

MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)



**Autonomous programme
Bachelor of Engineering**



**DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING**

SCHEME and SYLLABUS

I Semester - VIII Semester

(2023-24 Admitted Batch)

VISION

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns

MISSION

1. Impart world class engineering education to produce technically competent engineers.
2. Provide facilities and expertise in advanced computer technology to promote research.
3. Enhance Industry readiness and entrepreneurial abilities through innovative skills
4. Nurture ethical values and social responsibilities

PROGRAM EDUCATIONAL OBJECTIVES

- PEO1: Graduates will be efficient software developers in diverse fields and will be successful professionals and/or pursue higher studies.
- PEO2: Graduates will be capable to adapt to new computing technology for professional excellence and Research and will be lifelong learner
- PEO3: Graduates will work productively exhibiting ethical qualities for the betterment of society.
- PEO4: Graduates will possess leadership qualities, work harmoniously in a team with effective communication skills

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon graduation, students with a degree B.E. in Computer Science & Engineering will be able to:

PSO – 1: To make the students industry ready by facilitating them with software tools in recent technologies

PSO – 2: To develop IT based solutions for problems in diverse domains

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
6. The engineer and 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.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering 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
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Scheme of Teaching and Examinations 2023-24

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2023-24)

I SemesterPHYSICS CYCLE STREAMS:Civil, Mechanical, and Electrical										
Sl.No	CourseCode	CourseTitle	TD	Teaching Hours/Week			Examination			Credits
				L	T	P	CIE Marks	SEE Marks	TotalMarks	
1	23MATC11/ 23MATM11/ 23MATE11	Mathematics for CV/ME/EC Stream	Mathematics	2	2	2	50	50	100	04
2	23PHYC12/ 23PHYM12/ 23PHYE12	Physics for CV/ME/EC stream	Physics	2	2	2	50	50	100	04
3	23CIV13/ 23EME13/ 23BEE13 /23EEE13	Engg. Mechanics/ Elements of Mech. Engg./Basic Electronics/ Elements of Electrical Engg.	CV/ME/ EC/EEE	2	2	0	50	50	100	03
4	23ESC14x	Engineering Science Course-I	Respective Engg. department	3	0	0	50	50	100	03
5	23ETC15x	Emerging Technology Course	Any department	3	0	0	50	50	100	03
6	23ENG16	Communicative English	Humanities	1	0	0	50	50	100	01
7	23KSK17/ 23KBK17	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	50	50	100	01
8	23IDT18	Innovation and Design Thinking	Mechanical (Coordinating Dept)	0	0	2	50	50	100	01
TOTAL				14	06	06	400	400	800	20

TD- Teaching Department,L-Lecture, T-Tutorial, P-Practical,CIE–Continuous Internal Evaluation, SEE- Semester End Examination,

Scheme of Teaching and Examinations 2023-24

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2023-24)

I semester		CHEMISTRY CYCLE					STREAMS: Computer Science			
Sl.No	CourseCode	CourseTitle	TD	Teaching Hours/Week			Examination			Credits
				L	T	P	CIE Marks	SEE Marks	TotalMarks	
1	23MATS11	Mathematics for CSE Stream	Mathematics	2	2	2	50	50	100	04
2	23CHES12	Chemistry for CSE Stream	Chemistry	2	2	2	50	50	100	04
3	23CED13	Computer-Aided Engineering Drawing	CV/ME	2	0	2	50	50	100	03
4	23ESC14x	Engineering Science Course-I	Respective Engg. department	3	0	0	50	50	100	03
5	23PLC15x	Programming Language Course	Any department	2	0	2	50	50	100	03
6	23ENG16	Communicative English	Humanities	1	0	0	50	50	100	01
7	23ICO17	Indian Constitution	Humanities	1	0	0	50	50	100	01
8	23SFH18	Scientific Foundations of Health	Sports	1	0	0	50	50	100	01
TOTAL				14	04	08	400	400	800	20
TD- Teaching Department,L-Lecture, T-Tutorial, P-Practical, CIE–Continuous Internal Evaluation, SEE- Semester End Examination,										

Scheme of Teaching and Examinations 2023-24

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2023-24)

II Semester PHYSICS CYCLE STREAMS: Computer Science										
Sl.No	CourseCode	CourseTitle	TD	Teaching Hours/Week			Examination			Credits
				L	T	P	CIE Marks	SEE Marks	TotalMarks	
1	23MATS21	Mathematics for CS Stream-II	Mathematics	2	2	2	50	50	100	04
2	23PHYS22	Physics for CS stream	Physics	2	2	2	50	50	100	04
3	23PPC23	Principles of Programming Using C	CS	2	0	2	50	50	100	03
4	23ESC24x	Engineering Science Course-II	Respective Engg. department	3	0	0	50	50	100	03
5	23ETC25x	Emerging Technology Course	Any department	3	0	0	50	50	100	03
6	23PWS26	Professional Writing Skills in English	Humanities	1	0	0	50	50	100	01
7	23KSK27/ 23KBK27	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	50	50	100	01
8	23IDT28	Innovation and Design Thinking	Physics (Coordinating Dept)	0	0	2	50	50	100	01
TOTAL				14	04	08	400	400	800	20
TD- Teaching Department, L -Lecture, T -Tutorial, P -Practical, CIE –Continuous Internal Evaluation, SEE - Semester End Examination,										

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2023-24)

II semester		CHEMISTRY CYCLE			STREAMS: Civil, Mechanical, and Electrical					
Sl. No	CourseCode	CourseTitle	TD	Teaching Hours/Week			Examination			Credits
				L	T	P	CIE Marks	SEE Marks	Total Marks	
1	23MATC21// 23MATM21/ 23MATE21	Mathematics for CV/ME/EE Stream-II	Mathematics	2	2	2	50	50	100	04
2	23CHEC22/ 23CHEM22/ 23CHEE22	Chemistry for CV/ME/EE Stream	Physics	2	2	2	50	50	100	04
3	23CED23	Computer-Aided Engineering Drawing	CV/ME	2	0	2	50	50	100	03
4	23ESC24x	Engineering Science Course-II	Respective Engg. department	3	0	0	50	50	100	03
5	23PLC25x	Programming Language Course	Any department	2	0	2	50	50	100	03
6	23PWS26	Professional Writing Skills in English	Humanities	1	0	0	50	50	100	01
7	23ICO27	Indian Constitution	Humanities	1	0	0	50	50	100	01
8	23SFH28	Scientific Foundations of Health	Sports	1	0	0	50	50	100	01
TOTAL				14	04	08	400	400	800	20
TD- Teaching Department, L -Lecture, T -Tutorial, P -Practical, CIE –Continuous Internal Evaluation, SEE - Semester End Examination,										

Malnad College of Engineering, Hassan

List of Elective Courses

I Semester B. E.

(ESC-I) Engineering Science					(ETC-I) Emerging Technology Courses-I				
Code	Title	L	T	P	Code	Title	L	T	P
23ESC141	Introduction to Civil Engineering	3	0	0	23ETC15A	Smart Materials and Systems	3	0	0
23ESC142	Introduction to Electrical Engineering	3	0	0	23ETC15B	Green Buildings	3	0	0
23ESC143	Introduction to Electronics Engineering	3	0	0	23ETC15C	Introduction to Nano Technology	3	0	0
23ESC144	Introduction to Mechanical Engineering	3	0	0	23ETC15D	Introduction to Sustainable Engineering	3	0	0
23ESC141	Introduction to C Programming	2	0	2	23ETC15E	Renewable Energy Sources	3	0	0
					23ETC15F	Waste Management	3	0	0
					23ETC15G	Emerging Applications of Biosensors	3	0	0
					23ETC15H	Introduction to Internet of Things (IOT)	3	0	0
					23ETC15I	Introduction to Cyber Security	3	0	0
					23ETC15J	Introduction to Electric Vehicle Technology	3	0	0
(PLC-I) Programming Language Courses-I					22ETC15K	Introduction to Embedded System	3	0	
Code	Title	L	T	P					
23PLC15A	Introduction to Web Programming	2	0	2					
23PLC15B	Introduction to Python Programming	2	0	2					
23PLC15C	Basics of JAVA programming	2	0	2					
23PLC15D	Introduction to C++ Programming	2	0	2					

Malnad College of Engineering, Hassan

List of Elective Courses

II Semester B. E.

(ESC-I) Engineering Science					(ETC-I) Emerging Technology Courses-II				
Courses-II									
Code	Title	L	T	P	Code	Title	L	T	P
23ESC241	Introduction to Civil Engineering	3	0	0	23ETC25A	Smart Materials and Systems	3	0	0
23ESC242	Introduction to Electrical Engineering	3	0	0	23ETC25B	Green Buildings	3	0	0
23ESC243	Introduction to Electronics Engineering	3	0	0	23ETC25C	Introduction to Nano Technology	3	0	0
23ESC244	Introduction to Mechanical Engineering	3	0	0	23ETC25D	Introduction to Sustainable Engineering	3	0	0
23ESC245	Introduction to C Programming	2	0	2	23ETC25E	Renewable Energy Sources	3	0	0
					23ETC25F	Waste Management	3	0	0
					23ETC25G	Emerging Applications of Biosensors	3	0	0
					23ETC25H	Introduction to Internet of Things (IOT)	3	0	0
					23ETC25I	Introduction to Cyber Security	3	0	0
					23ETC25J	Introduction to Electric Vehicle Technology	3	0	0
(PLC-I) Programming Language Courses-II						Introduction to Embedded System	3	0	0
Code	Title	L	T	P					
23PLC25A	Introduction to Web Programming	2	0	2					
23PLC25B	Introduction to Python Programming	2	0	2					
23PLC25C	Basics of JAVA programming	2	0	2					
23PLC25D	Introduction to C++ Programming	2	0	2					

THIRD SEMESTER					
Course Category	Course Code	Course Title	L-T-P	Credits	Contact Hours
BSC	23MACS301	Mathematics for Computer Science - III	3-1-0	3	4
IPCC	23CS302	Digital Design and Computer Organization	3-0-2	4	5
PCC	23CS303	Operating Systems	3-0-0	3	3
PCC	23CS304	Data Structures and its Applications	3-1-0	3	4
PCCL	23CS305	Data Structures Laboratory	0-0-2	1	2
PCCL	23CS306	Unix and Shell Programming Laboratory	0-0-2	1	2
(ESC/ETC/PLC)	23CS307X	Engineering Science Course (ESC/ETC/PLC)	2-0-2	3	4
UHV	23SCR	Social Connect and Responsibility	0-0-2	1	2
AEC	23CS308X	Ability Enhancement Course	0-0-2	1	2
BSC	23BCM301	Bridge Course Mathematics -I (Mandate Non-Credit Course)	3(A)-0-0	AUDIT	3
MC	23NYP1	NSS, YOGA, PE	0-0-2	AUDIT	2
Total				20	33

Engineering Science Course (ESC/ETC/PLC)		
ESC/ETC/PLC	23CS307A	OOP with Java
ESC/ETC/PLC	23CS307B	OOP with C++

Ability Enhancement Course		
AEC	23CS308A	R Programming
AEC	23CS308B	Data Analytics with Excel
AEC	23CS308C	Data Visualization with Python
AEC	23CS308D	Version Controller with GiT

FOURTH SEMESTER					
Course Category	Course Code	Course Title	L-T-P	Credits	Contact Hours
BSC	23MACS401	Mathematics for Computer Science - IV	3-1-0	3	4
PCC	23CS402	Design and Analysis of Algorithms	3-0-0	3	3
IPCC	23CS403	Microcontroller and Embedded Systems	3-0-2	4	5
IPCC	23CS404	Database Management Systems	3-0-2	4	5
PCCL	23CS405	Algorithms Laboratory	0-0-2	1	2
ESC/ETC/PLC	23CS406X	Engineering Science Course (ESC/ETC/PLC)	3-0-0	3	3
AEC	23CS407X	Ability Enhancement Course	0-0-2	1	2
BSC	23CS408	Biology for Engineers	0-0-2	1	2
UHV	23UHV	Universal Human Values	0-0-2	1	2
MC	23NYP2	NSS, YOGA, PE	0-0-2	AUDIT	3
Total				21	31

Engineering Science Course (ESC/ETC/PLC)		
ESC/ETC/PLC	23CS406A	Optimization Techniques
ESC/ETC/PLC	23CS406B	Discrete Mathematical Structures
ESC/ETC/PLC	23CS406C	Graph Theory and Combinatorics

Ability Enhancement Course		
AEC	23CS407A	Computer Assembly and Networking
AEC	23CS407B	Introduction to Power Bi
AEC	23CS407C	Technical writing using Latex

FIFTH SEMESTER					
Course Category	Course Code	Course Title	L-T-P	Credits	Contact Hours
HSMC	23CS501	Technology Management and Entrepreneurship	3-0-0	3	3
PCC	23CS502	Software Engineering and Project Management	3-2-0	4	5
PCC	23CS503	Data Communications	3-0-0	3	3
IPCC	23CS504	Computer Graphics and Visualization	3-0-2	4	5
PCCL	23CS505	Web Programming Laboratory	0-0-4	2	4
PEC	23CS55X	Professional Elective Course - I	3-0-0	3	3
AEC	23RIP	Research Methodology and IPR	3-0-0	3	3
HSMC	23EVS	Environmental Studies	0-2-0	1	2
MC	23NYP3	NSS, YOGA, PE	0-0-2	AUDIT	2
Total				23	30

Sl. No.	Professional Elective Course - I	
	Course Code	Course Title
1.	23CS551	Digital Image Processing
2.	23CS552	Data Mining and Warehousing
3.	23CS553	Internet of Things
4.	23CS554	Advanced Java

SIXTH SEMESTER					
Course Category	Course Code	Course Title	L-T-P	Credits	Contact Hours
IPCC	23CS601	Machine Learning	3-0-2	4	5
IPCC	23CS602	Computer Networks	3-0-2	4	5
PCC	23CS603	Finite Automata and Formal Languages	2-2-0	3	4
PI	23CS604	Mini Project	0-0-4	2	4
PI	22CS605	Main Project Phase - I	0-0-4	2	4
AEC	23CS606X	Ability Enhancement Course	0-0-2	1	2
PEC	23CS66X	Professional Elective Course - II	3-0-0	3	3
OEC	23OEC6X	Open Elective – I	3-0-0	3	3
MC	23NYP4	NSS, YOGA, PE	0-0-2	AUDIT	2
AEC/SDC	23ASK	Analytical Ability and Soft Skills	0-0-2	1	2
Total				23	34
22CS605 - Mini Project: Student must develop a web based application using the concepts learnt in the courses - Database Management System (23CS505) and Web Programming (23CS602)					

Sl. No.	Professional Elective Course - II	
	Course Code	Course Title
1.	23CS661	Introduction to Computer Vision
2.	23CS662	Artificial Intelligence
3.	23CS663	Wireless Networks
4.	23CS664	Management Information System

Sl. No.	Open Electives	
	Course Code	Course Title
1.	23OEC61	Introduction to Cloud Computing
2.	23OEC62	Introduction to JAVA programming
3.	23OEC63	Web Technology

Sl. No.	Ability Enhancement Course	
	Course Code	Course Title
1	23CS606A	Application Development Laboratory
2	23CS606B	Full Stack Web Development
3.	23CS606C	UI/UX Laboratory
4.	23CS606D	Devops

SEVENTH SEMESTER												
Sl. No	Course Category	Course Code	Course Title	Teaching Hours per Semester					Exam Marks			Credits
				L	T	P	TW/SL	Total	CIE	SEE	Total	
1.	PCC	23CS701	System Software and Compiler Design	42	0	0	48	90	50	50	100	3
2.	PCC	23CS702	Network Security and Cyber Law	42	0	0	48	90	50	50	100	3
3.	PI	23CS703	Main Project Phase - II	0	0	56	4	60	50	50	100	2
4.	PEC	23CS74X	Professional Elective Course - III	42	0	0	48	90	50	50	100	3
5.	PEC	23CS75X	Professional Elective Course - IV	42	0	0	48	90	50	50	100	3
6.	OEC	23OECS7X	Open Elective - II	42	0	0	48	90	50	50	100	3
Total												17

Sl. No.	Professional Elective Course - III		Professional Elective Course - IV		
	Course Code	Course Title	Sl. No.	Course Code	Course Title
1.	23CS741	Deep Learning	1.	23CS751	Pattern Recognition
2.	23CS742	Data Science	2.	23CS752	Big Data Analytics
3.	23CS743	Mobile Communications	3.	23CS753	Cloud Computing
4.	23CS744	Software Testing	4.	23CS754	Green Computing
5.	23CS745	High Performance Computing	5.	23CS755	Natural Language Processing
6.	23CS746	Bio Inspired System	6.	23CS756	Cyber Security

Sl. No.	Open Electives	
	Course Code	Course Title
1.	23OECS71	Introduction to Data Science
2.	23OECS72	IOT and its Applications
3.	23OECS73	Introduction to Big Data

EIGHT SEMESTER												
Sl. No	Course Category	Course Code	Course Title	Teaching Hours per Semester					Exam Marks			Credits
				L	T	P	TW/SL	Total	CIE	SEE	Total	
1.	PEC	23SW01	Professional Elective (Online Course NPTEL)	3	0	0	-	-	50	50	100	3
2.	OEC	23SW02	Open Elective (Online course NPTEL)	3	0	0	-	-	50	50	100	3
3.	PI	23INT	Internship (Research / Industry)(14-16 weeks)	0	0	24	-	-	100	100	200	10
	Total											16

Program Outcome (PO) and Program Specific Outcome (PSO) Mapping

[illegible]

Course Title	MATHEMATICS FOR COMPUTER SCIENCE ENGINEERING - III		
Course Code	23MACS301	L-T-P	(3-1-0) 3
Exam	3 Hrs.	Hours/Week	4
SEE	50 Marks	Total Hours	40L+13T
Course Objective: Students will be able to use appropriate data structures for solving problems.			
Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors.	1	-
2.	Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required ing and analyse the system of equations to compute the number of linearly independent Eigen vectors.	1,2	-
3.	Compute Laplace transform on simple functions , Fourier series of periodic functions, the orthogonal basis, QR factors of Matrices, and solve homogeneous differential equations using matrices	1	-
4.	Examine for adopting different techniques of integration so as to compute Fourier series, Laplace transform of a given function.	1,2	-
5.	Model the real-life problems/engineering application problems and solve the same.	1,2	-
MODULE – 1			10 Hrs.
Laplace Transforms: Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions. Inverse Laplace Transforms: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications of initial value problems in engineering using Laplace transform Self-Study --Unit impulse functions (Dirac – delta function). Application of Fourier series to Laplace equation.			
MODULE – 2			10 Hrs.
Fourier Series: Periodic functions and their graphical representation, to find the function for standard graphs, to find Fourier series by change of interval method, to represent the experimental data as a Fourier series using the method - Practical harmonic analysis. application of Fourier series in engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function. Self-Study -- Half range series method. Applications of Fourier transforms/ fast Fourier transforms in computer science engineering.			
MODULE – 3			10 Hrs.

Linear Algebra: Importance of Matrices in engineering. Rank of a matrix. Consistency of non-homogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors. Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given. Applications of solution of system of equations to balance the chemical equations. Self-Study-- Traffic flow problem, to find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician.	
MODULE – 4	10 Hrs.
Linear Algebra: Eigen values and Eigenvectors, properties, Illustrative examples, Applications- Stretching of an elastic membrane, to determine the growth of a population model. Role of Eigen values, eigenvectors in determining natural frequency Rayleigh power method to find the highest Eigen value. Diagonalization and powers of 3X3 matrices when Eigen values are already given. Gram Schmidt process, QR-factorization, symmetric matrices and quadratic forms, Matrix method to solve homogeneous differential equations of order 2, degree 1. Self-Study-- Stability analysis of differential equations which governs the dynamical systems using the concept of Eigen value, eigenvectors. Applications of system of equations, Eigen value, eigenvectors, linear transformation in computer science. Application of Eigen value Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.	
TUTORIAL: 1. Need to study in rank of a matrix -L3 2. Examples on rank of a matrix and consistency -L3 3. Importance of solution of system of equation in application problems traffic flow –L4 4. Examples on Eigen values and Eigen vectors and diagonalization -L3 5. A report on role of Eigen values and Eigen vector in engineering –L4 6. To fit a Fourier series to the experimental data –L4 7. Examples on Fourier series(change of interval method)-L4 8. Examples on Laplace transform of periodic functions -L3 9. Examples on Laplace transform of unit step- function -L3 10. Examples on Laplace transform of initial value problem -L3 11. A report the application of Fourier series in engineering –L4 12. A report the application of Laplace transform in engineering –L4 Importance of solution of system of equation in application problems chemical reaction-L4	
ACTIVITIES: 1. To represent saw tooth periodic motion of a follower operated by a Cam which rotates uniformly, in the form of Fourier series 2. Application of Fourier series to Laplace equation, heat conduction. 3. Fourier series representation for the excitation described by the wave form, 4. Role of Eigen values, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system). 5. Lenovo input output method – application to balance the economy of a Country. 6. Applications of factorization of matrices-Google recommendation. 7. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering. 8. Diagonalize a matrix and determining the principal stresses. 9. Application of Laplace transformation. 10. Application of Eigen value and Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking. 11. Least square solution of system of equations- a matrix approach 12. Unit impulse functions (Dirac – delta function)- application.	

Course Title	DIGITAL DESIGN AND COMPUTER ORGANIZATION		
Course Code	23CS302	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	48L+12P
Course Objective: Understand organization of a computer system and design logic circuits.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain architecture and functioning of a digital computer components.	1	-
2.	Illustrate working of combinational and sequential logic circuits	1	-
3.	Design combinational and sequential logic circuit for a given problem.	3	-
4.	Apply arithmetic operations and cache mapping methods on a given problem.	2	-
Course Contents:			
MODULE – 1			12 Hrs
Digital Logic : The Basic Gates, The Universal Gates, Boolean Laws and Theorems, Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications - Overlapping, Eliminating Redundant Groups, Don't Care Condition Data-Processing Circuits: Multiplexers, Decoders			
MODULE – 2			12 Hrs
Flip-Flops: RS flip flop, Gated Flip Flop, Edge triggered flip-flop, D FLIP-FLOP, Edge-triggered D FLIP-FLOP, Edge-triggered FLIP-FLOP, JK Master-slave FLIP-FLOP. Various Representation of FLIP-FLOPs. Analysis of sequential Circuits, Conversion of Flip Flops, Registers: Types of Registers Counters: Counter Design as a Synthesis problem Self-Study: Applications of Registers ,Asynchronous and Synchronous Counters			
MODULE – 3			12 Hrs
Basic Structures of Computers: Functional units; Basic Operational Concepts: Bus Structures, Performance. Data Organization: Numbers, Arithmetic operations and characters, Memory Locations and Addresses: Byte addressability, Big-endian & Little-endian assignments, Word Alignment, Accessing Numbers, Characters & Character strings, Addressing Modes. Input/ Output Organization: Accessing I/O devices, Interrupts: Interrupt Hardware, Enabling & Disabling Interrupt, Handling Multiple devices, Controlling Device Requests, Exceptions Self-Study: Computer types ,Generation of Computers			
MODULE – 4			12 Hrs
Direct Memory Access: Bus Arbitration. The Memory System: Basic Concepts, Cache Memories: Mapping functions, Performance considerations: Interleaving, Hit Rate & Miss Penalty. Arithmetic: Multiplication of Positive numbers: Signed-Operand Multiplication: Booth Algorithm; Fast Multiplication; Bit-pair Recoding of Multipliers; Integer division, IEEE Standard for Floating-Point Numbers			
Text Book : 1. Donald P Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015. 2. Carl Hamacher, Z. Vranesic & S. Zaky, Computer Organization , 5 th Edition, McGraw Hill, 2012			
Reference Books:			

1. William Stallings, Computer Organization and Architecture, 9th Edition, Pearson India, 2013
2. M Morris Mano: Digital Logic and Computer Design, 1st Edition, Pearson, 2013.

MOOC:

<http://www.nptelvideos.in/2012/11/computer-organization.html>

Laboratory Component

1. In a battery powered computer, the diskette driver motor 1 should be ON iff
 - There is a diskette in the drive
 - The diskette drive door is closed
 - Diskette drive motor 2 is not ON
 - The battery low signal is not present and
 - The computer has started a read operation or the computer has started a write operationDesign a circuit to solve the above scenario using basic gates.
2. You will gain weight if you eat too much or you do not exercise enough, and your metabolism rate is too low. Design a system such that it alarms you when you gain weight using NAND gates.
3. The circuit breaker will trip iff
 - The hair drier is turned ON
 - The microwave oven is used
 - All the lights in the room are ON or
 - There is a short circuit in any applianceSolve the above issue using relevant MUX.
4. In an automated house, two lamps L1 and L2 are controlled by 3 switches: A, B,C. Any one of the lamps should be ON, following the below conditions
 - L1 is ON if switch A and B are open but not C
 - L1 is ON if switch B and C are open but not A
 - L2 is ON if only switch C is open
 - L2 is ON if only switch B is open
 - L2 is ON if switch A or C is open, but not BDesign a circuit to make the lamp ON using decoder.
5. Assume you are generating and transmitting binary data from one place to another. Check whether the sent data is transmitted properly.
6. Assume you need to send a secret message consisting of numbers from 1 to 9 and letters from A to F. Secret message is encoded using excess 3 code. Design a circuit using ADDER IC to send a secret message to your friend.
7. Consider a computer operator who needs to generate a sequence 1011 continuously which is transmitted across the network. Design a circuit to implement this job.
8. Consider a scenario where in you want to take print out of few selected random pages in sequence numbered from 0 to 15. Design a circuit to achieve this task using J-K Flip-flops.
9. Design and implement a 3-stage up/down counter that counts from a preset value using Decade presentable counter ICs. Display the result suitably.

Course Articulation matrix

[illegible]

Course Title	OPERATING SYSTEMS		
Course Code	23CS303	(L-T-P) C	(3-0-0)3
Exam. Hours	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Understand the role of Operating system in managing computer resources.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to :			
COs	Statement	Mapping to POs	Mapping to PSOs
1.	Explain fundamental concepts of operating system.	1	-
2.	Apply resource management strategies in operating system.	3, 5, 9, 10	2
3.	Explore various process synchronization techniques.	2	-
4.	Use Suitable algorithms to handle deadlock.	3	2
Course Contents:			
MODULE – 1			10 Hrs
Introduction to Operating Systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and security; Distributed system. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation;			
MODULE – 2			10 Hrs
Operating System structure; Virtual machines. Process Management: Process concept; Process scheduling; Operations on processes; Inter- process communication, Threads: Overview; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling;			
MODULE – 3			10 Hrs
Process Synchronization: Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization. Deadlocks: Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.			
MODULE – 4			10 Hrs
Memory Management: Main Memory: Background; Swapping; Contiguous memory allocation; Paging; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement. Mass-Storage Structures: Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management			
Text Book:			
Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8 th edition, Wiley-India, 2012.			
Reference Books:			
1. D.M. Dhamdhare: Operating systems - A concept based Approach, 3rd Edition, Tata McGraw- Hill, 2006. 2. P.C.P. Bhatt: Operating Systems, 2nd Edition, PHI, 2006. 3. Harvey M Deital: Operating systems, 3rd Edition, Pearson Education, 1990.			
MOOC:			

[illegible]

Course Title	DATA STRUCTURES AND ITS APPLICATIONS		
Course Code	23CS304	L-T-P-C	(3-1-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40L+10T
Course Objective: To be able to use appropriate data structures for designing programs.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the operations of linear and non-linear data structures	1	-
2.	Implement operations of linear and non-linear data structures	1	-
3.	Apply suitable data structures to solve a problem	2,3	-
4.	Develop a program using linear and non-linear data structures for a given scenario	2,3	2
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Structures and pointers revisited. Introduction to data structures - Basic terminology, Classification, Operations. The Stack - Definition, Operations, Array Representation of stacks in C Applications of stack: Infix, postfix and prefix, Basic definitions and examples, evaluating a postfix expression, Program to evaluate a postfix expression, converting an expression from infix to postfix, Program in C to convert an expression from infix to postfix.			
MODULE – 2			10 Hrs
Recursion - finding GCD, Fibonacci Series, Recursion Types, Tower of Hanoi, and Recursion versus iteration. Queues - Definition, Array representation of Queues, Operations on Queues, Types of Queues- Circular Queue and its implementation in C, Applications of Queues. Linked List: Introduction to linked list, linked list versus arrays, Singly linked list operations - Insert, Delete, Display, Search and Traverse.			
MODULE – 3			10 Hrs
Other Lists structures: Circular Lists - C Implementation by adding and deleting nodes, Doubly Linked List - C implementation by adding and deleting nodes, Circular doubly linked list, Linked list Applications: Linked Implementation of stacks and Queues, Polynomial Representation.			
MODULE – 4			10 Hrs
Trees: Basic Terminology, Types, Representation using array and Linked List. Creating a binary tree from a general tree, Traversing a binary tree- In-order, Pre-order, Post order, Level order, Constructing a binary tree from traversal results. Efficient Binary Trees: Binary Search trees - definition, Operations- Create, Insert, delete, display, Finding height, Finding number of nodes. AVL trees - Definition, Rotations, Constructing an AVL tree.			
Text Book: Data Structures Using C, Second edition, Reema Thereja, Oxford Press, 2017.			

