-type: none"> <li>- Ethical concerns surrounding AI and machine learning applications</li> <li>- AI ethics principles and responsible AI development</li> </ul> <p>2. Big Data and Algorithmic Fairness</p> <ul style="list-style-type: none"> <li>- Ethical challenges of big data and algorithmic decision-making</li> <li>- Ensuring fairness and accountability in algorithmic systems</li> </ul> <p>3. Internet of Things (IoT) and Ethical Implications</p> <ul style="list-style-type: none"> <li>- Ethical considerations in IoT deployment and connected devices</li> <li>- Addressing security and privacy issues in IoT ecosystems</li> </ul> <p>4. Ethical Hacking and Cyber security</p> <ul style="list-style-type: none"> <li>- Understanding ethical hacking practices and their role in cyber security</li> <li>- The ethics of vulnerability disclosure and responsible hacking</li> </ul>
<b>Unit 3</b>	<b>Ethical Leadership in the Digital Age</b>
	<p>1. Digital Ethics and Corporate Responsibility</p> <ul style="list-style-type: none"> <li>- Ethical responsibilities of organizations in the digital age</li> <li>- Corporate social responsibility and sustainable technology practices</li> </ul> <p>2. Ethical Decision-Making in Technology Companies</p> <ul style="list-style-type: none"> <li>- Developing ethical decision-making frameworks for technology firms</li> <li>- Case studies on ethical dilemmas faced by technology companies</li> </ul> <p>3. Ethical Implications of Emerging Technologies</p> <ul style="list-style-type: none"> <li>- Ethical considerations of emerging technologies like biotechnology, nanotechnology, and quantum computing</li> <li>- Navigating the ethical challenges of new and transformative innovations</li> </ul> <p>4. Ethical Innovation and Social Impact</p> <ul style="list-style-type: none"> <li>- Fostering ethical innovation for positive social impact</li> <li>- Balancing profit and ethical considerations in technology-driven</li> </ul>

	ventures
<b>Text book</b>	<ol style="list-style-type: none"> <li>1. "Ethics in the Age of Information Technology" - Author: Herman T. Tavani</li> <li>2. "The Ethics of Invention: Technology and the Human Future" - Author: Sheila Jasanoff</li> <li>3. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" - Author: Clayton M. Christensen</li> </ol>

<b>Course Code</b>	2022-4MCS12
<b>Course Name</b>	<b>GIC8- Business Intelligence</b>
<b>Total Credits</b>	<b>4</b>
<b>Course Outcomes (COs):</b>	<p>On completion of this course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Understand the concept of Business Intelligence and Get acquainted with the details of Decision Support System</li> <li>2. Apply the concepts of Business Intelligence in real world applications and Explore and use the data warehousing wherever necessary.</li> <li>3. Design and manage practical BI systems.</li> </ol>
<b>UNIT 1</b>	<b>Introduction to Business Intelligence and Decision Support Systems:</b>
	<p><b>Concepts with Mathematical treatment :</b> Introduction to data, Information and knowledge, Decision Support System, Theory of Operational data and informational data, Introduction to Business Intelligence, Determining BI Cycle, BI Environment and Architecture, Identify BI opportunities, Benefits of BI. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization.</p> <p><b>Decision Making Concepts :</b> Concepts of Decision Making, Techniques of Decision Support System (DSS), Development of Decision Support System (DSS), Applications of DSS, Role of Business Intelligence in DSS.</p>
<b>UNIT 2</b>	<b>Data-Warehouse and Data Pre-processing:</b>
	<p><b>Data-Warehouse :</b> Introduction: Data warehouse Modelling, data warehouse design, data-warehouse technology, Distributed data warehouse, and materialized view</p> <p><b>Data Pre-processing and outliers:</b> Data Analytics life cycle, Discovery, Data preparation, Pre-processing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization, and concept hierarchy generation, Model Planning, Model building, Communicating Results and Findings, Operationalizing, Introduction to OLAP. Real-world Applications, types of outliers, outlier challenges, Outlier detection Methods, Proximity-Based Outlier analysis, Clustering Based Outlier analysis.</p>
<b>Unit 3</b>	<b>Designing and managing BI systems:</b>
	<p><b>Designing and managing BI systems:</b> Determining infrastructure requirements, planning for scalability and availability, managing and maintenance of BI systems, managing BI operations or business</p>

	continuity.
<b>Text book</b>	<ol style="list-style-type: none"><li>1. R. Sharda, D. Delen, and E. Turban, Business Intelligence and Analytics. Systems for Decision Support, 10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;</li><li>2. Business Process Automation, Sanjay Mohapatra, PHI.</li><li>3. Introduction to business Intelligence and data warehousing, IBM, PHI, ISBN: 9788120339279</li></ol>