Sant Gadge Baba Amravati University, Amravati
Faculty: Science & Technology
Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree
(Master of Computer Science)
following Three Years UG Programme wef 2023-24
(Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option
Programme: M.Sc. Computer Science

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 Defense
- 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 recognise 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.

Sant Gadge Baba Amravati University, Amravati
FACULTY: Science & Technology
Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree (Master of Computer Science) following Three Years UG Programme wef 2023-24
(Two Years- Four Semesters Master's Degree Programme- NEPv23 with **Exit and Entry Option**
M.Sc. Computer Science First Year Semester- I

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme								
				Teaching Period Per Week				Credits				Maximum Marks						Minimum Passing		
												Theory		Practical		Total Marks				
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory +MCQ External	Internal	External		Marks Internal	Marks External	Grade
1.	1 Research Methodology and IPR	FSC-RM	N1MCS1	4	-	-	4	4	-	4	3	30	70			100	12	28	P
2.	2 Computer System Organization	DSC-I	N1MCS2	4	-	-	4	4	-	4	3	30	70			100	12	28	P
3.	3 Data Structure with OOP	DSC-II	N1MCS3	4	-	-	4	4	-	4	3	30	70			100	12	28	P
4.	4 Database Management Technologies	DSC-III	N1MCS4	4	-	-	4	4	-	4	3	30	70			100	12	28	P
5.	5 Compiler Construction/MOOC	DSE-I (1)/MOOC	N1MCS5(1)	3	-	-	3	3	-	3	3	30	70			100	12	28	P
6.	6 Software Testing/MOOC	DSE-I(2)/ MOOC	N1MCS5(2)																
7.	7 Software Engineering /MOOC	DSE-I(3)/ MOOC	N1MCS5(3)																
	Laboratories																**Minimum Passing Marks**		**Grade**
8.	Lab Programming(C/C++/Java/ALP) based on 2,3	Lab-I	N1MCS6	-	-	2	2	-	1	1	3	-	-	25	25	50	25		P
9.	Lab SQL/DBMS tools, MSsql, MySql based on 4	Lab-II	N1MCS7	-	-	2	2	-	1	1	3	-	-	25	25	50	25		P
10.	Lab Based on DSE I (1)/ DSE-I (2)/ DSE-I(3) /MOOC Lab**	Lab-III	N1MCS8	-	-	2	2	-	1	1	3	-	-	25	25	50	25		P
	On Job Training, Internship																		
11.	# On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively**	**Related to DSC**	N1MCS9	**120 Hours cumulatively during vacations of Semester I and Semester II**						4*									P*
12.	**Co-curricular Courses: Health andwellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine / Applied /Visual/ Performing Arts During Semester I, II, III and IV**	Generic **Optional**	N1MCS10	**90 Hours Cumulatively From Sem I to Sem IV**															
	TOTAL									22						650			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note : # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.**

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

**Students should opt MOOC Courses equivalent to given electives of 45 hours to 55 hours having minimum 3 credits . There will be no internal assessment for the MOOC theory courses whereas they should perform the practicals for the opted MOOC Courses in DSE Practicals. Evaluation of MOOC Practical's will be same as that of DSE.

NOTE: List of MOOCs for DSE subjects is given in Appendix-D

Sant Gadge Baba Amravati University, Amravati

FACULTY: Science & Technology

Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree (Master of Computer Science) following Three Years UG Programme wef 2023-24

(Two Years- Four Semesters Master's Degree Programme- NEPv23 with **Exit and Entry Option**

M.Sc. (Computer Science) First Year Semester- II   [Level 6.0]

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory +MCQ External	Internal	External		Marks Internal	Marks External	Grade
1.	1.Operating System Algorithms	DSC IV	N2MCS1	4	-	-	4	4	-	4	3	30	70	-	-	100	12	28	P
2.	2.Graphics Application programming	DSC V	N2MCS2	4	-	-	4	4	-	4	3	30	70	-	-	100	12	28	P
3.	3. Computer Network & Wireless Technology	DSC VI	N2MCS3	4	-	-	4	4	-	4	3	30	70	-	-	100	12	28	P
4.	4.IoT/ MOOC	DSE II (1)/MOOC	N2MCS4(1)	3	-	-	3	3	-	3	3	30	70	-	-	100	12	28	P
5.	5.Mobile Computing/ MOOC	DSE II (2)/MOOC	N2MCS4(2)																
6.	6. Data Mining Data Warehouse/ MOOC	DSE II (3)/MOOC	N2MCS4(3)																
	Laboratories																**Minimum Passing Marks**		
7.	Lab Programming (C/C++/Java) based on 1	Lab-IV	N2MCS5			2	2		1	1	3			25	25	50	25		P
8.	Lab Graphics Application programming based on 2	Lab-V	N2MCS6			2	2		1	1	3			25	25	50	25		P
9.	Lab Based on DSE II (1)/ DSE II (2)/ DSE II (3)/MOOC Lab**	Lab-VI	N2MCS7			2	2		1	1	3			25	25	50	25		P
	On Job Training /Internship																		
10.	# On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively**	**Related to Major**	N2MCS8	**120 Hours cumulatively during vacationsof Semester I and Semester II**						4*									P*
11.	**Co-curricular Courses: Health and wellness, Yoga Education, Sports andFitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV**	Generic **Optional**	N2MCS9	**90 Hours Cumulatively From Sem I toSem IV**															
				Exit Option with a PG Diploma with 4 Credits On-the-job training/internship in the respective Major subject • **Student has to earn Total minimum 4 Credits cumulatively during Vacations of Semester I and Semester II from internship in order to exit after First Year with PG Diploma (42-44 Credits) after Three Year UG Degree**															
	TOTAL									**18+4***						550			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note : # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II.**

This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

**Students should opt MOOC Courses equivalent to given electives of 45 hours to 55 hours having minimum 3 credits . There will be no internal assessment for the MOOC theory courses whereas they should perform the practicals for the opted MOOC Courses in DSE Practicals. Evaluation of MOOC Practical's will be same as that of DSE.

NOTE: List of MOOCs for DSE subjects is given in Appendix-D

Sant Gadge Baba Amravati University, Amravati

FACULTY: Science & Technology

Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree (Master of Computer Science) following Three Years UG Programme wef 2023-24

(Two Years- Four Semesters Master's Degree Programme- NEPv23 with **Exit and Entry Option**

M.Sc. (Computer Science) Second Year Semester- III

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory+ MCQ External	Internal	External		Marks Internal	Marks External	Grade
1.	1. Artificial Intelligence and Machine Learning	DSC VII	N3MCS1	4	-	-	4	4	-	4	3	30	70			100	12	28	P
2.	2. Web Computing	DSC VIII	N3MCS2	4	-	-	4	4	-	4	3	30	70			100	12	28	P
3.	3. Design and Analysis of Algorithms	DSC IX	N3MCS3	4	-	-	4	4	-	4	3	30	70			100	12	28	P
4.	4. Distributed Computing/MOOC	DSE III (1)	N3MCS4(1)	3	-	-	3	3	-	3	3	30	70			100	12	28	P
5.	5. Network Security/ MOOC	DSE III (2)	N3MCS4(2)																
6.	6. Theory of Computation/MOOC	DSE III (3)	N3MCS4(3)																
	Laboratories																**Minimum Passing Marks**		
7.	Lab LISP/Prolog/Python based on 1	Lab-VII	N3MCS5		-	2	2	-	1	1	3			25	25	50	25		P
8.	Lab HTML/JS/CSS/.net/PHP based on 2	Lab-VIII	N3MCS6		-	2	2	-	1	1	3			25	25	50	25		P
9.	Lab Based on DSE III (1)/ DSE III (2)/ DSE III (3) /MOOC Lab**	Lab-IX	N3MCS7		-	2	2	-	1	1	3			25	25	50	25		P
	On Job Training /Internship																		
12.	**Research Project Phase-I**	Major			2	4	6	2	2	4				50	--	50	25		P
13.	Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV	Generic Optional		90 Hours Cumulatively From Sem I to Sem IV															
	TOTAL									22						600			

L: Lecture, T: Tutorial, P: Practical/Practicum
Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

**Students should opt MOOC Courses equivalent to given electives of 45 hours to 55 hours having minimum 3 credits . There will be no internal assessment for the MOOC theory courses whereas they should perform the practicals for the opted MOOC Courses in DSE Practicals. Evaluation of MOOC Practical's will be same as that of DSE.

NOTE: List of MOOCs for DSE subjects is given in Appendix-D

Sant Gadge Baba Amravati University, Amravati

FACULTY: Science & Technology

Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree (Master of Computer Science) following Three Years UG Programme wef 2023-24

(Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option

M.Sc. (Computer Science) Second Year Semester- IV   [Level 6.5]

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme — Teaching Period Per Week				Credits			Duration Of Exam Hours	Theory		Practical		Total Marks	Minimum Passing		
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory+ MCQ External	Internal	External		Marks Internal	Marks External	Grade
1.	1. Cloud Computing	DSC X	N4MCS1	4	-	-	4	4	-	4	3	30	70	-	-	100	12	28	P
2.	2. Big Data	DSC XI	N4MCS2	4	-	-	4	4	-	4	3	30	70	-	-	100	12	28	P
3.	3. Block Chain Technology	DSC XII	N4MCS3	4	-	-	4	4	-	4	3	30	70	-	-	100	12	28	P
4.	4 Entrepreneurship Development /MOOC	DSE IV(1)	N4MCS4(1)	3	-	-	3	3	-	3	3	30	70	-	-	100	12	28	P
5.	5. Cyber Security/ MOOC	DSE IV(2)	N4MCS4(2)																
6.	6. Data Science and Analytics/ MOOC	DSE IV(3)	N4MCS4(3)																
	Laboratories																**Minimum Passing Marks**		
7.	Lab Cloud Computing and Big Data based on 1,2	Lab-X	N4MCS6	-	-	2	2	-	1	1	3	-	-	25	25	50	25		P
8.	Lab Block Chain based on 3	Lab-XI	N4MCS7	-	-	2	2	-	1	1	3	-	-	25	25	50	25		P
9.	Lab Based on DSE IV(1)/DSE IV(2)/ DSE IV(3) /MOOC Lab**	Lab-XII	N4MCS8	-	-	2	2	-	1	1	3	-	-	25	25	50	25		P
10.	**Research Project & Seminar -Phase-II**	**Major**			2	8	10	2	4	6	3			75	75	150	75		P
11.	**Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/PerformingArts During Semester I, II, III and IV**	Generic Optional		**90 Hours Cumulatively From Sem I to Sem IV**															
	TOTAL									24						700			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, OJT: On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM**: Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

**Students should opt MOOC Courses equivalent to given electives of 45 hours to 55 hours having minimum 3 credits. There will be no internal assessment for the MOOC theory courses whereas they should perform the practicals for the opted MOOC Courses in DSE Practicals. Evaluation of MOOC Practicals will be same as that of DSE.   NOTE: List of MOOCs for DSE subjects is given in Appendix-D

Table: Comprehensive Credits distribution amongst the type of Courses over Two Years (Four Semesters) PG Programme and Minimum Credits to be earned for PG Degree [Master inFaculty -------------Major   ]

Sr. No.	Type of Course		Total Credits Offered	Minimum Credits Required
1	**MAJOR**			
	i. DSC	56		56
	ii. DSE	16		16
		TOTAL	72	72
2	**Research Methodology and IPR (FSC/DSC:Major)**	04	04	04
2	On Job Training, Internship/ Apprenticeship;Field projects **Related to Major**	04	**04 for 120 Hours OJT/FP cum.**	**02 (Minimum 60 Hours OJT/FP is mandatory)**
3	**Research Project**	10	10	10
	OPTIONAL			
4	**Co-Curricular Courses (offline and/or online as applicable): Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts, CC** also include but not limited to Academic activitieslike paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.).		**Limited to Maximum 03 only** **(For 90 Hours of CC cumulatively)**	**00**
	TOTAL			
	TOTAL		93	88

Table A: Comprehensive Credit Distribution for CC

S. N.	Activities (offline/online as applicable)	Credits at Levels						Letter Grade
		College	University	State	Zone if exist	National	International if exist	
1	Health and wellness, Yoga* Competitions *If a Course (online/offline) on Yoga is completed for 60 Hours, 2credits will be awarded to the student (1 Credit = 30 Hours)	1	2	3	4	5	6	P (Pass)
2	Unnat Bharat Abhiyan [UBA]	1	2	3	4	5	6	P (Pass)
3	Sports and fitness activities (see separate **Table B**)	1	1 / 2	2 / 3	3 / 4	4 / 5	5 / 6	P (Pass)
4	Cultural activities, Fine/Applied/Visual/Performing Arts	1	2	3	4	5	6	P (Pass)
5	N.S.S. activities Camps	1	2	3	4	5	6	P (Pass)
6	Academic activities like Research Paper/Article/Poster presentations, Aavishkar, start-up, Hackathon, Quiz competitions, other curricular, co-curricular activities, students exchange programme etc. Research Paper/Article published	1 --	2 1	3 2	4 -	5 4	6 6	P (Pass) P (Pass)
7	Participation in Summer school/ Winter School / Short term course (not less than 30 hours 1 or 2 weeks duration)(not less than 60 hours 2 or 3 weeks duration) Scientific Surveys, Societal Surveys Field Visits, Study tours, Industrial Visits,	2 Credits 4 Credits 2 Credits 1 Credit						P (Pass) P (Pass) P (Pass) P (Pass)
8	NCC Activities	As given in **Table C**						

Table B: Credit Distribution for Sports and Fitness

Sr. No.	Particulars of Sports Status (Individual/ Team)	Credits	Letter Grade
1	College Level Participation	1	P (Pass)
2	University Level Participation	1	P (Pass)
3	University Level Rank 1, 2, 3	2	P (Pass)
4	State Level Participation	2	P (Pass)
5	State Level Rank 1, 2, 3	3	P (Pass)
6	Zonal Level Participation	3	P (Pass)
7	Zonal Level Rank 1, 2, 3	4	P (Pass)
8	National Level Participation	4	P (Pass)
9	National Level Rank 1, 2, 3	5	P (Pass)
10	International Level Participation	5	P (Pass)
11	International Level 1,2,3	6	P (Pass)

Table C: Credit Distribution for NCC activities

Sr. No.	Particulars of NCC Activities	Credits	LetterGrade
1	Participation in NCC activities	1	P (Pass)
2	'B' Certificate obtained	2	P (Pass)
3	'C' Certificate obtained	3	P (Pass)
4	State Level Participation	4	P (Pass)
5	National level Participation	5	P (Pass)
6	International Level Participation	6	P (Pass)

Appendix -D

N1MCS5 (1) DSE-I (1) Compiler Construction

a. Compiler Design

        By Prof. Santanu Chattopadhyay | IIT Kharagpur

        Duration: 12 weeks

        Credit Points : 3

        Start Date :   18 Jan 2021

        End Date :   09 Apr 2021

N1MCS5 (2) DSE-I (2) Software Testing

a. Software testing (IIITB)

        By Prof. Meenakshi D'souza | IIIT Bangalore

        Duration :   12 weeks

        Credit Points :   3

        Start Date :   24 Jul 2023

        End Date :   13 Oct 2023

        Enrollment Ends :   31 Jul 2023

b. Software Testing (IITKGP)

        Duration :   4 weeks

        Credit Points :   1

        Level :   Undergraduate/Postgraduate

        Start Date :   24 Jul 2023

        End Date :   18 Aug 2023

        Enrollment Ends :   31 Jul 2023

DSE I(3)/ N1MCS5(3) Software Engineering

a. Software Engineering

    By Dr. B. LAVANYA, Assistant Professor | University of Madras

Duration :   12 weeks

Credit Points : 4

Start Date :   30 Jan 2020

End Date :   30 Apr 2020

b. Software Engineering

By Prof.Rajib Mall | IIT Kharagpur

Duration :   12 weeks

Credit Points : 3

Start Date :   29 Jul 2019

End Date :   18 Oct 2019

DSE II (1)/ N2MCS4(1): Internet of Things

a. Introduction To Internet Of Things

By Prof. Sudip Misra | IIT Kharagpur

Duration : 12 weeks

Credit Points : 3

Start Date : 24 Jul 2023

End Date : 13 Oct 2023

Enrollment Ends : 31 Jul 2023

b. Introduction To Industry 4.0 And Industrial Internet Of Things

By Prof. Sudip Misra | IIT Kharagpur

Duration : 12 weeks

Credit Points : 3

Start Date : 24 Jul 2023

End Date : 13 Oct 2023

Enrollment Ends : 31 Jul 2023

DSE II(2)/N2MCS4(2) : Mobile Computing

a. Android Mobile Application Development

> By Dr. Himanshu N. Patel | Dr. Babasaheb Ambedkar Open University (BAOU), Ahmedabad
>
> Duration :   12 weeks
>
> Credit Points :   4
>
> Start Date :   31 Jul 2023

DSE II(3)/ N2MCS4(3) : Data Mining and Data Warehousing

a. Data Mining

> By Prof. Pabitra Mitra | IIT Kharagpur
>
> Duration :   8 weeks
>
> Credit Points : 2
>
> Start Date :   15 Feb 2021
>
> End Date :   09 Apr 2021

b. Data Mining

> By Mr. L. Abraham David | St.John's College, Palayamkottai Tirunelveli
>
> Duration :   12 weeks
>
> Credit Points : 4
>
> Start Date :   06 Aug 2019
>
> End Date :   10 Oct 2019