Reference Books:

1. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
2. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C, Cengage Learning, 2005.
3. Debasis Samanta: Classic Data Structures, 2nd Edition, PHI, 2009.
4. Balagurusamy E, Programming in ANSI C, 7th Edition, Tata McGraw Hill, 2017.

MOOC:

http://nptel.ac.in/keyword_search_result.php?word=data+structures

Problems solved in tutorial classes:

1. Sort array elements using pointers.
2. Design a structure COMPLEX that represents the complex number. Write program to
 - i. add complex numbers
 - ii. subtract complex numbers
3. Find the factorial of a given number using pointers
4. Reverse an array using pointers
5. Given an array A[] and a number x, check for pair in A[] with sum as x
6. Find the Number Occurring Odd Number of Times
7. Find Median of two sorted arrays
8. Problems on linked list
9. Split a Circular Linked List into two halves
10. Check for balanced parentheses in an expression
11. Find the first circular tour that visits all petrol pumps
12. Maximum Depth or Height of a Tree
13. Check if a binary tree is BST or not
14. AVL Tree construction.

Course Articulation matrix

[illegible]

Course Title	DATA STRUCTURES LABORATORY		
Course Code	23CS305	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: Design and implement various data structures.			
Course Outcomes (COs): Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Implement operations of linear and non-linear data structures statically or dynamically	3	2
2.	Develop programs to demonstrate applications of data structures	3	2
3.	Document the programs executed	10	-
Course Contents:			
Practice Programs			
1.	Write a C program to find the maximum and minimum element in an array of n integers. Use only pointers for referencing the array.		
2.	Write a C program for Dynamic Memory allocation of 10 elements and find the largest element.		
3.	Write a C program to represent a complex number using structure variable. Write user defined functions that accept two complex numbers and finds their sum and difference.		
4.	Define a structure Author name with fields: First name, Middle name and Last name. Using the above structure, design another structure Book: ISBN, Author name, Book Title, Price, Publisher, and Edition. Write a function to search a book given the Author name. Using the above function write a C Program to store N books information and display the details of a book given the author name.		
Exercise Programs			
1.	Files are placed one over another in my study room. The file which is at the top is the first one to be removed, i.e. the file which has been placed at the bottom most position remains in the pile of files for the longest period of time. Help me out to add a file and remove the bottom most file from the pile of files.		
2.	Consider an algebraic expression which needs to be evaluated by a computer system. Operating System (OS) consumes less time to evaluate if it is in postfix form of the expression. Thus, help your OS to evaluate by converting the expression into its postfix form.		
3.	Assume you have converted an algebraic expression into its postfix form to process the expression fast. This expression needs to be evaluated for a given set of values. Implement the above.		
4.	Assume you come across a toll gate while you are on your way to home town. Illustrate the working of the toll gate using suitable data structure		
5.	a) Suppose you want to search a text book in a huge library where books are arranged in alphabetical order. Optimize your search by using recursion. b) Implement Tower of Hanoi problem using recursion.		
6.	Consider a traffic signal controlled by a computer system. Traffic signal has three colors: Red, yellow and Green. All these glow in a circular fashion based on the traffic. Implement the above using suitable data structure.		

7.	The parking lot has a fixed number of parking spaces. Cars can enter the parking lot and occupy an available space, and they can also exit the parking lot, freeing up the space for other cars. Designing a parking lot management system using a circular queue.
8.	Consider a treasure hunt task where a series of clues are given. Clue1 gives hint to clue2, clue2 Provides hint for clue3 and so on until you can get a hint to the final treasure. Develop an illustration to demonstrate the above scenario.
9.	Consider a list of numbers. Find i. Maximum number ii. Minimum number iii. Sum of all the numbers
10.	The phonebook will contain a list of contacts sorted in ascending order based on their names. Each contact will have a name and a phone number. Developing a phonebook management system using an ordered linked list.
11.	Assume you have an iPod, where in you have stored plenty of songs so that you get engaged during a long journey. If you want to hear a particular song, you need to use forward button to reach that song and can also traverse back using backward button. Implement the following using relevant data structure.
12.	Your text book contains chapters, sections, subsections, subdivisions, etc. Illustrate this scenario of text book using tree structure.

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-

Course Title	UNIX AND SHELL PROGRAMMING LABORATORY		
Course Code	23CS306	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: Develop shell scripts.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Execute the UNIX commands.	1	-
2.	Develop shell script for a given problem and document the same.	3,10	1,2
Course Contents:			
Practice Programs			
Execute basic UNIX commands, VI editor commands and File comparing commands.			
Exercise Programs			
- Write a shell script to read a message “Good Morning” and display it 10 times at regular intervals of 60 seconds. - Write a shell script that accepts a string as a command line argument and reverse it. - Write a shell script to generate multiplication table. - Write a shell script to print sum of individual digits of a number. - Write a shell script to search a given pattern in file, if found display the message “Found” or else display “Not found”. Accept the pattern and input file as command line arguments. - Write a shell script to accept the pattern and file to be used. If the pattern is not entered display a message ”String not entered”. If file name is not mentioned display appropriate message. - Write a shell script to check whether the given file has read and write and execute permission. - Write a shell script that searches a given string in a given file and prints the number of times it repeats, else display proper error message. The script should accept the file as command line argument. - Write a shell script to display all the process running in the system every 30 seconds for 5 times using a) while b) for. - Write a shell script that takes a command –line argument and reports on whether it is directory, a file, or something else. - Write a shell script that accepts one or more file name as arguments and converts all of them to uppercase, provided they exist in the current directory. - Write a shell script that deletes all lines containing a specified word in one or more files supplied as arguments to it - Write a shell script that computes the gross salary of an employee according to the following rules: i) If basic salary is < 1500 then HRA =10% of the basic and DA =90% of the basic. ii) If basic salary is >=1500 then HRA =Rs500 and DA=98% of the basic the basic salary is entered interactively through the key board. - Write a shell script that accepts two integers as its arguments and computes the value of first number raised to the power of the second number.			

12. Write an interactive file-handling shell program. Let it offer the user the choice of copying, removing, renaming, or linking files. Once the user has made a choice, have the program ask the User for the necessary information, such as the file name, new name and so on.
13. Write shell script that takes a login name as command – line argument and reports when that Person logs in.
14. Write a shell script which receives two file names as arguments. It should check whether the two file contents are same or not. If they are same then second file should be deleted.
15. Write a shell script to perform the following string operations:
 - i. To extract a sub-string from a given string.
 - ii. To find the length of a given string.
16. Write a menu driven shell script to perform the following:
 - i) List of users who are logged in
 - ii) List of files in the current directory
 - iii) List of processes of users
 - iv) Today's date
 - v) Quit to Unix

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	2	-	-	2	2

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	23CS307A	L-T-P-C	(2-0-2)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	36L+10P
Course Objective: Develop java application programs using object-oriented concepts.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the fundamentals of Object Oriented Programming and Java syntax	1	-
2.	Develop java programs for a given problem using suitable Object Oriented concepts	3,5	1,2
3.	Analyze the syntax and semantics of a given java code/snippet.	2	1
Course Contents:			
MODULE – 1			9 Hrs
Object Oriented Concepts and Java: Concepts of Object-Oriented programming language: Object, Class, Message passing, inheritance, encapsulation, and polymorphism Difference between OOP and other conventional programming – advantages and disadvantages of OOP. Java Programming Fundamentals: Java and Java Applications, Java Development Kit (JDK), The Byte Code, The Java Buzzwords, A first Simple program, handling syntax errors, The Java Keywords, Identifiers in Java. Data Types and Operators: Java’s Primitive Types, A Closer Look at Variables, The Scope and Lifetime of Variables, Operators: Arithmetic, Bitwise, Relational, Boolean Logical, Assignment Operators, the ‘?’ Operator, Type conversion and Casting, Arrays, Strings.			
MODULE – 2			9 Hrs
Program Control Statements: Input characters from the Keyboard, if statement, Nested ifs, if-else-if Ladder, Switch Statement, Nested switch statements, for Loop, Enhanced for Loop, While Loop, do-while Loop, Nested Loops, Use of break and continue. Introducing Classes, Objects and Methods: Class Fundamentals, Declaring Objects, Object Reference Variables, Methods, Constructors, the “This” keyword, Garbage collection, Overloading Methods and constructors, Argument Passing, Returning Objects, Access Control, Understanding Static, Nested and Inner Classes.			
MODULE – 3			9 Hrs
Inheritance: Inheritance Basics, Member Access and Inheritance, Constructors and inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding, Overridden Methods support polymorphism, Why overridden Methods, Using Abstract Classes, Using final, The object class.			
MODULE – 4			9 Hrs
Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Implementing Multiple Interfaces, Interfaces can be extended, Nested Interfaces. Packages: Package Fundamentals, Packages and Member Access, Importing Packages, Static import. Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and Catch, Multiple catch Clauses, throw, finally, Java’s Built-in Exceptions, Customized exceptions.			
Text Books: 1. Java Fundamentals, A comprehensive Introduction by Herbert Schildt, Dale Skrien. Tata McGraw Hill Edition 2013 (Chapters 1,2,3,4,5,6,7,8,9,10,12) 2. Java –The complete Reference, by Herbert Schildt Eight Edition Tata McGraw Hill Education (Chapter 19).			

1. Programming in JAVA2 by Dr K Somasundaram ,Jaico publications
2. Java Programming by Hari Mohan Pandey, Pearson Education, 2012.
3. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson.

1. <http://nptel.ac.in/courses/106106147/>
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. <https://www.coursera.org/specializations/object-oriented-programming>

Write and execute the following programs in java:

1. Write java programs
 - a. To print Fibonacci series without using recursion and using recursion.
 - b. To check prime numbers.
 - c. To sort an array elements using bubble sort algorithm.
2. Create a class called account with the data members (accNum: integer, name: string, phoneNum:integer, balAmt:float) and following methods:
 - a. getInput() to get input from the user.
 - b. deposit() method which takes the amount to be deposited in to his/her account and do the calculation.
 - c. withdraw() method which gets the amount to be withdrawn from hi/her account.
 - d. Print the appropriate results.
3. Define a stack class to implement the stack data structure. Include constructors to perform initialization, method push to push an element into the stack, method pop to remove an element from the stack and display method to display the elements of the stack.
4. Define a class Complex with data members as two complex numbers, constructors for initialization these numbers, members, methods to add and subtract two complex numbers.
5. Write a java program to work with strings:
 - a. Program to check whether a string is a Palindrome
 - b. Read a text and count all the occurrences of a particular word.
 - c. Replace a substring in the given string,
 - d. Rearrange the string and rewrite in alphabetical order.
 - e. Compare two string ignoring case.
 - f. Concatenate two strings.
6. Write a Java program to create a class called Shape with a method called getArea(). Create a subclass called Rectangle that overrides the getArea() method to calculate the area of a rectangle.
7. Write a Java program to create an abstract class BankAccount with abstract methods deposit () and withdraw(). Create subclasses: SavingsAccount and CurrentAccount that extend the BankAccount class and implement the respective methods to handle deposits and withdrawals for each account type.
8. Write a Java program that reads a list of integers from the user and throws an exception if any numbers are duplicates.

[illegible]

Course Title	OBJECT ORIENTED PROGRAMMING WITH C++		
Course Code	23CS307B	L-T-P-C	(2-0-2)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	36L+10P
Course Objective: Students will be able to solve real world problems using Object oriented concepts.			
Course Outcomes (COs): Upon completion of the course, students shall be able to			
#	Course outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the object-oriented programming concepts.	1	-
2.	Develop reusable and extensible programs using Inheritance.	3	-
3.	Implement the concept of Encapsulation, Polymorphism and exception handling.	3	-
4.	Design the solution to a real world problem using Object – Oriented programming concepts.	3	-
Course Contents:			
MODULE – 1			9 Hrs.
Introduction to Object Oriented Programming: A Look at Procedure-Oriented Programming, Object-Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, Object-Oriented Languages, Applications of OOP. A Simple C++ Program, More C++ Statements, Structure of C++ Program, An Example with Class, Tokens, Keywords, Identifiers and constants, Reference Variables, Operators in C++, Scope resolution operator, Expressions and their types– Special assignment expressions.			
MODULE – 2			9 Hrs.
Functions in C++: Function prototyping, Call by reference, Return by reference, Inline functions, Default arguments, Function overloading. Classes and Objects: Specifying a Class, Defining Member Functions, A C++ Program with Class, Static Data Members, Static Member Functions, Arrays of Objects, Objects as Function Arguments, Friend Functions, Returning Objects, Constructors, Parameterized Constructors, Multiple Constructors in a class, Copy Constructor, Destructors.			
MODULE – 3			9 Hrs.
Operator Overloading: Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators - Overloading Binary Operators using Friend function – Manipulation of strings using Operators – Rules for Overloading Operators. Inheritance: Derived class Constructors, destructors, Types of Inheritance, Defining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.			
MODULE – 4			9 Hrs.
Templates: Class Templates – Class Templates with Multiple Parameters, Function templates, Function Templates with Multiple Parameters, Overloading of Template functions, Member Function Templates. Exception Handling: Introduction to Exception, Benefits of Exception handling, Try and catch block Throw statement, Pre-defined exceptions in C++.			
Text Book: E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , 8 th Edition 2020.			

Reference Book:
Bhushan Trivedi, “Programming with ANSI C++”, Oxford Press, Second Edition, 2012.

Bhushan Trivedi, “Programming with ANSI C++”, Oxford Press, Second Edition, 2012.

Laboratory Component:

Sl. No.	Experiments
1.	Develop C++ program to demonstrate the use of scope resolution operator.
2.	Develop C++ program to demonstrate Call by reference.
3.	Develop C++ program to demonstrate Inline functions.
4.	Develop C++ program to demonstrate Default arguments.
5.	Develop C++ program to demonstrate Function overloading.
6.	Develop C++ program to demonstrate Constructors and Destructors.
7.	Develop C++ program to demonstrate Operator Overloading.
8.	Develop C++ program to demonstrate Friend function.
9.	Develop C++ program to demonstrate Single Inheritance.
10.	Develop C++ program to demonstrate Multiple Inheritance.
11.	Develop C++ program to demonstrate Hierarchical Inheritance.
12.	Develop C++ program to demonstrate Class Templates.
13.	Develop C++ program to demonstrate Function templates.
14.	Develop C++ program to demonstrate Exception handling.

Course Articulation matrix

[illegible]

Course Title	R PROGRAMMING		
Course Code	23CS308A	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: To learn and Practice Programming techniques using R Programming.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mappin gto PSOs
1.	Prepare the dataset in suitable format with required preprocessing.	1	-
2.	Apply suitable R programming language constructs to write a program.	2, 3, 5	-
3.	Use visualization packages and file handlers for data analysis.	1, 2	-
Course Contents:			
Practice Programs:			
1. Installation of R Studio 2. Write an R Program to take input from the user (name and age) and display the values. Also print the version of R installation. 3. Write an R Program to get the details of the objects in memory. 4. Write an R Program to create a sequence of numbers from 20 to 50 and find the mean and product of numbers from 20 to 60 and sum of numbers from 51 to 91. 5. Write an R Program to multiply two vectors of integer's type and length 3.			
Guided Laboratory Experiments			
1. Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors. d) Demonstrate Creation of Matrices e) Demonstrate the Creation of Matrices from Vectors using Binding Function. f) Demonstrate element extraction from vectors, matrices and arrays 2. Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: a. Profit for each month. b. Profit after tax for each month (Tax Rate is 30%). c. Profit margin for each month equals to profit after tax divided by revenue. d. Good Months – where the profit after tax was greater than the mean for the year. e. Bad Months – where the profit after tax was less than the mean for the year. f. The best month – where the profit after tax was max for the year. g. The worst month – where the profit after tax was min for the year.			

Note: a. All Results need to be presented as vectors b. Results for Dollar values need to be calculated with \$0.01 precision, but need to be presented in Units of \$1000 (i.e 1k) with no decimal points c. Results for the profit margin ratio need to be presented in units of % with no decimal point. d. It is okay for tax to be negative for any given month (deferred tax asset) e. Generate CSV file for the data.

3. Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication
4. Develop a program to find the factorial of given number using recursive function calls.
5. Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.
6. The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:
 - a) Find the Pearson and Spearman correlation coefficients. Are they similar?
 - b) Plot the data using the plot command.
 - c) Plot the logarithm (log) of each variable and see if that makes a difference.
7. Develop R program to create a Data Frame with following details and do the following operations.

Item code	Item category	Item price
1001	Electronics	700
1002	Desktop Supplies	300
1003	Office Supplies	350
1004	USB	400
1005	CD Drive	800

- a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
- b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
- c) Create another Data Frame called “item-details” with three different fields item_Code, ItemQtyonHand and ItemReorderLvl and merge the two frames
8. Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.
 - a) Assigning names, using the air quality data set.
 - b) Change colors of the Histogram
 - c) Remove Axis and Add labels to Histogram
 - d) Change Axis limits of a Histogram
 - e) Add Density curve to the histogram
9. Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.

Course Title	DATA ANALYTICS WITH EXCEL																																						
Course Code	23CS308B	L-T-P-C	(0-0-2)1																																				
Exam Hrs.	3	Hours / Week	2																																				
SEE	50 Marks	Total Hours	14P																																				
Course Objective: To learn and Practice various Data analytics using Excel tool.																																							
Course Outcomes (COs): Upon completion of the course, students shall be able to:																																							
#	Course Outcomes	Mapping to POs	Mapping to PSOs																																				
1.	Apply the mathematical calculations in Excel	1, 2	2																																				
2.	Apply sorting, Filtering and condition format for various problems	2, 3, 5	1																																				
3.	Create different excel charts for the given problem.	1,5,12	1,2																																				
Course Contents:																																							
Guided Laboratory Experiments																																							
1. In a company, 30 employee details (name, Date of Joining, Qualification, and Salary) are stored in Microsoft Access Database and text file. Using Excel tool import the data from different sources for analysis and perform the following: a. Show average salary. b. Show salary between 30000/- and 50000/- c. Sort the employee list on the date of joining.																																							
2. Suppose a class of size 40 having SGPA of 8 semesters between 5 to 10. Calculate the CGPA of each student in below Grade form:																																							
<table><tr><td>O</td><td>S</td><td>A</td><td>B</td><td>C</td></tr><tr><td>100>=9</td><td>8 - 8.9</td><td>7 – 7.9</td><td>6 – 6.9</td><td>5 – 5.9</td></tr></table>				O	S	A	B	C	100>=9	8 - 8.9	7 – 7.9	6 – 6.9	5 – 5.9																										
O	S	A	B	C																																			
100>=9	8 - 8.9	7 – 7.9	6 – 6.9	5 – 5.9																																			
3. Create 40 students name in the form of First name, Middle name and Last name. Concatenate all the names and store in one column and also find the length of each name.																																							
4. Suppose your customer survey results from the east and west regions, month wise are																																							
<table><tr><td>Month</td><td>East</td><td>West</td><td>Low (<50%)</td><td>Medium (50%-80%)</td><td>High (>80%)</td></tr><tr><td>Apr-15</td><td>86.4%</td><td>63.0%</td><td>50%</td><td>30%</td><td>20%</td></tr><tr><td>May-15</td><td>45.8%</td><td>58.9%</td><td>50%</td><td>30%</td><td>20%</td></tr><tr><td>Jun-15</td><td>44.1%</td><td>81.6%</td><td>50%</td><td>30%</td><td>20%</td></tr><tr><td>Jul-15</td><td>77.6%</td><td>86.1%</td><td>50%</td><td>30%</td><td>20%</td></tr><tr><td>Aug-15</td><td>80.7%</td><td>95.0%</td><td>50%</td><td>30%</td><td>20%</td></tr></table>				Month	East	West	Low (<50%)	Medium (50%-80%)	High (>80%)	Apr-15	86.4%	63.0%	50%	30%	20%	May-15	45.8%	58.9%	50%	30%	20%	Jun-15	44.1%	81.6%	50%	30%	20%	Jul-15	77.6%	86.1%	50%	30%	20%	Aug-15	80.7%	95.0%	50%	30%	20%
Month	East	West	Low (<50%)	Medium (50%-80%)	High (>80%)																																		
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Jul-15	77.6%	86.1%	50%	30%	20%																																		
Aug-15	80.7%	95.0%	50%	30%	20%																																		
For the above date, display customer satisfaction survey using Band Chart.																																							
5. A Person takes a loan of Rs. 5,00,000/- for a tenure of 30 years, find the monthly payments (EMI) for the varied interest rates (Assume interest rate start with 12% and incremented by 2% in each month). Calculate the amount of interest and Principal that is paid in the second year. (use what if Analysis tool)																																							
6. Suppose there is a bookstore that has 100 books in storage. The original price of the book is 250 and certain number of books was sold at that price. Later, the bookstore announced a 10% discount on that book and cleared off the stock. You might want to know how many books are sold at the original price to obtain total revenue of 24,500.																																							
7. Suppose you want to have a report displaying the following – (Explore Data using Pivot Table)																																							

- a. Data for five disciplines - Archery, Diving, Fencing, Figure Skating and Speed Skating.
 - b. Regions that scored more than 80 medals in these 5 disciplines.
 - c. The count of medals in each of the five disciplines in each of these regions.
 - d. Total count of medals for the five disciplines in each of these regions.
8. Consider the data of 30 employees are stored in two different tables. First table consists of name, employee ID and Second table consists of employee ID, salary. Find the employee salary using lookup table from second table to first.
9. In Olympic, 20 countries participated and won various medals by male and female in equal proportions. Display the medal count for each country with the charts (Pie, Column, Bar, Line, Scatter, and Bubble).
10. Consider the sequence of data from 1 to 100, where Male are 48% and Female are 52% in the data. For the given data create Male vs Female Info-graphic Chart, Male vs Female Ratio Chart and Waffle chart.

Course Articulation matrix

[illegible]

Course Title	DATA VISUALIZATION WITH PYTHON		
Course Code	23CS308C	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: To explore principles and techniques of data visualization using Python.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate the use of IDLE or PyCharm IDE to create Python Applications	1, 5	-
2.	Apply various visualization techniques using suitable python libraries.	2, 5, 9	2
3.	Implement, document and present the data visualization projects for the chosen problems.	2, 5, 9, 10	2
Course Contents:			
1. Write a Python program to read data from a CSV file and create a line plot to visualize the trend over time. Customize the plot with appropriate labels, title, and color. 2. Load a dataset containing information about students' scores in different subjects. Create a scatter plot to visualize the relationship between two variables (e.g., math score vs. science score). Use Seaborn to enhance the plot with appropriate styling and add labels. 3. Given a dataset with multiple variables, create a figure with two subplots: one displaying a line plot and the other showing a bar chart. Customize the subplots with appropriate titles, legends, and colors. 4. Load a dataset containing information about employees' salaries across different departments. Create a box plot and a violin plot to visualize the distribution of salaries by department. Customize the plots and add appropriate labels and titles. 5. Load a dataset containing stock prices over time. Create a line plot to visualize the stock prices and add appropriate labels and titles. Format the x-axis tick labels to display the dates properly. 6. Load a dataset containing temperature readings over time. Create an interactive line plot using Plotly, which displays the temperature when hovering over the data points. Add appropriate labels and customize the plot's appearance. 7. Load a dataset with information about population density by country. Create a choropleth map using GeoPandas to visualize the population density. Customize the map's appearance and add a color legend. 8. Design and implement an interactive dashboard using Dash to display various visualizations. Include at least two interactive controls (e.g., dropdowns, sliders) to update the visualizations dynamically. 9. Select a dataset related to a specific topic of interest (e.g., climate change, COVID-19). Design a series of visualizations that tell a compelling data story, highlighting key insights and trends. Present the visualizations with appropriate annotations and captions. 10. Choose a dataset related to a real-world problem (e.g., retail sales, customer behavior). Explore the dataset, identify interesting patterns, and design a set of visualizations to present the findings effectively. Present the visualizations along with a brief explanation of the insights gained.			