DSE III(1) N3MCS4(1): Distributed computing

a. Distributed Systems

> By Prof. Rajiv Misra | IIT Patna
>
> Duration : 8 weeks
>
> Credit Points : 2
>
> Start Date : 26 Jul 2021
>
> End Date : 17 Sep 2021

b. Cloud Computing and Distributed Systems

    By Prof. Rajiv Misra | IIT Patna

    Duration : 12 weeks

    Credit Points : 3

    Start Date : 23 Jan 2023

    End Date : 17 Mar 2023

DSE III(2)/N3MCS4(2)- Network Security

a. Cryptography And Network Security

    By Prof. Sourav Mukhopadhyay | IIT Kharagpur

    Duration : 12 weeks

    Credit Points : 3

    Start Date : 25 Jul 2022

    End Date : 14 Oct 2022

DSE III(3)/N3MCS4(3) - Theory of Computation

a. Theory of Computation

    By Prof. Raghunath Tewari | IIT Kanpur

    Duration : 8 weeks

    Credit Points : 2

    Start Date : 26 Jul 2021

    End Date : 17 Sep 2021

b. Theory of Computation

    By Prof. Ragunath Tewari | IIT Kanpur

    Duration : 8 weeks

    Credit Points : 2

    Start Date : 29 Jul 2019

    End Date : 20 Sep 2019

DSE IV(1)/N4MCS4(1)- Entrepreneurship Development

a. Entrepreneurship development

By Dr. Nilam Panchal | B.K.School Of Professional And Management Studies, Gujarat University

Duration :   12 weeks

Credit Points :   4

Start Date :   31 Jul 2023

End Date :   22 Oct 2023

Enrollment Ends :   31 Aug 2023

b. Entrepreneurship

By Prof. C Bhaktavatsala Rao | IIT Madras

Duration :   12 weeks

Credit Points :   3

Start Date :   24 Jul 2023

End Date :   13 Oct 2023

Enrollment Ends :   31 Jul 2023

Exam Registration Ends :   18 Aug 2023

Exam Date :   29 Oct 2023 IST

c. Entrepreneurship And IP Strategy

By Prof. Gouri Gargate | IIT Kharagpur

Duration :   8 weeks

Credit Points :   2

Start Date :   24 Jul 2023

End Date :   15 Sep 2023

Enrollment Ends :   31 Jul 2023

Exam Registration Ends :   18 Aug 2023

Exam Date :   24 Sep 2023 IST

d. Innovation, Business Models And Entrepreneurship

By Prof. Rajat Agrawal, Prof. Vinay Sharma | IIT Roorkee

Duration :   8 weeks

Credit Points :   2

Start Date :   21 Aug 2023

End Date :   13 Oct 2023

Enrollment Ends :   21 Aug 2023

Exam Registration Ends :   15 Sep 2023

Exam Date :   29 Oct 2023 IST

e. Understanding Incubation And Entrepreneurship

By Prof. B.K. Chakravarthy | IIT Bombay

Duration :   12 weeks

Credit Points :   3

Start Date :   24 Jul 2023

End Date :   13 Oct 2023

Enrollment Ends :   31 Jul 2023

Exam Registration Ends :   18 Aug 2023

Exam Date :   28 Oct 2023 IST

DSE IV(2)/N4MCS4(2) - Cyber Security

1. Cyber Security

By Dr.G.PADMAVATHI | Avinashilingam Institute for Home Science & Higher Education for Women,Coimbatore

Duration :   15 weeks

Credit Points :   4

Start Date :   31 Jul 2023

End Date :   31 Oct 2023

Enrollment Ends :   31 Aug 2023

a. Cyber Security Tools Techniques and Counter Measures

By Prof. Dr. Nilesh K Modi | Dr. Babasaheb Ambedkar Open University, Ahmedabad, Gujrat

Duration :   12 weeks

Credit Points :   4

Level :   Certificate

b. Cyber Security and Privacy

     By Prof. Saji K Mathew | IIT Madras

     Duration :   12 weeks

     Credit Points :   3

     Start Date :   24 Jul 2023

     End Date :   13 Oct 2023

     Enrollment Ends :   31 Jul 2023

     Exam Registration Ends :   18 Aug 2023

     Exam Date :   28 Oct 2023 IST

c. Introduction to Cyber Security

     By Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani

     Duration :   12 weeks

     Credit Points :   4

     Level :   Undergraduate

     Start Date :   31 Jul 2023

d. Security Analysis & Portfolio Management

     By Prof. J. P. Singh | IIT Roorkee

     Duration :   12 weeks

     Credit Points :   3

     Start Date :   24 Jul 2023

     End Date :   13 Oct 2023

     Enrollment Ends :   31 Jul 2023

     Exam Registration Ends :   18 Aug 2023

     Exam Date :   28 Oct 2023 IST

e. Privacy And Security In Online Social Media

     By Prof. Ponnurangam Kumaraguru | IIIT Hyderabad

     Duration :   12 weeks

     Credit Points :   3

     Start Date :   24 Jul 2023

     End Date :   13 Oct 2023

     Enrollment Ends :   31 Jul 2023

Exam Registration Ends :   18 Aug 2023

Exam Date :   28 Oct 2023 IST

DSE IV (3)/N4MCS4(3) Data Science and Analytics

a. Foundation of Data Science

By Dinesh Kumar | Indian Institute of Management Bangalore (IIMB)

Duration :   8 weeks

Credit Points :   2

Start Date :   31 Jul 2023

End Date :   31 Oct 2023

Enrollment Ends :   31 Aug 2023

b. Data Science For Engineers

By Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan | IIT Madras

Duration :   8 weeks

Credit Points :   2

Start Date :   24 Jul 2023

End Date :   15 Sep 2023

Enrollment Ends :   31 Jul 2023

Exam Registration Ends :   18 Aug 2023

Syllabus PG Programme: M.Sc. (Computer Science)
First Year Semester: I

FSC-RM/N1MCS1   Research Methodology & IPR

Course Outcomes:
On completion of this course, students would be able to:
1. Study the basic concepts of research and related methodologies.
2. Identify appropriate research problem and good research designing.
3. To develop and implement the techniques of data collection, analysis of data and interpretation.
4. Describe foundational knowledge, learn, adapt and successfully apply analytical and computational approaches on changing societal and technological challenges
5. Learning research tools.
6. To study the IPR, Patent, Copyright, Design patent, and Trademark.

Unit	Contents	Periods
I	**Introduction:** Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research. **Defining the Research Problem:** What is a Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.	10
II	**Reviewing the literature:** Place of the literature review in research, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Knowledge of IKS, Writing about the literature reviewed. **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.	10
III	**Methods of Data Collection/ Required Data Sets**: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Research: methods to search required information effectively Reference Management Software like Zotero/ Mendeley.	10
IV	**Processing and Analysis of Data**: Processing Operations, Some Problems in Processing, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes, Other Measures	10
V	**Interpretation of Data and Paper Writing**: Publishing research papers:- Structure of a research paper, Layout of a Research Paper, Journals in Computer Science, awareness on paper publication, formats-IEEE Tran, Impact factor, h, hb, g indices, research repositories- WoS& Scopus; DOI, Plagiarism and Plagiarism checking and detection tools.	10
VI	**Tools used for Research and IPR: Trends** in research of computer science, Dataset available, Introduction to Research tools (e.g. Data Mining tool, Network Simulators, Cloud Simulators, Data analytics Tool etc.), **Intellectual property rights**: New Developments in IPR, Administration of Patent System; IPR of Computer Software, Computer hardware etc., **Patents:** Scope of Patent Rights. Licensing and transfer of technology, Copyright.	10
Text books:		
1. Handbook of Research Methodology- Dr. Shanti Bhushan Mishra, Dr.Shashi Alok		

Edu creation Publishing. 2. A Beginners Guide to Latex Paperback – Illustrated, by Chetan Shirore,	
Reference Books: 1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition 2. Business Research Methods – Alan Bryman& Emma Bell, Oxford University Press. 3. 3. Research Methodology – C.R. Kothari	
Web links: 1. https://onlinecourses.swayam2.ac.in/aic21_ge02/preview 2. https://onlinecourses.nptel.ac.in/noc23_ge36/preview 3. https://onlinecourses.swayam2.ac.in/nou23_cm06/preview 4. https://onlinecourses.swayam2.ac.in/cec23_ge07/preview 5. https://onlinecourses.nptel.ac.in/noc23_hs128/preview 6. https://onlinecourses.swayam2.ac.in/nou22_hs85/preview 7. https://onlinecourses.swayam2.ac.in/nou23_hs38/preview	

N1MCS2/DSC1 Computer System Organization

Course Outcomes:

After completion of this course student will be able to:

Learn the concepts of computer organization for several engineering applications.
1. Develop the ability and confidence to use the fundamentals of computer organization as a tool in the engineering of digital systems.
2. Work and identify the different hardware of CPU and performs operation on them.
3. To identify, formulates, and solves hardware and software computer engineering problems using sound computer engineering principle.
4. To impart the knowledge on micro programming
5. To comprehend the concepts of advanced pipelining techniques.

Unit	Contents	Periods
I	Basic Functional units of Computers: Functional units, basic Operational concepts, Bus structures. Software, Performance, Multiprocessors, Multicomputer. Data Representation: Signed number representation, fixed and floating point Representations. Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms. Error detection and correction codes.	10
II	Register Transfer Language and Micro Operations: RTL- Registers, Register transfers, Bus and memory transfers. Micro operations: Arithmetic, Logic, and Shift micro operations, Arithmetic logic shift unit. Basic Computer Organization and Design: Computer Registers, Computer instructions, Instruction cycle. Instruction codes, Timing and Control, Types of Instructions: Memory Reference Instructions, Input – Output and Interrupt.	10
III	Central Processing Unit organization: General Register Organization, Stack organization, Instruction formats, Addressing modes, Data Transfer and Manipulation, Program Control, CISC and RISC processors Control unit design: Design approaches, Control memory, Address sequencing, micro program example, design of CU. Micro Programmed Control.	10
IV	Memory Organization: Semiconductor Memory Technologies, Memory hierarchy, Interleaving, Main Memory-RAM and ROM chips, Address map, Associative memory-Hardware organization. Match logic. Cache memory-size vs. block size, Mapping functions-Associate, Direct, Set Associative mapping. Replacement algorithms, write policies. Auxiliary memory Magnetic tapes etc.	10
V	Input –Output Organization: Peripheral devices, Input-output subsystems, I/O device interface, I/O Processor, I/O transfers–Program controlled, Interrupt driven, and DMA, interrupts and exceptions. I/O device interfaces – SCII, USB Pipelining and Vector Processing: Basic concepts, Instruction level Parallelism Throughput and Speedup, Pipeline hazards.	10
VI	MULTI PROCESSORS: Characteristics or Multiprocessors, Interconnection Structures, Interprocessor Arbitration. Inter Processor Communication and Synchronization Cache Coherence. Shared Memory Multiprocessors	10
Text books:		
1. Computer Organization – Carl Hamacher, ZvonksVranesic, SafeaZaky, Vth Edition,		

	McGraw Hill.	
2.	Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI	

Reference Books:	
1.	1."Computer Architecture and Organization", 3rd Edition by John P. Hayes,WCB/McGraw-Hill
2.	"Computer Organization and Architecture: Designing for Performance", 10th Edition by i. William Stallings, Pearson Education.
3.	"Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry ii. F. Jordan, Pearson Education.
4.	Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI
5.	Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI/Pearson
6.	Fundamentals or Computer Organization and Design, - SivaraamaDandamudi Springer Int. Edition.
7.	Computer Architecture a quantitative approach, John L. Hennessy and David A. Patterson, Fourth Edition Elsevier

Web Resources: Weblinks
1. www.youtube.com/results?search_query=computer+system+organization+weblinks+nptel +
2. https://youtu.be/leWKvuZVUE8
3. https://youtu.be/Ol8D69VKX2k
4. https://youtu.be/VG9VopzV_T0
5. https://nptel.ac.in/courses/106105163
6. https://archive.nptel.ac.in/courses/106/105/106105163/
7. https://onlinecourses.nptel.ac.in/noc21_cs61/preview
8. https://nptel.ac.in/courses/106106166

N1MCS3/DSC II Data Structure with OOP

Course Outcomes:

After completion of this course student will be able to:

1. Learn the concepts of linear data structures such as arrays, linked lists, stacks and queues.
2. Understand and use the concepts of non-linear data structures such as trees & Graph.
3. Learn and understand various data searching and sorting methods with its complexity.
4. Demonstrate operations such as insertion, deletion, searching and traversing on data structures.
5. Analyse and apply specific sorting and searching methods depending upon factors like type of data, volume of data.
6. Learn & Understand B-tree indexing, hashing, collisions processing and its applications.

Unit	Contents	Periods
I	Arrays, Matrices and Linked List, Arrays, Arrays the Abstract Data Type, Array Representation, Matrices, Special Matrices, The Linear List- Array Representation, Data Objects and Structures, The Linear List Data structure, Array Representation, Vector Representation, Multiple List in a Single Array, Linear Lists- Linked Representation, Singly Linked Lists and Chain, Circular Lists and Header Nodes, Doubly Linked Lists, Sparse Matrices and its Representation, Searching in Array & Linked List.	10
II	Stacks and Queues, Stack: Definition and Application, Array Representation, Linked Representation, Applications, Queues: Definition and Application, Array Representation, Linked Representation, Applications, Priority Queue, Definition and Application.	10
II	Trees: Terminology and Concepts, Binary and Other Trees, Trees, Binary Trees, Properties of Binary Trees, Representation of Binary Trees, Common Binary Trees Operations, Binary Trees Traversal, The ADT Binary Trees, The Class linked Binary Trees, Application, Binary Search Trees, Definition, Abstract Data Types, Binary Search Trees Operations and Implementation, Balanced Search Trees, AVL Trees.	10
IV	Sorting: Internal Sorting, Optimal Sorting Time, Sorting Objects, Insertion Sort, Selection Sort, Merge Sort, Quick Sort, Heap Sort, Radix Sort, External Sorting: Run Generation, Sorting with Tapes, Sorting with Disks.	10
V	Graphs: Definition, Representation of Graphs, Graph Implementation, Graph Traversals, Application of Graph Traversals, Minimum Cost Spanning Trees, Shortest Path Problems, All Pair Shortest Paths.	10

VI	Indexing: Indexed Binary Search Trees, B-Trees: Indexed Sequential Access Method (ISAM), m-Way Search Trees, B-Trees of Order m, Height of a B-Tree, Searching a B-Tree, Inserting into a B-Tree, Deletion from a B-Tree, Node Structure, Hashing: Hash Function, Collision Resolution, Rehashing, Extensible Hashing.	10	

Text books:
1. "Data structure algorithms and Applications in C++" : SartajSahani (Second Edition Universities Press)
2. "Object Oriented Data Structures Using C++: K. S. Easwarakumar (Vikas Publishing House Pvt Ltd)

Reference Books:
1. "Introduction to Data Structures" - Bhagat Singh & T.L. Naps.
2. "Data structures using C"-Tanenbaum, Langsam, Augenstein PHI
3. "Classic Data Structures", - D. Samanta PHI
4. "Data structure and Program design in C" - Kruse, Leung, Tondo (PHI)
5. "Data structure" - Tenanbaum
6. "Data structure and algorithm analysis in C++ ": Mark Allan Welss, Addison wesley
7. https://nptel.ac.in/courses/106102064

Weblinks:
1. https://youtu.be/8hly31xKli0
2. https://youtu.be/hCrO_cR7kno
3. https://youtu.be/6wXZ_m3SbEs
4. https://youtu.be/odW9FU8jPRQ

N1MCS4/DSC III Data Base Management Technologies

Course Outcomes (COs):

On completion of this course, students would be able to:
1. Understand and apply the basic concepts and principles of database systems, including their purpose, structure, design, query languages, and relational operations.
2. Demonstrate understanding of data manipulation, retrieval, database management concepts and apply SQL query language effectively.
3. Design efficient and normalized databases using the Entity-Relationship model and will be able to achieve good relational designs and improve database by normalization techniques.
4. Apply knowledge of physical storage systems, data storage structures, and indexing techniques for efficient and effective management of databases.
5. Comprehend and apply the fundamental concepts and techniques related to transactions (ACID property), concurrency control & Protocols, recovery mechanisms, deadlock handling, and recovery algorithms.
6. Understand recent trends in database technology and analyze different database architectures, cloud- based services, No SQL databases, and big data storage systems based on Map Reduce and Hadoop.

Unit	Contents	Periods
I	**Introduction to DBMS and Relational Model:** Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Design ,Database Engine, Database and Application Architecture, Database Users and Administrators ,Structure of Relational Databases ,Database Schema, Keys ,Schema Diagrams, Relational Query Languages, Relational Operations, The Relational Algebra.	10
II	**Introduction to SQL:** Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-queries, Modification of the Database, Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization, Functions and Procedures, Triggers.	10
III	**Database Design Using the E-R Model:** The Entity-Relationship Model, Attributes & its types, Mapping Cardinalities, Participation Constraints, Keys, Removing Redundant Attributes in Entity Sets, E-R Diagrams, Reducing E-R	10

	Diagrams to Relational Schemas, Entity-Relationship Design Issues. **Relational Database Design:** Features of Good Relational Designs, Decomposition Using Functional Dependencies, Normal Forms:(1NF, 2NF, 3NF, BCNF, 4NF, 5NF), Functional-Dependency Theory, Decomposition Using Multivalued Dependencies.	
IV	**Physical storage Systems:** Types of Physical Storage Media, Storage Interfaces, Magnetic Disks, Flash Memory, RAID, Disk-Block Access. **Data Storage Structures:** File Organization, Organization of Records in Files, Data - Dictionary Storage, Database Buffer. **Indexing:** Basic Concepts, Ordered Indices, B$^+$-Tree Index Files, Hash Indices, Bitmap Indices, Hash Function, Handling Bucket overflow, Static and Dynamic Hashing.	10
V	**Transactions:** Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serialize ability, Transaction I solation and Atomicity. **Concurrency Control:** Lock- Based Protocols, Deadlock Handling, Time stamp Based Protocols, Validation Based Protocols, and Snapshot Isolation. **Recovery System:** Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, ARIES.	10
VI	**Database-System Architectures:** Overview, Centralized Database Systems, Server System Architectures, Parallel Systems, Distributed Systems, Transaction Processing in Parallel and Distributed Systems, Cloud-Based Services. **Emerging Database Technologies:** NoSQL Databases and Big Data Storage Systems, Big Data Technologies Based on Map Reduce and Hadoop.	10

Textbooks :
1. Database System Concepts,6th edition by Abraham Silberschatz, Henry F.Korth, S. Sudarshan McGraw-Hill.(referforunit1to6).
2. Fundamentals ofDatabaseSystems,7theditionbyElmasriR.,NavatheS.,PearsonEducation, (referforunit6)

Reference Books
1. S.K.Singh, "Database Systems: Concepts, Design and Application".
2. C.J.Date,"AnIntroductiontoDatabaseSystems",Addison-Wesley,8thEdition
3. Rab P., Coronel C. "Database Systems Design, Implementation andManagement",5th edition,ThomsonCourseTechnology,2002
4. Ramkrishna R.,Gehrke J. "Database Management Systems",3rdedition,McGrawHill
5. Ivan Bayross,"SQL,PL/SQL the Programming Language of Oracle", BPB Publications. Kevin Roebuck, "Storing and Managing Big Data-NoSQL, HADOOP and More".

Web Link :
1. https://onlinecourses.nptel.ac.in/noc23_cs79/previewhttps://nptel.ac.in/courses/106105175
2. https://youtube.com/playlist?list=PLrjkTql3jnm-CLxHftqLgkrZbM8fUt0vn
3. https://youtube.com/playlist?list=PLWPirh4EWFpGrpcMfZ6UcdI786QdtSxV8
4. https://youtube.com/playlist?list=PLdo5W4Nhv31b33kF46f9aFjoJPOkdlsRc
5. https://livesql.oracle.com/apex/f?p=590:1000
6. https://freevideolectures.com/course/2668/database-management-system
7. https://www.geeksforgeeks.org/mongodb-an-introduction/
8. https://www.mongodb.com/docs/manual/

N1MCS5 (1) DSE-I (1) Compiler Construction

Course Outcomes:

On completion of this course, students would be able to:
1. Explore the principles, algorithms, and data structures involved in the design and construction of compilers.
2. Write the machine dependent code and learn the all table involved in compiler design phases.
3. Learn the Static and dynamic memory allocation and their tables.
4. Design the flow graph for the intermediate codes.
5. Implements the knowledge to find lexical and syntax error and compile I/O statements.
6. Design a compiler for a simple programming language

Unit	Contents	Periods
I	Introduction to Compilers: Overview, typical compiler Structure, implementation. Programming Language Grammars: Elements of formal language grammars, derivation, reduction, syntax tree, ambiguity, regular grammars and expressions. Bootstrapping, Back patching.	7
II	Scanning and Parsing Techniques: The scanner, top-down and bottom-up parsing, Shift-reduce parsing, Operator –precedence parsing, syntax directed translation, Contents of symbol table, Symbol table organization, Hash table organization, Linked List and Tree structured symbol tables, symbol table organization for structures and records.	7
III	Memory Allocation: Static and dynamic memory allocation, array allocation and access, allocation for strings, structure allocation, common and equivalence allocation.	8
IV	Compilation of expressions: Intermediate code forms, Code generation for expressions. DFA, NFA, Turing Machine, S-attribute, L-attribute, Dependency graph. Compilation of control structures: Control transfers, procedural calls, conditional execution, iteration control constructs.	8
V	Error detection, indication and recovery: Lexical and Syntax errors, semantic errors, Run time errors, Debugging Aids and options. Compilation of I/O statements: Compilation of I/O list, compilation of FORMAT list, the I/O routine, file control.	8
VI	Code optimization: Major issues, optimizing transformations, local optimizations, and program flow analysis, Global optimization, folding (constant folding). Code Generation: Problems in code generation, machine model, and simple code generator. Writing compilers, YACC (Construction tool for UNIX compiler).	7

Text books:
1. Compiler construction – D.M. Dhamdhere, Macmillan India Ltd.

Reference Books:
1. Principles of Compiler Design – Alfred V. Aho, Jeffrey D. Ullman
2. The Theory and Practice of Complier Writing – J.P. Trembly, P.G. Sorenson McGraw Hill Publication.
3. Engineering a compiler – K.D. Cooper and Linda Torczon, Elsevier Direct Publication

Video Links
1. https://youtu.be/XUsw5igq4DM
2. https://youtu.be/5ZmFlxrNaN8
3. https://youtu.be/KBulg_u-b3w
   Swayam Web-Links
4. https://onlinecourses.nptel.ac.in/noc20_cs13/preview

MOOCS:
1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview (3 credits)
2. https://nptel.ac.in/courses/106108113 (3 credits)

N1MCS5 (2) DSE-I (2) Software Testing

Course Outcomes:

On completion of this course, students would be able to:
1. Design test cases suitable for a software development for different domains.
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.
3. Prepare test planning based on the document.
4. Document test plans and test cases designed.
5. Design test cases that adequately cover different aspects of software functionality, including boundary cases, error handling, and performance scenarios.
6. Apply automated testing tools and frameworks to streamline the testing process and improve efficiency.

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.	7
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.	7
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	8
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.	8
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.	8
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.	7
Text books: 1. Introducing Software Testing: Louise Tamres (PE) 2. Software Testing in the Real World by Kit – Pearson 3. Effective methods for software testing – William E. Perry 4. Srinivasan Desikan and Gopala swamy Ramesh, ―Software Testing – Principles and Practices‖, Pearson Education, 2006. 5. Ron Patton, ―Software Testing‖, Second Edition, Sams Publishing, Pearson Education, 2007. AU Library.com		
Reference Books: 1. Ilene Burnstein, ―Practical Software Testing‖, Springer International Edition, 2003. 2. Edward Kit,‖ Software Testing in the Real World – Improving the Process‖, Pearson Education, 1995. 3. Boris Beizer,‖ Software Testing Techniques‖ – 2nd Edition, Van Nostrand Reinhold, New York, 1990. 4. Aditya P. Mathur, ―Foundations of Software Testing _ Fundamental Algorithms and Techniques‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008		
Video Lecture 1. https://youtu.be/zEgVjx85lWs 2. https://youtu.be/zEgVjx85lWs?t=89 3. https://youtu.be/OGImfxO2TEU		

MOOCS 1. https://onlinecourses.nptel.ac.in/noc20_cs77/preview (3 credits) 2. https://onlinecourses.nptel.ac.in/noc23_cs81/preview (1 credits) **3.** https://swayam.gov.in/explorer?searchText=software+testing (4 credits) 4. **https://onlinecourses.nptel.ac.in/noc23_cs91/preview** (3 credits)	

DSE I(3)/ N1MCS5(3) Software Engineering

Course Outcomes:

1. Recognize evolving role of software project management.
2. Understand and estimate cost for software project
3. Identify & analyse aspects of managing time, process & resources effectively with quality concept.
4. Estimate software productivity using metrics and indicator & identify important issues for planning a project
5. Judge different testing techniques used to test software.
6. Apply various `testing strategies for software testing and validation.

Units	Contents	Periods
I	Evolving role of Software. Software crises & myths. Software engineering. Software process & process models: Linear sequential, prototyping, RAD, Evolutionary Product & Process. Project management concepts: People, Product, Process, Project. W5HH principle, critical practice.	7
II	Measures, Metrics & Indicators . Metrics in process & project domains-software measurement, Metrics for software quality, small organization. Software projects Planning : Scope, resources, estimation, decomposition technique, Tools. Software risks: identification, risk projection, refinement &RMMM plan.	7
III	Project Scheduling :Concepts. Peoples Efforts. Task set, Task network. Scheduling. EV analysis, Project Plan. Software quality concepts. SQ Assurance, Software reviews, technical reviews, software reliability, ISO 900L,SQA Plan. SCM process. Version control. SCM standard.	8
IV	System Engineering: Hierarchy, Business Process & Product Engineering: Overviews. Requirement engineering, System modelling. Requirement analysis. Analysis principles. Software prototyping. Specification. Design Process. Design Principles & Concepts. Effective modular design. Design model & documentation.	8
V	Software architecture :Data Design, Architectural styles, Requirement mapping. Transform & Transaction mappings. User- interface design : Golden Rule. UTD, Task analysis & modeling, ID activities, Tools, design evaluation. Component level design: Structure programming, Comparison Of design notation	8
VI	Software Testing Fundamentals; test case design, White box testing. Basis path, control structure-, Black box-Testing, & for specialized environments. Strategic approach to S/W testing. Unit testing, integration testing, validation testing, system testing. Debugging. Technical metrics for software.	7
	Text Books : 1. Pressman Roger. S.: Software Engineering, A Practitioner's Approach TMH. **Reference Books :** 2. Somer ville: Software Engineering (Addison-Wesley)(5/e) 3. Fairly R.: Software Engineering(McGrawHill) 4. Davis A.: Principles of Software Development (McGrawHill)	

5. Shooman, M.L.: Software Engineering(McGraw-Hill)		
Weblinks: 1. https://www.youtube.com/watch?v=Z6f9ckEElsU 2. https://www.youtube.com/watch?v=ykZ-_UGcYWg		
MOOCS: 1. https://onlinecourses.swayam2.ac.in/cec20_cs07/preview (4credits) 2. https://onlinecourses.nptel.ac.in/noc19_cs69/preview (3 credits)		

Lab I: Based on CSO & DS with OOP –Lab Programming(C/C++/Java/ALP)

N1MCS6 - CSO & DS with OOP Lab

Course Outcomes (COs): Computer System Organization

1. Implementation of Computer organisation Programs using Simulators
2. Testing the working of Digital Electronics components and operations.
3. Ability to understand Input –Output Organization
4. To impart the knowledge on micro programming.
5. Implementation of Logic Gates.
6. Able to design electronic circuits.

List of Practical's: Computer System Organization

1. Implement a C/ C++ program to convert a Hexadecimal, octal, and binary number to decimal number vice versa.
2. Implement a C/ C++ program to perform Binary Addition & Subtraction.
3. Implement a C/ C++ program to perform Multiplication of two binary numbers
4. Implement a C/ C++ program to perform Multiplication of two binary numbers
5. (signed) using Booth's Algorithms.
6. Implement a C/ C++ program to perform division of two binary numbers (Unsigned) Using restoring division algorithm.
7. Implement a C/ C++ program to perform division of two binary numbers (Unsigned) Using non-restoring division algorithm.
8. Implement Logic gates using NAND gates
9. Implement Logic gates using NOR gates
10. Design a Full adder using gates
11. Design and implement the 4:1 MUX using gates /ICs.
12. Design and implement the 8:1 MUX using gates /ICs
13. Design and Implement a 3 to 8 decoder using gates
14. Design a 4-bit comparator using gates/IC
15. Design and Implement a 4-bit shift register using Flip flops
16. Design and Implement a Decade counter
17. Write 8085 Program 8-bit addition
18. Write 8085 Program 8-bit Subtraction
19. Write 8085 Program 8bit multiplication.
20. Write 8085 Program 8 bit division

Course Outcomes (COs): Data Structure with OOP

1. Apply the basic concepts of C++/ Java programming in developing the code for various applications.
2. Individually Apply C++/Java programming concepts to design various data structures.
3. Identify and apply a suitable data structure for a given application.
4. Implement various searching techniques
5. Implement various sorting techniques
6. Implement various graph technique.

List of Practical's: Data Structure with OOP

1. Write a program to find an item using sequential search in array.
2. Write a program to find an item using binary search in array.
3. Write a program to find factorial of number using recursion.
4. Write a program to find factorial of number using iteration.
5. Write a program to insert new element in the middle of the one dimensional array.
6. Write a program to delete the element from the middle of the one dimensional array.
7. Write a program to create a linked list having n nodes.

8. Write a program to insert new node at the beginning of the linked list.
9. Write a program to create a linked list in sorted order.
10. Write a program to insert new node in the middle of the linked list.
11. Write a program to delete a node from beginning of the linked list.
12. Write a program to delete a node at the middle of the linked list.
13. Write a program to delete a node at the end of the linked list.
14. Write a program to create a singly circular linked list.
15. Write a program to create a doubly linked list.
16. Write a program to create a doubly sorted linked list.
17. Write a program to insert a new node in a doubly linked list.
18. Write a program to delete any node from the doubly linked list.
19. Write a program to find an item in a Linked List.
20. Write a program for array implementation of a Stack.
21. Write a program for linked list implementation of a Stack.
22. Write a program for circular implementation of a Queue.
23. Write a program for linked list implementation of a Queue.
24. Write a program to create a binary tree using linked representation.
25. Write a program to create a binary search tree using linked representation.
26. Write a program for Preorder traversal of binary tree using recursion.
27. Write a program for Inorder traversal of binary tree using recursion.
28. Write a program for Postorder traversal of binary tree using recursion.
29. Write a program to insert a new node in a binary search tree.
30. Write a program to delete any node from the binary search tree.
31. Write a program to create a threaded binary tree using linked representation.
32. Write a program to create a AVL tree using linked representation.
33. Write a program to store a Sparse Matrix using linked representation.
34. Write a program for Depth First Search Graph Traversal.
35. Write a program for Breadth First Search Graph Traversal.
36. Write a program for the Radix sorts of Array.
37. Write a program for the Insertion sorts of Array.
38. Write a program for the Selection sorts of Array.
39. Write a program for the Shell sorts of Array.
40. Write a program for the Quick sorts of Array.
41. Write a program for the Heap sorts of Array.
42. Write a program for the Merge sorts of Array.
43. Write a program for Hashing Function.

Lab II: Based on Database Management Technologies -
Lab SQL/DBMS tools, MS Sql, My Sql

N1MCS7- DBMT Lab

Course Outcomes (COs): DBMT

On completion of this course, students would be able to:
1. Install and configure database systems proficiently.
2. Analyze and assess database models and entity relationship models.
3. Design and implement a database schema for a specific problem domain.
4. Acquire thorough understanding of relational database systems.
5. Execute effective data population and querying using SQLDDL, DML, and DCL commands.
6. Develop a back end database for an organization based on case study.

List of Laboratory Practical's: DBMT

Write PL/Sql Block/Sql queries/Sql triggers/Sql functions/ Sql procedures for:
1. Installing and configuring a database management system.
2. Creating and manipulating database tables using SQLDDL commands.
3. Inserting and retrieving data from database able using SQLDML commands.

4. Implementing primary key and foreign key constraints in database tables.
5. Performing basic CRUD operations (Create, Read, Update, Delete) on database records.
6. Writing SQL queries to filter and sort data from single table.
7. Joining multiple tables using various types of joins (inner join, outer join, etc.).
8. Implement in aggregation functions(e.g., SUM,COUNT, AVG) on data base records.
9. Creating views to provide a customized view of the database.
10. Implementing transactions to ensure data integrity and consistency.((use BEGINTRANSACTION/STARTTRANSACTION,COMMIT,ROLLBACK along with other sql queries)
11. Applyingdatabasenormalizationtechniquestoeliminateredundancyandimprovedataintegrity.
12. Designing and implementing a database schema for a specific problem domain.
13. Creating and managing index estooptimize database per for mance.
14. Implementing database security measures(e.g., user authentication, access control).
15. Writing stored procedures and triggers to automate database operations.
16. Handling database exceptions and error conditions.
17. Backup and restore operations for database recovery.
18. Implementing concurrency control mechanisms to handle multiple simultaneous transactions.
19. Designing and implementing a database for an e-commerce application.
20. Implementing database replication for high availability and fault to clearance.
21. Performing data import and export operations between databases.
22. Implementing full-text search functionality in a database.
23. Designing and implementing a data warehouse for analytics and reporting.
24. Implementing datamining techniques to discover patterns and trends in large datasets.
25. Working with No SQL databases and performing CRUD operations.
26. Implementing distributed database systems and handling data partitioning.
27. Utilizing cloud-based database services for scalability and flexibility.
28. Working with in-memory databases for high-performance data processing.
29. Implementing graph databases for managing and querying graph-like data structures.
30. Exploring big data processing technologies and performing data analytics on large datasets.
31. Create a database with suitable example using Mongo DB and implement Inserting and saving document, Removing document, Updating document
32. Execute at least 10 queries on any suitable Mongo DB database that demonstrates following querying techniques: find and find One, Query criteria, Type-specific queries.
33. Draw ER Diagram for any information system application.