MOOC:

1. <https://www.coursera.org/learn/python-for-data-visualization>
2. <https://www.edx.org/learn/data-visualization/ibm-visualizing-data-with-python>

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	3	-	-	-	3	-	-	-	-	3
CO3	-	3	-	-	3	-	-	-	3	3	-	-	-	3

Course Title	VERSION CONTROLLER WITH GiT		
Course Code	23CS308D	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: To use GitLab/Git and utilize it for software development.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Construct the repository using various Git commands.	3, 5	1, 2
2.	Demonstrate and document the work carried out	5, 9, 10	1, 2
Course Contents:			
1. Initializing a Repository: Initialize a new Git repository for a simple project. Add a few files to the repository and commit them. 2. Committing Changes: Make changes to the files in the repository and commit them. Practice creating meaningful commit messages 3. Creating and Switching Branches: Create a new branch in the repository, make changes in the branch, and switch between branches. 4. Merging Branches: Create a branch, make changes in both the main branch and the new branch, and merge the changes back into the main branch. 5. Resolving Merge Conflicts: Create a merge conflict by making conflicting changes in two different branches. Practice resolving the conflict using Git's conflict resolution tools. 6. Working with Remote Repositories: Clone a remote repository to your local machine. Make changes locally and push the changes back to the remote repository. 7. Collaborating with Others: Practice collaborating with others using Git. Clone a shared repository, make changes, push the changes, and pull changes made by others. 8. Reverting and Rolling Back Commits: Experiment with reverting commits and rolling back changes to a previous state in the repository using Git commands. 9. Tagging Releases: Tag a specific commit in the repository as a release version. Practice creating annotated tags and lightweight tags. 10. Ignoring Files: Create a .gitignore file to exclude certain files or directories from being tracked by Git. 11. Viewing Repository History: Use Git commands to view the commit history, explore differences between commits, and track changes made over time. 12. Branch Management: Practice creating, deleting, and renaming branches in the repository using Git commands.			
eBook: https://www.oreilly.com/library/view/version-control-with/9781492091189/			
MOOC: 1. https://www.coursera.org/learn/version-control-with-git 2. https://www.classcentral.com/course/microsoft-learn-introduction-to-version-control-with-git-2391			

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	3	-	-	-	-	-	-	-	2	3
CO2	-	-	-	-	3	-	-	-	2	2	-	-	2	3

Course Title	SOCIAL CONNECT & RESPONSIBILITY		
Course Code	23SCR	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2
CIE	100 Marks	Total Hours	20 hours
Course Objective: Provide a formal platform for students to communicate and connect with their surroundings and create a responsible connection with society. Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe societal challenges and build solutions to alleviate these complex social problems through immersion, design & technology.	3,5,6	
2.	Communicate and connect with their surroundings.	7,12	
Course Content			
MODULE – 1			5 Hrs
Plantation and adoption of a tree: Plantation of a tree that will be adopted by a group of students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.			
MODULE – 2			5 Hrs
Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms.			
MODULE -3			5 Hrs
Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.			
MODULE -4			5 Hrs
Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices. Food Walk City's culinary practices, food lore, and indigenous materials of the region used in cooking.			
Course Conduction			
A total of 15-20 hours engagement per semester is required for the course. Students will be divided into teams and each team will be handled by two faculty mentors . Faculty mentors will design the activities for evaluation.			
Guideline for Assessment Process: Continuous Internal Evaluation (CIE) After completion of, the social connect, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. • Dairy recording the details of activity conducted • Planning and scheduling the social connect • Information/Data collected during the social connect • Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below			
Excellent		80 to 100	

	Good	60 to 79	
	Satisfactory	40 to 59	
	Unsatisfactory and fail	<=39	

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	2	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	3	-	-	-	-	3	-	-

Course Title	BRIDGE COURSE MATHEMATICS		
Course Code	23BCM301	L-T-P	(3-0-0)
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	42
Course Objective: Students will be able to use appropriate data structures for solving problems. Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping To PSO's
1.	Solve simple problems on determinants, matrix multiplication, partial differentiation, and integration.	1	-
2.	Compute the roots of transcendental equations and interpolate when the experimental data is given.	1	-
3.	Expand the given function in terms of Taylor/ Macluarin's series.	1	-
Course Content			
MODULE – 1			10Hrs.
Basic Formulas: Partial fractions. Matrices and determinants: matrix multiplication, evaluation of determinants, finding inverse. Differentiation-I: Review of limit and Continuity, differentiation- Basic formulas, Sum rule, product rule, quotient rule, chain rule and problems. Differentiation-II: Taylor's series, and Macluarin's series of simple functions for single variable, simple problems.			
MODULE – 2			10 Hrs.
Partial Differentiation: Definition, Illustrative examples on Partial differentiation, Total differentiation, chain rule, Differentiation of composite and implicit functions, Jacobians, illustrative examples and problems, simple problems.			
MODULE -3			10 Hrs.
Integration: Basic formulas, Illustrative examples, evaluation of definite integrals, Integration by parts, Bernoulli's rule of Integration. Integral calculus: Reduction formula for functions $\sin^n$, $\cos^n x$ (without proof), Simple problems, Double & triple integration, simple problems with standard limits.			
MODULE -4			12 Hrs.
Numerical Methods - Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method. Numerical Interpolation-Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formula, central difference formulas- Bessel and			
Note –1. Theorems and properties without proof. Applicable to all the modules. 2. Self study part is not included for Semester End Examination.			
Text Books: - Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 40th edition (2007). - Erwin Kreyszig, Advanced Engineering Mathematics, Tata McGraw Hill, Publications, 8th edition (2007).			
Reference Books: Calculus by Thomas Finney, 9th edition, Pearson education, 2002.			

2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010..

Course Articulation Matrix

[illegible]

Course Title	MATHEMATICS FOR COMPUTER SCIENCE - IV		
Course Code	23MACS401	L-T-P	(3-1-0) 3
Exam	3 Hrs.	Hours/Week	4
SEE	50 Marks	Total Hours	53(40L+13T)
Course Objective: Students will be able to use appropriate data structures for solving problems.			
Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Correlate the experimental data using correlation coefficient. Predict the output corresponding to input using regression, fit a curve to the data, solve simple problems on probability and joint probability.	1	-
2.	Validate an assumption through "hypothesis testing" (that is the assumption is not simply because of chance).	1,2	-
3.	Analyze the problems connected with probability to apply suitable probability distribution and also, predict the probability in the long run for Markov chain based problems.	1,2	-
4.	Model real life problems/engineering application problems and solve the same.	1,2	-
MODULE – 1			10Hrs.
Statistics: Correlation, Karl Pearson coefficient of correlation and Spearman's rank correlation coefficient. Physical interpretation of numerical value of the rank correlation coefficient. Linear Regression analysis (when the experimental output depends on one input). Illustrative examples from engineering field, multiple linear regression analysis (When the experimental output depends on two inputs). Curve fitting-exponential. Continuous Random Variables: Definition of PDF and CDF, Expectation and Variance, illustrative examples. Self-study/Applications: Curve fitting-linear, quadratic.			
MODULE – 2			10 Hrs.
Continuous Probability distribution: Exponential pdf, Normal/Gaussian pdf. Discussion on the choice of PDF. Illustrative examples from engineering field. Sampling theory: Population & sampling, sampling with & without replacement, sampling distribution of means, sampling distribution of Proportions, sampling distribution of differences & sums. Applications: Current measurement problems and Digital transmission channel connected with pdf. Self-study: Uniform pdf, Detection of signal connected with pdf.			
MODULE -3			10 Hrs.
Confidence intervals & Hypothesis Testing: Brief introduction to confidence intervals, Testing a hypothesis, central limit theorem-statement, Level of significance, Simple sampling of attributes, Test of significance for large samples, Comparison of large samples, Student's t-distribution, Chi-square distribution. Applications: Propellant burning rate, process-capacity problem, drying time problem, Two catalyst effect on chemical reaction Self-study: F-test, Analysis of variance.			

MODULE -4	10Hrs.
Joint Probability Distribution & Stochastic Processes: Concept of joint probability, Joint distributions of discrete random variables, Independent random variables-problems. Joint expectation, co- variance, and correlation. Markov Chains: Introduction, stochastic matrices, fixed probability vectors and regular stochastic matrices. Applications: Application of Markov chain to determine the voting tendencies. Self-study: Estimating the population distribution of a city due to migration.	
Tutorial: 1. A report on the need of studying Correlation & Linear Regression -L4 2. Examples on Correlation & Linear Regression- L3 3. A report on the need of studying Multiple Regression. -L4 4. Examples on Multiple Regression. - L3 5. Examples on Continuous Random Variable. - L3 6. Examples on Normal probability distribution & exponential probability distribution. - L3 7. Discussion on the applications connected with Normal probability distribution. -L4 8. Discussion on the applications connected with Exponential probability distribution. -L4 9. Examples on Hypothesis testing such as student-t test, Chi-square. - L3 10. Examples on Joint probability distribution. - L3 11. Application of Joint probability distribution in engineering. -L4 12. Examples on Markov chain. - L3 13. Application of Markov chain in engineering. -L4	
Activity: 1. Negative binomial distribution: Failure of server's problems, 2. Poisson distribution: Contamination problem, flaws in wires. 3. Exponential distribution: lack of memory property. 4. Continuous random variable: Shaft conforms. 5. Continuous random variable: detection of signal, Digital transmission channel. 6. Hypothesis analysis Depression treatment. 7. Hypothesis analysis defect in printed circuit board. 8. Confidence levels: Doping the cement with lead effect on percentage of calcium. 9. Current measurement problems, Propellant burning rate, process-capacity problem, drying timeproblem, two catalyst effect on chemical reaction. 10. Application of Markov chain in estimating the population distribution of a city due to migration.	
Note 1. Theorems and properties without proof. Applicable to all the modules. 2. Self study part is not included for Semester End Examination.	
Text Books: 1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44thEdition, 2016. 2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd 9th edition, 2014. 3. B V Ramana Higher Engineering Mathematics, Tata McGraw Hill Publications, 2nd edition, 2007.	

Reference Books:

1. Scott L. Miller, Donald G. Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition, 2013.
2. Statistics for engineers and Scientists, William Navide, Mc-Graw hill education, India pvt. Ltd., 3rd edition 2014.
3. T. Veerarajan: "Probability, Statistics and Random Process", 3rd Edition, Tata McGraw Hill Co., 2008.
4. Theory and problems of probability, Seymour Lipschutz and marclarslipson, Schaum out lineseries, 2nd edition.

MOOC Course:

1. <http://nptel.ac.in/courses.phd?disciplineID=111>
2. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
3. <http://academicrath.org/>

Course Articulation matrix

[illegible]

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS		
Course Code	23CS402	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To develop algorithms using suitable design technique and analyze it.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the algorithm analysis framework and design strategies.	1	-
2.	Apply algorithms to solve a given computational problem.	1	2
3.	Analyze algorithms with respect to time complexity.	2	2
4.	Design algorithm for a given problem using suitable algorithm design strategy.	3	2
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms, Examples. Brute Force: Selection Sort and Bubble Sort, Sequential Search and String Matching, Depth First and Breadth First Search, Self Study: Exhaustive Search.			
MODULE – 2			10 Hrs
Decrease-and-Conquer: Insertion Sort, Topological Sorting, Algorithms for Generating, Combinatorial Objects, Binary Search. Divide-and-Conquer: Merge sort, Quick sort			
MODULE – 3			10 Hrs
Transform-and—Conquer: Presorting, Heaps and Heapsort. Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching-Horspool algorithm, Hashing. Dynamic Programming: The knapsack Problem, Warshall's Algorithm, Floyd's Algorithm, Self Study: Memory Functions.			
MODULE – 4			10 Hrs
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees. Limitations of Algorithm Power Lower-bound Arguments, Decision Trees, P, NP and NP-Complete Problems. Coping with the Limitations of Algorithm Power: Backtracking – N Queens, Branch-and-Bound – Assignment Problem.			
Text Books : 1. Anany Levitin, Introduction to The Design and Analysis of Algorithms, 3 rd Edition, Pearson Education, 2022 2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, 2 nd Edition, Press 2014.			

1. Cormen T.H., Leiserson C. E., and Rivest R. L., Introduction to Algorithms, 3rd edition, PHI, 2015.
2. R.C.T. Lee, S.S. Tseng, R.C. Chang and Y.T. Tsai, Introduction to the Design and Analysis of Algorithms A Strategic Approach, 1st Edition, Tata McGraw Hill, 2005.

[illegible]

Course Title	MICROCONTROLLER AND EMBEDDED SYSTEMS		
Course Code	23CS403	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours/Week	5
SEE	50 Marks	Total Hours	48L+10P
Course Objective: To make familiar with programming a microcontroller based embedded systems.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the concepts of embedded system, ARM core and its instruction set.	1	-
2.	Illustrate interfacing for different hardware devices.	1	-
3.	Analyze the given assembly language code snippet for its correctness and output.	2	-
4.	Develop ARM based programs using IDE for a given problem.	2,3,5	2
Course Contents:			
MODULE – 1			12 Hrs
Introduction to Embedded Systems: Embedded system, Processor Embedded into a system, Embedded software in a system, Examples of Embedded systems, Classification of Embedded systems, Skills required for an Embedded system designer. ARM Systems: The RISC Design Philosophy, The ARM Design Philosophy, ARM based Embedded System Hardware and Software.			
MODULE – 2			12 Hrs
ARM Processor Fundamentals : ARM core data flow model, Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and the Vector Table, Core Extensions Introduction to the ARM Instruction Set: Data Processing Instructions-move, barrel shifter, arithmetic, logical, comparison, multiply.			
MODULE – 3			12 Hrs
Introduction to the ARM Instruction Set (Continued) Branch Instructions, Load-store instructions-single register transfer, single register load- store addressing modes, multiple register transfer, stack operations, and swap instruction ,Program Status Register Instructions, Loading Constants, and conditional execution.			
MODULE – 4			12 Hrs
Introduction to ARM7 LPC2148 Microcontroller: Introduction, Features of the LPC 214X Family, Internal Block Diagram of LPC 2148, LPC 2148 GPIO. Interfacing: LED interfacing, 7 segment LED display interfacing, stepper motor interfacing, LCD interfacing, Keyboard interfacing and DAC interfacing.			
Text Books: 1. ARM system developers guide, Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier, Morgan Kaufman publishers, 2008. (1.1 to 1.4, 2.1 to 2.5.1, 3.1 to 3.3, 3.5 to 3.6 (Excluding 3.5.1, 3.5.2), 3.8)			

Course Title	DATABASE MANAGEMENT SYSTEMS		
Course Code	23CS404	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours/ Week	5
SEE	50 Marks	Total Hours	48L+10P
Course Objective: Design a database and write SQL queries. Course Outcomes(COs): Upon completion of the course, students shall be able to			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the concepts of DBMS.	1	-
2.	Formulate and execute SQL queries for a given problem	3, 5,12	1, 2
3.	Apply normalization techniques to enhance the quality of database schema	2	-
4.	Design and create database for a given scenario.	3, 5	1, 2
Course Contents:			
MODULE-1			12 Hrs
Introduction: Introduction;Anexample;CharacteristicsofDatabaseapproach;Actorsonthescreen; Advantages of using DBMS approach.Data models, schemas andinstances;Three-schemaarchitectureanddataindependence;Databaselanguagesandinterfaces;Thedatabasesystemenvir onment;Centralizedandclient-serverarchitectures; Classification of Database Management systems. Entity-Relationship Model: UsingHigh-Level Conceptual Data Models for Database Design; An sample Database Application; Entity Types, Entity Sets, Attributes and Keys. Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; ER Diagrams, Naming Conventions and Design Issues.			
MODULE-2			12 Hrs
Relational Model and Relational Algebra: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN-variations of JOIN, OUTER JOIN operations.			
MODULE-3			12 Hrs
SQL: SQL Data Definition and Data Types; Specifying basic constraints in SQL; Basic Retrieval queries in SQL;Insert,Delete and Update statements in SQL; Additional features of SQL, More complex SQL Retrieval Queries; Views; Schema Change Statements in SQL.			
MODULE-4			12 Hrs
Database Design: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys-1NF, 2NF, 3NF, Boyce-Codd Normal Form. Multi-valued Dependencies and Fourth Normal Form; Concurrency control techniques: Two- Phase Locking Techniques for Concurrency control; Concurrency Control Based on Timestamp Ordering			
Text Books: 1. Elmasri and Navathe, Fundamentals of Database Systems, Addison-Wesley, 7 th Edition, 2015. 2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3 rd Edition, 2007.			

Reference Books:

1. Silberschatz, Korth and Sudharshan, Database System Concepts, 5th Edition, Mc-GrawHill, 2006.
2. C.J.Date, A.Kannan, S.Swamynatham, An Introduction to Database Systems, Pearson education, 8th Edition, 2006.

MOOCs:

1. <http://nptel.ac.in/courses/106106093>
2. <https://www.edx.org/course/database-systems-concepts-design-gtx-cs6400x>

Laboratory Component

1. Design an Employee database and answer following queries:
 - a) List all the employees who are above 40 years of age
 - b) List the employees who work in a particular department
 - c) List the female employees who are 30 years of age and drawing salary >8000
 - d) List the employee number, employee name and his department name of all employees
2. Design a video parlor database and solve the following queries as outlined below using SQL.
 - a) List only videos in the Children category with a daily rental rate of less than 100 and sorted according to video title.
 - b) List the catalogNo, title and category of the Video table, ordered by video title
 - c) List all videos with a certification of “U” or “B” in the Video table.
3. Consider the Insurance database. Create the tables by properly specifying the primary keys and the foreign keys, Enter at least five tuples for each relation.
 - a) Demonstrate how you
 - i. Update the damage amount for the car with a specific regno in accident with report number 12 to 25000
 - ii. Add a new accident to the database \
 - b) Find the total number of people who owned cars that were involved in accidents in 2006.
 - c) Find the number of accidents in which cars belonging to a specific model were involved.
4. Consider the database of student enrollment in courses and books adopted for each course.
 - a) Demonstrate how you add a new text book to the database and make this book be adopted by some department.
 - b) Produce a list of text books(include course # ,book_isbn, book-title) in the alphabetical order for courses offered by the cs department that use more than 2 books.
 - c) List the department that has adopted books published by specific publisher.
5. Consider an order processing database application in a company. Create the tables by properly specifying the primary keys and the foreign keys. Enter at least five tuples for each relation.
 - a) Produce a listing: CUSTNAME, NO_OF_ORDERS, and AVG_ORDER_AMT, where the middle column is the total number of orders by the customer and the last column is the average order amount for that customer.
 - b) List the Order# for the orders that were shipped from all the warehouses that the company has in a specific city.
 - c) Demonstrate how you delete a customer from the CUSTOMER table and make that field *null* in the ORDER table.
6. Design a relational database for a real estate agency. It should store information about houses for sale, seller information, Buyer information, agents information (who can act on behalf of either the buyer or the seller), and the sale of houses. Answer the following queries in SQL.
 - a) What are the ids, addresses, asking_price, and selling_price of all houses that sold for less than

the asking price?

- b) What are names of all of (prospective) buyers who have not bought a house? Each name should appear only once.
 - c) Find the addresses and asking prices of all houses that have at least 3 bedrooms and two bathrooms that have not sold. Each address, asking price pair should appear only once.
7. Consider the details maintained by a book dealer. Create the tables by properly specifying the primary keys and the foreign keys. Enter at least five tuples for each relation.
 - a) Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2000 .
 - b) Find the author of the book which has maximum sales.
 - c) Demonstrate how you increase the price of books published by a specific publisher by 10%.
8. Consider the following schema:
Suppliers(sid: integer, sname: string, address: string)
Parts(pid: integer, pname: string, color: string)
Catalog(sid: integer, pid: integer, cost: real)

Design a database to satisfy the above requirements and answer the following queries

- Find the names of parts for which there is some supplier.
- Find the names of suppliers who supply every part.
- Find the id's of suppliers who supply red parts.

Course Articulation matrix

[illegible]

Course Title	ALGORITHMS LABORATORY		
Course Code	23CS405	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: To demonstrate various algorithmic design techniques.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Implement various algorithms	3, 5	1, 2
2.	Document the executed algorithms	10	1, 2
Course Contents:			
Practice Programs			
1. Sort a given set of elements using Insertion sort method. 2. Obtain the topological ordering of vertices in a given digraph. 3. Write a program using Transform and Conquer technique for checking whether the digits of mobilenumber of a person are unique. 4. Find the Binomial Co-efficient using Dynamic Programming 5. Implement computing a mode using pre-sorting method. 6. Implement 0/1 Knapsack problem using dynamic programming.			
Exercise Programs			
1. Employees in an organization need to be grouped for a tournament based on their ages. Sort the ages using Merge sort and find the time required to perform the sorting. 2. Students in a department need to be selected for a high jump competition based on their height (integer values only). Sort the heights of students using Quick sort and find the time required for the Sorting. 3. Print all the nodes reachable from a given starting node in a digraph using BFS and DFS method. 4. Sort a given set of elements using the Heap sort method. 5. Implement Horspool algorithm for String Matching. 6. Consider N cities. The shortest path between every pair of cities needs to be determined. Implement Floyd's algorithm for the All-Pairs- Shortest-Paths problem. Also find transitive closure by implementing Warshall's algorithm 7. There are N different routes from hostel to college. Each route incurs some cost. Find the minimum cost route to reach the college from hostel using Prim's algorithm. 8. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm. 9. Consider the distance between Hassan and N different cities. Every city can be reached from Hassan directly or by using intermediate cities whichever costs less. Find the shortest distance from Hassan to other cities using Dijkstra's algorithm. 10. Consider a scenario where you need to send a secret message across a network. To ensure the confidentiality of the message, encode it using Huffman coding and transmit the encoded message. 11. Consider the problem having weights and profits are: Weights: {3, 4, 6, 5} Profits: {2, 3, 1, 4} The weight of the knapsack is 8 kg. Find the optimal set of items to include in the knapsack using dynamic programming.			

12. Implement N-Queens problem using back tracking.

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	3	-	-	-	-	-	-	-	3	3
CO2	-	-	-	-	-	-	-	-	-	3	-	-	3	3

Course Title	OPTIMIZATION TECHNIQUES		
Course Code	23CS406A	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Solve optimization problems using various methods			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop mathematical model for a given problem.	1	-
2.	Apply techniques of Operations Research.	2	1, 2
3.	Solve prediction and estimation problems.	1, 2	1, 2
4.	Use scientific tools for solving optimization problems.	3, 5	1
Course Contents:			
MODULE – 1			10 Hrs
Introduction : Introduction: The origin, nature and impact of OR; Overview of the Operations Research Modeling Approach: Defining the Problem and Gathering Data; Formulating a Mathematical Model; Deriving Solutions from the Model; Testing the Model; Preparing to Apply the Model; Implementation Linear Programming – 1 : Prototype example; The Linear Programming (LP) Model, Assumptions of LP, Additional Examples			
MODULE – 2			10 Hrs
Simplex Method - 1 : The Essence of the Simplex Method; Setting up the Simplex Method; The Algebra of the Simplex Method; The Simplex Method in Tabular Form; Tie Breaking in the Simplex Method Simplex Method – 2 : Adapting to other Model Forms; Post Optimality Analysis, Computer implementation			
MODULE – 3			10 Hrs
Revised Simplex Method: Foundations of the Simplex Method, The revised simplex method, A Fundamental Insight Duality Theory: The Essence of Duality Theory; Economic Interpretation of Duality. Primal-Dual Relationships, Adapting to other primal forms, The role of duality in sensitive analysis; The essence of sensitivity analysis; Applying sensitivity analysis, The dual simplex method ; Parametric linear programming; The upper bound technique.			
MODULE – 4			10 Hrs
Transportation Model: Definition of the Transportation Model, Nontraditional Transportation Models, The Transportation Algorithm. Assignment Model and Network Models : The Assignment Model, CPM and PERT			
Text Books : 1. Frederick S. Hillier and Gerald J. Lieberman, “Introduction to Operations Research”, Tata McGraw Hill, 9th Edition, 2012. (Chapters: 1.1 to 1.3, 2, 3.1 to 3.3, 4.1 to 4.7, 5, 6.1 to 6.7, 7.1) 2. Hamdy A Taha, “Operations Research: An Introduction”, Prentice Hall India, 8th Edition, 2005. (Chapters: 5, 6.4)			

Reference Book:

Wayne L. Winston, “Operations Research Applications and Algorithms”, Thomson Course Technology, 4th Edition 2003

Activity:

1. Problems on Formulating a Mathematical model and deriving solution.
2. Problems on Linear Programming (LP) Model.
3. Problems on Essence of the Simplex Method.
4. Problems on Simplex Method in Tabular Form.
5. Problems on Post Optimality Analysis.
6. Problems on Revised Simplex Method.
7. Problems on Duality Theory.
8. Problems on Relationships.
9. Problems on Transportation Model.
10. Problems on Assignment Model and Network Models.

Course Articulation matrix

[illegible]

Course Title	DISCRETE MATHEMATICAL STRUCTURES		
Course Code	23CS406B	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To introduce concepts of mathematical logic for analyzing propositions and proving theorems.			
Course Outcomes: At the end of the course, student will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply logic, mathematical proof and counting principles to given problem.	2 , 3	-
2.	Use concepts of functions in analyzing problems on algorithms.	2	-
3.	Analyze programming problems related to Group theory and Coding theory.	2	-
MODULE-1			10 Hrs
Principles of Counting: The rule of sum and product, permutation principle, combination principle, Combination with repetition Fundamentals of Logic: Basic logic connectives and truth tables. Logical equivalence and Tautologies. Statement of laws of logic Self-study: Set theory – set operations, Venn diagram, Inclusion Exclusion principle.			
MODULE-2			10 Hrs
Fundamentals of Logic (contd...): Logic implication - Rules of inference theory. Application of switching network. Relation: Cartesian Product of Sets, Relations, Zero-one Matrix, Directed graph, Properties of Relation, Equivalence Relation, Partially ordered sets, Hasse diagram, Lattice. Self-study: Quantifiers			
MODULE-3			10 Hrs
Functions: Ceiling function, Floor function, Functions, Types of Functions, Properties of Functions, Composition of Functions, and Inverse Functions, Application of Stirling numbers of second kind. The Pigeon hole principle. Self-study: Application of functions in vending machine, Application to algorithm testing using computational complexity.			
MODULE-4			10 Hrs
Group theory: Examples and elementary properties Coding theory: Elements of coding theory, the humming matrix, the parity – check and Generator matrices, Group codes: Decoding with coset leaders. Hamming matrices. Self-study: sub-groups, cosets, Matrix row operations.			
Textbooks:			
Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.			
Reference Books:			
Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006.			

Activity:

1. Problems on permutation and combination.
2. Problems on logic connectives and Logical equivalence
3. Problems on laws of logic
4. Problems on Logic implication
5. Problems on Relation
6. Problems on Hasse diagram and Lattice
7. Problems on Functions:
8. Problems on Group theory
9. Problems on Coding theory
10. Problems on Group codes

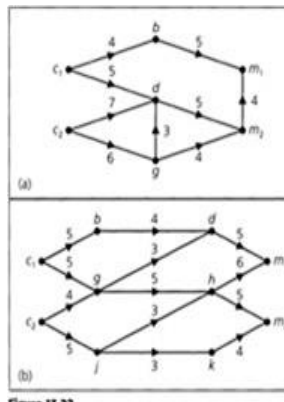
Course Articulation matrix

[illegible]

Course Title	GRAPH THEORY AND COMBINATORICS		
Course Code	23CS406C	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Understand the fundamentals of graph theory and combinatory. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the concepts of graphs and counting principles.	1	-
2.	Apply the concepts of graphs and counting principles in solving problems	2	-
3.	Analyze various concepts of graph and counting techniques	2	-
4.	Solve a given problem adopting the concepts of graph and counting principles	3, 5	2
Course Contents:			
MODULE – 1			10 Hrs
An Introduction to Graph theory: Definitions and examples, Sub graphs, Complements and Graph isomorphism, Vertex degree, Euler Trails and Circuits, Hamilton paths and cycles,			
MODULE – 2			10 Hrs
An Introduction to Graph theory (conti.): Planar graphs, Graph coloring, chromatic number, and chromatic polynomials. Optimization and Matching: Transport Networks: The Max-Flow Min-Cut Theorem, Matching Theory.			
MODULE – 3			10 Hrs
The Principles of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, generalizations of the principle, dearrangements, Rook Polynomials, Arrangements with forbidden Positions. Generating function: Introductory examples, Definition and examples; Partitions of Integers.			
MODULE – 4			10 Hrs
Generating function (conti.): The exponential generating function, the Summation Operator. Recurrence relations: First-order and second order linear recurrence relations, with constant coefficients, The non- homogeneous recurrence relation, The Method of Generating Functions.			
Text Books : 1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004. Chapters 8, 9,10,11,12. 2. Dr. D.S. Chandrashekar: Graph Theory and Combinatorics, 4th Edition, Prism, 2012 (Chapter 4)			
Reference Books: 1. Narsing Deo, Graph Theory with applications to Engineering and Computer Science, PHI Publications. 2. V Balakrishnan, Combinatorics, Schaum Series, Tata-McGraw Hill Publications			
MOOCs: 1. http://nptel.ac.in/courses/111106050/ 2. http://nptel.ac.in/courses/106108051/			

Activity:

- Two cases of soft drinks, 24 bottles of one type and 24 of another are distributed among five surveyors who are conducting taste tests. In how many ways can the 48 bottles be distributed so that each surveyors gets (a) at least two bottles of each type? (b) At least two bottles of one particular type and at least three of the other?
- How can Mary split up 12 hamburgers and 16 hot dogs among her sons Richard, Peter Christopher, and James in such a way that James gets at least one hamburger and three hot dogs, and each of his brothers gets at least two hamburgers but at most five hot dogs?
- Sergeant bueti must distribute 40bullets (20 for rifkes and 20 for handguns) among four officersso that each officer gets at least two, but no more than seven, bullets of each type. In how manyways can he do this
- Nineteen students in a nursery school play a game each day where they hold to hands to form a circle. For how many days can they do this with no students holding hands with the same playmate twice?
- In each of the following “transport networks” two companies c1 and c2, produce a certain product that is used by two manufactures, m1 and m2. For the network shown in part(a) ofFig. 13.23, company c1 can produce 8 units and company c2 can produce 7 units; manufacturer m1 requires 7 units and manufacturerm2 needs 6 units. In the network shown in Fig 13.22 (b), each company can produce 7 units and each manufacturer needs 6 units. In which situation(s) can the producers meet the manufactures demands?



6. Fritz is in charge of assigning students to part-time jobs at the college where he works. He has 25 student applications, and there are 25 different part-time jobs available on the campus. Each applicant is qualified for at least four of the jobs, but each job can be performed by at most four of the applicants. Can Fritz assign all the students to jobs for which they are qualified? Explain. Characterize the type of graph in which an Euler trail (circuit) is also a Hamilton path (cycle).

Course Articulation matrix

[illegible]

Course Title	COMPUTER ASSEMBLY AND NETWORKING		
Course Code	23CS407A	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P
Course Objective: Acquire hands on experience on computer assembly and disassembly, trouble shooting and computer networking			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Demonstrate computer assembly and disassembly and troubleshooting of computer systems hardware, software and other peripheral equipment.	1	-
2	Familiar with wired and wireless communication and computer networks instruments.	2,3	-
3	Gain practical experiences in networking hardware, device configuration, testing and troubleshooting.	4	-
4	Demonstrate network simulation using virtual network simulator software and analyze their performances.	5	1
Course Contents:			
Lab 1: Computer assembly and disassembly			02 Hrs
Computer Assembly: Open the case, Install the power supply, Attach the components to the motherboard and install the motherboard, install internal drives, connect all internal cables, install motherboard power connections, connect external cables to the computer, Boot the computer for the first time. Computer Disassembly: Unplugging, Open the case, disconnect all the connectors, Remove the fan, Remove the power supply, Removing HDD and optical drive, Remove RAM (random access memory), modules, remove expansion cards, remove motherboard, Reassemble the components.			
Lab 2: Troubleshooting			02 Hrs
Diagnose and troubleshooting of microcomputer/computer systems hardware and software and other peripheral equipment: Approaches to solve a PC problem, troubleshooting a failed boot before the OS is loaded, different approaches to installing and supporting I/O device, managing faulty components. Troubleshooting printer and scanner problems, troubleshooting hard drive problems.			
Lab 3: Network cables assembling and testing			01 Hrs
This lab introduces three types of cabling, i.e. twisted pairs, coaxial cable, and fiber optic. Students assemble connectors to a twisted pair cable using crimping tool, and then they test the cable to ensure properly wired connections. This is important because many of the network installation problems are related to cabling errors.			
Lab 4: Network cards installation and test			01 Hrs
This lab shows how to install and configure the network card into a PC expansion slot of a client computer. Connect the client computer to the network. Install the cable and document all network connections on a classroom LAN network.			
Lab 5: LAN configuration			02 Hrs
Once the network operating system and the physical hardware are installed and configured, shares must be set up on the workstations. The lab introduces how to locate the network configuration screen used with Windows XP and configure a workstation with a unique computer name and configure a hub with an IP address. Each workstation becomes a client for Microsoft Networks, and File and Print Sharing is enabled. The basic elements will be in place to share files between workstations on			

Course Title	INTRODUCTION TO POWER BI		
Course Code	23CS407B	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	15
Course Objective: To learn and Practice Programming techniques using Microsoft Power BI.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Prepare the dataset in suitable format with required preprocessing using Power Query Editor.	1, 2	-
2.	Apply suitable visualization techniques to generate report for the various problem.	3, 5, 9	-
3.	Implement, document and present the data visualization projects for the chosen problems.	3, 5, 9, 10	-
Course Contents:			
Practice Programs:			
1. Installation of Power BI 2. Building Blocks and Components of Power BI 3. Overview of GU 4. Introduction to Power Query Editor			
Guided Laboratory Experiments			
1. You have a dataset in an Excel file named SalesData.xlsx with the following columns: Date, Product, Quantity, and Price. You want to: a) Import the data. b) Filter out rows where the Quantity is less than 10. c) Remove duplicate rows. d) Add a new column TotalSales which is the product of Quantity and Price. 2. ABC Retailers deals with various data sources and formats, leading to inconsistencies and errors in the data. To derive meaningful insights, the data must be transformed and prepared using Power BI. This includes establishing appropriate data types, replacing erroneous values, handling nulls and errors, performing pivoting and un-pivoting operations, merging and appending queries, and importing data from folders. 3. ABC Retailers needs to perform advanced data transformations to derive more meaningful insights from their data. This involves creating custom columns, conditional columns, summarizing data with group by, managing queries, and optimizing report performance by enabling/disabling load and report refresh options. 4. ABC Corporation has a diverse dataset comprising sales transactions, product details, customer information, and category classifications. The company seeks to utilize Power BI to establish and manage relationships between these datasets to facilitate comprehensive data analysis and reporting. 5. XYZ Corporation is leveraging Power BI to analyze their sales and customer data. They need to understand how to configure cross-filter directions and effectively manage relationships between their datasets to enhance data analysis capabilities. 6. ABC Corporation is looking to enhance its data analysis capabilities using Power BI. Employee's need comprehensive training on understanding various visualization types, utilizing the Format tab effectively, and mastering the creation of tables and bar charts for insightful reporting.			

7. XYZ Corporation aims to enhance its data analysis capabilities by leveraging Power BI for insightful data visualization. Employees need training on creating and customizing Clustered Column Charts, Matrix Visuals, Pie Charts, and Donut Charts to effectively present data and derive actionable insights.
8. XYZ Corporation is leveraging Power BI to analyze sales and operational data. Employees need training on creating Clustered Column charts, applying Conditional Formatting, and understanding various types of Filters in Power BI to enhance data visualization and analysis capabilities.
9. ABC Corporation is enhancing its data analytics capabilities using Power BI. Employees require training on utilizing Slicers, managing Edit Interactions, creating Bookmarks, and implementing Drill Down and Drill Through features to optimize data exploration and reporting.
10. XYZ Corporation is adopting Power BI for enhanced data visualization and analytics. Employees need training on using Tooltips, creating interactive Buttons, incorporating KPI Cards, generating Waterfall Charts, and integrating Custom Visuals to develop compelling and actionable reports.

Text books:

1. Introducing Microsoft Power BI by Alberto Ferrari and Marco Russo, Microsoft Press, 2016
2. Mastering Microsoft Power BI by Brett Powell, Packt Publishing, 2018

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	3	-	-	-	2	-	-	-	-	-
CO3	-	-	2	-	3	-	-	-	3	2	-	-	-	-

Course Title	TECHNICAL WRITING USING LATEX		
Course Code	23CS407C	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	14P

Course Objective: To prepare a LaTeX document.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design a document layout using a given problem.	3	1
2.	Prepare the document using mathematical equations, tables and figures.	1, 5	1, 2
3.	Demonstrate and document the work carried out.	5, 9, 10	1

Course Contents:

1. Design an Introduction chapter with two sections, each containing a subsection with the relevant information, and include a header [title of document] and a footer [institute name, page number].
2. Create a document that displays the sample Abstract and Summary consists of relevant information.
3. Develop a LaTeX script to create a simple title page of the MCE project Report [Use suitable Logos and text formatting].
4. Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry]
5. Develop a LaTeX script to create a document that contains the following table with proper labels.

Sl No.	USN	Student Name	Marks		
			Subject 1	Subject 2	Subject 3
1	4MC23xx00 1	Name 1	70	80	85
2	4MC23xx00 2	Name 2	80	84	90
3	4MC23xx00 3	Name 3	88	98	50

6. Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept
7. Develop a LaTeX script to create a document that consists of the following two mathematical equations

$$\begin{aligned}
 x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} & \varphi_{\sigma}^{\lambda} A_t &= \sum_{\pi \in C_t} \text{sgn}(\pi) \varphi_{\sigma}^{\lambda} \varphi_{\pi}^{\lambda} \\
 &= \frac{-2 \pm \sqrt{2^2 - 4 \cdot (1) \cdot (-8)}}{2 \cdot 1} & &= \sum_{\tau \in C_{\sigma t}} \text{sgn}(\sigma^{-1} \tau \sigma) \varphi_{\sigma}^{\lambda} \varphi_{\sigma^{-1} \tau \sigma}^{\lambda} \\
 &= \frac{-2 \pm \sqrt{4 + 32}}{2} & &= A_{\sigma t} \varphi_{\sigma}^{\lambda}
 \end{aligned}$$

8. Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document
9. Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section

10. Develop a LaTeX script to design a simple tree diagram or hierarchical structure in the document with appropriate labels using the Tikz library
11. Develop a LaTeX script to present an algorithm in the document using algorithm/algorithmic/algorithm2e library
12. Develop a LaTeX script to create a simple report and article by using suitable commands and formats of user choice.

Text Book:

LATEX Beginner's Guide, Stefan Kottwitz.

MOOC:

<https://www.my-mooc.com/en/mooc/latex-for-students-engineers-and-scientists>

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	2	
CO2	2	-	-	-	3	-	-	-	-	-	-	-	2	3
CO3	-	-	-	-	3	-	-	-	3	3	-	-	3	-

Course Title		BIOLOGY FOR ENGINEERS		
Course Code	23CS408	L-T-P-C		(0-0-2)1
Exam Hrs.	3	Hours/Week		2
CIE	100 Marks	Total Hours		14
Course Objective:				
Course Outcomes: At the end of the course, student will be able:				
#	Course Outcomes		Mapping to POs	Mapping to PSOs
1.	To familiarize engineering students with basic biological concepts		1	
2.	To involve students in an interdisciplinary vision of biology and engineering		2	
3.	To gain an appreciation for how biological systems can be designed and engineered to substitute natural system		2	
4.	To develop biological models using AI tools		3	
MODULE-1				3 Hrs
Introduction to Human Anatomy: Overview of human anatomy, Structural organization of the human body - cardiovascular system, endocrine system, digestive system, respiratory system, excretory system, lymphaticsystem, nervous system, muscular system and skeletal system.				
MODULE-2				4 Hrs
Bioinspired Engineering based on human physiology: Circulatory system (artificial heart, pacemaker,stents), Nervous system (Artificial neural network).				
MODULE-3				4 Hrs
Bioinspired Algorithms and Applications: Genetic algorithm, Gene expression modelling. Parallel Genetic Programming: Methodology, History, and Application to Real-Life Problems. Dynamic Updating DNA Computing Algorithms. Beehive: New Ideas for Developing Routing Algorithms Inspired by Honey Bee Behaviour.				
MODULE-4				3 Hrs
Artificial Intelligence and Biology: Applications of AI in medical imaging, neural engineering, systems biology,microbiome and data mining.				
Text Books:				
1. Jenkins, C.H. Bioinspired Engineering, NY: Momentum press, 2012 ISBN: 97816066502259				
2. A Practical Guide to Bio-inspired Design, Hashemi Farzaneh, Helena, Lindemann, Udo, Springer 2019, ISBN978-3-662-57683-0				
Evaluation :				
Continuous Internal Evaluation (CIE)				
Two CIEs will be conducted for 20 marks each.				
For the activity component students should form a team of 3 to 4 members each. A group activity should be assigned to each team based on the modules covered in the course. Students should show the progress in this activity as a preliminary phase for SEE.				
CIE	Schedule	Assessment Method	Marks	Duration (Min.)
CIE I	At the end of 8 weeks	Objective Questions	20	60

Course Title	UNIVERSAL HUMAN VALUES		
Course Code	23UHV	L-T-P	(0-0-2)1
CIE	50 marks	Hours/Week	2
SEE	50 marks	Total Hours	28
Course Objective: The course aims at the development of the value education by the right understanding through the process of self-exploration (about themselves), family, society and nature/existence. Strengthening of self-reflection by development of commitment and courage to act are presented as the prime focus throughout the course towards qualitative transformation in the life of the student. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to POs
1.	Start exploring themselves, get comfortable with each other and with the teacher and they start appreciating the need and relevance for the course. Also they are able to note that the natural acceptance (intention) is always for living in harmony.	6, 7, 8, 9, 12	-
2.	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.	6, 7, 8, 9, 12	-
3.	Present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.	6, 7, 8, 9, 12	-
Course Contents			
MODULE - 1			8 Hrs
Introduction to Value Education : Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.			
MODULE – 2			6 Hrs
Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self Lecture, Understanding Harmony in the Self Tutorial, Harmony of the Self with the Body to ensure self-regulation and Health.			
MODULE-3			8 Hrs
Harmony in the Family, Nature and Existence: Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order. Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.			
MODULE-4			6 Hrs

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models, Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Self-Learning Activities-

1. Sharing about One self and Exploring Natural Acceptance
2. Exploring Harmony of Self with the Body
3. Exploring the Feeling of Respect
4. Exploring the Four Orders of Nature Lecture and Exploring Co-existence in Existence
5. Exploring Humanistic Models in Education, Exploring Steps of Transition towards Universal Human Order

Text Book and Teachers Manual-

1. The Textbook: A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. The Teacher's for a Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books-

1. Jeevan Vidya:EkParichaya, ANagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. HumanValues, A.N.Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5. Small is Beautiful-E.F Schumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence-J C Kumarappa
8. Bharat Mein Angreji Raj–Pandit Sunderlal.
9. Redis covering India-by Dharampal
10. Hind Swarajor Indian Home Rule-by Mohandas K. Gandhi.
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland(English)
13. Gandhi-Romain Rolland(English)

Evaluation :

Continuous Internal Evaluation (CIE)

Two CIEs will be conducted for 20 marks each.

For the activity component students should form a team of 3 to 4 members each. A group activity should be assigned to each team based on the modules covered in the course. Students should show the progress in this activity as a preliminary phase for SEE.

CIE	Schedule	Assessment Method	Marks	Duration (Min.)
CIE I	At the end of 8 weeks	Objective Questions	20	60
CIE II	At the end of 11 weeks	Objective Questions	20	60
Activity	After CIE 2	Presentation/Role Play/Prototype development	10	-

Semester End Examination

SEE will be conducted for 50 marks in practical mode based on the assigned activity which may be a presentation/ prototype development/any other activity.

Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	-	-	-	-	-	2	1	3	2	-	-	1	-	-
CO2	-	-	-	-	-	2	1	3	2	-	-	1	-	-
CO3	-	-	-	-	-	2	1	3	2	-	-	1	-	-

Course Code	23CS501	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE	50 Marks	SEE	50 Marks
Total Hours			40
Course Objective: To lead and manage teams, become entrepreneur and to prepare project proposal. Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Explore corporate culture and management principles.	1	-
2.	Inculcate research and protection of ideas.	3,10,11,12	2
3.	Acquire skills for entrepreneurship and startups.	1,12	-
4.	Document and present the report on Industry visit.	8,10	-
Course Contents:			
MODULE – 1			10 Hrs.
Planning, and Decision making: Planning: Preview, Nature of planning, the foundation for planning, some planning concepts. Decision Making: Preview, Nature of decision making, Types of decisions/decision making. Some human aspects of organizing: Preview, Staffing technical organizations, Authority and power, Delegation.			
MODULE – 2			10 Hrs.
Motivating & Leading Technical People and Controlling: Motivating and leading technical people: Preview. Motivation. Leadership. Motivating and leading technical professionals (methods). Managing the Research Functions: Preview. Product and technology life cycles. Nature of R & D. Research strategy and organization. Selecting R & D projects. Protection of ideas. Intellectual Property Rights (IPR), Creativity.			
MODULE -3			10 Hrs.
Entrepreneurship: Meaning Evolution of the concept, functions of an Entrepreneur, Characteristics of an Entrepreneur, types of entrepreneurs, Intrapreneur. Entrepreneurship: Concept of Entrepreneurship, Characteristics of Entrepreneurship ,Development of Entrepreneurship ,Stages in Entrepreneurial process, Role of Entrepreneurs in economic development, Entrepreneurship in India, Entrepreneurship barriers, Women entrepreneur – Concept & steps to develop Women Entrepreneur. Small Scale Industry: Definition, Characteristics, Objectives, Scope and role of SSI in economic Development, Advantages of SSI, Problems of SSI ,Steps to start an SSI.			
MODULE -4			10 Hrs.
Government Policy towards SSI; Different Policies of SSI, Introduction to GATT/ WTO. Supporting Agencies of Government for SSI: Meaning, Nature of support; Objectives, functions. Ancillary Industry and Tiny Industry. Institutional Support: Different Schemes: SSIDC, SSIB, DICs/ Single Window Concept, TCOs, ICICI, NSIC, SIDO, IDBI, SIDBI, SFCS, IFCI. Preparation of Project: Meaning, Project identification ,Project selection, Project Report Need of Project, Contents ;formulation, Network Analysis Errors of project report, Project Appraisal, Feasibility Study-Market Feasibility Study, Technical Feasibility Study, Financial Feasibility Study, Social Feasibility Study			
Text Books:			

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Managing Engineering and Technology	Daniel Babcock & Lucy C. Morse	6 th	PHI	2014

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Entrepreneurship Development, Small Business Enterprises	Poornima.M.Charan timath	1 st	Pearson Education	2006
2.	Dynamics of Entrepreneurial Development & Management	Vasant Desai	1 st	Himalaya publishing House	-
3.	Management Fundamentals- Concepts, Application, Skill Development	Rober Lousier	1 st	Thomson	-
4.	Principles of Management	P. C .Tripathi, P .N. Reddy	1 st	Tata Mc Graw Hill	-

MOOCs:

1.<https://nptel.ac.in/courses/110/106/110106141>

2.<https://nptel.ac.in/courses/127/105/127105007>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conducted for 20 marks & converted to 10	10
	CIE2	Conducted for 20 marks & converted to 10	10
	CIE3	Conducted for 20 marks & converted to 10	10
Activity Details		- Writing a proposal for SSI (10 marks) - Coding Exercise (10 marks)	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	3	2	2	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	2	-	-	3	-	-	-

Course Title	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT
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Course Code	23CS502	(L-T-P)C	(3-2-0)4
Exam	3 Hrs.	Hours/Week	5
CIE	50 Marks	SEE	50 Marks
Total Hours			50
Course Objective: Use Software Engineering Principles for Application development			
Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Explore diverse software development process	1	2
2.	Document SRS for a given scenario	1	2
3.	Design and validate a software product	3,5	2
4.	Apply appropriate project estimation and management techniques	9,11	2
Course Contents:			
MODULE – 1			13 Hrs.
Introduction: Professional Software Development, Software Engineering Ethics. Case studies: An insulin pump control system, Software Processes: Software Processes models, Process activities, coping with change, The Rational Unified Process. Agile Software Development: Agile Methods, Plan- driven and Agile Development, Extreme programming. Agile Project Management. Scaling Agile Methods. Self-Study: Case Studies- A patient information system for mental health care, A wilderness weather station			
MODULE – 2			13 Hrs.
Requirements Engineering: Functional and non-functional requirements. The software Requirements Document. Requirements Specification, Requirements Engineering Processes. Requirements Elicitation and Analysis. Requirements validation. Requirements Management. System Models: Context models. Interaction models. Structural models. Behavioral models. Model-driven engineering. Self-Study: Behavioral models as applied to case study.			
MODULE -3			12 Hrs.
Design and Implementation: Object-oriented design using the UML, Design patterns, Implementation issues, Open source development. Software Testing: Development testing, Test-driven development, Release testing, User testing. Software Evolution: Evolution processes, Program evolution dynamics. Software maintenance. Self-Study: Legacy system management			
MODULE -4			12 Hrs.
Software Project Management: Software Project Management Complexities, Responsibilities of a software project Manager, Project Planning and Metrics for project size estimation, Project estimation techniques, Empirical estimation techniques, Scheduling, Organization and Team Structures. Self-Study: COCOMO—A Heuristic Estimation Technique.			
Text Books:			

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Software Engineering (Chapters:1,2,3,4,5,7,8,9)	Ian Sommerville	9 th	Person Education	2014
2.	Fundamentals of Software Engineering	Rajib Mall	1 st	Prentice-Hall Of India Pvt. Ltd	2015

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Software Engineering - A Practitioners Approach	Roger S. Pressman	7 th	McGraw-Hill	2007
2.	Software Engineering Principles and Practice	Waman S. Jawadkar	1 st	Tata McGraw-Hill	2004
3.	Software Engineering: A Concise introduction to Software Engineering	Pankaj Jalot	1 st	Springer.	-

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details:		- Create SRS document for given scenario. - Scrum tool demonstration	20

MOOC Course:

<https://nptel.ac.in/courses/106/105/106105182/>

Tutorial:

1. Discuss on ethical and professional issues and why they are of concern to Software Engineers.
2. Requirement specification for (functional and nonfunctional) the specified scenario.
3. Write sequence diagram for the given case.
4. Write a SRS document for the given case study.
5. Write behavioral model and interaction model for the given scenario.
6. By referring to embedded device depict requirement specification.
7. Employ software testing tool to address a given problem.
8. Practice scrum tool for the Project management.

NOTE: Self-study components are assessed in tutorial.

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	3		3	-	-	-	-	-	-	-	-	2
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-	2

Course Title	DATA COMMUNICATIONS
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Course Code	23CS503	L-T-P-C	(3-0-0)3		
Exam Hrs.	3	Hours/ Week	3		
CIE	50 Marks	SEE	50 Marks		
		Total Hours	40		
Course Objective: Students will gain knowledge of TCP/IP Protocol Model and functionalities of Data link Layer and Physical Layer					
Course Outcomes (COs): Upon completion of the course, students shall be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Apply the concept of TCP/IP reference models, digital transmission methods.	1,4	-		
2.	Analyze various transmission impairments, switching methods, multiplexing techniques and transmission media.	2,4	-		
3.	Formulate and analyse the functionalities of different framing formats, medium access control methods, different coding techniques, error detection and correction methods.	2, 3	-		
4.	Demonstrate the concepts of data communications using various networking tools and programming.	5, 12	1		
Course Contents:					
MODULE-1			10 Hrs.		
Introduction: Data Communications; Networks; Network Types; Network Models: Protocol Layering; TCP / IP Protocol Suite; Physical Layer: Introduction to Physical Layer, Data and Signals; Periodic Analog Signals; Digital Signals; Transmission impairment; Data rate limits;					
MODULE-2			10 Hrs		
Digital Transmission: Digital-to-Digital conversion: Line Coding, Line Coding Schemes, Block Coding, and Scrambling; Analog-to-Digital conversion: Pulse Code Modulation (PCM), Delta Modulation (DM); Multiplexing: FDM, WDM, TDM, Multiplexing; Spread spectrum					
MODULE-3			10 Hrs		
Transmission Media: Twisted pair cable, Coaxial cable, Fiber-Optic cable, Radio waves, Microwaves, Infrared. Switching: Introduction; Circuit-Switched Networks: Three Phases and Delay; Packet Switching: Datagram Networks: Virtual Circuit Networks; Introduction to Data-Link Layer: Link-layer Addressing: Three Types of Addresses, Address Resolution Protocol (ARP); Error Detection and Correction: Introduction; Block coding: Error Detection; Cyclic codes: CRC, Polynomials, Cyclic Code Encoder using Polynomials, Cyclic Code Analysis, Checksum: Concept, Other Approaches to the Checksum; Forward Error Correction.					
MODULE-4			10 Hrs		
Data Link Control: DLC Services: Framing, Flow and Error control, Connectionless and Connection Oriented; Data Link Layer Protocols: Simple, Stop & Wait, Piggybacking; HDLC; Point to Point Protocol: Services and Framing; Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA; Controlled Access: Reservation, Polling, Token Passing; Channelization: FDMA, TDMA, CDMA.					
Text Books:					
Sl.No	Book Title	Authors	Edition	Publisher	Year

1.	Data Communications and Networking	Behrouz A. Forouzan	5 th	Tata McGraw-Hill	2006									
Reference Books:														
Sl.No	Book Title	Authors	Edition	Publisher	Year									
1.	Communication Networks–Fundamental Concepts and Key architectures	Alberto Leon-Garcia and Indra Widjaja	2 nd	Tata McGraw-Hill	-									
2.	Data and Computer Communication	William Stallings	8 th	Pearson Education	-									
MOOC: http://nptel.ac.in/keyword_search_result.php?word=data+communication														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool		Remarks											Marks	
CIE	CIE-1	CIE will be conducted for 20 marks and reduced to 10 marks											10	
	CIE-2	CIE will be conducted for 20 marks and reduced to 10 marks											10	
	CIE-3	CIE will be conducted for 20 marks and reduced to 10 marks											10	
Activity Details		Group activity will be conducted for 20 marks											20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-	2	2	-

Course Title	COMPUTER GRAPHICS AND VISUALIZATION			
Course Code	23CS504	L-T-P-C		(3-0-2)4

Exam Hrs.	3	Hours / Week	5		
CIE	50 Marks	SEE	50 Marks		
Total Hours			50		
Course Objective: To learn the concepts of computer graphics to design a 2D and 3D scene using OpenGL.					
Course Outcomes (COs): Upon completion of the course, students shall be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Describe core concepts of computer graphics with OpenGL.	1	-		
2.	Apply concepts of geometric transformations, projections, and illumination to render image.	2, 3	-		
3.	Analyze line clipping and polygonal clipping algorithms	2, 3	-		
4.	Design a 2D/3D image using graphical concepts throughOpenGL.	2, 3, 4, 5	2		
Course Contents:					
MODULE – 1			13 Hrs		
Introduction: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model; The programmer’s interface: Pen Plotter Model, Graphics architectures; Graphics Programming: The Sierpinski gasket; Programming two - dimensional applications. The OpenGL: The OpenGL API; Primitives and attributes;					
MODULE – 2			13 Hrs		
The OpenGL (Continued): Color; Viewing; Control functions; The Gasket program; Polygons and recursion; The three-dimensional gasket.					
Input and Interaction: Interaction; Input devices; Clients and Servers; Display lists; Display listsand modeling; Programming event-driven input; Menus, Animating interactive programs.					
MODULE – 3			12 Hrs		
Geometric Objects and Transformations: Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Frames in OpenGL; Modeling a colored cube; Affine transformations; Rotation, translation and scaling; Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices					
MODULE – 4			12 Hrs		
Viewing: Classical and computer viewing; Viewing with a computer; Positioning of the camera- Positioning of the Camera Frame; Simple projections; Projections in OpenGL; Hidden-Surface Removal, Lighting and Shading: Light and Matter; Light Sources; The Phong Lighting Model; Polygonal Shading; Light sources in OpenGL; Specification of materials in OpenGL Implementation: Clipping; Line- Segment Clipping; Bresenham’s Algorithm					
Text Books:					
Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Interactive Computer Graphics A	Edward Angel	5 th	Addison-Wesley	2013

	Top-Down Approach with OpenGL (Chapters 1, 2, 3, 4, 5, 6, 7)													
Reference Books:														
Sl.No	Book Title	Authors	Edition	Publisher	Year									
1.	Computer Graphics Using OpenGL	F.S. Hill,Jr,	2 nd	Pearson education	2011									
2.	Computer Graphics	James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes	1 st	Addison-wesley.	-									
Lab Component:														
Write C program using OpenGL functions to														
1. Recursively subdivide a tetrahedron to from 3D Sierpinski gasket. The number of recursive steps is to be specified by the user.														
2. Draw a Rocket and allow the user to change the color.														
3. Create robot face using display list.														
4. Generate square for right click and to exit for left click using mouse function.														
5. Draw box at each location on the screen where the mouse cursor is located.														
6. Create hierarchical menus.														
7. Create a house like figure and rotate it about a given fixed point using OpenGL functions.														
8. Create a Rotating Square.														
9. Draw a color cube and spin it using OpenGL transformation matrices.														
10. Clip the line segment A(-4,2) and B(-1,7) in a window defined by left bottom corner at (-3,1) and upper right corner at (2,6). Find the visible portion of the line segment using Cohen Sutherland line clipping algorithm.														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool		Remarks				Marks								
CIE	CIE1	Module 1				10								
	CIE2	Module 2				10								
	CIE3	Module 3 and part of Module 4				10								
Activity Details		Programming test, Mini Project.				20								
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	3	3	-	-	-	-	-	-	-	-	2

Course Title	WEB PROGRAMMING			
Course Code	23CS505	L-T-P-C		(0-0-4)2

Exam Hrs.	3	Hours / Week	4
CIE	50 Marks	SEE	50 Marks
Total Hours			30
Course Objective: Create web pages with client side and server-side scripting			
Course Outcomes (COs): Upon completion of the course, students shall be able to :			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Create webpages using HTML/XHTML and CSS.	3	1,2
2.	Develop client-side script to design a webpage	3,5	1,2
3.	Develop server-side script to create a webpage	3,5	1,2
4.	Design, document and present the concept for the chosen problem.	5,9,10,12	1,2
Course Contents:			
1. Create and test an HTML document that describes a table with the following contents: The columns of the table must have the headings “Pine,” “Maple,” “Oak,” and “Fir.” The rows must have the labels “Average Height,” “Average Width,” “Typical Life Span,” and “Leaf Type.” You can make up the data cell values. 2. Create a JavaScript that prompts the user for a number and then counts from 1 to that number displaying only the odd numbers using alert window. 3. Write a java script to validate the following fields in a registration page Name (should contains alphabets and the length should not be less than 6 characters) Password(should not be less than 6 characters) E-mail(should not contain invalid addresses) 4. Develop and demonstrate, using JavaScript script, a XHTML document that collects the USN (the valid format is: A digit from 1 to 4 followed by two upper-case characters followed by two digits followed by two upper-case characters followed by three digits; no embedded spaces allowed) of the user. Event handler must be included for the form element that collects this information to validate the input. Messages in the alert windows must be produced when errors are detected. 5. Design an HTML page that captures and displays the mouse cursor’s position when the user clicks anywhere on the page. Use JavaScript to show: • The x and y coordinates relative to the browser’s client area. • The x and y coordinates relative to the screen. 6. Create an XHTML page that collects name, email, userId and password. Design an Assistance to a r user filling out a form can be provided with an associated text area called help box the content of the help box can change depending on the placement of the mouse cursor. 7. Develop and demonstrate, using JavaScript, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough space for each showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible.			