Sample Problem domain/ Information systems / Schemas for implementing above practical's:

1. **E-commerce: (**Product Name (varchar(100)), Product Description(text), Price(decimal(10, 2)), Category (varchar(50)),Manufacturer (varchar(50)), Quantity in Stock(integer), Image URL(varchar(255)),Date Added(date), Rating(decimal(3,2)))
2. **Hospital Management:** (PatientID (varchar(10)), Patient Name (varchar (100)), Date of Birth(date), Gender (varchar(10)),Address (varchar(255)), Contact Number (varchar(20)), Blood Group (varchar(5)),Medical History(text), Doctor Name (varchar(100)))
3. **Library Management:**(BookID (varchar(10)),Book Title (varchar(100)), Author (varchar(100)), Publication Year(integer), ISBN (varchar(20)), Category (varchar (50)),Available Copies(integer),Borrower ID (varchar(10)),Due Date(date))
4. **Human Resources:**(Employee ID(varchar(10)), Employee Name(varchar(100)) ,Date of Birth(date), Gender (varchar(10)), Address(varchar(255)), Contact Number (varchar(20)), Position (varchar(50)), Salary (decimal(10, 2)),Joining Date(date))
5. **Inventory Management:**(Product ID (varchar(10)), Product Name (varchar(100)), Description (text), Category (varchar(50)), Manufacturer (varchar(50)), Quantity in Stock (integer), Cost Price (decimal (10,2)), Selling Price (decimal(10,2)), Supplier ID(varchar(10)))

6. **Social Networking:** (User ID (varchar(10)), Username(varchar(50)), Email (varchar(100)), Password (varchar (50)), Date of Birth (date), Gender (varchar (10)), Profile Picture URL(varchar (255)), Bio (text), Friends Count(integer))

7. **Event Management:**(Event ID (varchar(10)), Event Name (varchar (100)), Date (date), Time (time), Location (varchar (255)), Organizer Name (varchar (100)), Description (text), Attendee Count (integer), Registration Deadline(date))

8. **Banking System:**(Account Number (varchar (20)), Account Holder Name (varchar (100)), Account Type (varchar (50)), Balance (decimal(10, 2)), Opening Date (date), Branch Code (varchar(10)), Address (varchar (255)), Contact Number (varchar (20)), Transaction History (text))

9. **Hotel Reservation:**(ReservationID(varchar(10)),GuestName(varchar(100)),Check-in Date (date), Check-outDate(date), Room Type(varchar(50)), Number of Guests(integer), Contact Number(varchar(20)), Total Amount (decimal(10,2)), Reservation Status (varchar(20)))

10. **Student Information System:** (Student ID(varchar(10)), Student Name (varchar(100)), Date of Birth (date), Gender (varchar(10)), Address (varchar (255)), Contact Number (varchar(20)), Course (varchar(50)), Year (integer), GPA (decimal(3,2)))

<div align="center">

Lab III:Lab Based on DSE I (1)/ DSE-I (2)/ DSE-I(3)
1MCS8
N1MCS8 -DSE-I(1): Compiler Construction Lab

</div>

Course Outcomes (COs):

1. Acquire knowledge of different phases and passes of the compiler and also able to use the compiler tools like LEX, YACC, etc.
2. Understand the parser and its types i.e. Top-Down and Bottom-up parsers and construction of LL, SLR, CLR, and LALR parsing table.
3. Implement the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.
4. Acquire knowledge about run time data structure like symbol table organization and different techniques used in that.
5. Understand the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.

Practical List: Compiler Construction

Perform the following with the help of C/C++/Python.
1. Understand the different phases of the compilation process, including lexical analysis, parsing, semantic analysis, code generation, and optimization.
2. Implement a lexical analyzer (lexer) to tokenize input programs based on specified language rules.
3. Design and implement a parser for a given grammar using top-down or bottom-up parsing techniques.
4. Develop symbol table management techniques to store and retrieve information about program symbols.
5. Explore different methods of handling lexical, syntax, and semantic errors in the compilation process.
6. Apply optimization techniques to improve the generated intermediate code, such as constant folding or dead code elimination.
7. Develop semantic analysis routines to perform type checking, scope resolution, and other semantic checks.
8. Experiment with different code generation strategies for translating high-level language constructs into target machine code.
9. Understand the role of optimization in improving the performance and efficiency of compiled programs.

10. Analyse the impact of various compiler optimizations on the generated code and measure their effectiveness.
11. Investigate error recovery techniques to handle syntax errors gracefully and provide helpful error messages.
12. Design and implement a complete compiler for a subset of a programming language, incorporating multiple stages and components.

N1MCS8-DSE-I(2): Software Testing Lab

Course Outcomes(COs):

1. To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
2. To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
3. To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
4. To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.
5. To gain software testing experience by applying software testing knowledge and methods to practice-oriented software testing projects.
6. To understand software test automation problems and solutions.

Practical List: Software Testing

1. Understand The Automation Testing Approach (Theory Concept).
2. Install Selenium IDE. Write a test suite containing minimum 4 test cases.
3. Understanding Test Automation. Using Selenium write a simple test script to validate each field of the registration page (Eg: Facebook Registration Page)
4. Install Selenium server and demonstrate it using a script in Java/PHP.
5. Conduct a test suite for any two web sites.
6. Write and test a program to login a specific web page.
7. Write test cases to validate a mobile number using one time pin identification(OTP)
8. Write and Test a program to find out list of employees having salary greater than Rs 50,000 and age between 30 to 40 years.
9. Write and test a program to update 10 student records into table into Excel file.
10. Write and test a program to select the number of students who have scored more than 60 in any one subject (or all subjects).
11. Write and test a program to provide total number of objects present / available on the page.
12. Write and test a program to get the number of list items in a list / combo box.
13. Write and test a program to count number of items present on a desktop.
14. Understanding the use of bug tracking and testing tool Bugzilla.
15. Demonstrate any one open source tool for software other than that used in lab exercises
16. Prepare test cases for any software application like Admission form, Shopping cart, Travel Booking, Hotel Booking, Utility Bill Payment..

N1MCS8- DSE-I (3) : Software Engineering Lab

Course Outcomes (COs):

Upon completion of this course successfully, students would be able to:

1. Identify different actors and use cases from a given problem statement and draw use case diagram to associate use cases with different types of relationship.
2. Draw a class diagram after identifying classes and association among them.
3. Graphically represent various UML diagrams and associations among them and identify the logical sequence of activities undergoing in a system, and represent them pictorially.

4. Use modern tools for demonstrating the complete Software life cycle activities (specification, design, implementation and testing) from requirements analysis to maintenance using the modern tools and techniques.
5. Translate end-user requirements into system and software requirements
6. Apply standard data mining methods and techniques such as association rules, data clustering and classification.

Practical List: Software Engineering

1. Analysis and Identification of the suitable process models
2. To prepare PROBLEM STATEMENT for any project.
3. Identifying the Requirements from Problem Statements.
4. Estimation of Project Metrics.
5. Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based) and Estimations
6. Estimation of Test Coverage Metrics and Structural Complexity
7. Designing Test Suites.
8. An introduction to software engineering.
9. Requirement modelling using Entity Relationship Diagram(Structural Modeling) for any project
10. Requirement modelling using Context flow diagram, DFD (Functional Modeling) for any project
11. Requirement modelling using State Transition Diagram (Behavioral Modeling) for any project
12. Development of DFD, data dictionary, E-R diagram, structured chart for the project.
13. To study and draw various UML diagrams.
14. To illustrate the use of class diagrams.
15. To draw an activity diagram and use case diagram.(for eg. ATM and Library Management System)
16. Draw Object Diagram (For eg. ATM System)
17. Development of OO design — Use case Model, Class Model
18. Development of OO design — Interaction Models
19. Development of OO design — Package, Component and deployment models
20. Development of State Transition Diagram.
21. Draw ER Diagram for Hospital Management System
22. Design and demonstration of test cases. Functional Testing and Non- Functional Testing (using any open source tools)
23. Design of Story Boarding and User Interface design Modeling.

Syllabus PG Programme: M.Sc. (Computer Science)
First Year Semester: II

DSC IV/ N2MCS1: Operating System Algorithms

Course Outcomes:

On completion of this course, students would be able to:
1. To make aware of different types of Operating System and their services.
2. Know basic components of an operating system.
3. Comprehend how an operating system virtualises CPU and memory.
4. Discuss various scheduling and swapping policies.
5. Explain how a simple file system organizes data in the hard disk.
6. get to know how an operating system protects the computer system.

Units	Contents	Total Lectures
I	Introduction: Services, Types, Operating System Interface: Command Interpreter, Graphical User Interface, System Calls, System Programs, Operating System Structure: Simple, Layered Approach; Micro-kernels, Modules, Virtual Machine, System Boot.	10
II	Process Management: Process Concept, Process States, Process Control Block, Process Scheduling: Schedulers, Context Switch; Operations on Process: Creation, Termination, Inter Process Communication; Threads: Concept, Benefits; CPU Scheduling: Burst Cycle, Types of Scheduling, Scheduler, Dispatcher, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, Priority Scheduling, Round-Robin,[multiple processor scheduling]	10
III	Process Synchronization and Deadlocks: Critical Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors. Deadlock: System Model, Deadlock Characterization, And Resource Allocation Graph, Methods for handling Deadlock: Prevention, Avoidance and Detection; Recovery from Deadlock: Process Termination, Resource Pre-emption.	10
IV	Memory Management: [Basic Hardware, Address Binding]; Logical and Physical Address Space, Swapping, Contiguous Allocation, Dynamic Storage Allocation: First-fit, Best-Fit, Worst-fit; Fragmentation; Paging; Segmentation. Virtual Memory: Introduction, Virtual Address Space, Demand Paging, Copy-on-write, Page Replacement: Concept, Page Replacement Algorithms: FIFO, Optimal Page Replacement, LRU, Second-Chance Page Replacement; Thrashing, I/O Interlock	10
V	File System: File: Concept, Attributes, Operations; File Organization and Access: Sequential, Index Sequential, Indexed, Direct or Hash File. Directory: Operations, Structures. Protection: Access Control and Permissions. File System Structure, Allocation Methods, Free Space Management. Disk Structure, Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK. [Disk Management, Swap Space Management], RAID: Concept. I/O Systems: I/O Hardware, Interrupts, DMA, Application I/O Interface, Kernel I/O Subsystem.	10
VI	Distributed File System: Concept, Naming and Transparency, Remote File Access, Stateful Vs Stateless Service, File Replication, Remote Login, Remote File Transfer, Data Migration, Computation Migration, Process Migration. Embedded Operating Systems: Embedded Systems: Definition, Requirements and Constraints, Organization of Embedded System; Characteristics of Embedded Operating Systems. Case Studies: Linux and Mobile Operating Systems	10
Books:		

Books:
1. Operating System Concepts–Seventh Edition: Abraham Silberschatz, Peter Galvin, Greg Gagne (John Wiley & Sons)
2. Operating Systems: William Stallings (Pearson)
3. Modern Operating System: Andrew S.Tanenbaum
4. Distributed Operating Systems, Prentice Hall M. Singhal & N. Shivaratri,
5. Advanced Concepts in Operating Systems, McGraw Hill
6. Understanding theLinuxKernel,2nd Edition By Daniel P. Bovet, Oreilly
7. The Design of Unix Operating System Maurice Bach,Pearson

Weblinks :	
1. https://youtu.be/vBURTt97EkA 2. https://www.youtube.com/watch?v=WJ-UaAaum 3. https://youtu.be/RozoeWzT7IM	

DSC V/ N2MCS2: Graphics Application Programming

Course Outcomes:

On completion of this course, students would be able to:

1. Able to understand the mathematical modelling of graphical objects to be drawn/used in different kind of applications.
2. Learn and understand the concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in2 D&3D.
3. Learn and understand the algorithms to generate line segments, polygon and its transformations, windowing and clipping.
4. Demonstrate operations such as various Transformation and Projection.
5. Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis.
6. Get the knowledge of display control, 3D geometry, primitives and conversions, algorithms for hidden surfaces and lines, concepts of shading and curves.

Unit	Content	Total Lectures
I	Geometry and line generation: Introduction, Points and Lines, Planes and Coordinates, Line segments, Perpendicular line segments, Vectors, Pixels and Frame Buffers, Vector generation, Character generation, Displaying the frame buffer. Graphics primitive: Introduction, Display devices, Primitive operations, The Display-FileInterpreter,Normalizeddevicecoordinates,Display-file structure, Display control.	10
II	Polygon: Introduction, Polygon, Polygon representation, Entering polygon, An inside test, Filling polygon, Antialiasing. Transformations: Introduction, matrices, scaling transformations, sinandcos, Sum of angles, identifiers, rotation, homo generous coordinates and translation, rotation about an arbitrary point, other transformations, and display procedures.	10
II	Segments: Introduction, the segment table, segment creation, closing a segment, deleting a segment, renaming a segment, visibility, image transformations, saving and showing segments, other display file structures, Some Raster techniques, Windowing and clipping: Introduction, view in transformation, implementation, clipping, clipping the polygon, Adding Clipping to the system, Generalized Clipping.	10
IV	Interaction: Introduction, hardware, Input devices-handling Algorithm, Event handling, Sample devices, The delectability attributes, Simulating a Locator with a Pick and Pick with a Locator, Echoing, Interactive Techniques. Three dimensions: Introduction, 3DGeometry, Primitives and Transformations, Rotation about an arbitrary axis, Parallel projection, Perspective projection, Viewing parameters, Conversion to View Plane Coordinates, The3D Viewing Transformation.	10
V	Hidden Surfaces and Lines: Introduction, Back face removal & algorithm, ZBuffers, Scan-Line algorithm, The Painter s algorithm, Comparison Techniques, Warnock's algorithm, Franklin algorithm, Hidden Line method, Binary Space Partition, An Application.	10
VI	Shading: Introduction, diffusion, illumination, point source illumination, specular reflection, transparency and shadows. Curves: Introduction, curve generation, implementation, interpolating polygons, E-splines, B-Splines and Curves.	10
	Text Books : 1. "Computer Graphics A Programming approach"- Steven Harington. Reference	

	Books:	
	2. "Computer Graphics, C Version"-Donald Hearn, M.Pauline Baker-(Prentice Hall Press) 3. "Interactive Computer Graphics"-Newmann andSproul 4. "Computer Graphics"-Rogers.	

Weblinks:
    1. https://youtu.be/uTBKa1PSyf8
    2. https://youtu.be/NmMky9Pg8Yc
    3. https://youtu.be/UiDinO0lzOg		

DSC VI N2MCS3: Computer Networks and Wireless Technology

Course Outcome

After successful completion of the course, the students would be able to :
1. Understand the basics of data communication and computer networking
2. Compare and describe the structure and working of various reference models for networking
3. Infer the process of communication in client server model
4. Develop knowledge about design of various protocols used in communication
5. Anticipate various anomalies that may occur during network communication
6. Build knowledge about wireless technology

Units	Contents	Total Lectures
I	**Data Communication:** Types: Analog & Digital; **Modulation:** Amplitude, Frequency, Phase Shift, PAM, PCM; **Multiplexing:** FDM, WDM, TDM; **Switching:** Circuit, Message, Packet; Delays in Packet Switched Network, Packet Loss; **Network Reference Models:** ISO-OSI model, TCP/IP model	10
II	**Application Layer:** Services; **Principles of Network Applications:** Client-Server Architecture, Client and Server Processes, Socket Interface; Transport Services Available to Applications; **HTTP:** Introduction, RTT, HTTP Handshake, types of HTTP Connections, HTTP Messages, Cookies; Electronic Mail, SMTP; **DNS:** Services, working	10
III	**Transport Layer:** Services; Multiplexing and Demultiplexing in Transport Layer; Connectionless Transport – UDP; Principles of Reliable of Data Transfer (RDT): RDT 1.0, 2.0, 2.1, 2.2 and 3.0; Stop-and-wait and Pipelined protocols; Go-Back-N (GBN) and Selective Repeat (SR) protocols; Connection Oriented Transport: TCP Connection, Flow Control; Principles of Congestion Control; Approaches to Congestion Control; TCP Congestion Control	10
IV	**Network Layer:** Services; Network Service Model: Datagram, Virtual Circuit; Internet Protocol: IP Addressing, IPv4 datagram format, IPv6 datagram format; Routing Principles; Routing Algorithms: Classifications, RIP, OSPF, BGP; Hierarchical Routing; DHCP; ICMP: Overview and message types; SNMP: overview.	10
V	**Data Link Layer:** Services; Error Detection and Correction Techniques; Multiple Access Protocols: Polling, ALOHA, CSMA/CD; MAC Addresses and ARP; Switches; Point-to-Point Protocol.	10
VI	**Wireless Technology:** Advantages, Applications; **Signals:** Characteristics, Propagation, Fading, Multipath Propagation; Frequency Reuse Principle, Cellular System; Wireless LAN: Advantages, Disadvantages, Infra-red and radio transmission, infrastructure and ad-hoc wireless networks; Bluetooth.	10
Text Books:		

1. Data Communications and Networking, 4/e - Behrouz A. Forouzan (McGraw Hill Education) 2. Computer Networking: A Top-Down Approach - James Kurose & Keith Ross (Pearson Education) 6th/7th edition 3. Mobile Communications – Jochen Schiller (Pearson Education)	
Reference Books: 1. Computer Network & Internet - Douglas E. Comer (Pearson) 2. Data and Computer Communication – William Stallings (Pearson) 3. Computer Networks - Andrew S. Tanenbaum (PHI)	
Weblinks: 1. https://www.youtube.com/watch?v=I2PKJslPObM 2. https://www.youtube.com/watch?v=8kICGfKCA1o 3. https://www.youtube.com/watch?v=ut-EMl-uHXY	

DSE II (1)/ N2MCS4(1): Internet of Things

Course Outcome:

On completion of this course, students would be able to:
1. Understood what Internet of Things are.
2. Identify the use of IOT from the global market.
3. Able to control home appliances from anywhere in the world.
4. Analyze the IOT enabling technologies.
5. Design applications using IOT.
6. Determine the real-world problems and challenges in IOT.