8. Write an XML file which displays the book details that includes the following:

- i. Title of book
- ii. Author name
- iii. Edition
- iv. Price

Write a XSLT to validate the above XML file and display the details using XSL.

9. a) Write a PHP program to store current date-time in a COOKIE and display the Last visited on date-time on the web page upon reopening of the same page.
b) Write a PHP program to Send SESSION ID to the Browser.
10. Develop a PHP-based student information dashboard. Each student has a unique name (used as the key in an associative array) and an associated value that could be their age or a descriptor (e.g., "wizard", "hobbit"). Display this information in various sorted orders depending on the administrator's preference.
11. Write XHTML form and PHP to insert name and age information entered by the user into a table created using MySQL and to display the current contents of this table.
12. Create a XHTML form with Name, Address and E-mail text fields and use PHP script to store the values in MySQL table and to Retrieve and display the data based on Name.

Activity :

Mini project (Carry out a mini project in a team of 2 to 4 members)

Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Programming the World Wide Web	Robert W. Sebesta	8 th	Pearson Education	2014

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Lab CIE	10
	CIE2	Lab CIE	10
	Report	Submission of record	10
Activity Details		Group based activity to create web page	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	3	3
CO2	-	-	3	-	2	-	-	-	-	-	-	-	3	3
CO3	-	-	3	-	2	-	-	-	-	-	-	-	3	3
CO4	-	-	-	-	3	-	-	-	3	3	-	3	3	3

Course Title	DIGITAL IMAGE PROCESSING			
Course Code	23CS551		L-T-P-C	(3-0-0)3

Exam Hrs.	3	Hours/ Week	3		
CIE	50 Marks	SEE	50 Marks		
		Total Hours	40		
Course Objective: To study the image fundamentals and mathematical transforms necessary for image processing Course Outcomes (COs): Upon completion of the course, students shall be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Clarify the basic principles of Digital image processing	1	-		
2.	Apply concepts of Digital image processing, transformation, restoration, compression and segmentation	2,3	-		
3.	Analyze image processing algorithms	3	-		
4.	Develop image processing application for real time problems	3,4,8,12	1,2		
Course Contents:					
MODULE-1			10 Hrs.		
Introduction: Basic concepts, Examples of fields that use Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of visual perception. Image sensing and acquisition: Image sampling and quantization. Basic concepts in sampling and quantization, Representing digital images, Spatial and Intensity resolutions, some basic relationships between pixels: An Introduction to the Mathematical tools used in digital image processing.					
MODULE-2			10 Hrs		
Intensity Transformations and Spatial Filtering: Background: The basics of intensity transformations and spatial filtering, Some basic intensity transformation functions, Histogram Processing. Fundamentals of spatial filtering: The mechanics of spatial filtering, Spatial correlation and convolution. Image Restoration: A model of the image restoration/degradation process. Noise Models: Spatial and Frequency properties of Noise.					
MODULE-3			10 Hrs		
Image Restoration: Some important noise probability density functions, Periodic noise, Estimation of noise parameters, Restoration in the presence of Noise only- Spatial Filtering, Mean Filters. Color Image Processing: Color fundamentals, Color models: The RGB color model. Image Compression: Fundamentals: Coding redundancy, Spatial and Temporal redundancy, Irrelevant information, Measuring image information, Fidelity Criteria.					
MODULE-4			10 Hrs		
Image Compression: Some basic compression methods: Arithmetic coding, LZW coding, Bit_Plane coding, Digital image watermarking. Image Segmentation : Fundamentals, Point, Line, and Edge Detection, background, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection: The Image Gradient and its Properties, Gradient Operators, Combining the Gradient with Thresholding, Thresholding: Foundation, The Basics of Intensity Thresholding, The Role of Noise in Image Thresholding, The Role of Illumination and Reflectance in Image Thresholding.					
Text Books:					
Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Digital Image Processing	Rafael C. Gonzales, Richard	4 th	Pearson	2018

		E. Woods		publications										
Reference Books:														
Sl.No	Book Title	Authors	Edition	Publisher	Year									
1.	Fundamentals of Digital Image Processing	A.K. Jain	2 nd	Pearson	2018									
2.	Digital Image Processing and Analysis	B. Chanda , Dutta Majumdeer	2 nd	Prentice-Hall of IndiaPvt.Ltd	2011									
3.	Introduction to Digital Image Processing with Matlab	Rafael C. Gonzales, Richard E. Woods,Steven L.Eddins	2 nd	Mcgraw Higher Ed	2010									
MOOC: http://nptel.ac.in/courses/106105032														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool		Remarks				Marks								
CIE	CIE1	CIE will be conducted for 20 marks and reduced to 10 marks				10								
	CIE2	CIE will be conducted for 20 marks and reduced to 10 marks				10								
	CIE3	CIE will be conducted for 20 marks and reduced to 10 marks				10								
Activity Details: Group activity						20								
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	3		-	-	3	-	-	-	3	3	2

Course Title	DATA MINING AND WAREHOUSING			
Course Code	23CS552	L-T-P-C		(3-0-0)3

Exam Hrs.	3	Hours/ Week	3		
CIE	50 Marks	SEE	50 Marks		
		Total Hours	40		
Course Objective: Students will be able to select appropriate Data mining and warehousing techniques for real-time application					
Course Outcomes (COs): Upon completion of the course, students shall be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Describe the fundamentals of data mining and data warehousing	1			
2.	Apply various data preprocessing techniques to prepare data for mining	1	1		
3.	Apply the process of Classification, Clustering and Association Analysis for a given problem	3	-		
4.	Implement appropriate data mining algorithm for a given scenario using Python	3,5,9	2		
Course Contents:					
MODULE-1			10 Hrs.		
Introduction: Data: Why Data Mining? What is Data Mining? What kinds of data can be mined? What kinds of pattern can be mined?, Which technologies are used? Major issues in data mining. Getting to know your data: Data objects and attribute types, Basic statistical description of data: measuring the central tendency, Measuring the dispersion of data, measuring data similarity and dissimilarity					
MODULE-2			10 Hrs		
Data Pre-processing: Data Pre-processing: An overview, Data cleaning, Data integration, Data Reduction: overview of data reduction strategies, wavelet transforms, Principal component analysis, attributes subset selection, Data Transformation: min-max normalization and Z-score normalization. Data Warehouse and online Analytical processing: Data Warehouse: Basic Concepts ,Data Warehouse modelling: Data cube and OLAP , Data warehouse design and usage: A business analysis frame work for data warehouse design, Data warehouse design process, Data warehouse usage for information processing.					
MODULE-3			10 Hrs		
Classification: Preliminaries, General Approach to Solving a Classification Problem, Decision Tree Induction, Rule-based classification, K- Nearest- neighbour Classifier. Mining frequent patterns. Association and correlations: Basic Concepts and Methods: Basic Concepts, Frequent item set mining methods: Apriori Algorithm, generating association rules from frequent item sets, Improving the efficiency of Apriori, A Pattern growth Approach for Mining Frequent item sets.					
MODULE-4			10 Hrs		
Cluster Analysis: Basic Concepts and Methods, Cluster Analysis, Partitioning Methods, Agglomerative versus divisive hierarchical clustering, DBSCAN. Data Mining Trends and research frontiers: Data Mining Applications, Data mining and society, Data mining trends					
Text Books:					
Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Data Mining	Pang-Ning Tan, Michael Steinbach, Vipin Kumar	1 st	Pearson Education	2014
2.	Data Mining – Concepts and Techniques,	Jiawei Han and Micheline Kamber, V	3 rd		2012
Reference Books:					

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Insight into Data Mining – Theory and Practice	K.P. Soman, Shyam Diwakar, V.Ajay	1 st	PHI	2006
2.	Introduction to Data Mining with Case Studies	G. K. Gupta	3 rd	PHI	2009

MOOCs:

1. <http://nptel.ac.in/courses/110106064/>
2. <http://nptel.ac.in/courses/106106093/>
<https://www.edx.org/course/analytics-for-decision-making>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details		Implement appropriate data mining algorithm for a given scenario using Python	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	-	-	-	3	-	-	-	-	3

Course Title	INTERNET OF THINGS			
Course Code	23CS553		L-T-P-C	(3-0-0)3

Exam Hrs.	3	Hours / Week	3		
CIE	50 Marks	SEE	50 Marks		
Total Hours			40		
Course Objective: Explore the interconnection, integration of the physical world and design IOT applications.					
Course Outcomes (COs) : Upon the completion of the course the students will be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Explain the impact and challenges posed by IoT networks, and compare IoT architectures	1	-		
2.	Illustrate smart objects, IoT Access Technologies, and protocols to leverage connectivity.	2	-		
3	Design IoT applications using Raspberry Pi and analyze real-world smart city use-cases.	3,5	-		
Course Contents:					
MODULE – 1			10 Hrs		
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack.					
MODULE – 2			10 Hrs		
Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: Communications Criteria, IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and IEEE 802.15.4e.					
MODULE – 3			10 Hrs		
IP as the IoT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances. Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods.					
MODULE – 4			10 Hrs		
IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, Exploring the RaspberryPi Board; Operating System setup on RaspberryPi, RaspberryPi commands, Programming RaspberryPi with Python. Smart City Use-Case Examples: Connected Street Lighting, Street Lighting Architecture, Smart Parking, Smart Parking Use Cases, Smart Parking Architecture, Smart Traffic Control, SmartTraffic Control Architecture, Smart Traffic Application.					
Text Books:					
Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry	1 st	Pearson Education (Cisco Press Indian Reprint).	
2.	Internet of Things	Srinivasa K G, Siddesh G M Hanumantha Raju R	1 st	CENGAGE Learning India	2017

Reference Books:														
Sl.No	Book Title				Authors				Edition	Publisher			Year	
1.	Internet of Things - A Hands on Approach				Arshdeep Bahga and Vijay Madisetti				1 st	Universities Press			2015	
2.	The Internet of Things: Key Applications and Protocols				Olivier Hersent, David Boswarthick, Omar Elloumi				2 nd	Wiley			2012	
Proposed Assessment Plan (for 50 marks of CIE):														
Tool					Remarks								Marks	
CIE		CIE1			Conduction for 20 marks & reduced to 10 marks								10	
		CIE2			Conduction for 20 marks & reduced to 10 marks								10	
		CIE3			Conduction for 20 marks & reduced to 10 marks								10	
Activity Details					Group based simulation activity								20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	2	-	-	-	-	-	-	-	-	-

ADVANCED JAVA			
Course Code	23CS554	LTPC	(2-2-0)3
Exam. Hours	3	Hours / Week	4
CIE:	50 Marks	SEE:	50 Marks
Total Hours			40
Course Objective:		Students will be able to apply J2EE concepts to create an application.	
Course Outcomes(COs):		Upon completion of the course, students shall be able to :	
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain and use java enumerations, collections, type wrapper and Event handling in developing modular programs	1	-
2.	Design GUI using swings and applets	3,5	1
3.	Build database applications using JDBC.	3,5	1
4.	Develop distributed web application using Servlets and JSP.	3,5,12	1
Course Contents:			
MODULE – 1		10 Hrs	
Enumeration and Autoboxing: Enumeration fundamentals, values() and valuesOf() Methods, Java Enumerations are class types, example, Type Wrappers, Autoboxing and Autounboxing. Event Handling The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes			
MODULE – 2		10 Hrs	
User Interface components with Swing Components and containers, Layout managers, A first simple swing example, Event Handling, Creating a swing applet, Exploring Swing Controls-JLabel and ImageIcon, Jtextfield The Swing buttons, JTabbedPane, JScrollPane, JList, JCombobox.			
MODULE – 3		10 Hrs	
The Collections Framework – Collections overview, The collection Interfaces, The collection classes, Accessing collection via an iterator. Database Access- The Concept of JDBC, JDBC Driver Types, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Statement Objects, Result Set			
MODULE – 4		10 Hrs	
Servlets and JSP - Lifecycle of a sevelet, A simple servlet, The Servlet API, javax.servlet Package, Reading Servlet parameters, The javax.servlet.http Package, Handling HTTP Request and Responses, Using Cookies, Session tracking. Java Server Pages (JSP): JSP, JSP Tags, User Sessions, Cookies, Session Objects. RMI -. Java Remote Method Invocation: Remote Method Invocation concept; Server side, Client side.			
Text Books:			
1.	Herbert Schildt: Java The Complete Reference Eighth Edition, McGraw Hill, 2013.		
2.	Jim Keogh: J2EE The Complete Reference, Tata McGraw Hill, 2007.		
Reference Books:			
1.	Advanced Java Programming ,Uttam.K.Roy , Oxford Press,2015		
2.	Java Fundamentals Herbert Schildt Dale Skrien, McGrawHill 2013		
3.	"Head First Servlets and JSP" by Shroff,2nd Edition, O,Reilly Publications ,2008.		

MOOCs														
1.	http://www.nptelvideos.com/java/java_video_lectures_tutorials.php													
2.	https://www.youtube.com/watch?v=0KL_zftem4g/													
Demonstration Programs														
1. A traveler is travelling around the world. He wants to convert the Indian currency to the currency denomination of the other countries when he wants to purchase some items. Use enumerations concepts and help him to convert other countries currency to Indian currency. 2. Implement the stack operation which allows working on different data types. 3. A stopwatch is a handheld timepiece designed to measure the amount of time that elapses between its activation and deactivation. Great for races, games and other timed activities, this stopwatch is easy to use, making it perfect for both children and adults. Create a simple stop watch with start, pause and reset button using JLabel and JButton. 4. A substitution cipher is a method of encrypting by which units of plaintext are replaced with ciphertext, according to a fixed system; the "units" may be single letters, pairs of letters, and triplets of letters, mixtures of the above, and so forth. The receiver deciphers the text by performing the inverse substitution. Implement a simple substitution cipher for encoding and decoding a message using swing controls. 5. Design an application for online food ordering that allows the customer to order the food based on the menu display to him, using different swing components. 6. Create a student database to hold student name, usn, marks in five course and display the result as fail if he/she scores less than 40 in any one course else print pass. Also calculate the total percentage of marks. Display the information using the JDBC concepts. 7. A bank offers home loan to its customer at different interest rates based on the location. Create an application for home loan processing using servlets and JDBC. The application has to provide functionality to calculate EMI, pay EMI and display the customer details along with his loan details 8. Do the following with only JSPs (and no servlets) and using JSP scripting elements 1. Create a method that take two int numbers and return their sum as int. 2. Invoke the method from within template text using JSP elements (example o/p - Sum of 3 and 4 is 7.) 3. Print above line using JSP elements. 9. Manage the user session on a browsing activity using session management and display its information. 10. Design a client-server application using RMI.														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool					Remarks								Marks	
CIE		CIE1			Conduction for 20 marks & reduced to 10 marks								10	
		CIE2			Conduction for 20 marks & reduced to 10 marks								10	
		CIE3			Conduction for 20 marks & reduced to 10 marks								10	
Activity Details:					Group based activity to implement java concepts								20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	2	-	-	-	-	-	-	-	1	-
CO3	-	-	3	-	2	-	-	-	-	-	-	-	1	-
CO4	-	-	3	-	2	-	-	-	-	-	-	1	1	-

Course Title	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS		
Course Code	23RIP	L-T-P	(3-0-0) 3
CIE	50	Hours/Week	3
SEE	50	Total Hours	40
Course Objective: To give an overview of technical research activities and patenting methodology. Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Carry out Literature Review and write technical paper	2,3,4,8,12	-
2.	Describe the fundamentals of patent laws and the patent drafting procedure.	6,8,10,12	-
3.	Elucidate the copyright laws and subject matters of copyright	6,8, 10,12	-
MODULE-1			10 Hrs.
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research. Ethics in Engineering Research: Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship. Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art ,Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward, Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading.			
MODULE-2			10 Hrs.
Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions. Technical Writing and Publishing : Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Patent or Technical Paper?—The Choice, Writing, Journal Paper: Structure and Approach: Title, Abstract, and Introduction, Methods, Results, and Discussions, Table, Figures, Acknowledgments, and Closures			
MODULE-3			10 Hrs.
Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, Major Amendments in IP Laws and Acts in India. Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Process of Patenting: Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Do I Need First to File a Patent in India. Patent Related Forms. Fee Structure. Types of Patent Applications.			
MODULE-4			10 Hrs

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC).

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration.

Self study: Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, IP Organizations In India.

Text Books:

1. Dipankar Deb, Rajeeb Dey, Valentina E, Balas, "Engineering Research Methodology", Springer, 2019.
2. Prof. Rupinder Tewari, Ms. Mamta Bhardwa, "Intellectual Property" , Professor Gurpal Singh Sandhu Honorary Director, Publication Bureau, Panjab University, 2021.

Reference Books:

1. David V. Thiel, "Research Methods for Engineers", Cambridge University Press, 2014.
2. N.K.Acharya, "Intellectual Property Rights", Asia Law House, 8th Edition, 2021.

MOOC:

https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1		
	CIE2		
	CIE3		

Activity Details

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	2	3	-	-	-	2	-	-	-	3	-	-
CO2	-	-	-	-	-	3	-	2	-	3	-	3	-	-
CO3	-	-	-	-	-	3	-	2	-	3	-	3	-	-

Course Title		ENVIRONMENTAL STUDIES		
Course Code	23EVS	L-T-P	(0-0-2) 1	
Exam	3 Hrs.	Hours/Week	2	
CIE	100 Marks	Total Hours	20	
Course Objective: To create environmental awareness among the students.				
Course Outcomes: At the end of the course, student will be able to:				
#	Course Outcomes (CO)		Mapping to POs	Mapping to PSOs
1.	Acquire an awareness of sensitivity to the total environment and its allied problems.		7, 9,12	-
2.	Develop strong feelings of concern, sense of ethical responsibility for the environment and the motivation to act in protecting and improving it.		6,8	-
3.	Analyze and evaluate environmental measures in real world situations in terms of ecological, political, economical, societal and aesthetic factors.		6, 7,8, 9	-
MODULE-1				5 Hrs
Environment: Definition, Ecosystem, Balanced ecosystem, Effects of human activities on environment Agriculture Housing Industry Mining and Transportation.				
MODULE-2				5 Hrs
Natural Resources: Water resources, Availability and Quality, Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources - Forest Resources - Material Cycles - Carbon, Nitrogen and Sulphur Cycles.				
MODULE-3				5 Hrs
Pollution: Effects of pollution - Water pollution - Air pollution Land pollution - Noise pollution.				
MODULE-4				5 Hrs
Current Environmental issues of importance: Acid Rain, Ozone layer depletion - Population Growth, Climate change and Global warming. Environmental Impact Assessment and Sustainable Development Environmental Protection - Legal aspects. Water Act and Air Act.				
Text Books:				
1. Environmental Studies - Dr. D.L Manjunath, Pearson Education -2006				
2. Environmental Studies - Dr. S. M. Prakash - Elite Publishers - 2006				
Reference Books:				
1. Environmental Studies - Benny Joseph - Tata McGraw Hill- 2005				
2. Principles of Environmental Science and Engineering P. Venugopala Rao, Prentice Hall of India.				
3. Environmental Science and Engineering - Meenakshi, Prentice Hall India.				
Assessment Strategy				
CIE	Schedule	Assessment Method	Marks	Duration (Min.)
CIE I	At the end of 8 weeks	Objective Questions	25	60
CIE II	At the end of 11 weeks	Objective Questions	25	60
Project	At the end of 14 weeks	Project/Presentation/Prototype development/Plantation	50	-

Proposed Assessment Plan (for 50 marks of CIE):														
Tool					Remarks								Marks	
CIE	CIE1													
	CIE2													
	CIE3													
Activity Details														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	3	-	-	3	-	-
CO2	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	3	2	-	-	-	-	-

NATIONAL SERVICE SCHEME (NSS)														
Course Code			23NYP3					(L-T-P) C				(0-0-2)		
Exam Hrs			-					Hours/ Week				2		
SEE			-					Total Hours				24		
Course Outcomes: At the end of the course, the student will be able to														
#	Course Outcomes							Mapping to POs			Mapping to PSOs			
1.	Understand the importance of his / her responsibilities towards society							6			-			
2.	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.							3,6			-			
3.	Evaluate the existing system and to propose practical solutions for the same for sustainable development							3,6			-			
4.	Implement government or self-driven projects effectively in the field.							11			-			
5.	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.							11			-			
MODULE 1									8 HRS					
Developing Sustainable Water management system for rural areas and implementation approaches. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.														
MODULE 2									8 HRS					
Spreading public awareness under rural outreach programs.(minimum5 programs).														
MODULE 3									8 HRS					
Social connect and responsibilities.														
Reference Books :														
1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.														
2. Government of Karnataka, NSS cell, activities reports and its manual.														
3. Government of India, NSS cell, Activities reports and its manual.														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool			Remarks									Marks		
CIE	CIE1													
	CIE2													
	CIE3													
Activity Details														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

PHYSICAL EDUCATION (PE)														
Course Code		23NYP3						(L-T-P) C				(0-0-2)		
Exam Hrs		-						Hours/ Week				2		
SEE		-						Total Hours				24		
Course Outcomes: At the end of the course, the student will be able to														
#	Course Outcomes							Mapping to POs			Mapping to PSOs			
1.	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.							9,10,11			-			
2.	Familiarization of health-related Exercises, Sports for overall growth and development							9,11			-			
3.	Create a foundation for the professionals in Physical Education and Sports							11			-			
4.	Participate in the competition at regional/ state / national / international levels.							9,10,11			-			
5.	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.							9,10,11			-			
MODULE 1											4 HRS			
Orientation - Fitness, Food & Nutritio														
MODULE 2											4 HRS			
General Fitness & Components of Fitness - Agility – Shuttle Run, Flexibility – Sit and Reach, Cardiovascular Endurance – Harvard step Test														
MODULE 3											16 HRS			
Specific games (Any one to be selected by the student)														
1. Badminton (Fore hand low/high service, back hand service, smash, drop)														
2. Basketball (Dribbling, passing, shooting etc.)														
3. Athletics (Field events – Throws)														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool			Remarks								Marks			
CIE	CIE1													
	CIE2													
	CIE3													
Activity Details														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														

YOGA														
Course Code	23NYP3								(L-T-P) C				(0-0-2)	
Exam Hrs	-								Hours/ Week				2	
SEE	-								Total Hours				24	
Course Outcomes: At the end of the course, the student will be able to														
#	Course Outcomes								Mapping to POs		Mapping to PSOs			
6.	Understand the Philosophical and Scientific Basis of Yoga								11		-			
7.	Demonstrate Proficiency in Basic Yoga Practices								9		-			
8.	Analyze the Role of Yoga in Managing Stress and Enhancing Lifestyle								7,11		-			
9.	Apply Yoga Principles for Personal and Professional Growth								10, 11		-			
MODULE 1									4 HRS					
Orientation - Fitness, Food & Nutritio														
MODULE 2									4 HRS					
General Fitness & Components of Fitness - Agility – Shuttle Run, Flexibility – Sit and Reach, Cardiovascular Endurance – Harvard step Test														
MODULE 3									16 HRS					
Proposed Assessment Plan (for 50 marks of CIE):														
Tool			Remarks										Marks	
CIE	CIE1													
	CIE2													
	CIE3													
Activity Details -														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														

Course Title	MACHINE LEARNING		
Course Code	23CS601	L-T-P-C	(3-0-2) 4
Exam Hrs.	3	Hours / Week	5
CIE	50 Marks	SEE	50 Marks
Total Hours			50
Course Objective: To apply the techniques of machine learning for real time projects.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe and Apply preprocessing, Modeling, Evaluation and concept learning for the given problem.	2, 3	-
2.	Design and Develop various supervised and unsupervised machine learning algorithms for solving the given problem	3, 5	1, 2
3.	Illustrate the Neural networks, Bayesian learning and other forms of learning for the given problem	3, 4, 5	1
4.	Implement various machine learning algorithms for a given data sets.	3, 5	1, 2
Course Contents			
MODULE - 1			13 Hrs
Introduction to Machine learning: Human learning and its types, Machine learning and its types, Applications, tools and issues in machine learning, Activities in machine learning, Types of data, Exploring structure of data, Data quality and Preprocessing. Modelling and Evaluation: Introduction, Selecting a model, training a model, model representation and interpretability, Evaluating performance of a model.			
MODULE – 2			13 Hrs
Learning Problems and Concept Learning: Well Posed learning problems, Designing a Learning systems, Concept Learning Tasks, Search, Find-S, Version Spaces and Candidate Elimination Algorithm, Inductive bias. Supervised Learning: Introduction, example, classification model, classification learning steps, and Common algorithms – KNN, Decision Tree, and Random forest model.			
MODULE - 3			12 Hrs
Supervised Learning (contd.): SVM, Regression-Simple linear regression, Multiple linear regression, Assumptions in Regression analysis. Unsupervised Learning: Supervised Vs Unsupervised, Application, clustering, Finding pattern using Association rule.			
MODULE – 4			12 Hrs
Basics of Neural Networks: Exploring the artificial neuron, Types of activation function, Early implementations of ANN, Architectures of NN, Learning process in ANN, Backpropagation algorithm. Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Bayesian Belief Networks. Other types of Learning – Representation learning, Active Learning, Instance based Learning, Association rule Learning, Ensemble learning			
Demonstration: 1. Demonstration of Python Libraries for Machine Learning-Pandas, Sklearn, numpy, matplotlib. 2. Demonstration of Exploratory Data Analysis and Data Visualization. Practical Component:			

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to implement k -Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
4. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Implement a clustering algorithm using K-means clustering for the given dataset.
6. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
7. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

Text Books:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019
2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (INDIAN EDITION), 2013.