Unit	Contents	Total Lectures
I	**Introduction and Concepts:** Definition and Characteristics of Introduction to loT, Physical design of loT, Things in toT, IoT protocols, Logical Design of loT, IoT functional blocks, loT communication Model, loT Communication API, IoT Enabled Technologies.	7
II	**Developing loT:** IoT platform and design methodology-Purpose & requirement specification, process specification, Domain Model specification, Information Model Specification, service specification, loT level specification, functional view specification, Operational view specification, Device & Component Integration, Application Development.	7
III	IoT Physical Device Endpoints-Basic building blocks of an loT Device, Exemplary Device Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python.	8
IV	IoT and M2M-Machine 2 Machine, Difference between loT and M2M, Web of Things, Applications-- Remote Monitoring and Sensing, Remote Controlling, Performance Analysis. Security aspects of IoT.	8
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.	8
VI	Data analytics for IOT: MapReduce Progamming Model, Ozie workflow for IOT data analysis, setting up a strong, cluster, REST –based approach web socket-based approach, case studies	7
Text books: 1. Internet of Things (A Hands on Approach), Vijay Madisetti, Arshdeep Bahga 2. Getting Started with Internet of Things: Connecting Sensors and Microcontrollers to the cloud by Cuno Pfister, O'RiellyPublications		
Reference Books: 1. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler VlasiosTsiatsis Catherine Mulligan Stefan Aves & Stamatis Kamouskos		

2. Getting Started with the Internet of Things by Cuno Pfister.		
3. The Internet of Things: Connecting Objects by Hakima Chaouchi.		
4. Francisda Costa. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", I Edition, A press Publications, 2013.		
5. Raj Kamal" Internet of Things", 1st edition 2016,McGraw-Hill		

Weblinks:
1. https://www.youtube.com/watch?v=LlhmzVL5bm8
2. https://www.youtube.com/watch?v=APH6Nrar27w
3. https://www.youtube.com/watch?v=Fj02iTrWUx0

MOOCS :
1. https://onlinecourses.nptel.ac.in/noc23_cs89/preview   (3 Credit)
2. https://onlinecourses.nptel.ac.in/noc23_cs90/preview   (2 Credit)
3. https://onlinecourses.nptel.ac.in/noc21_cs14/preview   (2 Credit)
4. https://archive.nptel.ac.in/courses/106/105/106105167   (4 Credit)

DSE II(2)/N2MCS4(2) : Mobile Computing

Course Outcome:

On completion of this course, students would be able to:

1. Study and aware of fundamentals of mobile computing
2. Study and analyse wireless networking protocols, applications and environment.
3. Understand various data management issues in mobile computing.
4. Analyse different type of security issues in mobile computing environment.
5. Data synchronisation used in mobile computing.
6. Learn Android application development, Mobile OS, XML

Unit	Contents	Periods
I	**Introduction to Mobile Computing:** Evolution of mobile computing, Architecture for Mobile Computing, Three tier Architecture, Mobile Devices and Mobile-Enabled Applications. **Mobile Devices and Systems:** Mobile Phones, Digital Music Players, Handheld Pocket Computers, Handheld Devices: Operating System, Smart Systems, Limitations of Mobile Devices, Automotive Systems	7
II	**GSM-Services and Similar Architecture:** GSM-Services and System Architecture, Radio Interfaces, Protocols, Radio Interfaces , Localization, Calling Handover, Security, Short message services, Mobile computing over SMS, Value added services through SMS, Accessing the SMS bearer. **Wireless Medium Access Control and CDMA-based Communication** Medium Access Control Introduction to CDMA-based Systems, Spread Spectrum in CDMA Systems, Coding Methods in CDMA IST, IS-105 cdma One System, IMT-2000, i-mode, OFDM.	8
III	**Mobile IP Network Layer:** IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, Dynamic Host Configuration Protocol. **Mobile Transport Layer** Conventional TCP/IP Transport Layer Protocols , Indirect TCP , Snooping TCP Mobile TCP, Other Methods of TCP-layer Transmission for Mobile, Networks TCP Over 2.5G/3G Mobile Networks.	8
IV	**Databases** Database Hoarding Techniques, Data Caching, Client-Server Computing and Adaptation ,Transactional Models, Query Processing, Data Recovery Process Issues relating to Quality of Service **Data Dissemination and Broadcasting Systems** Communication Asymmetry, Classification of Data-Delivery Mechanisms, Data Dissemination Broadcast Models ,Selective Tuning and Indexing Techniques, Digital Audio Broadcasting.	8
V	**Data Synchronization in Mobile Computing System**, Synchronization Software for Mobile Devices, Synchronization Protocols, SyncML-Synchronization Language for Mobile Computing Sync4J (Funambol) ,Synchronized Multimedia Markup Language (SMIL) Mobile Devices: Server and Management Mobile Agent , Application Server, Gateways ,Portals ,Service Discovery , Device Management, Mobile File Systems, Security.	7
VI	**Introduction to Android Operating System & Programming:** Overview and evolution of Android, Features of Android, Android architecture, Components of an Android Application, Manifest file, Android Activity and Service Lifecycle,	7

| UI Designing (layout desiginig) All components (e.g Button , Slider, Image view, Toast) Event Handling –Introduction to XML, **Mobile Operating Systems:** IoS, PalmOS, WindowsCE, Symbian OS, Linux for Mobile Devices. | |

Text books:
1. Mobile Computing: Raj Kamal (Oxford)
2. Jochen Schiller, Mobile communications, Addison wisely , Pearson Education

Reference Books:
1. Mobile Communication: Jochen Schiller (PE)
2. Principles of mobile communication: Gordon L. Stuber (Springer)
3. Wireless Communications: Principles and Practice: Theodore S. Rappaport (Pearson)
4. 4) Beginning Android 3 by Mark Murphy APress , ISBN 9788132203568

Weblinks:
1. https://www.youtube.com/watch?v=GT-tYP8RGIs&list=PLV8vIYTIdSnZMKTQSTxWbx4NGNfxyZq_N
2. https://www.youtube.com/watch?v=hIEJR4XYepg&list=PLPIwNooIb9vj5gQ64BL7iVpFtymBt9A22
3. https://www.youtube.com/watch?v=6yHOrDT7Ct0&list=PLYwpaL_SFmcAjqrKO-b9UMa2AaAlzZY7D

MOOCS:
1. https://onlinecourses.nptel.ac.in/noc23_ge36/preview   (2 Credit)
2. https://onlinecourses.swayam2.ac.in/nou23_cm06/preview (6 Credit)
3. https://onlinecourses.swayam2.ac.in/nou22_cm14/preview (6 Credit)
4. https://onlinecourses.swayam2.ac.in/cec23_ge07/preview   (4 Credit)
5. https://onlinecourses.swayam2.ac.in/nou22_ge57/preview   (4 Credit)

DSE II(3)/ N2MCS4(3) : Data Mining and Data Warehousing

Course Outcomes:

Upon completion of this course successfully, students would be able to

1. Use basic concepts and techniques of Data Mining
2. Develop skills of using recent data mining software for solving practical problems.
3. Develop experience of doing in dependent study and research.
4. Study the methodology of engineering legacy databases for data warehousing and data mining to derive business rules for decision support systems.
5. Develop and apply critical thinking, problem-solving, and decision- making skills.

Units	Contents	Total Lectures
I	Introduction, Data Mining Functionalities, Data Preprocessing: Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.	7
II	Data Warehouse and OLAP Technology: Overview, A Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, From Data Warehousing to Data Mining. Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Data Generalization and Concept Description.	7
III	MiningFrequentPatterns,Associations,andCorrelations:BasicConcepts, EfficientandScalableFrequentItemsetMiningMethods,MiningVariousKinds of Association Rules, From Association Mining to Correlation Analysis, Constraint- Based Association Mining.	8
IV	Classification and Prediction: Issues, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation. Prediction: Linear Regression, Nonlinear Regression, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor.	8
V	Cluster Analysis: Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-	8

	Dimensional Data. Mining Time-Series Data, Mining Sequence Patterns in Biological Data.	
VI	Graph Mining, Social Network Analysis and Multi-relational Data Mining. Mining Object, Spatial, Multimedia, Text, and Web Data, Data Mining Applications, Trends in Data Mining.	7

Text Books:

Data Mining: Concepts and Techniques - J. Han, M. Kamber

Reference Books:

1. Data Mining: Introductory and Advanced Topics – Margaret H.Dunham, Pearson Education
2. Data Warehousing in the real world - Sam Anahory, Dennis Murry, Pearson Education
3. Principles of Data Mining - David Hand, Heikki Manila, Padhraic Symth, PHI
4. Data Warehousing, Data Mining & OLAP, Alex Bezon, Stephen J. Smith McGraw-Hill Edition
5. Data   Warehousing Fundamentals, Paulraj Ponniah, Wiley-Interscience Publication

Weblinks:

1. https://youtu.be/T_D2tDTmrWE
2. https://youtu.be/cLI_bIlq-oU
3. https://youtu.be/KgjUsie50WQ
4. https://youtu.be/ykZ-_UGcYWg
5. https://youtu.be/jzDZZ-msoQc
6. https://youtu.be/m-aKj5ovDfg

MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview   (2 Credit)
2. https://onlinecourses.swayam2.ac.in/cec19_cs01/preview   (4 Credit)

Lab IV: Based on Operating System Algorithm - Lab Programming (C/C++/Java)
N2MCS5

Course Outcomes (COs): Operating System Algorithm

1. Able to learn various CPU scheduling algorithms.
2. Able to learn memory management techniques.
3. Able to learn disk scheduling algorithms.
4. Able to learn memory allocation algorithms.
5. Able to learn the various page replacement algorithms.

Practical List: Operating System Algorithm

1. Write a program to demonstrate the use of FCFS CPU Scheduling algorithm.
2. Write a program to demonstrate the use of SJF CPU Scheduling algorithm.
3. Write a program to demonstrate the use of Priority CPU Scheduling algorithm.
4. Write a program to demonstrate the use of Round Robin CPU Scheduling algorithm.
5. Write a program to demonstrate the use of resource allocation to identify whether thesystem is in safe state.
6. Write a program to demonstrate the use of resource allocation to identify cycle in the system.
7. Write a program to demonstrate the use of dynamic memory allocation.
8. Write a program to demonstrate the use of First fit/Best Fit / Worst Fit memory allocationalgorithms.
9. Write a program to demonstrate the use of FIFO Page Replacement algorithm.
10. Write a program to demonstrate the use of LRU Page Replacement algorithm.
11. Write a program to demonstrate the use of Optimal Page Replacement algorithm.
12. Write a program to demonstrate the use of FCFS Disk Scheduling algorithm.
13. Write a program to demonstrate the use of SSTF Disk Scheduling algorithm.
14. Write a program to demonstrate the use of SCAN Disk Scheduling algorithm.
15. Write a program to demonstrate the use of CSCAN Disk Scheduling algorithm.
16. Write a program to demonstrate the use of LOOK Disk Scheduling algorithm.

Lab V: Lab Based on Graphics Application Programming
N2MCS6

Course Outcomes (COs): Graphics Application Programming

1. Apply the basic concepts of C programming in developing the code for various Graphics applications.
2. Individually Apply C programming concepts to do the Program in Computer Graphics.
3. Identify and apply a suitable transformation for a given application.

List of Practical: Graphics Application Programming

1. Write a program to draw a line using Bresenham's line drawing algorithm.
2. Write a program to draw a line using DDA line drawing algorithm.
3. Write a program to draw a circle using ARCDDA algorithm.
4. Write a program to draw a rectangle.
5. Write a program to draw a ellipse using ARCDDA algorithm.
6. Write a program to rotate a object about origin.
7. Write a program to rotate a object about any arbitrary point.
8. Write a program to implement 2D Scaling Transformation.
9. Write a program to implement 3D Scaling Transformation.

10. Write a program to implement 2D Translation Transformation.
11. Write a program to implement 3D Translation Transformation.
12. Write a program to move an image (ball) on the screen.
13. Write a program to generate a Cubic Bezier Curve.
14. Write a program to draw a Polygon using Absolute and Relative commands.
15. Write a program to clip user defined area of a screen.
16. Write a program to clip line segment.
17. Write a program to clip polygon.
18. Write a program to demonstrate rotation of point.
19. Write a program to fill area by given pattern.
20. Write a program to fill the closed area using flood fill method.
21. Write a program to fill the closed area using Scan line method.

Lab-VI: Lab Based on DSE II (1)/ DSE II (2)/ DSE II (3)
2MCS7
N2MCS7- DSE II (1)- Internet of Things

Course Outcomes (COs): Internet of Things
1. To be able to design hardware for IoT on different platforms for devices that can be connected to internet
2. To recognize the functionality of micro controller, latest version processor and its application
3. Acquire thinking and designing capability, to solve real world engineering problem, and analyses results.
4. To be able to design a components with realistic constraints, for IOT nodes and systems.

List of Practical: Internet of Things
1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
3. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings
4. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
5. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
6. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
8. To interface Bluetooth with Arduino Raspberry Pi and write o program to turn LED ON/OFF when 170 is received from smartphone using Bluetooth
9. To insert MySQL database on Raspberry Pi and perform RC basic SQL queries
10. Write a program on Arduino Raspberry Pi to publish temperature data to MOTT Broker

Lab VI- Lab Based on DSE II (1)/ DSE II (2)/ DSE II (3)
N2MCS7 - DSE II (2)-Mobile Computing

DSE II (2): Mobile Computing

Course Outcomes(COs): Mobile Computing
1. To understand the basic concepts of mobile computing.
2. To learn the basics of mobile telecommunication system .
3. To be familiar with the network layer protocols and Ad-Hoc networks.

4. To know the basis of transport and application layer protocols.
5. To gain knowledge about different mobile platforms and application.

List of Practical's: Mobile Computing

1. Study the three tier architecture of Mobile Computing
2. Study GSM services and System Architecture
3. Study of WMAC and CDMA communication.
4. Study of Packet Delivery and Handover Management,
5. Study of IP and Mobile IP Network Layers.
6. Study of Classification of Data-Delivery Mechanisms
7. Study of Selective Tuning and Indexing Techniques
8. Study of Mobile File Systems
9. Study of Data Synchronization System.
10. Script writing using Synchronized Multimedia Markup Language (SMIL)
11. Study of UI in Android
12. Study of Activity Life Cycle
13. Study of Indent in Android
14. Develop an application that uses GUI components, Font and Colours
15. Study of Adapters and View
16. Design an android application Using Radio buttons
17. Create a screen that has input boxes for User Name, Password, Address, Gender(radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button (use any layout)
18. Develop an application that uses Layout Managers and event listeners.
19. Write an application that draws basic graphical primitives on the screen.
20. Develop an application that makes use of databases.
21. Create a user registration application that stores the user details in a database table.

Lab VI- Lab Based on DSE II (1)/ DSE II (2)/ DSE II (3)
N2MCS7 -DSE II (3) - Data Mining Data Warehousing

Course Outcomes (COs): Data Mining Data Warehousing

1. Be familiar with mathematical foundations of data mining tools.
1. Understand and implement classical models and algorithms in data warehouses and data mining
2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
3. Master data mining techniques in various applications like social, scientific and environmental context.
4. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

List of Practical: Data Mining Data Warehousing

Data mining Tools used: Weka / Rapid miner
1. **Create an Employee Table with the help of Data Mining Tool**. **Description:** We need to create an Employee Table with training data set which includes attributes like name, id, salary, experience, gender, phone number.

2. **Create a Weather Table with the help of Data Mining Tool. Description:** We need to create a Weather table with training data set which includes attributes like outlook, temperature, humidity, windy, play.

3. **Apply Pre-Processing techniques to the training data set of Weather Table Description:** Real world databases are highly influenced to noise, missing and inconsistency due to their queue size so the data can be pre- processed to improve the quality of data and missing results and it also improves the efficiency. There are 3 pre-processing techniques they are:

   1) Add
   2) Remove
   3) Normalization

4. **Apply Pre-Processing techniques to the training data set of Employee Table Description:** Real world databases are highly influenced to noise, missing and inconsistency due to their queue size so the data can be pre- processed to improve the quality of data and missing results and it also improves the efficiency. There are 3 pre-processing techniques they are:

   1) Add
   2) Remove
   3) Normalization

5. **Normalize Weather Table data using Knowledge Flow.**
   Description: The knowledge flow provides an alternative way to the explorer as a graphical front end to WEKA's algorithm. Knowledge flow is a working progress. So, some of the functionality from explorer is not yet available. So, on the other hand there are the things that can be done in knowledge flow, but not in explorer. Knowledge flow presents a dataflow interface to WEKA. The user can select WEKA components from a toolbar placed them on a layout campus and connect them together in order to form a knowledge flow for processing and analyzing the data.

6. **Normalize Employee Table data using Knowledge Flow.**
   Description: The knowledge flow provides an alternative way to the explorer as a graphical front end to WEKA's algorithm. Knowledge flow is a working progress. So, some of the functionality from explorer is not yet available. So, on the other hand there are the things that can be done in knowledge flow, but not in explorer. Knowledge flow presents a dataflow interface to WEKA. The user can select WEKA components from a toolbar placed them on a layout campus and connect them together in order to form a knowledge flow for processing and analyzing the data.

7. **Finding Association Rules for Buying data.**
   Description: In data mining, association rule learning is a popular and well researched method for discovering interesting relations between variables in large databases. It can be described as analyzing and presenting strong rules discovered in databases using different measures of interestingness. In market basket analysis association rules are used and they are also employed in many application areas including Web usage mining, intrusion detection and bioinformatics.

8. **Finding Association Rules for Banking data.**
   Description: In data mining, association rule learning is a popular and well researched method for discovering interesting relations between variables in large databases. It can be described as analyzing and presenting strong rules discovered in databases using different measures of interestingness. In market basket analysis association rules are used and they are also employed in many application areas including Web usage mining, intrusion detection and bioinformatics.

9. **Finding Association Rules for Employee data.**
   Description: In data mining, association rule learning is a popular and well researched method for discovering interesting relations between variables in large databases. It can be described as analyzing and presenting strong rules discovered in databases using different measures of interestingness. In market basket analysis association rules are

used and they are also employed in many application areas including Web usage mining, intrusion detection and bioinformatics.

10. **To Construct Decision Tree for Weather data and classify it.**
    Description:
    1. **Classification & Prediction:** Classification is the process for finding a model that describes the data values and concepts for the purpose of Prediction.
    2. **Decision Tree:** A decision Tree is a classification scheme to generate a tree consisting of root node, internal nodes and external nodes. Root nodes representing the attributes. Internal nodes are also the attributes. External nodes are the classes and each branch represents the values of the attributes Decision Tree also contains set of rules for a given data set; there are two subsets in Decision Tree. One is a Training dataset and second one is a Testing data set. Training data set is previously classified data. Testing data set is newly generated data.

11. **To Construct Decision Tree for Customer data and classify it.**
    Description:
    1. **Classification & Prediction:** Classification is the process for finding a model that describes the data values and concepts for the purpose of Prediction.
    2. **Decision Tree:** A decision Tree is a classification scheme to generate a tree consisting of root node, internal nodes and external nodes. Root nodes representing the attributes. Internal nodes are also the attributes. External nodes are the classes and each branch represents the values of the attributes Decision Tree also contains set of rules for a given data set; there are two subsets in Decision Tree. One is a Training dataset and second one is a Testing data set. Training data set is previously classified data. Testing data set is newly generated data.

12. **To Construct Decision Tree for Location data and classify it.**
    Description:
    1. **Classification & Prediction:** Classification is the process for finding a model that describes the data values and concepts for the purpose of Prediction.
    2. **Decision Tree:** A decision Tree is a classification scheme to generate a tree consisting of root node, internal nodes and external nodes. Root nodes representing the attributes. Internal nodes are also the attributes. External nodes are the classes and each branch represents the values of the attributes Decision Tree also contains set of rules for a given data set; there are two subsets in Decision Tree. One is a Training dataset and second one is a Testing data set. Training data set is previously classified data. Testing data set is newly generated data.

13. **Write a procedure for Visualization for Weather Table.**
    Description: This program calculates and has comparisons on the data set selection of attributes and methods of manipulations have been chosen. The Visualization can be shown in a 2-D representation of the information.

14. **Write a procedure for Visualization of Banking Table.**
    Description: This program calculates and has comparisons on the data set selection of attributes and methods of manipulations have been chosen. The Visualization can be shown in a 2-D representation of the information.

15. **Write a procedure for cross-validation using J48 Algorithm for weather table.**
    Description: Cross-validation, sometimes called rotation estimation, is a technique for assessing how the results of a statistical analysis will generalize to an independent data set. It is mainly used in settings where the goal is prediction, and one wants to estimate how accurately a predictive model will perform in practice. One round of cross-validation involves partitioning a sample of data into complementary subsets, performing the analysis on one subset (called the training set), and validating the analysis on the other subset (called the validation set or testing set).

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

DSC VII/ N3MCS1-Artificial Intelligence and Machine Learning

Course Outcomes:

On completion of this course, students would be able to:

1. Analyze artificial intelligence (AI) techniques and describe their principles.
2. Examine and demonstrate the important role that search algorithms play in problem-solving, inference, perception, knowledge representation, and learning.
3. Use the concepts of logic and knowledge representation to solve challenges in the real world.
4. Recognize the features of machine learning that allow it to be used in solving a real-world problem.
5. Implement the various supervised learning techniques for tree-based and support vector machine models.
6. Use several linear approaches for classification and regression, then optimize them using various regularization strategies.

Unit	Contents	Periods
I	**Introduction to AI** 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. **Intelligent Agent**: Types of AI Agent, Concept of Rationality, nature of environment, structure of agents. Turing Test in AI.	10
II	**Problem Solving** **Search Algorithms in Artificial Intelligence:** Terminologies, Properties of search Algorithms, Types of search algorithms: uninformed search and informed search, State Space search **Heuristic Search Techniques:** Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best-first Search; Problem Reduction. **Constraint Satisfaction problem**: Interference in CSPs; Back tracking search for CSPs; Local Search for CSPs; structure of CSP Problem. **Beyond Classical Search:** Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action and partial observation, online search agent and unknown environments.	10
III	**Knowledge and Reasoning** **Knowledge-Based Agent in Artificial intelligence:** 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 **Reasoning in Artificial intelligence:** Types of Reasoning and Probabilistic reasoning, Uncertainty.	10
IV	**Introduction to ML** **Introduction to Machine Learning:** History of ML Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI & ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation.	10
V	**Learning** **Types of Learning:** Supervised, Unsupervised and Semi-Supervised Learning. **Supervised:** Learning a Class from Examples, Types of supervised Machine learning Algorithms, **Unsupervised:** Types of Unsupervised Learning Algorithm, Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis.	10

Unit	Contents	Periods
VI	**Classification & Regression Classification: Binary and Multiclass Classification**: Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest. **Regression:** Assessing performance of Regression – Error measures, Overfitting and Underfitting,	10

Text books:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall
2. J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016
3. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.

Reference Books:

1. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI, 2010
   2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011.
2. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.
3. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.
4. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT.
5. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.
6. Nilsson Nils J, "Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, and ISBN: 978-1-55-860467-4.

Weblinks :

1. https://www.youtube.com/watch?v=wnqkfpCpK1g
2. https://youtu.be/GwIo3gDZCVQ
3. https://youtu.be/Pj0neYUp9Tc

DSC VIII/ N3MCS2 - Web Computing

Course Outcomes:

On completion of this course, students would be able to:

1. Describe the basic concept PHP, Server-Side Scripting Language.
2. Design applications using Arrays and Function.
3. Understand OOP concepts for application development.
4. Implement the knowledge of PHP-Database handling.
5. Develop PHP framework for effective design of web application.
6. Implement JavaScript to develop dynamic web pages.

Unit	Contents	Periods
I	**Introduction to Web Techniques:** 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)	10
II	**Function, String and Arrays:** 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(), strcasecmp(), strncmp(), soundex(), metaphone(), Manipulating and searching string functions, Regular expressions **Arrays**: Indexed Vs. Associative arrays, Identifying elements of an array, Storing data in arrays,range(), count(), sizeof(), array_pad(), Multidimensional arrays,	10

	Extracting Multiple Values from array-list(), array_slice(), array_chunk(), array_splice(), Converting between arrays and variables-extract(), Traversing arrays using iterator functions and using array_walk(), array_reduce(), **Array Sorting**-sort(), assort(), ksort().	
III	**Introduction to Object Oriented Programming** Classes, Objects, adding a method, adding a property, visibility, Introspection, constructor anddestructors Serialization, Inheritance, overriding, Interfaces, Encapsulation	10
IV	**Databases**: 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	**Web Techniques:** 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	**Web Designing Technologies (JavaScript-DHTML)** 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
Text books: 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		
Reference Books: 1. PHP for Beginners, SPD publication 2. Programming the World Wide Web , Robert W Sebesta(3rd Edition) 3. PHP 5 for Dummies, Janet Valade, Wilely Publication 4. PHP: The Complete Reference, Steven Holzner, McGraw-Hill Education		
Online References: Weblinks 1. www.coursera.org 2. www.php.net.in 3 www.W3schools.com 4. www.wrox.com 5. https://youtu.be/JsbxB2l7QGY 6. https://youtu.be/3-2Pj5hxwrw 7. https://www.youtube.com/live/s-iza7kAXME?feature=share		

N3MCS3/DSC IX - Design and Analysis of Algorithm

Course Outcomes:
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. Proved the hardness of NP hard problems using simple reduction.
6. Do performance analysis of simple approximation algorithm

Unit	Contents	Periods
I	**Introduction:** Introduction to Algorithms, Algorithm Specification, Space Complexity and Time Complexity, Basics of Probability Theory, Advantages & Disadvantages of Randomized Algorithms. **Elementary Data Structures:** Stacks and Queues, Trees, Heaps, Graphs & Graphs Representation.	10
II	**Divide-and-conquer:** 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	**Greedy Approach:** General Method, Optimal storage on tapes, Knapsack problem, job sequencing with deadlines, optimal merge patterns, Minimum cost spanning trees, Single source shortest path problem, **Dynamic Programming:** 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	**Search & Traversal Technique:** AND/OR graph, biconnected components, Breadth first search & depth first search. **Backtracking:** General method, 8 Queens Problem, Graph colouring, Sum of subset problem, Hamiltonian cycle. **Branch and Bound**: 0/1 Knapsack problem, Traveling salesman problem.	10
V	**Algebraic Problems:** Evaluation & Interpolation, The Fast Fourier Transform, Modular arithmetic **Lower bound theory:** Comparison trees for sorting and searching, techniques for algebraic problems, some lower bounds and parallel computation. **NP Hard & NP Complete Problems:** 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	**Mesh Algorithm:** 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

Text books:
  1. Introduction to Algorithms, Corman , Leiserson and others , 2nd edition , PHI
  2. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Second Edition, Universities Press, Hyderabad, 2008.
  3. Design and Analysis of Algorithms , Dave and Dave , Pearson Education Inc
  4. Introduction to Algorithms,Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Second Edition, Prentice Hall of India, New Delhi, 2007
  5. Computer Algorithm, Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Galgotia Publications Pvt. Ltd., 1999		

Reference Books:
  1. Data Structures, Lipschutz , Tata McGraw Hills
  2. Design Methods and Analysis of Algorithms , S.K.Basu , PHI.
  3. The Art of Computer Programming, Vol 1,2,3 , Dr.Kunth , Addison Wesley
  4. The Design and Analysis of Computer Algorithms, Aho , Hopcroft and Ullman, Addison Wesley
  5. Computer Algorithms, Kenneth A. Berman and Jerome L. Paul,
  6. Algorithms, Cengage learning India Edition, Sara Baase and Allen Van Gelder,
  7. Introduction to Design & Analysis, Third Edition, Pearson Education, New Delhi, 2000.		

Video Links	
1. https://www.udemy.com/share/102ari/ 2. https://youtu.be/GQNT0v5zKhE 3. https://youtu.be/3udyFh_Dbbc 4. https://youtu.be/XqWYatsgwfU 5. https://onlinecourses.nptel.ac.in/noc23_cs96/preview	

DSE III(1) N3MCS4(1): Distributed Computing

Course Outcomes:

On completion of this course, students would be able to:

1. Learn the fundamental concepts of distributed computing systems.
2. Learn the concepts of message passing in distributed systems with inter Process Communication.
3. Learn and understand Remote Procedure Call-RPC
4. Learn and understand the concept of Synchronization
5. Learn and understand Deadlock in distributed computing systems with solutions
6. Learn and understand resource management and process management and also learn the concept of threads with issues in designing treads packages.

Unit	Contents	Periods
I	**Distributed Operating System:** Introduction, **distributed computing models:** Workstation model, Workstation server Model, processor pool model, Comparison of models, advantages and disadvantages of distributed system. **Issues in designing Distributed system:** Transparency, Reliability, Flexibility, Performance, Scalability, Security, fault tolerance, client server model.	7
II	**Network Communication:** ISO/OSI reference model, ATM protocol reference model. **Message Passing:** Introduction, Features of Message-Passing Systems, inter process message format, IPC Synchronization, Message buffering strategies, Multi datagram Messaging, Process Addressing, Failure Handling, group communication.	7
III	**Remote Procedure Calls-RPC:** Introduction, RPC basics, **Implementing RPC:** RPC messages, Parameter Passing Semantics, Server management **RPC communication:** Call semantics, Communication protocol, Client-Server Binding, **Other RPC issues:** Exception Handling & Security Heterogeneous Environments, Failure handling, RPC optimization. **RMI Basics & Implementation**	8
IV	**Synchronization:** Introduction, Clock Synchronization, Logical clocks, Mutual Exclusion, **Deadlock:** Necessary Conditions for Deadlock, Deadlock Modeling, **Handling Deadlocks in Distributed Systems:** Deadlock Avoidance, Deadlock Prevention, Deadlock Detection, Ways for Recovery from Deadlock, Issues in Recovery from Deadlock, **Election Algorithms:** The Bully Algorithm, A Ring Algorithm	8
V	**Distributed Shared Memory:** Introduction, Basic concepts of DSM, Hardware DSM, Design issues in DSM, Issues in implementing DSM system, Granularity, Heterogeneous & other DSM system. **Distributed File System:** Introduction, File Models, Distributed File system design, Semantics of file sharing, DFS implementation, file caching in DFS, Replication in DFS	8
VI	**Resource and Process Management:** Introduction, Desirable Features of a global scheduling algorithm, Task assignment approach, Load Balancing approach, Load balancing approach, **Process Management:** Functions, Desirable features, Process Migration, **Threads**: Introduction, **Issues In Designing Threads Package**: Creation, Termination, Synchronization, Scheduling	7
Text books:		
	1. Distributed Computing (Oxford Higher Education)– Sunita Mahajan & Seema	

	Shah	
	2. Distributed Operating Systems - Tanenbaum S.,Pearson Education	
Reference Books:		
	1. Distributed Systems Principles and Paradigms - Tanenbaum S. and Maarten V.S., Pearson Education	
	2. Distributed Operating Systems -Concepts and Design - Pradeep K. Sinha (PHI)	
Web Resources :		
	1. https://archive.nptel.ac.in/courses/106/106/106106168/	
	2. https://onlinecourses.nptel.ac.in/noc21_cs87/preview	
	3. https://www.digimat.in/nptel/courses/video/106106168/L01.html	
MOOC:		
1. https://onlinecourses.nptel.ac.in/noc21_cs87/preview (2 credits)		
2. https://youtube.com/playlist?list=PLp6ek2hDcoNAOfn2X55uHBAvxicuCwF6T (2 credits)		
3. https://onlinecourses.nptel.ac.in/noc21_cs87/preview (2 credits)		
4. https://nptel.ac.in/courses/106106168 (2 credits)		
5. https://onlinecourses.nptel.ac.in/noc21_cs15/preview (2 credits)		

DSE III(2)/N3MCS4(2)- Network Security

Course Outcomes:

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.

Unit	Contents	Periods
I	**Introduction:** Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for network Security, Internet Standards and the Internet Society. **Symmetric Encryption and Message Confidentiality:** Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Stream Ciphers and RC4, Cipher Block Modes of Operation.	8
II	**Public-Key Cryptography and Message Authentication:** Approaches to Message Authentication, Secure Hash Functions and HMAC, Public Key Cryptography Principles, Public Key Cryptography Algorithms, Digital Signatures, Key Management.	7
III	**Authentication Applications & Key Distribution:** Kerberos, X.509 Authentication Service, Public-Key Infrastructure, Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME,	7
IV	**IP Security:** IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management, **Web Security:** Web Security Considerations, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).	8
V	**Network Management Security:** Basic Concepts of SNMP, SNMPv1 Community Facility, SNMPv3, **Intruders:** Intruders, Intrusion Detection, Password Management.	8
VI	**Malicious Software:** Viruses and Related Threats, Virus Countermeasures, Distributed Denial of Service Attacks, **Firewalls:** Firewall Design Principles, Trusted Systems, Common Criteria for Information Technology Security Evaluation.	**7**

Text books: format (Title, Author, Publisher, Edition)	
1. William Stallings: "Network Security Essentials Applications and Standards" Pearson Education, Third Edition.	
Reference Books: format (Title ,Author, Publisher, Edition)	
1. Network Security: Private Communication in a Public World, Second Edition : Charlie Kaufman; Radia Perlman; Mike Speciner (Prentice Hall)	
2. Atul Kahate: "Cryptography and Network Security" Mc Graw Hill.	
3. Forouzan and Mukhopahyay: "Cryptography and Network Security" Mc Graw Hill.	
4. Matt Bishop: "Computer Security: Art & Science" Pearson Education.	
4. Brijendra Singh: " Network Security & Management" PHI.	
Online References	
1. https://youtu.be/IkfggBVUJxY	
2. https://www.youtube.com/live/k-k1cfIOLnQ?feature=share	
3. https://youtu.be/6Jubl1UnJTE	
4. https://youtu.be/VJelZrYc49c	
MOOC:	
1. https://onlinecourses.nptel.ac.in/noc22_cs90/preview (3 credits)	
2. https://nptel.ac.in/courses/106105031 (3 credits)	
3. https://nptel.ac.in/courses/106105162 (5 credits)	

DSE III(3)/N3MCS4(3) - Theory of Computation

Course Outcomes:

Upon completion of this course successfully, students would be able to
1. Learn basic concepts of formal languages of finite automata techniques
2. Design Finite Automata for different Regular Expressions and Languages
3. Construct context free grammar for various languages
4. Solve various problems of applying normal form techniques, push down automata and Turing Machines
5. Learn context sensitive language and able to solve the problem of decidability
6. understand recursive & non recursive language.