Reference Books:

1. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer; 1st edition, 2001
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006
3. Yegnanarayana B. Artificial Neural Networks PHI Learning Pvt., Ltd.
4. Ethem Alpaydin, Introduction to Machine Learning, 2nd Ed., PHI Learning Pvt. Ltd., 2013

MOOCS:

1. https://swayam.gov.in/nd1_noc19_cs52/preview
2. <https://www.coursera.org/learn/machine-learning/>
3. <https://nptel.ac.in/courses/106105152>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks	10
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks	10
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks	10
	Lab CIE	Lab CIE Conducted for 10 marks	10
Activity Details		Project Based Activity for 10 marks	10
Total			50

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	2	-		-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	3	-	-	-	-	-	-	-	2	3
CO3	-	-	3	3	3	-	-	-	-	-	-	-	3	
CO4	-	-	3	-	3	-	-	-	-	-	-	-	2	3

Course Title	COMPUTER NETWORKS		
Course Code	23CS602	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours/Week	5
CIE	50 Marks	SEE	50 Marks
		Total Hours	50
Course Objective: Students will be able to acquire knowledge of the working mechanisms of different types of Networks, Address Mechanisms, and Protocols.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Recognize and usages of Network Layer Services and versions of IP.	1,12	-
2.	Design unicast and multicast routing techniques using basic algorithms.	2,3,5	-
3.	Implement the Transport Layer Protocols to provide different services.	3,4,5	1
4.	Apply Flow Control, Error Control, and Congestion Control mechanisms to design QoS. models.	2,4	-
Course Content			
MODULE-1			13 Hrs
Network Layer: Network Layer Services, IPv4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, NAT; Network Layer Protocols: Internetwork Protocol: Datagram format, Fragmentation, Options, Security of IPV4 Datagrams; ICMPv4: Messages, Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP.			
MODULE-2			13 Hrs
Unicast Routing: Introduction: General Idea, Least Cost Routing; Routing Algorithms: Distance Vector, Link-State Routing, Path-Vector Routing; Unicast Routing Protocols: Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4); Multicast Routing: Introduction: Unicasting, Multicasting, Broadcasting; Multicasting Basics: Multicast Addresses, Delivery at Data-Link Layer, Collecting Information about Groups, Multicast Forwarding, Two Approaches to Multicasting.			
MODULE-3			12 Hrs
Intradomain Multicast Protocols: Multicast Distance Vector (DVMRP), Multicast Link State (MOSPF) Protocol Independent Multicast (PIM); Inter domain Multicast Protocols: IGMP: Messages, Propagation of Membership Information, Encapsulation; Next Generation IP: IPV6 Addressing, The IPV6 Protocol; Transport Layer protocols: Introduction: Services, Port Numbers, User Datagram Protocol (UDP): User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, ATCP Connection,			
MODULE-4			12 Hrs
Windows in TCP; Flow Control, Error Control, TCP Congestion Control; TCP Timer and Options; Stream Control Transmission Protocol (SCTP): Services, Features, Packet Format and Association; Quality of Services: Data Flow Characteristics; Flow Control to Improve QoS: Scheduling, Traffic Shaping or Policing, Resource Reservation, Admission Control; Integrated Services (INTSERV): Flow Specification, Admission, Service Classes, Resource Reservation Protocol (RSVP). Differentiated services (Dffserv).			

Text Book: Behrouz A. Forouzan, Data Communications and Networking, Tata McGraw-Hill,5thEdition														
Reference Books: 1. AlbertoLeon-Garcia and Indra Widjaja, “Communication Networks–Fundamental Concepts and Key architectures”, Tata McGraw-Hill,2nd Edition. 2. William Stallings, “Data and Computer Communication”, Pearson Education,8thEdition. 3. Nader F. Mir, Computer and Communication Networks, PearsonEducation,2014.														
MOOCs: 1. https://nptel.ac.in/courses/106105183														
Laboratory Programs 1. Learn Networking Commands 2. Implement of error correction code (like CRC). 3. Simulate the transmission of ping messages over a network topology consisting of 6 nodes. 4. Simulate three nodes point– to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped. 5. Simulate five nodes point– to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets sent with different types of traffic. 6. Implement distance vector algorithm to find the suitable path for transmission between sender and receiver. 7. Simulation of Link State Routing algorithm. 8. Simulation of Routing Information Protocol. 9. Simulate an Ethernet LAN using n nodes, change error rate and data rate and compare throughput. 10. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source/destination.														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool					Remarks								Marks	
CIE		CIE1			Conduction for 20 marks & reduced to 10 marks								10	
		CIE2			Conduction for 20 marks & reduced to 10 marks								10	
		CIE3			Conduction for 20 marks & reduced to 10 marks								10	
Activity Details					Conduction of lab CIE								20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	2	3	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	3	2	2	-	-	-	-	-	-	-	2	
CO4	-	3	-	3	-	-	-	-	-	-	-	-	-	-

Course Title	FINITE AUTOMATA AND FORMAL LANGUAGES		
Course Code	23CS603	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
CIE	50 Marks	SEE	50 Marks
Total Hours			40
Course Objective: To design grammar production for the programming constructs. Course Outcomes (COs) : Upon Completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe various automata to write grammar productions	1	-
2.	Apply appropriate automata to obtain grammar productions	1,2	-
3.	Design automata for a given programming construct	2,3	-
4.	Construct an automata and grammar for a given scenario using the simulation tool	3,5	1,2
Course Contents:			
MODULE – 1			10 Hrs
Introduction to Finite Automata: Why Study Automata Theory? The Central Concepts of Automata Theory. Finite Automata: An Informal Picture of Finite Automata, Deterministic Finite Automata, Non-Deterministic Finite Automata, Finite Automata with Epsilon-Transitions.			
MODULE – 2			10 Hrs
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions. Properties of Regular Languages: Proving Languages Not to Be Regular – Pumping Lemma, Closure Properties of Regular Languages, Equivalence and Minimization of Automata.			
MODULE – 3			10 Hrs
Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages. Pushdown Automata: Definition of the Pushdown Automata, The languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.			
MODULE – 4			10 Hrs
Properties of Context-Free Languages: Normal Forms for Context-Free Grammars- Eliminating Useless symbols, Eliminating epsilon productions, Eliminating Unit productions, Chomsky Normal Form (CNF), Greibach Normal Form (GNF). Introduction to Turing Machines: Problems that Computers cannot Solve, The Turing Machine Programming Techniques for Turing Machines.			
Text Book: John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3 rd Edition, Pearson Education, 2013.			

Reference Books:

1. Peter Linz, An Introduction to Formal Languages and Automata, IV Edition, Narosa Publishing House, 2011.
2. John C Martin, Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.

MOOCs

<http://elearning.vtu.ac.in>

Tutorial Class

1. Introduction to JFLAP tool.
2. Designing of DFA, NFA, Grammar productions using JFLAP tool.
3. Assume a scenario of an online shopping store which uses electronic money. Identify the events and states for this scenario and design an automata individually for
 - Customer
 - Bank
 - Store
3. Design an automata to verify the authentication of the user before allowing them to access the confidential information. (Assume the user password is 101101)
4. Construct a Finite Automata to search your name in your class attendance list.
5. A shopping cart logs the sequence of actions: A for Add, R for Remove, and C for Checkout. You want to allow any number of add/remove steps but require that checkout is optional and may happen anytime.
6. Assume you go for shopping a trouser searching for particular fabric and of particular color. Design grammar for the above scenario.
7. A compiler checks for balanced parentheses in a code editor. You're asked to design a PDA that accepts strings with correctly nested parentheses, e.g., ((())), (), but not ((), ())
8. A robot receives a command string and needs to reverse the first half and match it with the second half.
9. A robot writes a sequence with # as a temporary placeholder (e.g., 1#0#1). You need to clean the tape by removing all #s and shifting the rest.
10. A security system uses binary palindromes as access codes. You need to check if a string is a palindrome (e.g., 10101, 0110) using turing machine.

Proposed Assessment Plan (for 50 marks of CIE):

Tool				Remarks										Marks	
CIE	CIE1			Conduction for 20 marks & reduced to 10 marks										10	
	CIE2			Conduction for 20 marks & reduced to 10 marks										10	
	CIE3			Conduction for 20 marks & reduced to 10 marks										10	
Activity Details				Solving scenario based problems using simulation tool										20	
Course Articulation matrix															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	-		-	-	-	-	-	-	-	-	-	-	-	
CO2	3	3		-	-	-	-	-	-	-	-	-	-	-	
CO3	-	2	3	-	-	-	-	-	-	-	-	-	-	-	
CO4	-	-	3	-	3	-	-	-	-	-	-	-	2	2	

MINI PROJECT			
Course Code	23CS604	L-T-P-C	(0-0-4)2
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	30
CIE	50 Marks		
Course Objective: Design and implement solution for an identified real world problem.			
Course Outcomes (COs): Upon completion of course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify the requirements of a chosen real world problem	1,2,6,8	2
2.	Design the solution for the chosen problem and document the same.	1,3,4,11	1,2
3.	Implement the design using appropriate tools	3,5,9,12	1,2
4.	Demonstrate and document the project work in team.	1, 5,10,11	1,2
- A team of 3-4 students must develop the mini project. However, during the final evaluation, each student must demonstrate the project individually. - The team must submit a Project Report (25 to 30 Pages) after completion with the following contents - Introduction - Requirements - System Architecture - Implementation - Testing - Conclusion and Future work - References - The project will be evaluated in three phases as outlined below.			

Rubrics for Evaluation of Mini Project (Inter-Discipline)					
Phase I (Project Proposal Submission and Evaluation Scheme):					
After finalizing the topic with the guidance of Supervisor, students should submit the project proposal along with Synopsis not exceeding 10 pages. Approval of synopsis is done for 15 marks by concerned project committee.					
Sl. No	Performance Indicators	Needs Improvement (0-1 mark)	Average (2-3 marks)	Good (4-5 marks)	Max marks
1	Literature Survey	Survey of literature is not recent or no literature survey	Survey of literature is not clear	Literature survey is sufficient.	5
2	Synopsis writing	Objective of the work is not identified.	Objective of the work is identified but no evidence of Inter disciplinary approach found.	Objective of the work is identified with evidence of Inter disciplinary approach found.	5
3	Presentation	Contents not delivered completely.	Contents not delivered clearly.	Contents delivered clearly with confidence.	5
Total					15

Phase II (Project Progress):					
Evaluation of project phase II is carried out by evaluation committee.					
Sl. No.	Performance Indicators	Needs Improvement (0-1 marks)	Average (2-3 marks)	Good (4-5 marks)	Max marks
1.	System design and development	System specification is not identified.	System specification is identified but not Satisfactory.	System specification is identified correctly.	5
2.	Identification of appropriate tool for application	Application tools are not identified.	Application tools identified but not used.	Application tools identified and used.	5
3.	Oral presentation	Entire contents not delivered.	Contents not delivered clearly.	Contents delivered Clearly with confidence.	5
Total					15
Phase III (Project Demonstration with Report):					
Evaluation of this phase is done by evaluation committee.					
Sl. No	Performance Indicators	Needs Improvement (0-1 marks)	Average (2-3 marks)	Good (4-5 marks)	Total marks allocated
1.	Design and Implementation	Not done	Incomplete.	Complete.	5
2.	Demonstration	Incomplete	Complete but not satisfactory.	Complete and satisfactory	5
3.	Documentation	Organization and clarity of report and technical content is not clear and complete	Organization and clarity of report and technical content is clear but not complete.	Organization and clarity of report and technical content is clear and complete.	5
4.	Oral presentation	Presentation with ppt is not clear.	Presentation with ppt is clear but not satisfactory	Presentation with ppt is clear and satisfactory.	5
Total					20

Semester End Evaluation														
Evaluation committee consists of panel of examiners containing external as well as internal evaluators. This evaluation is carried out for 50 marks.														
SN		Performance Indicators								Marks allocated			Marks awarded	
1.		Project execution		Project specification						5				
				Progress										
2.		Methodology /Result Analysis		System Design						5				
				System Implementation										
				System Testing										
3.		Project Report		Organization and Clarity						5				
				Technical content										
				Conclusion and Future Work										
Final presentation										10				
Total Marks										50				
Rubrics for Semester End Exam														
		Marks	Overall criteria											
1.		48-50	Project is reaching professional standards.											
2.		40-47	Project is excellent and may contain publishable material. Presentation is excellent.											
3.		35-39	Project and presentation are very good. All design aims are met.											
4.		30-34	Project and presentation are good. Most design aims are met.											
5.		25-29	Minimum core of design aims has been met. Presentation is satisfactory.											
6.		20-24	Design aims and implementation are met partially. Presentation is moderate.											
7.		0-20	Most design aims are not met and implementation does not work. Presentation is not satisfactory.											
Proposed Assessment Plan (for 50 marks of CIE):														
Tool						Remarks							Marks	
CIE		CIE1				Evaluation Phase -1							15	
		CIE2				Evaluation Phase-2							15	
		CIE3				Evaluation Phase-3							20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	3	-	3	-	-	-	-	-	3
CO2	3	-	3	3	-	-	-	-	-	-	3	-	3	3
CO3	-	-	3	-	3	-	-	-	2	-	-	2	3	3
CO4	3	-	-	-	3	-	-	-	-	3	3	-	3	3

Course Title	MAIN PROJECT PHASE - I		
Course Code	23CS605	L-T-P-C	(0-0-4)2
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	-
Course Objective:	To be able to identify a relevant problem that requires technical solution and conduct survey for the same.		
Course Outcomes (COs):	Upon completion of the course the students will be able to:		
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Identify a problem, through Extensive literature Survey leading to publication of a survey paper.	1,2	-
2	Plan & design the solution to the chosen problem	3	1
3	Make oral presentation and documentation of the work carried out	8, 9, 10	-
Course Contents:			
During VII semester, candidates in consultation with the guides shall carry out a literature survey to finalize the topic of the project. <i>The same project will be continued in Eighth semester.</i> Students are expected to present the project synopsis, system analysis, requirements specification and should publish a technical paper on the Literature Survey. The evaluation will be carried out in three stages • Project Phase 1 – Team Formation, Topic Selection & Guide allotment (No marks) • Project Phase 2 – Extensive Literature Survey, Problem Definition • Project Phase 3 – Preliminary Design, Report Preparation and Publication The evaluation of the project phases shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the project coordinator in consultation with the Head of the department. <i>For Multidisciplinary projects guides will be allotted from each concerned branch.</i>			
Phase 2			
Performance Indicators	Low (40%)	Medium (70%)	High (100%)
Literature Survey and Problem Definition (20 Marks)	Literature Survey not pertaining to the title of the project (0-8)	Incomplete literature survey and improper problem definition (9-14)	Extensive literature survey with clear state-of-the-art problem definition (15-20)
Preliminary Design (10 Marks)	Has no coherent strategies for problem Solving (0-4)	Has some strategies for problem – solving, but does not apply them consistently (5-7)	Formulates strategies for solving problems (8-10)
Group Participation(5 Marks)	Contributed less than peers; primarily listened without actively participating. Shared no ideas, which were often not aligned with the project (1-2)	Contributed nearly as much as others. They took part in discussions and occasionally offered suggestions. Consistently completed assigned tasks on time. (3-4)	Consistently completed their share of the work, going above and beyond—and willingly offered assistance to others. Contributed numerous valuable ideas, inspired peers, and communicated

			thoughts and needs effectively. Completed assigned tasks ahead of schedule (5)											
Ethics(5 Marks)	Upholds the standards of honesty and integrity. (1-2)	Upholds the standards of honesty and integrity. Addressed few societal and environmental issues (3-4)	Upholds the standards of honesty and integrity. Addressed the society and environmental issues and responsibilities. (5)											
Phase 3														
Presentation (10 marks)	Disorganized and ineffective presentation (0-4)	Organized, but ineffective presentation (5-7)	Effectively organized presentation (8-10)											
Report Preparation (20 Marks)	Disorganized and contents are not sufficient (0-8)	Organized but not good content wise (9-14)	Effectively organized and well framed contents (15-20)											
Paper Publication (20 Marks)	Paper submitted & awaiting results (0-8)	National conference International Conference (9-14)	Journal (15-20)											
Punctuality (Project Dairy Maintenance) (10 marks)	Not meeting the guide regularly (0-4)	Meeting regularly but doesn't document details of every session (5-7)	Up to date dairy maintenance (8-10)											
Proposed Assessment Plan (for 50 marks of CIE):														
Tool		Remarks	Marks											
Phase Evaluation		Phase 1	00											
		Phase 2	40											
		Phase 3	60											
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	3	3	-	-	-	-

Course Title	APPLICATION DEVELOPMENT LABORATORY		
Course Code	23CS606A	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
CIE	50 Marks	SEE	50 Marks
Total Hours			28
Course Objective: Design and develop apps for android devices.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop simple applications, using built-in widgets and components of android studio.	3,5,8,12	1,2
2.	Document and present the apps designed.	9,12	1
Course Contents:			
1. Develop an android application which accepts the SGPA of all the six semesters and displays your CGPA. 2. Develop an android application to login into a system which is redirected to the Home screen. The login should be successful on email: admin@example.com password: rtWi2p_10 If the email/password is invalid display a Toast with an error message 3. Assume you are accepting employee details: Name, Designation, Salary, Phone number. Develop app that displays an alert message if phone number entered is more than 10 digits. 4. Design an app that displays the names of all planets in our universe. Clicking on “Solar System” in first activity should display all the planet’s names in second activity and it should return the total number of planets to first activity. 5. Develop a QUIZ app that displays a question with four answers as options. Clicking an option should display whether the selected option is right or wrong. 6. Assume you need to accept order online for fast food items. Design an app such that it accepts the order for multiple items and displays the total amount to be paid on placing the order. 7. Design an app to display menu options on clicking a button “FILE”. The menu options are: New, Open, Save, Save as, And Print. Clicking on any option should display the relevant information. 8. Design an app to accept your name, roll number and branch programmatically. 9. Develop an android application to list all the engineering branches of MCE and displays a brief information of any department which the user clicks on in a separate page. 10. Consider a scenario where you need to send an email to multiple users. Design an app to implement the same. 11. Develop an android application to display a gallery view (Grid View) of at least 10 images. 12. Develop an android application to render the text data into Text View from the remoteserver. Show progress bar when the data is loading or Toast message if data fails to load.			
Proposed Assessment Plan (for 50 marks of CIE):			
Tool	Remarks		Marks
CIE	CIE1	Lab CIE	20

	CIE2			Report								10		
Activity Details				Design an app for a given scenario								20		
Total Marks												50		
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	3	-	-	3	-	-	-	3	2	2
CO2	-	-	-	-	-	-	-	-	3	-	-	3	2	-

Course Title		FULL STACK DEVELOPMENT LABORATORY												
Course Code		23CS606B							L-T-P-C				(0-0-2)1	
Exam Hrs.		3							Hours / Week				2	
CIE		50 Marks							SEE				50 Marks	
											Total Hours		28	
Course Objective: To build functional, cross platform web applications.														
Course Outcomes (COs): Upon completion of the course, students shall be able to:														
#	Course Outcomes								Mapping to POs			Mapping to PSOs		
1.	Design web pages using ReactJs, NodeJs and Django								2, 5			1		
2.	Develop a complete web application for a given scenario								3, 5, 9, 12			1		
Course Contents:														
1. Build a basic server using Node.js and Express. Create routes to handle HTTP requests like GET and POST and respond with simple JSON data.														
2. Extend the previous Node.js server by integrating a database (e.g., SQLite or MongoDB). Implement endpoints to perform CRUD operations on a dataset.														
3. Design and implement a RESTful API using Node.js, Express, and a database of your choice. Define endpoints for managing resources, such as creating, reading, updating, and deleting data.														
4. Create a library of reusable React components. Build components like buttons, cards, and modals and use them in a sample React application.														
5. Write a program to create a simple calculator Application using React JS.														
6. Create a Simple Login form using React JS.														
7. Build a real-time chat application using React for the front end and Node.js with Socket.IO for the back end. Enable users to send and receive messages in real-time.														
8. Develop a Django app that displays current date and time in server														
9. Develop a simple Django app that displays an unordered list of fruits and ordered list of selected students for an event.														
10. Develop a Django app that performs student registration on a course. It should also display a list of students registered for any selected course. Create students and course as models with enrolment as many to many fields.														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool				Remarks									Marks	
CIE	CIE1		Lab CIE									10		
	CIE2		Lab CIE									10		
	Report		Submission of report									10		
Activity Details				Group based activity to develop web application									20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	-	-	3	-	-	-	-	-	-	-	3	-
CO2	-	-	3	-	3	-	-	-	-	3	-	2	3	-

Course Title	AUTOMATED SOFTWARE TESTING		
Course Code	23CS606C	L-T-P-C	(0-0-2) 1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28
Course Objective: To design and execute automated tests using Selenium tool for effective web application testing.			
Course Outcomes (COs): Upon completion of course the students will be able to			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Gain hands-on experience with Selenium WebDriver	3,5	2
2.	Develop and implement data-driven and modular test automation frameworks.	3,5	2
3.	Apply best practices in automation testing, debugging, and maintenance	5,6,11	1,2
Course Contents			
1: Introduction to Automated Testing - Basics of Software Testing - Manual vs. Automated Testing - Benefits and Limitations of Automation - Overview of Automation Tools - Introduction to Selenium 2: Selenium Fundamentals - Selenium Components: IDE, WebDriver, Grid - Selenium Architecture and Features - Setting up Selenium WebDriver - Supported Browsers and Programming Languages - Writing First Test Script (Hello World in Selenium) 3: WebDriver Programming Basics - Locating Web Elements: ID, Name, XPath, CSS Selectors - Browser Commands (Open, Close, Navigation) - Working with Web Elements (Text boxes, Buttons, Drop-downs) - Handling Alerts, Pop-ups, and Frames - Waits in Selenium: Implicit and Explicit 4: Advanced WebDriver Concepts - Data-Driven Testing using Excel or CSV - Page Object Model (POM) - Cross-Browser Testing - Screenshot Capture and Logging - Exception Handling in Selenium Scripts 5: Integration with Testing Frameworks - Introduction to TestNG or JUnit - Creating Test Suites and Groups - Assertions and Annotations - Parallel Test Execution - Generating Test Reports 6: Automation Framework Design			

- Types of Automation Frameworks
- Designing a Reusable Framework with POM and TestNG
- Utilities, Configuration Files, and Reporting Tools (like ExtentReports)

7: Selenium Grid and CI/CD Integration

- Introduction to Selenium Grid
- Setting up Nodes and Hubs
- Running Tests on Remote Browsers
- Integration with Jenkins or GitHub Actions

8: Real-time Project & Best Practices

- End-to-End Testing Scenario (e.g., E-commerce Application)
- Writing Scalable and Maintainable Test Scripts
- Debugging Techniques
- Test Optimization and Maintenance

Text Book:

1. Selenium WebDriver 3 Practical Guide: End-to-end automation testing for web and mobile browsers with Selenium WebDriver. *U. Gundecha, Birmingham, UK: Packt Publishing, 2018.*
2. Mastering Selenium WebDriver 3.0: Test automation for web applications. *M. Collin, Birmingham, UK: Packt Publishing, 2018.*

Proposed Assessment Plan (for 50 marks of CIE):

Tool			Remarks										Marks	
CIE	CIE1	Laboratory CIE										20		
	CIE2	Laboratory Record Submission and Continuous Evaluation										10		
Activity Details: Develop a software web application testing												20		
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	3	-	-	-	-	-	-	-	-	3
CO2	-	-	3	-	3	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	3	3	-	-	-	-	3	-	-	-

Course Title	DevOps		
Course Code	23CS606D	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
CIE	50 Marks	SEE	50 Marks
Total Hours			28
Course Objective: Develop a DevOps application on real world problems			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understand the role and significance of Maven and Gradle build tools in modern software development.	1, 5	1
2.	Apply Build Tool to manage Java applications using Maven and Gradle.	1, 3, 5	1
3.	Build, test, and deploy Java applications through a complete DevOps lifecycle using Jenkins, Ansible, and Azure DevOps.	5, 9, 11	1
Course Contents:			
1.	Demonstration: Introduction to Maven and Gradle: Overview of Build Automation Tools, Key Differences between Maven and Gradle, Installation and Setup. Working with Maven: Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins. Working with Gradle: Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation		
	Practical Exercise: Build and Run a Java Application with Maven, Migrate the Same Application to Gradle		
2.	Demonstration: Introduction to Jenkins: Practical Exercise and Wrap-Up: Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A Continuous Integration with Jenkins: Setting Up a CI Pipeline, Integrating Jenkins with Maven/Gradle, Running Automated Builds and Tests Configuration Management with Ansible: Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook		
	Practical Exercise: Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins		
3.	Demonstration: Introduction to Azure DevOps: Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project Creating Build Pipelines: Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports Creating Release Pipelines: Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines		

	Practical Exercise and Wrap-Up: Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A													
Course outcomes (Course Skill Set): At the end of the course the student will be able to: • Demonstrate different actions performed through Version control tools like Git. • Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle. • Experiment with configuration management using Ansible. Demonstrate Cloud-based DevOps tools using Azure DevOps.														
Suggested Learning Resources: • https://www.geeksforgeeks.org/devops-tutorial/ • https://www.javatpoint.com/devops • https://www.youtube.com/watch?v=2N-59wUIPVI https://www.youtube.com/watch?v=87ZqwoFeO88														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool					Remarks							Marks		
CIE		CIE			CIE conducted for 20 marks							20		
		Lab Report			Lab Report Submission							10		
Activity Details					Project based activity							20		
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	3	-
CO2	3	-	3	-	3	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	3	-	-	-	2	-	2	-	3	-

Course Title	INTRODUCTION TO COMPUTER VISION		
Course Code	23CS661	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
CIE	50 Marks	SEE	50 Marks
Total Hours			40
Course Objective: To learn basic principles of image formation, image processing algorithms and different algorithms for recognition from single or multiple images (video).			
Course Outcomes Course Outcome: Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1. 1	Describe the fundamentals of Computer Vision	1	-
2.	Perform shape analysis	3	-
3.	Develop applications using computer vision techniques	2	-
4.	Describe video analysis and motion computation	1	-
Course Content			
MODULE – 1			10 Hrs
Introduction and Image Formation: What is computer vision? A brief history, Geometric primitives and transformations, Photometric image formation, The digital camera. Pinhole Perspective, Weak Perspective, Cameras with Lenses, The Human Eye, Intrinsic Parameters and Extrinsic Parameters, Geometric Camera Calibration.			
MODULE – 2			10 Hrs
Early Vision – One Image: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Local Image Features, Texture.			
MODULE - 3			10 Hrs
Early Vision – Multiple Images: Stereopsis and Structure from Motion Early Vision – Mid-level Vision: Segmentation by Clustering, Grouping and Model fitting, Tracking.			
MODULE – 4			10 Hrs
High-level Vision: Registration, Smooth Surface and their Outlines, Range Data Detecting Objects in Images, Recognition.			
Text Books:			
1. Computer Vision: Algorithms and Applications (CVAA), Richard Szeliski, Springer, 2nd edition, 2020, http://szeliski.org/Book/			
2. Computer Vision – A modern approach, by D. Forsyth and J. Ponce, Prentice Hall, 2nd edition, 2012			
Reference Books:			
1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.			
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.			
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.			
4. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University, Press, 2012			
5. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.			
6. Building Computer Vision Applications Using Artificial Neural Networks - With Step-by-step Examples in Opencv And Tensorflow With Python, Shamshad Ansari, Apress, 2020			

Proposed Assessment Plan (for 50 marks of CIE):														
Tool				Remarks									Marks	
CIE	CIE1			Conducted for 20 marks & reduced to 10 marks									10	
	CIE2			Conducted for 20 marks & reduced to 10 marks									10	
	CIE3			Conducted for 20 marks & reduced to 10 marks									10	
Activity Details: Real time scenarios activity and simulation of search algorithms by visualization													20	
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Title	ARTIFICIAL INTELLIGENCE		
Course Code	23CS662	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will be able to apply the concepts of Artificial Intelligence to construct knowledge-based systems.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Classify different types of Artificial Intelligence agents and analyze various search strategies.	2	-
2.	Trace and assess the effectiveness of algorithms using various search strategies for a given problem	2	-
3.	Design simple knowledge-based systems using first-order logic	3	2
4.	Apply various learning techniques to improve decision-making.	3,4	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction: What is AI? Intelligent Agents: Agents and environment; Good behavior: The Concept of Rationality; The nature of environment; The structure of agents. Problem-solving: Problem-solving agents. Example problems; Searching for solution; Uninformed search strategies: Breadth-first search, Uniform-cost search.			
MODULE – 2			10 Hrs
Uninformed search strategies: Depth-first search, Depth-limited search, Iterative deepening depth first search, Bidirectional search, Comparing uninformed search strategies; Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Optimality of A*, Memory-bounded heuristic search; Heuristic functions; Local Search Algorithms and Optimization Problems: Hill-climbing search, Simulated annealing, Local beam search, Genetic algorithms.			
MODULE – 3			10 Hrs
On-line search agents and unknown Environments: Online search problems, Online search agents, online local search, learning in online search, Logical Agents: Knowledge-based agents; The Wumpus world; First-Order Logic: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic, Knowledge engineering in first-order logic.			
MODULE – 4			10 Hrs
Learning from Examples: Forms of Learning; supervised learning; Learning decision trees; Practical Machine Learning. Statistical and Reinforcement learning: Statistical learning, maximum likelihood parameter learning, Bayesian parameter, learning, passive reinforcement learning, active reinforcement learning.			
Text Book: Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.			