Units	Contents	Periods
I	Strings, alphabets and languages, Graphs and trees, Inductive proofs, set notations, relations, Finite automata and regular Expression: Finite state system, Nondeterministic finite automata, Finite automata with €-moves. Deterministic finite automata, equivalence between NFA and DFA, Conversion of NFA to DFA.	7
II	Regular set and regular expression, Two-way finite automata, finite automata with output, Applications of finite automata. Equivalence of RE and FA, inter conversion, pumping lemma, closure property of regular sets, Regular grammars, right linear and left linear grammar, equivalence between Regular linear grammar and FA inter conversion between RE and RG.	7
III	Context free grammar, derivation trees, Chomsky Normal Form, Greibach Normal Form. Push Down Automata: Definition, model, acceptance of CFL, equivalence of CFL and PDA, Interconversion, Enumeration of properties of CFL.	8
IV	Turing Machine: Definition, model, Design of Turing machine, computable languages and function, Techniques of Turing machine construction, Modifications of Turing machine, Church's Hypothesis.	8
V	Chomsky Hierarchy of languages, Linear bounded automata and context sensitive languages, Introduction of DCFL and DPDA, Decidability of problems.	8
VI	Undecidability: Properties of recursive & non recursive enumerable languages, Universal Turing machine, post correspondence problem, Introduction to recursive function theory.	7
	Text books: 1. "Introduction to Automata theory, Languages and Computation"- Hopcraft J.E.& Ullman J.D. **Reference Books:** "An Introduction to Formal Languages and automata"- Peter Liz.	

	"Introductory theory of Computer Science"- V. Krishnamurthy (EWP) "Elements of Theory & Computations"- Lavis and Padadimitron-PHI.	
	Weblinks 1. https://www.youtube.com/watch?v=z65frJP2x5s 2. https://www.youtube.com/watch?v=KKDn9U4SE2M 3. https://www.youtube.com/watch?v=eDAOxyZkl68 4. https://www.youtube.com/watch?v=6wSbiIASZks 5. https://www.youtube.com/watch?v=6wSbiIASZks	
	MOOC: 1. https://onlinecourses.nptel.ac.in/noc21_cs83/preview (2 credits) 2. https://onlinecourses.nptel.ac.in/noc23_cs31/preview (3 credits) 3. https://onlinecourses.nptel.ac.in/noc19_cs79/preview (2 credits)	

Lab VII - Based on Artificial Intelligence & Machine Learning - Lab LISP/Prolog/Python
N3MCS5

Course Outcomes (COs): Artificial Intelligence & Machine Learning
Upon completion of the course, students will be able to
1. Apply various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction,)
2. Understand the fundamentals of knowledge representation, inference.
3. Understand the fundamentals of theorem proving using AI and ML tools.
4. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information

Practical List: Artificial Intelligence
1. Implementation of uninformed search techniques like,
    i) a. Breadth first Search
    ii) b. Depth First Search
2. Implementation of informed (Heuristic) search techniques like
    i) Best first Search
    ii) Branch and Bound Search.
    iii) A* Search
    iv) Hill Climbing search
    v) AO* Search
3. Implementation of Water Jug problem.
4. Implementation of Missionaries and Cannibals problem.
5. Implementation of Tic-Tac-Toe game.
6. Implementation of Tower of Hanoi Problem.
7. Implementation of 8 queen problem.

Practical List: Machine Learning
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%)
2. Extract the data from database using python
3. Implement k-nearest neighbor's classification using python.
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)   .
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.
6. Implement linear regression using python
7. Implementation of Python basic Libraries such as Math, Numpy and Scipy
8. Implementation of Python Libraries for ML application such as Pandas and Matplotlib
9. Creation AND Loading different datasets in Python.
10. Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets
11. Implementation of Find S Algorithm
12. implementation of Candidate elimination Algorithm
13. Write a program to implement simple Linear Regression and Plot the graph
14. Implement naive bayes theorem to classify the English text
15. Implement an algorithm to demonstrate the significance of genetic algorithm
16. Implement the finite words classification system using Back-propagation algorithm

Lab-VIII - Based on Web Computing -Lab HTML/JS/CSS/.net/PHP
N3MCS6

Course Outcomes (COs): Web Computing
1. To introduce the fundamentals of Internet, the principles of web design analyse a web page and identify its elements and attributes.
2. Create or construct basic websites using XHTML and Cascading Style Sheets.
3. Build dynamic web pages using JavaScript (Client-side programming) objects by applying different event handling mechanisms.
4. Create XML documents and Schemas.
5. Build interactive web applications using AJAX
6. To develop modern interactive web applications using PHP, XML and MySQL

Practical List: Web Computing

1. Write a PHP script to print prime numbers between 1-50
2. HP script to
   - Find the length of a string.
   - Count no of words in a string.
   - Reverse a string.
   - Search for a specific string.
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.)
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, desgnation). 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)

Lab Based on DSE III (1)/ DSE III (2)/ DSE III (3) Lab-IX
N3MCS7

N3MCS7- DSE III (1): Distributed Computing

Course Outcomes (COs): Distributed Computing

1. To provide hardware and software issues in modern distributed systems.
2. To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
3. To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.
4. To know about Shared Memory Techniques.
5. Have Sufficient knowledge about file access.
6. Have knowledge of Synchronization and Deadlock.

Practical List: Distributed Computing

1. Write the Programs for Remote Procedure call.
2. Write the Programs for Remote Method Invocation.
3. Program to implement termination detection
4. Write a program for implementation of distributed mutual exclusion.
5. Write a program to implement distributed deadlock detection algorithm
6. Write a program to implement locking algorithm.
7. Write a Program to implement termination detection
8. Write a program to demonstrate the use of semaphore

9. Write a program to demonstrate the use of Bully Algorithm
10. Write a program to demonstrate the use of Ring Algorithm
11. Write a program to demonstrate the use of Election Algorithm

Lab-IX - Based on DSE III (1)/ DSE III (2)/ DSE III (3)
N3MCS7

N3MCS7- DSE III (2): Network Security
Course Outcomes (COs): Network Security

1. Identify the major techniques, approaches and tools used to discover network and system vulnerabilities.
2. Understand the role of cryptography in Network security.
3. Study the major types of cryptographic algorithms and typical applications.
4. Designing a code to encrypt and decrypt information using some of the standard algorithm.
5. Study the authentication protocols and process.

Practical List: Network Security
1. Study and Understand the network security Model.
2. Study various security tools which are available on internet
3. Demonstrate use of symmetric encryption algorithm.
4. Demonstrate use of symmetric decryption algorithm.
5. Write a program to implement RSA Algorithm
6. Write a program to implement the DES algorithm logic
7. Write a program to implement triple DES
8. Implement AES i.e. AES is a symmetric (secret key) algorithm.
9. Demonstrate the use of Diffie-Hellman key exchange algorithm
10. Implement MAC (Message Authentication Code) algorithm for cryptographic checksum.
11. Calculate the message digest of a text using the MD5 algorithm.
12. Implement MD5 algorithm which takes as input a message of arbitrary length and produces as output a 128-bit "message digest" of the input.
13. Find MAC address into the network interface
14. Calculate the message digest of a text using the SHA-1 algorithm in JAVA
15. Study and Understand Network management protocols (SNMPv1, SNMPv2)

Lab-IX - Lab Based on DSE III (1)/ DSE III (2)/ DSE III (3)
N3MCS7

N3MCS7 - DSE III (3): Theory of Computation
Course Outcomes (COs):
Upon the successful completion of the course, students will be able to:
1. Develop hand written lexical analyzers or scanners for a sample C code
2. Apply the knowledge of LEX to develop a C scanner.
3. Develop hand written top down parsers like recursive descent parser and construct first and follow sets for a given grammar.
4. Explain hand written shift reduce parser for a given grammar.
5. Apply the knowledge of YACC to syntax directed translations for generating intermediate code – 3 address code.
6. Estimate and Optimize target code.

Practical List: Theory of Computation
1. Write a C/C++ program toconstruct DFA from NFA.
2. Write a LEX program toimplement standalone.
3. Write a C/C++ program forconstruction of predictive parsing table.
4. Write a C / C++ program forSLR parser table generation.
5. Write a C/C++ program forimplementing unification algorithm.
6. Write a C/C++ program for IRParser table generation.
7. Write a program to implement parser usingYACC .
8. To write a program for implementing a calculator for computing the given expression using semantic rules of the YACC tool.
9. Write a C/C++ program oncode generation.
10. Write a C/C++ program oncode optimization.
11. Basic LEX Programs.
12. Write a C/C++ program to implement recursive descentparsing.
13. Write a C/C++ program to findFIRST and FOLLOW for the given grammar.

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

DSC X/ N4MCS1- CLOUD COMPUTING

Course Outcomes:
On completion of this course, students would be able to:
1. Describe the basic concept of Cloud Computing and Its Models.
2. Analyze the application and virtualization infrastructures for cloud computing.
3. Exhibit in-depth understanding of key cloud-based services.
4. Understand the necessity of management activity at cloud environment.
5. Study different cloud deployment tools.
6. Understand various security aspects related to cloud.

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

Text books:
1. "Cloud Computing: Methodology, System, and Application", Lizhe Wang, CRC Press, 2017.
2. "Cloud Computing a Practical Approach", Toby Velte et.al., McGraw Hill, 2017.
3. "Cloud Computing and Virtualization", Dac-Nhuong Le et.al., Wiley, 2018.
4. "Design and Use of Virtualization Technology in Cloud Computing",P. Kumar Das, IGI Global, 2018.

Reference Books: 1. "Cloud Computing: Concept, Technology and Architecture", Thomas Erl et.al., Pearson, 2013. 2. "Cloud Computing for Science and Engineering", Ian Foster and Dennis, MIT Press, 2017. 3. "Cloud Computing: From Beginning to End", Ray Rafaels, 2018. 4. "Virtualization Essentials", Matthew Portnoy, Sybex, 2012. 5. "The Value Of Virtualization And Cloud Computing", Manny Vergara, 2013.		
Online References: Weblinks 1. https://onlinecourses.nptel.ac.in/noc23_cs89/preview 2. https://onlinecourses.nptel.ac.in/noc23_cs90/preview 3. https://youtu.be/_a6us8kaq0g 4. https://youtu.be/RmuVkB3siYY 5. https://youtu.be/Dv0sjAYnVCY		

DSC XI/ N4MCS2 - Big Data

Course Outcomes:

On completion of this course, students would be able to:

1. Identify current scenarios of big data and provide various facets of big data.
2. Illustrate different types of big data technologies.
3. Familiar with the big data technology framework and file systems.
4. Describe the components of Map Reduce & it's working.
5. Understand the use of Apache Spark in Distributed processing System
6. Apply NoSQL to store big data and real time web application

Unit	Contents	Periods
I	**Introduction to Big Data:** 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. **Big data analytics**: 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	**Introduction to Hadoop**: History and overview of Hadoop, RDBMS versus Hadoop, Distributed Computing Challenges, Hadoop Distributors, Processing Data with Hadoop. **Hadoop Ecosystem**: Introduction to Hadoop ecosystem technologies: Serialization: AVRO, Co-ordination: Zookeeper, **Databases:** HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm	10
III	**Hadoop Framework:** Requirement of Hadoop Framework - Design principle of Hadoop, Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's. **Hadoop Distributed File System (HDFS):** The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Basic Filesystem Operations, Hadoop Filesystems. – HDFS Commands.	10
IV	**Map Reduce:** 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	**Apache Spark**: 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	**NoSQL**: 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,	10

	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.	
Text books:		
	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.	
	2. Tom White , ―Hadoop: The Definitive Guide, O'Reilly, 3rd Edition, 2012	
	3. Black Book Big Data, dreamtech publications , 1st Edition, 2017	
Reference Books:		
	1. Michael Minelli, Michele Chamber s, Ambiga Dhi raj ,―Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Wiley CIO Series, 1St Edition, 2013.	
	2. Arvind Sathi,―Big Data Analytics: Disruptive Technologies for Changing the Game , IBM Corporation, 1st Edition, 2012.	
	3. Dan Mcary and Ann Kelly Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press	
	4. Venkat Ankam, "Big Data Analytics" Published by Packt Publishing Ltd., 1st Edition, 2016	
Video Links:		
	1. https://www.youtube.com/watch?v=zez2Tv-bcXY	
	2. https://www.youtube.com/watch?v=1vbXmCrkT3Y	
	3. https://www.youtube.com/watch?v=S2MUhGA3lEw	
Swayam Web Links:		
	1. https://onlinecourses.nptel.ac.in/noc23_cs112/preview	

DSC XII/ N4MCS3 -BLOCKCHAIN TECHNOLOGY

Course Outcomes:

On completion of this course, students would be able to:

1. Describe the basic concept of Blockchain and Distributed Ledger Technology.
2. Interpret the knowledge of the Bitcoin network, nodes, keys, wallets and transactions.
3. Implement smart contracts in Ethereum using different development frameworks.
4. Develop applications in permissioned Hyperledger Fabric network.
5. Understand different Crypto assets and Crypto currencies.
6. Analyse the use of Blockchain in different use cases and with AI, IoT and Cyber Security using case studies.

Unit	Contents	Periods
I	**Introduction to Blockchain:** 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.	10
II	**Bitcoin:** 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. **Bitcoin Network:** 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, **Basics of Bitcoin Forensics:** Analysis of Address and Wallet, Clustering of Addresses following Money.	10
III	**Permissionless Blockchain: Ethereum:** 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:	10

	Structure of Transaction, Transaction Nonce, Transaction GAS, Recipient, Values and Data, Transmitting Values to EOA and Contracts. **Smart Contracts and Solidity**: 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. **Smart Contract Deployment:** Introduction to Truffle, Use of Remix and test networks for deployment.	
IV	**Basic Solidity:** 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 **Advanced Solidity:** 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	10
V	**Permissioned Blockchain: Hyperledger Fabric:** 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.	10
VI	**MultiChain**: Introduction to MultiChain, Privacy and Permissions in MultiChain, Mining in MultiChain, Multiple configurable Blockchains using MultiChain, setting up a Private Blockchain. **Crypto assets and Cryptocurrencies:** ERC20 and ERC721 Tokens, comparison between ERC20 & ERC721, NFT, ICO, STO, Different Crypto currencies. **Blockchain Use Cases:** Business Use Cases, Technology Use Cases, Legal and Governance Use Cases, Private block chain use cases, Blockchain in IoT, AI, Cyber Security	10

Text books:
1. "Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN", 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press.
4. Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric, Ashwani Kumar, BPB publications.
5. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Ritesh Modi, Packt publication.
6. Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond, Chris Burniske & Jack Tatar.

Reference Books:
1. Mastering Blockchain, Imran Bashir, Packt Publishing.
2. Mastering Bitcoin Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media.
3. Blockchain Technology: Concepts and Applications, Kumar Saurabh and Ashutosh Saxena, Wiley.
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.
5. Blockchain For Dummies,Tiana Laurence

Online References:
1. NPTEL courses:
   a. Blockchain and its Applications,
   b. Blockchain Architecture Design and Use Cases
2. www.swayam.gov.in/

	3. 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/	

DSE IV(1)/N4MCS4(1)- Entrepreneurship Development

Course Outcomes:

Upon completion of this course, students would be able to:

1. Understand the Key concepts underpinning entrepreneurship and its application
2. Analyse the recognition and popularization of product/ service/process opportunities.
3. Apply new ideas, methods and ways of thinking
4. Create new business plan and marketing it.
5. Investigate the issues associated with securing and managing financial resources in new and established organisations.
6. Design creative strategies for pursuing, exploiting and further developing new opportunities.

Units	Contents	Period
I	**The Nature and Importance of Entrepreneurs:** Nature and Development of Entrepreneurship, Definition of Entrepreneur today, The Entrepreneurial Decision Process, Types of Startups, Role of Entrepreneurship in Economic Development, Entrepreneurial Careers and Education, Ethics and Social Responsibility of Entrepreneurs, The Future of Entrepreneurship. **The Entrepreneurial and Intrapreneurial Mind:** The Entrepreneurial Process, Managerial versus Entrepreneurial Decision Making, Causes for Interest in Intrapreneurship, Corporate versus Intrapreneurial Culture, Climate for Intrapreneurship, Intrapreneurial Leadership Characteristics, Establishing Intrapreneurship in the Organization, Problems and Successful Efforts.	7
II	**The Individual Entrepreneur:** Entrepreneurial Feelings, Entrepreneur Background and Characteristics, Motivation, Role Models and Support Systems, Male versus Female Entrepreneurs, Minority Entrepreneurship, Entrepreneurs versus Inventors **International Entrepreneurship Opportunities:** The Nature of International Entrepreneurship, The Importance of International Business to the Firm, International versus Domestic Entrepreneurship, Entrepreneurial Entry into International Business, Barriers to International Trade	7
III	**Creativity and the Business Idea:** Sources of New Ideas, Methods of Generating Ideas, Creative Problem Solving, Opportunity Recognition, Product Planning and Development Process, E-Commerce and Business Start-Up **Legal Issues for Entrepreneur:** Intellectual Property, Need for a Lawyer, Selecting a Lawyer, Legal Issues in Setting Up the Organization, Patents, Business Method Patents, Trademarks, Copyrights, Trade Secrets, Licensing, Product Safety and Liability, Insurance, Contracts	8
IV	**The Business Plan:** Creating and Starting the Venture: Planning as Part of the Business Operation, Write the Plan, Scope and Value of the Business Plan-Read the Plan, Potential Lenders and Investors Evaluate the Plan, Presenting the Plan, Information Needs, Using the Internet as a Resource Tool, Writing the Business Plan, Using and Implementing the Business Plan, Investigating the failure of Business Plan. **The Marketing Plan:** Industry Analysis, Marketing Research for the New Venture, Understanding the Marketing Plan, Characteristics of a Marketing Plan, The Marketing Mix, Steps in Preparing the Marketing Plan, Contingency Planning, Why Some Plans Fail	8

V	**The Organizational Plan:** Developing the Management Team, Legal Forms of Business, Tax Attributes of Forms of Business, The Limited Liability Company versus the S Corporation, S Corporation, The Limited Liability Company, Designing the Organization, Building the Management Team and a Successful Organization Culture, The Role of a Board of Directors, The Board of Advisors, The Organization and Use of Advisors. **The Financial Plan:** Operating and Capital Budgets, Pro Forma Income Statement, Pro Forma Cash Flow, Pro Forma Balance Sheet , Break-Even Analysis , Pro Forma Sources and Applications of Funds , Software Packages	8
VI	**Sources Of Capital:** An Overview, Personal Funds, Family and Friends, Commercial Banks, Role of SBA in Small Business Financing, Research and Development Limited Partnerships, Government Grants, Private Placement. **Bootstrap Financing Informal Risk Capital and Venture Capital:** Financing the Business, Informal Risk-Capital Market, Venture Capital, Valuing Your Company, Deal Structure	7
	Text Books: 1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd: "Entrepreneurship" (Sixth Edition) Tata McGraw Hill Education Private Limited, Special Indian Edition. **Reference Books:** 1. Rajeev Roy "Entrepreneurship" Oxford Higher Education. 2. Colombo Plan Staff College for Technical Education, Manila "Entrepreneurship Development" Tata McGraw-Hill. Vasant Publishing House.	
	Weblinks 1. https://www.youtube.com/watch?v=vXKoRWAhJVg 2. https://www.youtube.com/watch?v=3OQzo6u3VFM 3. https://www.youtube.com/watch?v=fAz9pQ8w9aY	
	MOOCS: 1. https://onlinecourses.swayam2.ac.in/cec20_mg19/preview (3 credits) 2. https://onlinecourses.nptel.ac.in/noc20_mg35/preview (3 credits) 3. https://www.youtube.com/watch?v=k0nirz2vphA (3 credits)	

DSE IV(2)/N4MCS4(2) - Cyber Security

Course Outcomes (COs):

On completion of this course, students would be able to:

1. Analyses and evaluate the importance of personal data & its privacy & security.
2. Recognized the importance of firewall in cyber-attacks from unauthorized access in network.
3. Increase awareness about Cyber-attack vectors and safety against Cyber-frauds
4. Take measures for self -Cyber protection as well as societal Cyber- Protection.
5. Analyses and evaluate existing legal framework and laws on Cyber security
6. Analyses and evaluate the digital payment system security and remedial measures against digital payment frauds

Unit	Contents	Periods
I	**Introduction to Cyber Security** 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.	7

			66
II	**Network Defence tools** **Firewalls and Packet Filters:** Firewall Basics, Packet Filter Vs Firewall, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address, Translation (NAT) and Port Forwarding. **VPN:** the basic of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System.		7
III	**Digital Devices Security , Tools and Technologies for Cyber Security** 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		8
IV	**Introduction to Cyber Crime, law and Investigation** 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, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, attack, SQL injection, Buffer Overflow, Attack on wireless Networks.		8
V	**Social Media Overview and Security** 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,		8
VI	**E-Commerce and Digital Payments** 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.		7

Textbooks :
1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.

Reference Books :
1. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India.
2. Fundamentals of Network Security by E. Maiwald, McGraw Hill.
3. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
4. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers. Pvt. Ltd..

Web Link :

Web link to Equivalent MOOC on SWAYAM/NPTEL if relevant:
1. https://www.youtube.com/watch?v=yr1Psapupsc
2. https://www.youtube.com/watch?v=PlHnamdwGmw
3. https://www.youtube.com/watch?v=inWWhr5tnEA
4. https://www.youtube.com/watch?v=mo3R-LDTdos
5. https://www.youtube.com/watch?v=3pntAu95Phk

MOOCs:
1. https://onlinecourses.swayam2.ac.in/nou23_cs10/preview   (**3 credits**)
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview   (**3 credits**)
3. https://onlinecourses.nptel.ac.in/noc23_cs127/preview   (**3 credits**)

DSE IV (3)/N4MCS4(3) Data Science and Analytics

Course Outcomes:

On completion of this course, students would be able to:
1. Present an overview of data science and applications.
2. Plan the methods of data collection.
3. Describe the statistical methods in EDA.
4. Apply statistical methods to develop and evaluate the models.
5. Understand the importance of decision making in complex projects
6. Use essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.

Unit	Contents	Periods
I	Introduction to Data Science, Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues. Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning.	7
II	Data Integration and Transformation, Data Reduction, Data Discretization, Exploratory Data Analytics, Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics.	7
III	Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample, Evaluation, Prediction and Decision Making.	8
IV	Data Analytics lifecycle, Exploratory Data Analysis (EDA), Definition, Motivation, Steps in data exploration, The basic data types Data Type Portability, Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation Basics, Missing data handling, Improving the accuracy of analysis	8
V	Introduction to Bayesian Estimation, Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data, Statistical data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, ND Statistical data analysis	8
VI	Introduction, Extreme Value Analysis, Clustering based, Distance Based and Density, Based outlier analysis, Outlier Detection in Categorical Data, Feature selection algorithms: filter methods, wrapper methods and embedded methods, Forward selection backward elimination, Relief, greedy selection, genetic algorithms for features election.	7
Text books:	1. Data Science for Beginners, Andrew Park 2. Fundamentals of Data Visualization, Claus O. Wilke, O'Reilly 2019 3. Data Analytics: The Ultimate Beginner's Guide to Data Analytics, Edward Mize , Repro Books 2019	
Reference Books:	1. "Learning PySpark", Tomasz Drabos, PACKT, 2017. 2. "Apache Spark for Data Science", Padma Priya Chitturi, PACKT, 2017. 3. "Learning Spark". Holden Karau, PACKT, 2016. 4. "Advanced Analytics with Spark", Sandy Riza, O' Reilly, 2016. 5. "Mastering Apache Spark", Romeo Kienzler, PACKT, 2017. 6. "Applied Missing Data Analysis", Craig K. Enders, The Guilford Press, 2010. 7. "Analysis of Multivariate and High dimensional data", Inge Koch, Cambridge University Press, 2014. 8. "Exploratory and multivariate data analysis", Michael Jambu, Academic Press Inc. , 1990. 9. "Data Classification Algorithms and Applications", Charu C. Aggarwal, CRC press, 2015	

Weblinks: 1. https://www.youtube.com/watch?v=CaqJ65CIoMw&t=113s 2. https://www.youtube.com/watch?v=Y6vY-fJbwUA&t=3916s 3. https://www.youtube.com/watch?v=LcWFedjaR4Q&t=1202s 4. https://www.youtube.com/watch?v=X3paOmcrTjQ 5. https://www.youtube.com/watch?v=csG_qfOTvxw 6. https://www.youtube.com/watch?v=eaFaD_IBYW4	
MOOC: 1. https://nptel.ac.in/courses/106106179 (**3 credits)** 2. https://onlinecourses.nptel.ac.in/noc21_cs45/preview (**3 credits)** 3. https://nptel.ac.in/courses/110106072 (**3 credits)**	

Lab-X- Based Cloud Computing and Big Data

N4MCS6

Course Outcomes (COs): CLOUD COMPUTING

On completion of this course, students would be able to:
1. Describe the basic concept of Cloud Computing and Its Models.
2. Analyze and the application and virtualization infrastructures for cloud computing.
3. Exhibit in-depth understanding of key cloud-based services.
4. Understand the necessity of management activity at cloud environment.
5. Create Virtual environment using hypervisor.
6. Develop own cloud with desired functions.

List of Practical's: CLOUD COMPUTING
1. The Study of NIST model of cloud computing.
2. To Install Virtual Box used to create Virtual Environment.
3. To Create Virtual Machine using Virtual Box and deploy Ubuntu operating System.
4. Demonstration of Virtual Box Manager Tool.
5. Demonstration of Capturing, Releasing Keyboard and Mouse with Resizing the Machine's Window in Virtual Box.
6. To Find procedure to install storage controller and interact with it at Virtual Box
7. To Install a 'C' Compiler in the Virtual Machine and Execute a Sample Program.
8. To move the files between virtual machine using virtual box.
9. To Install Google App Engine and Create hello world app.
10. To use Google App Engine launcher to launch the web applications.
11. Demonstration of IAM using Google App Engine.
12. To installation of Openstack and creation of virtual a machine.
13. To implementation of infrastructure as Service using Open Stack.
14. To demonstrate and implement IAAS service using AWS EC2 Instance (Free Tier Account)

Course Outcomes (COs): BIG DATA

1. Able to work with HDFS Commands
2. Able to implement Map Reduce programs
3. Able to Work with the Mongo DB
4. Able to use Spark in designing analytic solutions

List of Practical: BIG DATA

1. HDFS Commands:
   a. Starting and shutting down
   b. Operation to write in file
   c. Listing files
   d. Inserting Data into HDFS
   e. Retrieving Data from HDFS
2. Write a simple program for Word Count Using Map Reduce Programming.
3. Write a program in Map Reduce for Union operation.
4. Write a program in Map Reduce for Intersection operation.
5. Write a program in Map Reduce for GroupSum operation.
6. Write a program in Map Reduce for Matrix Multiplication.
7. Program to Demonstrate spark operators.
8. Program to Demonstrate Spark RDD Transformations methods.
9. Program to Demonstrate Spark RDD Action methods.
10. Practical using Mongo DB to demonstrate Create and Drop commands for Database
11. Practical using Mongo DB to insert or add new documents to the collection
12. Practical using Mongo DB to demonstrate read, update and delete operations.

Lab-XI - Lab Based on Block Chain Technology
N4MCS7

Course Outcomes (COs): Block Chain Technology

1. Explain the fundamental characteristics of block chain using bitcoin.
2. Demonstrate the application of hashing and public key cryptography in protecting the block chain
3. Analyse the block chain applications in a structure manner
4. Handle the crypto currency
5. Perform a transaction in bitcoin testnets.

Each student should perform sample practical list given below using listed tools. More practicals can be added to implement BCT more efficiently.

1. To study basic Hadoop commands
2. To study and implement hash table using hash functions
3. Create simple blockchain using any suitable tool
4. Implementing proof of work
5. Miner rewards and transactions
6. Signing transactions
7. Use Geth for Creating private blockchain using Ethereum
8. Use Geth for Creating account using Ethereum blockchain
9. Use Geth for mining
10. Write a smart contract on solidity to store and get hello world

List of Tools used for Block chain Technology Analysis Software:

1. **AnChain.ai** :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.
2. **Coin base Tracer :**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**.**
3. **Crystal Blockchain :**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.
4. **Uppsala Security :**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.
5. **Coinfirm:** 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.

Lab Based on DSE IV(1)/DSE IV(2)/ DSE IV(3) Lab-XII
N4MCS8

N4MCS8 - DSE IV(1) : Entrepreneurship Development

Course Outcomes (COs): Entrepreneurship Development
1. Able to think innovatively, with effective business model.
2. Able to design business plan.
3. Able to pitch their innovation.
4. Able to marketing the product.
5. Able to learn regarding IPRs, Patents.
6. Able to learn the financial projections.

Practical List for Entrepreneurship Development:

1. **Idea Generation**: Conduct a brainstorming session to generate business ideas and evaluate their feasibility and prepare the idea description.
2. **Opportunity Identification and Assessment**: Analyze real-life business opportunities using techniques such as SWOT analysis and market research. Testing the viability of the idea and prepare the report.
3. **Business Plan Development**: Guide students in creating a comprehensive business plan for a startup idea, covering all essential components and submit the Business Plan.
4. **Case Study Analysis**: Analyze case studies of successful entrepreneurs and their ventures to understand the entrepreneurial decision-making process.eg. Oyo , Ola cabs, Makemytrip, Bharat pay, Paytm, Bigbasket, Zomato, Flipkart, Grofers, Uber, etc.
5. **Intrapreneurship Simulation**: Simulate an intrapreneurial environment within the classroom setting and have students develop and present innovative ideas within an existing organization.
6. **Field Visit to Startups**: Organize visits to local Incubation centre to provide students with practical exposure to the entrepreneurial ecosystem.
7. **Pitching Event**: Conduct a pitching Event where students present their business ideas to a panel of judges, simulating real-life investor presentations and receiving feedback and suggestions for improvement.
8. **Market Research Project**: Assign students to conduct market research for a specific industry or market segment to identify potential opportunities and consumer preferences.
9. **Legal Clinic**: Illustrate the legal aspects of starting a business, including intellectual property rights, contracts, and finance.
10. Write a report on legal aspects on starting a business.
11. Write a report on legal aspects of the business related to IPR.
12. Write a report on legal aspects of the business related to Contracts.
13. Write a report on legal aspects of the business related to Finance.
14. **Entrepreneurial Mindset**: Conduct seminars focused on developing an entrepreneurial mindset, including problem-solving, resilience, creativity and idea creation.
15. **Business Model Canvas**: Guide students in using the Business Model Canvas framework to design and refine their business models.
16. **Out of Box Thinking:** Design a business model with Innovative Thinking & Creative ideas.
17. **Financial Projections Exercise**: Provide students with a hypothetical business scenario and ask them to create financial projections, including income statements, cash flow statements, and balance sheets.
18. **Marketing Plan Simulation**: Assign students to develop a marketing plan for a given product or service, incorporating market analysis, target audience identification, and promotional strategies.

    These practical activities aim to provide students with hands-on experience, develop their entrepreneurial skills, and reinforce the theoretical concepts covered in the Entrepreneurship Development syllabus.

<div align="center">

Lab Based on DSE IV(1)/DSE IV(2)/ DSE IV(3) Lab-XII
N4MCS8
N4MCS8- DSE IV(2) :Cyber security

</div>

Course Outcomes:
1. Understand the cyber security threat landscape.
2. Develop a deeper understanding and familiarity with various types of cyberattacks, cyber crimes, vulnerabilities and remedies thereto.
3. Analyse and evaluate existing legal framework and laws on cyber security.
4. Analyse and evaluate the digital payment system security and remedial measures against digital payment frauds.
5. Analyse and evaluate the importance of personal data its privacy and security

Sr.No.	Practical list
1.	Study of different types Prepare password policy for computer and mobile device.
2.	Study of different types security controls for computer and implement technical security controls in the personal computer.
3.	Steps to Installation and configuration of computer Anti-virus.
4.	Study of different wireless network components and features of any one of the Mobile Security Apps.
5.	Study of the features of firewall in providing network security and to set Firewall Security in windows.
6.	Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
7.	Study of different types of vulnerabilities for hacking a websites / Web Applications.
8.	Analysis the Security Vulnerabilities of E-commerce services.
9.	Analysis the security vulnerabilities of E-Mail Application
10.	Study of different types cryptography
11.	Study of different types digital payments
12.	Steps to Installation and configuration of Computer Host Firewall
13.	Steps to Wi-Fi security management in computer.
14.	Steps to Setting privacy settings on social media platforms.
15.	Study of different Platforms for reporting cybercrimes.
16.	Steps to Configuring security settings in Mobile Wallets and UPIs.
17.	Study of secure net banking.
18.	Study of email phishing attack and preventive measures.
19.	Study of basic checklist, privacy and security settings for popular Social media platforms.
20.	Steps to log into computer system as an administrator and check the security policies in the system.

<div align="center">

Lab Based on DSE IV(1)/DSE IV(2)/ DSE IV(3) Lab-XII
N4MCS8

N4MCS8- DSE IV(3): Data Science & Analytics

</div>

Course Outcomes:

1. Make the use of the python libraries for data science
2. Make the use of the basic Statistical and Probability measures for data science.
3. Perform descriptive analytics on the benchmark data sets. [e.g. Medical images, Trading data, Sensex data, census data etc]
4. Perform correlation and regression analytics on standard data sets.
5. Present and interpret data using visualization packages in Python**.**

List of Practical:

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Write a Python program to demonstrate basic array characteristics.
3. Write a Python Program to Perform Array Slicing.
4. Write a Program in Python to Handle and Analyze data using Pandas
5. Write a Program in Python to handle Missing Valuesin Data .
6. Write a Program in Python to Read and write different types of Files (csv, json,txt etc).
7. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
8. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.

9. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the Bivariate analysis: Linear and logistic regression modelling

10. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the Multiple Regression analysis

11. Write a Program in Python to Make sense of Data by Visualization Methods – I

12. Write a Program in Python to Make sense of Data by Visualization Methods– II

13. Write a Program in Python to perform Regression Analysis on Data.

14. Write a Program in Python to Prepare Data from Text Documents for Text Data Analysis

15. Write a Program in Python to Prepare Data from Image for Image Data Analysis