Reference Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015.
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details		Real world scenarios based activity and search algorithm simulation visualization.	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	3	3	-	-	-	-	-	-	-	-	-	-

Course Title	WIRELESS NETWORKS		
Course Code	23CS663	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	SEE	50 Marks
		Total Hours	40
Course Objective: Students will be able to gain knowledge of wireless devices and different methodologies used in Wireless Communication Networks.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping To POs	Mapping To PSOs
1	Explore the applications, types of transmissions, Multiplexing and satellite Systems.	1,2,12	-
2	Analyse energy efficiency, mobility, scalability of Global System and management schemes in wireless networks.	2,3	-
3	Demonstrate medium access control protocols, routing, IEEE standards and cellular networks.	3,4	-
4	Apply knowledge of network resources, security for mobile and wireless networking.	1,2	-
Course Contents:			
MODULE-1			10 Hrs
Introduction: Wired Network vs. Wireless Network, Overview of Wireless Applications, Wireless Transmission: Path loss, Multi-path propagation, Doppler shift, Fading, Time Division Multiplexing, Frequency Division Multiplexing, Code, Spread Spectrum Technique, Satellite Communication;			
MODULE-2			10 Hrs
Cellular System: Cellular Network Organization, Cellular System Evolution, Cellular Fundamentals: Capacity, Topology, Operation of Cellular Systems, Handoff, Power control, Case study: Global System for Mobile communication (GSM) Network, General Packet Radio Service (GPRS), Code Division Multiple Access (CDMA 2000), Cordless System, Wireless Local Loop, Mobility Management-Location Management, HLR-VLR scheme, Hierarchical scheme, Predictive location management schemes.			
MODULE-3			10 Hrs
Wireless Network: Protocols: Media Access Protocol, Mobile IP, Mobile Transport Layer Protocol, Wireless Access Protocol, Ad-Hoc Networks and Routing, Standards: IEEE 802.11, Wi-Fi, Wireless Broadband-Wi-MAX, Bluetooth, IEEE 802.15, Security in Wireless Network, Hyper LAN.			
MODULE-4			10 Hrs
Mobile Computing: Mobile Computing, Issues: Resource Management, Interference, Bandwidth, Cell Splitting, Frequency reuse, Mobile Data Transaction Models, File Systems, Mobility Management, Security.			
Text Books:			
1. William Stallings, "Wireless Communications & Networks", 2/E, Pearson Education India, Reprint 2007.			
2. Jochen Schiller, "Mobile Communications", 2/E, Pearson Education India, reprint 2007			

Reference Book:

1. Sandeep Singhal, "The Wireless Application Protocol" , Addison Wesley, India, reprint 2001
2. T S Rappaport, "Wireless Communications: Principles & Practice", 2/E, Pearson Education, 2002.
3. C E Perkins, "Ad Hoc Networking", Addison Wesley, 2000.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_ee61/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details		Implement appropriate concepts of wireless network for a given scenario.	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-

Course Title	MANAGEMENT INFORMATION SYSTEMS		
Course Code	23CS664	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To describe the role of information technology and decision support systems in business.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to POs
1.	Describe basic concepts and technologies used in the field of management information systems.	1, 11	-
2.	Compare the processes of developing and implementing information systems.	1, 2	-
3.	Outline the role of the ethical, social, and security issues of information systems.	1,8	-
4.	Apply information systems to accomplish the objectives of an organization.	1, 10	-
Course Contents:			
MODULE – 1			10 Hrs
Management Information System (MIS): Concept , MIS: Definition ,Role of the Management Information System , Impact of the Management Information System , MIS and the User, Management as a Control System , MIS: A Support to the Management, Management Effectiveness and MIS, Organisation as a System, MIS: Organisation Effectiveness, MIS for a Digital Firms.			
MODULE – 2			10 Hrs
System Engineering-Analysis and design: System Concepts, System control, Types of system, Handling System Complexity, Classes of Systems, General Model of MIS, Need for system analysis, System analysis of the existing system, System analysis of a new requirements, System Development Model.			
MODULE – 3			10 Hrs
Decision Support Systems and Knowledge Management: Decision Support Systems (DSS): Concept and Philosophy ,DSS Models: Behavioural, Management Science and Operations Research Models, Group Decision Support System (GDSS), Artificial Intelligence (AI)system, Knowledge based Expert System (KBES) , DSS Application in E-enterprise, MIS and the Benefits of DSS.			
MODULE – 4			1
Technology of information system: Data processing, Transaction processing, application processing, Information system processing, OLAP for Analytical Information ,TQM of Information System, Human Factors and User Interface, Real Time Systems and Good Design, Case Tools and I-Case, Strategic Nature of IT Decision, Evaluation and Feasibility of IT Solutions, MIS: Choice of the ‘Information Technology’.			
Text Book:			
1. Jawadekar, W.S., “Management Information Systems”, Tata McGraw Hill Private Limited, New Delhi, 2013,5 th edition.			

Reference Books:

1. Goyal, D.P.: “Management Information System”, MACMILLAN India Limited, New Delhi, 2008.
2. Mahadeo Jaiswal, Monika Mital: “Management Information System”, Oxford University Press, New Delhi.
3. Kenneth C. Laudon and Jane P. Laudon: “Management Information Systems” 9/e, Pearson Education, New Delhi.

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details		Group activity based on flipped classroom	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	-	-

Course Title	INTRODUCTION TO CLOUD COMPUTING		
Course Code	23OEC61	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
CIE	50 Marks	SEE	50 Marks
Total Hours			40
Course Objective: To expose students to frontier areas of cloud computing service models and applications.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Uncover the history, security and privacy issues that arise from cloud computing architectures intended for delivering Cloud based IT services.	1, 12	-
2.	Explore the key technical, organizational, architectural and virtualization techniques applied to different types of cloud environment with energy efficiency.	2,8	-
3.	Ascertain different cloud platforms, Cloud Computing services, challenges of cloud computing and tools used in real life scenarios.	2, 5 ,9,10	-
4.	Explore the security and privacy issues that arise from cloud computing architectures intended for delivering Cloud based IT services.	6,8	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Cloud computing at a glance, historical developments, building cloud computing environments, computing platforms and technologies. Principles of parallel and Distributed computing: Eras of computing, parallel vs. Distributed computing, elements of parallel computing, elements of distributed computing, technologies for distributed computing.			
MODULE – 2			10 Hrs
Virtualization: Introduction, characteristics of virtualized environments, Taxonomy of virtualization techniques, virtualization and cloud computing, pros and cons of virtualization technology. Cloud Computing architecture: Introduction, Cloud reference model, types of clouds, economics of the cloud, open challenges.			
MODULE – 3			10 Hrs
Cloud platforms in industry: Amazon Web Services, Google App Engine, Microsoft Azure. Advanced topics in cloud computing: Energy efficiency in clouds, Market based management of clouds, Federated clouds/Inter clouds, Third party cloud services.			
MODULE – 4			10 Hrs
Infrastructure security, IAM: Infrastructure security: network level, host level, application level, Identity and Access management: trust boundaries and IAM, why IAM? IAM challenges, IAM definitions, IAM architecture and practices, getting ready for cloud, IAM standards and protocols for clouds services, IAM practices in the cloud, cloud authorization management. Security management in the cloud: security management standards, security management in the cloud,			

availability management, Saas, Paas. Iaas availability management, access control, security vulnerability, patch and configuration management. Privacy: What is privacy? What is data life cycle? What are the key privacy concerns in cloud? who is responsible for protecting privacy?

Text Books:

1. Mastering Cloud Computing, McGraw Hill publication, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi
2. Cloud security and privacy an enterprise perspective on risks and compliances, 2013, Tin Mather, Subra Kumarswamy, Shahed Latif

Reference Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescu, first edition, MK publishers.
2. Cloud Computing- A practical approach, McGraw Hill publication, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter.

MOOCs:

1. <https://www.youtube.com/watch?v=Eg4AAGCE7X4>
2. <https://www.coursera.org/learn/cloud-computing>
3. <https://www.edx.org/course/introduction-cloud-computing-microsoft-cloud200x>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conducted for 20 marks and reduced to 10 marks	10
	CIE2	Conducted for 20 marks and reduced to 10 marks	10
	CIE3	Conducted for 20 marks and reduced to 10 marks	10
Activity Details		Group Activity will be conducted using various cloud platforms	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-		-	-	-	-	3	-	-
CO2	-	3	-	-	-	-		2	-	-	-	-	-	-
CO3	-	3	-	-	3			-	2	2	-	-	-	-
CO4	-	-	-	-	-	2		2	-	-	-	-	-	-

Course Title	INTRODUCTION TO JAVA PROGRAMMING		
Course Code	23OECS62	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	SEE	50 Marks
Total Hours			40
Course Objective: Develop java programs using object-oriented concepts.			
Course Outcomes(COs):Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping To POs	Mapping To PSOs
1.	Describe the basic concepts of object-oriented programming.	1	-
2.	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages	2, 3	-
3.	Apply the concepts of String Handling and Exception handling to develop efficient and error free codes.	3	-
Course Contents:			
MODULE-1			10 Hrs
Basic concepts of Java : The History and Evolution of java: OOP Concepts, History of java, The java Buzz words, The Evolution of java, Data types, Variables, The Scope and Life time of variables, Operators, Expressions, Control statements, Type conversion and casting, Command Line Arguments.			
MODULE-2			10 Hrs
Arrays: Declaration, Initialization and accessing values, One-Dimensional Arrays, Multi- dimensional arrays, Alternative Array Declaration Syntax, var-arg methods. Strings: Explore String class, String Buffer and String Builder classes.			
MODULE-3			10 Hrs
Class fundamentals. Declaration objects, Assigning object reference variables, Introducing Methods, Constructors, “this” keyword, Garbage collection. Inheritance basics, Using Super keyword, Types of inheritance, Member access rules, Constructor and calling sequence, Using abstract Classes, Using final keyword. Method overriding and overloading.			
MODULE-4			10 Hrs
Defining an interface, Implementing interface, Accessing interface properties. Defining Package, finding packages and class path, accessing Protection. Exception handling Fundamentals, exception types, Built-in Exceptions, Using try-catch-finally throw- throws Keywords			
Text Books:			
3. Herbert Schildt, “Java The complete reference”, 9 th edition, McGraw Hill Education (India) Pvt. Ltd.			
Reference Book:			
1. An introduction to java programming and object oriented application development, R AJohson-Thomson.			
2. Introduction to Java programming-comprehensive, Y. Daniel Liang, Tenth Edition, Pearson ltd 2015.			
3. E Balagurusamy, Programming With Java : A Primer 5th Edition Tata McGraw Hill.			

MOOCs:

1. <http://nptel.ac.in/courses/106106147/>
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. <https://www.coursera.org/specializations/object-oriented-programming>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details		Program execution on concept learnt	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-

Course Title	WEB TECHNOLOGY		
Course Code	23OECS63	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
CIE	50 Marks	SEE	50
		Total Hours	40
Course Objective:	Create web pages with client-side and server-side scripting.		
Course Outcomes (COs):	Upon completion of the course, students shall be able to:		
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge of HTML/XHTML and CSS in designing webpage.	1	-
2.	Develop client-side script to design webpage.	3	-
3.	Design server-side script to create webpage.	3,5	-
4.	Create web pages using JavaScript, xml, PHP and MySQL for the real World applications.	1,3,5	-
Course Contents:			
MODULE – 1			10 Hrs
Fundamentals of Web, XHTML: Internet, WWW, Web Browsers, and Web Servers; URLs; MIME; HTTP; the Web Programmers Toolbox. XHTML: Basic syntax; Standard structure; basic text markup; Images; Hypertext Links; Lists; Tables; Forms; the audio element, the video element, organization elements, time element			
MODULE – 2			10 Hrs
CSS: Introduction; Levels of style sheets; Selector forms; Property value forms; Font properties. List properties; Color; Alignment of text; The box model; Background images; Theand<div>tags. JavaScript: Overview of JavaScript; Syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements; Object creation, and modification; Arrays; Functions; Pattern matching using regular expressions.			
MODULE – 3			10 Hrs
JavaScript and HTML Documents: The JavaScript execution environment; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The navigator object. Dynamic Documents with JavaScript: Introduction to dynamic documents; Element positioning; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor.			
MODULE – 4			10 Hrs
XML: Introduction; Syntax; Document structure; Namespaces, XML schemas, Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets. PHP: Origins and uses of PHP; Overview of PHP; General syntactic characteristics; Primitives, operations and expressions; Output; Control statements; Arrays; Functions; Pattern matching; Form handling; Cookies; Session tracking; Database Access using PHP and MySQL.			
Text Book: Robert W. Sebesta: Programming the World Wide Web, 8th Edition, Pearson Education, 2014.			

Reference Books:

1. Deitel H.M. and Deitel P.J., "Internet and World Wide Web How to program", Pearson International, 2012, 4th Edition.
2. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson, 2015.
3. ISRD Group: Internet Technology and Web Design, Tata McGraw Hill Publishing Ltd, 2011

MOOCs:

1. <https://www.mooc-list.com/course/programming-and-web-beginners-coursera>
2. <https://archive.nptel.ac.in/courses/106/105/106105084/>
3. <https://www.coursera.org/specializations/web-design>
4. <http://www.w3c.org>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conduction for 20 marks & reduced to 10 marks	10
	CIE2	Conduction for 20 marks & reduced to 10 marks	10
	CIE3	Conduction for 20 marks & reduced to 10 marks	10
Activity Details		Group based activity to create web page.	20

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	3	-	3	-	-	-	-	-	-	-	-	-

NATIONAL SERVICE SCHEME (NSS)														
Course Code		23NYP4					(L-T-P) C					(0-0-2)		
Exam Hrs		-					Hours/ Week					2		
SEE		-					Total Hours					24		
Course Outcomes: At the end of the course, the student will be able to														
#	Course Outcomes										Mapping to POs		Mapping to PSOs	
1.	Understand the importance of his / her responsibilities towards society										6			
2.	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.										3,6			
3.	Evaluate the existing system and to propose practical solutions for the same for sustainable development										3,6			
4.	Implement government or self-driven projects effectively in the field.										11			
5.	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.										11			
Module 1												8 Hrs		
Plantation and adoption of plants. Know your plants.														
Module 2												8 Hrs		
Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).														
Module 3												8 Hrs		
Govt. school Rejuvenation and helping them to achieve good infrastructure.														
Reference Books :														
1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.														
2. Government of Karnataka, NSS cell, activities reports and its manual.														
3. Government of India, NSS cell, Activities reports and its manual.														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool			Remarks										Marks	
CIE	CIE1													
	CIE2													
	CIE3													
Activity Details														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

PHYSICAL EDUCATION (PE)														
Course Code		23NYP4						(L-T-P) C				(0-0-2)		
Exam Hrs		-						Hours/ Week				2		
SEE		-						Total Hours				24		
Course Outcomes: At the end of the course, the student will be able to														
#	Course Outcomes										Mapping to POs		Mapping to PSOs	
1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.										9,10,11		-	
2	Familiarization of health-related Exercises, Sports for overall growth and development										9,11		-	
3	Create a foundation for the professionals in Physical Education and Sports										11		-	
4	Participate in the competition at regional/state / national / International levels.										9,10,11		-	
5	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.										9,10,11		-	
Module 1												4 Hrs		
Orientation - Postural deformities, Stress management														
Module 2												16 Hrs		
Specific games (Any one to be selected by the student)														
1.Throw ball														
2. Table Tennis														
3. Athletics (Field Events- Jumps) – Any event as per availability of Ground.														
Module 3												4 Hrs		
Aerobics														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool				Remarks								Marks		
CIE	CIE1													
	CIE2													
	CIE3													
Activity Details														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

YOGA														
Course Code		23NYP4						(L-T-P) C				(0-0-2)		
Exam Hrs		-						Hours/ Week				2		
SEE		-						Total Hours				24		
Course Outcomes: At the end of the course, the student will be able to														
#	Course Outcomes							Mapping to POs			Mapping to PSOs			
1.	Understand the Philosophical and Scientific Basis of Yoga							11			-			
2.	Demonstrate Proficiency in Basic Yoga Practices							9			-			
3.	Analyze the Role of Yoga in Managing Stress and Enhancing Lifestyle							7,11			-			
4.	Apply Yoga Principles for Personal and Professional Growth							10, 11			-			
Module 1											4 Hrs			
Ashtanga Yoga														
1. Dharana														
2. Dhyana (Meditation)														
3. Samadhi														
Module 2											4 Hrs			
Different types of Asanas														
a. Sitting 1. Bakasana 2. Hanumanasana 3. Ekapada Rajakapotasana 4. Yogarnudra in Vajrasana														
b. Standing 1. Vatayanasana 2. Garudasana														
c. Balancing 1. Veerabhadrasana 2. Sheershasana														
Module 3											16 Hrs			
Pranayama														
1. Bhastrika														
2. Bhramar														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool				Remarks								Marks		
CIE		CIE1												
		CIE2												
		CIE3												
Activity Details														
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

Course Title	ANALYTICAL ABILITY AND SOFT SKILLS		
Course Code	23ASK	L-T-P	(0-0-2)1
Exam	1	Hours/Week	2
SEE	50 Marks	Total Hours	24
This course will be conducted at the end of fifth semester for two weeks by TAP department. Course Objective: To Enhance problem solving skills and communication skills Course outcomes: At the end of course, student will be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Apply methods to solve numerical and reasoning problems	2,3	-
2.	Lead a team in corporate offices	8,9	-
3.	Communicate effectively in professional ambience	10	-
Course Content			
MODULE – 1			
Hard Skills: Speed/Distance, Probability, Permutations/Combinations, Profit/Loss, Simple Interest/Compound Interest, Number theories, Number/Letter series, Coding/Decoding, Blood relations, Directions, Clock, Calendar. Logical reasoning problems			
MODULE – 2			
Soft Skills: Basic grammar, Spotting errors, Sentence formation, Email writing, Public speaking, Client communication, Leadership, Managerial skills, Stress management, Presentation Skills			
MODULE -3			
Technical Skills: Review of C programming, Simple coding, Syntax rules, MCQs on C language.			
MODULE -4			
Activities: GD, JAM, Mock Interview, Pick and speak, Presentation			

Course Title	SYSTEM SOFTWARE AND COMPILER DESIGN		
Course Code	23CS701	(L-T-P) C	(3-0-0) 3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	Total Hours	42
SEE	50 Marks		
Course Objective: To understand and apply the concepts of system software and compiler design.			
Course Outcomes (COs): Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the principles of system software and compiler design phases for a given problem	1	-
2.	Analyze the concepts of System software and language processor to process the given input and interpret the features.	2	-
3.	Design assemblers and parsers for the assembly language code.	3	
4.	Implement lexical and syntactic analyzers for the grammars using Lex and Yacc tools.	3, 5	1
Course Contents:			
MODULE – 1			11 Hrs
Machine Architecture, Assembler 1: The Simplified Instructional Computer (SIC) and SIC/XE Assemblers: Basic assembler functions, Machine dependent assembler features. Assembler 2: Machine Independent Assembler Features, Assembler Design Options.			
MODULE – 2			11 Hrs
Loaders and Linkers: Basic Loader Functions, Machine-Dependent Loader Features, Machine- Independent Loader Features, Loader Design Options. Macro Processor: Basic Macro Processor Functions, Machine-Independent Macro Processor Features.			
MODULE – 3			10 Hrs
Introduction: Language Processors, The structure of a Compiler, Applications of Compiler Technology, Programming Language Basics. Lexical Analysis: Role of Lexical Analyzer, Input buffering, Specifications of tokens, Recognition of Tokens.			
MODULE – 4			10 Hrs
Syntax Analysis: Introduction, Context –free Grammar and Structure of Language, Parser and its Types, Top-Down parser-Recursive descent parsing and Non-Recursive descent parsing, Predicting parsing table, Error recovering strategies.			
Pre-requisite: Finite Automata and Formal Languages			
Tutorial/Lab programs/Activity			
Tutorial			
1. a) Write and execute a LEX program to count the number of characters, words, spaces & no. of lines in a given input file. b) Write a LEX program to count the number of comment lines in a given C program. Also eliminate them and copy that program into separate file.			
2. Write a LEX program to recognize a valid arithmetic expression and to recognize the identifiers and operators present and to print them separately.			
3. a) Write a LEX program to recognize and count the number of identifiers in a given input file. b) Write a LEX program to find & replace String.			
4. a) Write a LEX program to check the validity of a Date. b) Write LEX program by reading input file and copy the content with line number to another file.			
5. Write YACC program to recognize a valid arithmetic expression that uses operators +, -, * & /.			
6. Write YACC program to evaluate an arithmetic expression involving operators +, -, * and /.			
7. Write a YACC program to convert infix to postfix.			
8. a) Write YACC program to recognize the grammar ($a^n b, n \geq 10$).			

Course Title	NETWORK SECURITY AND CYBER LAW				
Course Code	23CS702	(L-T-P) C	(3-0-0) 3		
Exam Hrs.	3	Hours/Week	3		
CIE	50 Marks	Total Hours	42		
SEE	50 Marks				
Course Objective: To learn cryptography techniques, cyber law and IT Act.					
Course Outcomes (COs): Upon the completion of the course the students will be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Apply cryptographic algorithms and cyber law principles to ensure secure digital communication.	1	-		
2.	Analyze information security threats, identify cipher algorithm and cyber laws to evaluate secure digital communication.	2	-		
3.	Design network solution using the symmetric and asymmetric cryptographic algorithms.	3	-		
4.	Develop secure network communication solutions using cryptographic techniques in compliance with the IT Act.	3, 5, 6, 7, 8, 9	-		
Course Contents:					
MODULE – 1			11 Hrs		
Introduction: Security goals, attacks, Services and Mechanisms, Techniques, Mathematics of cryptography: Integer Arithmetic, The Extended Euclidean Algorithm; Traditional Symmetric-Key Ciphers: introduction, Categories of traditional ciphers: substitution ciphers.					
MODULE – 2			10 Hrs		
Transposition ciphers Introduction to Modern Symmetric-Key Ciphers: Modern block ciphers, Components of modern block ciphers, Two classes of Product Ciphers, Attacks for block ciphers.; Data Encryption Standard: History, DES Structure, DES Analysis, Multiple DES, Security of DES.					
MODULE – 3			10 Hrs		
Advanced Encryption Algorithm: introduction, Transformation used by AES; Asymmetric Key cryptography: introduction, Trapdoor One-Way Function, Knapsack Cryptosystem, RSA cryptosystem, Rabin Cryptosystem.					
MODULE – 4			11 Hrs		
The information Technology Act - IT act aim and objectives, Scope of the act, Major Concepts, Important provisions, Attribution, acknowledgement, and dispatch of electronic records, Secure electronic records and secure digital signatures, Regulation of certifying authorities: Digital Signature certificates, Duties of Subscribers, Penalties and adjudication, The cyber regulations appellate tribunal, Offences, Network service providers not to be liable in certain cases, Miscellaneous Provisions.					
Pre-requisite: Basic knowledge of Computer Networks, Data Communication and Programming Fundamentals.					
Activity: Students will design/implement security algorithms to address cybersecurity challenge					
Text Books					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Cryptography and Network Security	Behrouz A Forouzan, Debdeep Mukhopadhyay	3 rd	McGraw Hill Education	2017
2.	Cryptography, Network Security and Cyber Laws	Bernard Menezes	1 st	Cengage Learning	2010
Reference Books:					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Cryptography:	Hans Delfs, Helmut Knebl	1 st	Springer	-

	Principles and Applications													
2.	Number theory and cryptography	Neal Koblitz	1 st	Springer	2007									
3.	Cryptography and Network Security	William Stallings	5 th	Pearson Education	2013									
EBOOKS/MOOC:														
https://www.coursera.org/learn/crypto														
Video tutorials:														
https://nptel.ac.in/courses/106105031														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool	Remarks				Marks									
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks			10									
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks			10									
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks			10									
Activity Details	Activity	Group Based Activity			20									
Total Marks					50									
	Course Articulation matrix													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	2	2	2	2	-	-	-	-	-

Course Title		MAIN PROJECT PHASE - II			
Course Code	23CS703	(L-T-P) C	(0-0-2) 2		
Exam Hrs.	3	Hours/Week	4		
CIE	100 Marks	Total Hours	60		
SEE	100 Marks				
Course Objective: Design and implement solution for the identified real-world problem in Phase I.					
Course Outcomes (COs): Upon completion of course, the students will be able to:					
#	Course Outcomes		Mapping to POs	Mapping to PSOs	
1.	Design and implement the system components/modules towards the solution by considering the sustainable goals		3, 5, 6	1, 2	
2.	Use research-based knowledge and methods to interpret the results obtained and provide valid conclusions about the findings		4	-	
3.	Demonstrate ethical practices in project management, software development and professional activities.		6, 11, 12	-	
4.	Demonstrate the individual and team work ability to effectively collaborate and exhibit oral and document communication		9,10,	1	
Course Contents:					
The project teams will implement the project started in their sixth semester					
The project work is to be evaluated in three stages: • Stage I (30M) - First internal evaluation shall be taken up during this phase. This includes presentation on fine tuning of SRS & Design carried out in seventh semester. • Stage II (20 M) – Mid phase evaluation shall be taken up during this phase. This includes presentation, intermediate project demonstration, and draft copy of the paper. • Stage III (50 M) – Final project Demo, report submission and details of technical paper publication.					
The evaluation of the project stages shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the project coordinator in consultation with the Head of the department. For Multidisciplinary projects guides will be allotted from each concerned branch.					
Note: Students are required to submit a report that has been verified using the DrillBit plagiarism detection tool. The plagiarism similarity must not exceed 30% and AI similarity index less than 30%.					
Rubrics for Evaluation of project					
Stage I (Project Progress): Evaluation of Main Project Phase II is carried out by evaluation committee.					
SN	Performance Indicators	Average	Good	Excellent	Max marks
1.	System design and development	System specification is not identified. (0 – 3)	System specification is identified but not satisfactory. (4 – 6)	System specification is identified correctly. (7 – 10)	10
2.	Identification of appropriate tool for application	Applicationtools are not identified. (0 – 3)	Application tools identified but not used. (4 – 6)	Application tools identified and used. (7 – 10)	10
3.	Oral presentation	Entire contents not delivered. (1-2)	Contents not delivered clearly. (3-4)	Contents deliveredclearly with confidence. (5)	5
4.	Group Participation	Did less work than others. Listened mainly; Rarely spoke up, and ideas were off the mark. Needed much reminding;	Did almost as much work as others. Participated in discussions; on some occasions, made	Did a full share of the work or more and volunteers to help others? Provided many good ideas; inspired others;	5

		submission was late. (1-2)	suggestions. Completed assigned work on time. (3-4)	clearly communicated ideas and needs. Completed assigned work ahead of time. (5)	
Stage II (Mid Phase Project Demonstration with Draft paper):					
1.	Design and Implementation	Design not complete. (1-2)	Design partially completed. (3-4)	Design completed. (5)	5
2.	Demonstration	Incomplete. (1-2)	Complete but not satisfactory. (3-4)	Complete and satisfactory. (5)	5
3.	Technical paper Draft	Organization and technical content not relevant. (1-2)	Organization and technical content of paper complete but needs improvement. (3-4)	Organization and technical content of the report are complete and satisfactory. (5)	5
4.	Oral presentation	Presentation slides are not clear. (1-2)	Presentation slides are clear, but not satisfactory. (3-4)	Presentation slides are clear and satisfactory. (5)	5
Stage III (Final Project Demonstration):					
1.	Final project demonstration	Project incomplete (0 – 3)	Project complete but needs improvement in interface design/ functionality, etc. (4-6)	Project completed (7-10)	10
2.	Oral Presentation	Disorganized and ineffective presentation (4)	Organized, but ineffective presentation (7)	Effective organized presentation (10)	5
3.	Ethics	Upholds the standards of honesty and integrity. (1-2)	Upholds the standards of honesty and integrity. Addressed few societal and environmental issues (3-4)	Upholds the standards of honesty and integrity. Addressed the societal and environmental issues and responsibilities. (5)	5
4.	Report submission	Disorganized and contents are not sufficient (0-8)	Organized but not good content wise (9-14)	Effectively organized and well framed contents (15-20)	20
5.	Technical paper publication/KSCS T/Any Proposal Submitted (Granted) to VGST/DST/Unive rsity/ sponsoring agency	Paper submitted for National Conference (8)	Paper submitted / published in an International Conference (9)	Paper submitted / published in a Journal (10)	10
Proposed Assessment Plan (CIE – Scale Down to 50 Marks):					
Tool		Remarks			Marks
CIE	CIE1	Phase Evaluation – I			30
	CIE2	Phase Evaluation – II			20
	CIE3	Phase Evaluation – III			50
Total Marks					100

Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	3	3	-	-	-	-	-	-	3	3
CO2	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	-	-	-	-	3	3	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	3	-

Course Title		DEEP LEARNING			
Course Code		23CS741	L-T-P		(3-0-0) 3
Exam		3	Hours/Week		3
CIE		50 Marks	Total Hours		42
SEE		50 Marks			
Course Objective: Deploy deep learning algorithms and their applications to solve real world problems.					
Course Outcomes (COs): At the end of the course, student will be able to:					
#	Course Outcomes		Mapping to POs		Mapping to PSOs
1.	Apply specific deep learning algorithms to obtain solutions for appropriate problems		1		1
2.	Identify and analyse deep learning techniques suitable for training models using TensorFlow and Keras.		2		1
3.	Develop deep learning models and train them to solve real-life problems.		3, 5		1
4.	Conduct experiments to demonstrate techniques using deep neural networks, convolutional neural networks, and recurrent neural networks.		4, 5, 8, 9		1, 2
Course Contents :					
MODULE-1					11 Hrs
Introduction to Artificial Neural Networks with Keras- Biological Neurons, Artificial Neuron, what are activation functions, Importance of continues function in deep learning, Types of Activation Functions, Multilayer Perceptron (MLP), Forward propagation and Backpropagation, Weight Computation with Neurons using MLps, Implementation of MLps for Regression and Classification analysis. Using Keras and TensorFlow libraries. Different type of Weight initializations functions Glorot and He Initialization etc					
MODULE-2					11 Hrs
Training Deep Neural Networks- Challenges in Vanishing and Exploding Gradients, Batch Normalization, Gradient Clipping, Optimizers Technic: Momentum Optimization, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam and Nadam Optimization, Learning Rate, Avoiding Overfitting Through Regularization, ℓ_1 and ℓ_2 Regularization, Dropout, Monte-Carlo (MC) Dropout, Max-Norm Regularization.					
MODULE-3					10 Hrs
Convolutional Neural Networks – Why images are hard, Visual context inspiration [Hubel and Weise], Convolutional Layer, Filters, Convolution in 2D, Stacking Multiple Feature Maps Convolution in 3D , Padding, Pooling, Memory Requirements, Introduction to CNN Architectures LeNet-5, AlexNet, GoogLeNet, VGGNet, ResNet, DenseNet, MobileNet, EfficientNet, Image classification using Transfer Learning with ResNet-34 CNN. Text classification using CNN. Classification and Localization Object Detection: Fully Convolutional Networks (FCNs), You Only Look Once (YOLO), Semantic Segmentation					
MODULE-4					10 Hrs
Sequences Neural Networks - Recurrent Neural Networks, LSTM, Bidirectional LSTM, GRU, One to One, One to Many, Many to One RNN Network, Training RNNs, Implementing a Simple RNN. Forecasting a Time Series, using LSTM. Auto Encoders Decoders, GAN’s					
Pre-requisite: Knowledge of Python programming, machine learning fundamentals, linear algebra, and probability.					
Text Book :					
Sl.No	Book Title		Authors	Edition	Publisher
					Year

1.	Hands-On Machine Learning with Scikit-Learn-Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems				Aurelien Geron	2 nd	O'Reilly	2019						
Reference Books:														
Sl.No	Book Title				Authors	Edition	Publisher	Year						
1.	Deep Learning				Ian Goodfellow, Yoshua Bengio, Aaron Courville	1 st	MIT Press, ISBN: 978-0262035613	2016						
2.	Python Machine Learning				Sebastian Raschka and Vahid Mirjalili	3 rd	Packt Publishing, 2019	2019						
e-Book: https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/														
MOOCs: 1. https://www.edx.org/course/deep-learning-with-tensorflow 2. https://www.deeplearning.ai/tensorflow-in-practice/														
Proposed Assessment Plan (for 50 marks of CIE):														
Tool					Remarks				Marks					
CIE		CIE-1		Conducted for 20 marks(Module 1) & reduced to 10 marks					10					
		CIE-2		Conducted for 20 marks(Module 2) & reduced to 10 marks					10					
		CIE-3		Conducted for 20 marks(Module 3) & reduced to 10 marks					10					
Activity Details		Act		Project Based activity					20					
Total Marks									50					
Course Articulation matrix														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	2	-	3	-	-	-	-	-	-	-	3	-
CO4	-	-	-	2	3	-	-	3	3	-	-	-	3	3

Course Title	DATA SCIENCE		
Course Code	23CS742	(L-T-P) C	(3-0-0) 3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	Total Hours	42
SEE	50 Marks		
Course Objective: Students will be able to apply the data science process to real-time data.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the basic concepts of data science to solve simple data-driven problems	1	-
2.	Analyze datasets using exploratory data analysis (EDA) techniques using the R tool	2	-
3.	Implement machine learning algorithms to solve given data science problems	3	-
4.	Interpret data by generating and analyzing visualizations using appropriate data visualization tools	5, 8, 9	1, 2
Course Contents:			
MODULE – 1			10 Hrs
Introduction: What is Data Science? Big Data and Data Science hype - and getting past the hype, Why now? –Datafication, Current landscape of perspectives, Skill sets needed. Statistical Inference - Populations and samples, Statistical modelling, probability distributions, fitting a model. Demonstration: 1. R-Installation and basics. 2. Construct a dataset of students' grades, attendance, and extracurricular involvement. Use R to perform statistical tests and visualizations to analyze the impact of attendance on academic performance.			
MODULE – 2			11 Hrs
Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA. The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms - Linear Regression. Demonstration: 3. Import a .csv file and perform various Exploratory Data Analysis and Data Visualization techniques such as Box plot, Histogram, pie charts and bar charts using R Programming. 4. Design and implement a linear regression model using the iris dataset to predict sepal length. Include variable selection, model training, evaluation, and visual representation of the results. Justify the insights gained from the analysis.			
MODULE – 3			11 Hrs
k-Nearest, Neighbors (k-NN), k-means. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam Data Wrangling: APIs and other tools for scrapping the Web. Demonstration: 5. Design an R script to calculate and visualize correlation and covariance between variables in a self-constructed dataset. Interpret your findings and suggest data-driven decisions based on the results. 6. Using the iris dataset, build a KNN classification model in R to predict flower species based on their measurements. Analyze how varying the value of k affects model accuracy. 7. Develop an R program to apply the K-means clustering algorithm for data analysis. Demonstrate the process of selecting the appropriate number of clusters, executing the algorithm, and interpreting the clustering results. 8. Design and implement a Naïve Bayes classifier in a R programming language to classify a sample dataset stored in a .CSV file. After training the model, evaluate its accuracy by testing it on a separate set of test data. Analyze the classifier's performance and interpret the results.			

MODULE – 4												10 Hrs			
Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system. Data Visualization - Data Visualization History, What Is Data Science, Redux?, A Sample of Data Visualization Projects.															
Pre-requisite: Knowledge of Programming fundamentals, Statistics & probability, Linear algebra, and Database concepts.															
Text Books															
Sl. No	Book Title				Authors			Edition		Publisher		Year			
1.	Doing Data Science, Straight Talk from The Frontline				Cathy O’Neil and Rachel Schutt					O'Reilly		2014			
Reference Books:															
Sl. No	Book Title				Authors			Edition		Publisher		Year			
1.	Mining of Massive Datasets				Jure Leskovek, Anand Rajaraman and Jeffery Ullman			V2.1		Cambridge University Press		2004			
2.	Machine Learning: A Probabilistic Perspective				Kevin P. Murphy			ISBN 0262018 020				2013			
EBOOKS/MOOC:															
1. Introduction to data Analytics nptel.ac.in/courses/110106064/E-Books: a) An Introduction to Data Science. By J. Stanton, 2013. 2.															
2. Data Science https://drive.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit															
Online Courses and Video Lectures:															
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944380316303362566_shared/overview															
Proposed Assessment Plan (for 50 marks of CIE):															
Tool		Remarks										Marks			
CIE		CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks										10		
		CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks										10		
		CIE3	Conducted for 20 marks(Module 2) & reduced to 10 marks										10		
Activity Details		Activity 1	Infosys Springboard Certification										10		
		Activity 2	Project based Activity										10		
Total Marks												50			
Course Articulation matrix															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	
CO4	-	-	-	-	3	-	-	2	3	-	-		3	3	

Course Title		MOBILE COMMUNICATIONS			
Course Code	23CS743	(L-T-P) C		(3-0-0) 3	
Exam Hrs.	3	Hours/Week		3	
CIE	50 Marks	Total Hours		42	
SEE	50 Marks				
Course Objective: To build real time applications by deploying Mobile Communication technologies.					
Course Outcomes (COs): Upon the completion of the course the students will be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Apply the fundamental concepts of mobile communication applications, to solve problems related to real-world mobile communication systems.	1	-		
2.	Analyze the different transmission techniques and satellite communication systems to determine their suitability for specific mobile communication scenarios.	2	-		
3.	Design an appropriate wireless or mobile network architecture for a given scenario, incorporating suitable technologies and standards based on functional and performance requirements.	3	-		
4.	Implement the various protocols used in the mobile network layer, mobile ad-hoc networks (MANETs), and transport layer to evaluate their performance.	3,5	1		
Course Contents:					
MODULE – 1				11 Hrs	
Introduction to Mobile Communications: Applications, History of Wireless Communication, A Market for Mobile Communications, Some open research Topics, A simplified reference model.					
Wireless Transmission: Frequencies for Radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Cellular Systems					
MODULE – 2				11 Hrs	
Medium Access Control: Motivation for a specialized MAC, TDMA, CDMA, Comparison of S/T/F/CDMA.					
Satellite Systems: History, Applications, Basics, Routing, Localizations, Handover; Broadcast Systems: Overview, Cyclical Repetition of data, DAB, DVB, Convergence of Broadcasting and Mobile communications					
MODULE – 3				10 Hrs	
Wireless LAN: Infrared versus radio transmission, Infrastructure and Adhoc Network, IEEE-802.11- System Architecture and Protocol Architecture.					
Mobile Network Layer: Mobile IP: Goals, assumptions and requirements, Entities and terminology, IPpacket delivery, Agent discovery, Registration, Tunnelling and encapsulation, Optimizations; Dynamic host configuration protocol					
MODULE – 4				10 Hrs	
Mobile ad-hoc networks: Routing, Destination sequence distance vector, Dynamic source routing, Alternative metrics, Overview ad-hoc routing protocols					
Mobile Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, Performance enhancing proxies.					
Pre-requisite: Computer Networks					
Text Books					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Mobile communications	Jochen Schiller	2nd	Pearson Education	2003
2.	Mobile Cellular Communication	Gottapu Sasibhushana Rao	1st	Pearson Education	2012
Reference Books:					

Course Title		SOFTWARE TESTING					
Course Code		23CS744		(L-T-P) C		(3-0-0) 3	
Exam Hrs.		3		Hours/Week		3	
CIE		50 Marks		Total Hours		42	
SEE		50 Marks					
Course Objective: Apply effective testing techniques for developing quality software products.							
Course Outcomes (COs): Upon the completion of the course the students will be able to:							
#	Course Outcomes				Mapping to POs		Mapping to PSOs
1.	Apply the concepts of software testing to assess the right testing method				1		1
2.	Analyze various software testing methods and strategies				2,5		
3.	Design test cases and automate software testing for real-time applications using testing tools.				3,5		1
4.	Demonstrate effective collaboration and problem-solving abilities in the development of software projects.				8,9,10		1
Course Contents:							
MODULE – 1							11 Hrs
Basics of Software Testing: Human Errors and Testing; Software Quality; Requirements, Behavior and Correctness; Correctness versus Reliability; Testing and Debugging; Test Metrics. Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test generation Strategies, Static Testing. Model-Based Testing and Model Checking; Control-Flow Graph; Types of Testing; The Saturation Effect.							
MODULE – 2							11 Hrs
Test Generation from Requirements: Introduction; The Test-Selection Problem; Equivalence Partitioning; Boundary Value Analysis; Category-Partition Method. Test Generation from Requirements: Cause-Effect Graphing, Test Generation from Predicates.							
MODULE – 3							10 Hrs
Structural Testing: Overview; Statement testing; Branch testing; Condition testing, Path testing; Procedure call testing; Comparing structural testing criteria; The infeasibility problem. Dependence, Data Flow Models, and Data Flow Testing; Definition-Use pairs; Data flow analysis; Classic analyses; From execution to conservative flow analysis; Data flow analysis with arrays and pointers; Inter procedural analysis; Overview of data flow testing; Definition-Use associations; Data flow testing criteria; Data flow coverage with complex structures; The infeasibility problem.							
MODULE – 4							10 Hrs
Test Case Selection and Adequacy, Test Execution: Overview; Test specification and cases; Adequacy criteria; Comparing criteria; Overview of test execution; From test case specification to test cases; Scaffolding; Generic versus specific scaffolding; Test oracles; Self-checks as oracles; Capture and replay. Process: Test and analysis activities within a software process: The quality process; Planning and monitoring; Quality goals; Dependability properties; Analysis; Testing; Improving the process; Organizational factors. Integration and component-based software testing: Overview; Integration testing strategies; Testing components and assemblies. System, Acceptance and Regression Testing. Overview; System testing; Acceptance testing; Usability; Regression testing; Regression test selection techniques; Test case prioritization and selective execution.							
Pre-requisite: Basic knowledge of programming, object-oriented concepts, and Software Engineering including the Software Development Life Cycle (SDLC).							
Tutorial/Lab programs/Activity (if any): -Nil-							
Text Books							
Sl. No	Book Title		Authors		Edition	Publisher	Year
1.	Foundations of Software		Aditya P Mathur			Pearson	2014

	Testing (Chapters 1 excluding 1.15, 1.16, 1.17, 2, 6).			Education	
2.	Software Testing and Analysis – Process, Principles and Techniques (Chapters 4, 6, 9, 12, 13,17, 21, 22).	Mauro Pezze, Michal Young		John Wiley & Sons	2008

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Software testing Principles and Practices	Srinivasan Desikan, Gopalaswamy Ramesh	2nd	Pearson	2007
2.	Software Testing	Ron Patton	2nd	Pearson	2004
3.					

EBOOKS/MOOC:

<http://nptel.ac.in/courses/106105150>

Video tutorials: - Nil-

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks		Marks
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks	10
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks	10
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks	10
Activity Details	Activity 1	Design a test case for various web and desktop applications	20
Total Marks			50

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	3	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	2	2	2	-	-	3	-

Course Title	HIGH PERFORMANCE COMPUTING		
Course Code	23CS745	L-T-P	(3-0-0) 3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	Total Hours	42
SEE	50 Marks		
Course Objective: To enable students to develop and analyze parallel programs using message-passing and shared-memory programming paradigms for solving computationally intensive problems efficiently.			
Course Outcomes (COs): At the end of the course, student will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the fundamentals of parallel computing, parallel programming platforms, processor organization, communication mechanisms, and mapping techniques used in parallel systems.	1, 2	-
2.	Analyze and design parallel algorithms using decomposition, load balancing, communication operations, and appropriate parallel algorithm models.	3, 5	1
3.	Evaluate the performance of parallel programs using analytical models and implement message-passing applications using MPI with suitable communication and synchronization techniques.	4, 5	1, 2
4.	Develop parallel applications using shared-memory programming models (Pthreads and OpenMP) and implement parallel algorithms for matrix computations and sorting problems.	3, 5, 12	1, 2
Course Contents :			
MODULE-1			11 Hrs
Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.			
MODULE-2			11 Hrs
Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models. Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, Allto-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations			
MODULE-3			10 Hrs
Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems. Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs Section. Other Scalability Metrics, Programming Using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators			
MODULE-4			10 Hrs

Course Title		BIO- INSPIRED SYSTEMS			
Course Code	23CS746	(L-T-P) C	(3-0-0)3		
Exam Hrs.	3	Hours/Week	3		
CIE	50 Marks	Total Hours	42		
SEE	50 Marks				
Course Objective: To study biological systems from an engineering perspective and apply nature-inspired principles to design materials, algorithms, and medical devices.					
Course Outcomes (COs): Upon completion of the course, students shall be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Apply biological principles, biomimetic concepts, and bioenergetic mechanisms to understand engineering systems and applications..	1	-		
2.	Analyze biological systems and natural structures as engineering models.	2	-		
3.	Design bio-inspired computational for engineering applications.	3, 5, 6	1		
4.	Implement bio-inspired technologies for healthcare and engineering applications, document the outcomes and collaborate effectively through team based activities.	3, 5, 8, 9	1		
Course Contents:					
MODULE – 1			11 Hrs		
Introduction to Biological Foundations: Cellular Architecture: The cell as a fundamental engineering unit; structure and functions of organelles. Biomolecules & Bioenergetics: Proteins, enzymes, and nucleic acids; ATP production and energy conversion. Biological Signals: Generation of bioelectric potentials; membrane transport; synaptic transmission.					
MODULE – 2			10 Hrs		
Bio-materials & Structural Models: Hierarchical structure of bone, spider silk, and wood; mechanisms of high fracture toughness. Smart Materials: Self-healing materials and adaptive structures inspired by tissue regeneration. Biological Systems as Engineering Models: The Brain vs. CPU: Comparative analysis of parallel biological processing versus serial silicon computing. The Eye vs. Camera: Optical lensing, retinal photoreceptors, and image processing algorithms. The Heart as a Pump: Fluid dynamics of the cardiovascular system; artificial heart valves.					
MODULE – 3			11 Hrs		
Bio-Inspired Computing & Artificial Intelligence: Artificial Neural Networks (ANN): Biological neurons vs. artificial nodes; Perceptrons and Hebbian learning rules. Evolutionary Computing: Genetic Algorithms (GA); selection, crossover, mutation, and fitness functions. Swarm Intelligence: Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO) for routing and scheduling. Immune System Models: Artificial Immune Systems (AIS) for anomaly detection.					
MODULE – 4			10 Hrs		
Bio-Sensors & Medical Innovations: The Kidney as a Filter: Osmoregulation, microfiltration, and counter-current exchange mechanisms in dialysis. Transduction Principles: Bioreceptors, immobilized enzymes, and optical/electrochemical transducers. Microfluidics: Lab-on-a-chip technologies and Organ-on-a-chip models for drug testing. Biomedical Robotics: Prosthetics, orthotics, and micro-robots for targeted drug delivery					
Pre-requisite: Data Structures, algorithms, Machine Learning					
Text Books					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Bio-Inspired Computing and Applications	L. C. Jain	2nd	Springer	2018

Reference Books:													
Sl. No	Book Title				Authors			Edition		Publisher		Year	
1.	Biology for Engineers				G. K. Suraish kumar			1st		Oxford University Press		2019	
2.	Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies				Floreano, D. and Mattiussi			-		MIT Press		2008	
EBOOKS/MOOC:													
-													
Online Courses and Video Lectures:													
-													
Proposed Assessment Plan (for 50 marks of CIE):													
Tool		Remarks										Marks	
CIE	CIE1	Conducted for 20 Marks (Module 1) & reduced to 10 marks										10	
	CIE2	Conducted for 20 Marks (Module 2) & reduced to 10 marks										10	
	CIE3	Conducted for 20 Marks (Module 3) & reduced to 10 marks										10	
Activity Details	Group activity	Activity Based Learning										20	
Total Marks												50	
Course Articulation matrix													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	3	2	-	-	-	-	-	3	-
CO4	-	-	3	-	3	-	-	3	3	-	-	3	-

Course Title	PATTERN RECOGNITION				
Course Code	23CS751		L-T-P-C		(3-0-0) 3
Exam Hrs.	3		Hours / Week		3
CIE	50 Marks		Total Hours		42
SEE	50 Marks				
Course Objective: Apply pattern recognition techniques to real world problems.					
Course Outcomes (COs) : Upon completion of the course, students shall be able to:					
COs	Statement			POs	PSOs
1.	Apply Bayesian decision theory and discriminant functions to obtain solutions for classification problems.			1	-
2.	Identify and analyse parameter estimation and non-parametric techniques suitable for pattern classification and density estimation.			2	-
3.	Develop pattern recognition models using linear discriminant functions and stochastic learning methods to solve real life problems.			3	2
4.	Develop pattern recognition models for real-world problems using modern software tools through team-based projects, and communicate the findings effectively.			5, 8, 9	1,2
Course Contents:					
Module 1				11 Hrs	
Introduction: Machine perception, an example; Pattern Recognition System; The Design Cycle; Learning and Adaptation.					
Bayesian Decision Theory: Introduction, Bayesian Decision Theory; Continuous Features, Minimum error rate, classification, classifiers, discriminate functions, and decision surfaces; The normal density; Discriminant functions for the normal density.					
Module 2				11 Hrs	
Maximum-likelihood and Bayesian Parameter Estimation: Introduction; Maximum-likelihood estimation; Bayesian Estimation; Bayesian parameter estimation: Gaussian Case, general theory; Hidden Markov Models.					
Non-parametric Techniques: Introduction; Density Estimation; Parzen windows; kn – Nearest-Neighbor Estimation; The Nearest- Neighbor Rule; Metrics and Nearest-Neighbor Classification.					
Module 3				10 Hrs	
Linear Discriminant Functions: Introduction; Linear Discriminant Functions and Decision Surfaces; Generalized Linear Discriminant Functions; The Two-Category Linearly Separable case; Minimizing the Perception Criterion Functions; Relaxation Procedures; Non-separable Behavior; Minimum Squared-Error procedures; The Ho-Kashyap procedures.					
Stochastic Methods: Introduction; Stochastic Search; Boltzmann Learning; Boltzmann Networks and Graphical Models; Evolutionary Methods.					
Module 4				10 Hrs	
Non-Metric Methods: Introduction; Decision Trees; CART; Other Tree Methods; Recognition with Strings; Grammatical Methods.					
Unsupervised Learning and Clustering: Introduction; Mixture Densities and Identifiability; Maximum-Likelihood Estimates; Application to Normal Mixtures; Unsupervised Bayesian Learning; Data Description and Clustering; Criterion Functions for Clustering.					
Pre-requisite: Knowledge of probability and statistics, linear algebra, and machine learning fundamentals.					
Text Book :					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Pattern Classification	Richard O. Duda, Peter E. Hart, and David G.Stork	2nd	Wiley-Interscience	2012
Reference Books:					
Sl. No	Book Title	Authors	Edition	Publisher	Year

1.	Pattern Recognition and Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost		Pearson Education	2007
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Activity:

1.	Develop a Bayesian classifier to predict whether a patient is likely to have a particular disease based on observed symptoms and historical data.
2.	Develop a K-Nearest Neighbor (KNN) classifier to predict whether a customer will buy a product based on their demographic information and past purchasing behavior
3.	Design a Linear Discriminant Function to classify emails as 'Spam' or 'Not Spam' based on extracted textual features
4.	Apply stochastic methods to optimize the scheduling of tasks in a smart factory to minimize production time and resource conflicts
5.	Build a Decision Tree model to predict whether a loan application should be approved based on applicant details such as income, credit history, employment status, and existing debts
6.	Estimate the parameters of a Gaussian distribution to model and predict student test scores using Maximum Likelihood Estimation

EBOOKS/MOOC:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_ee56

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE	Conducted for 20 marks and reduced to 10 marks	10
	CIE	Conducted for 20 marks and reduced to 10 marks	10
	CIE	Conducted for 20 marks and reduced to 10 marks	10
Activity Details		Project-based learning involving real-world datasets will be evaluated as activity.	20
Total			50

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	3	-	-	3	3	-	-	-	3	3

Course Title		BIG DATA ANALYTICS			
Course Code	23CS752	(L-T-P) C		(3-0-0) 3	
Exam Hrs.	3	Hours/Week		3	
CIE	50 Marks	Total Hours		42	
SEE	50 Marks				
Course Objective: Introduce Big Data technologies for solving the real world problems					
Course Outcomes (COs): Upon completion of the course the students will be able to:					
#	Course Outcomes			Mapping to POs	Mapping to PSOs
1.	Apply the concepts of Big Data Analytics and Big Data tools to manage and process Big Data			1	-
2.	Analyze the architecture and applications of Hadoop framework and Big Data tools for handling large-scale data			2	-
3.	Design Big Data solutions using Big Data technologies for distributed data processing and analytics			3	-
4.	Implement Big Data applications using Hadoop, HDFS, MongoDB, Hive, and Pig to solve real-world data processing problems.			3,5,8,9	1
Course Contents:					
MODULE – 1				11 Hrs	
Introduction to Big Data: Types of Digital Data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data, Traditional Business Intelligence Vs Big Data, Typical data warehouse and Hadoop environment. Big Data Analytics: What is Big data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments Demonstration: Working on varieties of Data and their representations					
MODULE – 2				11 Hrs	
Introduction to Hadoop: Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, HDFS (Hadoop Distributed File System), Processing data with Hadoop, Interacting With Hadoop Ecosystemem. Demonstration: Install Hadoop and Implement the file management tasks in Hadoop: Adding files and directories Retrieving files Deleting files and directories.					
MODULE – 3				10 Hrs	
Introduction to Map Reduce Programming: Introduction, Mapper, Reducer, Combiner, Practitioner, Searching, Sorting, Compression. Introduction to MongoDB: What is MongoDB? Why MongoDB, Terms Used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language Demonstration: Application of Map Reduce to various scenarios					
MODULE – 4				10 Hrs	
Introduction To HIVE: What is Hive?, HIVE Architecture, HIVE Data Types, HIVE File Format, HIVE Query Language, User Defined Functions Introduction TO PIG: What is PIG? The Anatomy of PIG, PIG on Hadoop, PIG Philosophy, Use Case for PIG – ETL Processing, PIG Latin Overview, Data Types in PIG, Execution Modes of PIG, Relational Operators, User Defined Functions, Word Count Example Using PIG. Demonstration: Working with PIG and HIVE					
	Text Books				
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Big data and Analytics	Seema Acharya and	2 nd	Wiley India	2019

		Subhashini Chellappan													
	Reference Books:														
Sl. No	Book Title				Authors				Edition		Publisher		Year		
1.	“Hadoop: The Definitive Guide”				Tom White				4 th		O’reilly Media		2015		
2.	Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning				Rajkamal and Preeti Saxena						McGraw Hill Publication		2019		
EBOOKS/MOOC:															
https://nptel.ac.in/courses/106104189															
Proposed Assessment Plan (for 50 marks of CIE):															
Tool		Remarks											Marks		
CIE		CIE1	Conducted for 20 marks and reduced to 10 marks											10	
		CIE2	Conducted for 20 marks and reduced to 10 marks											10	
		CIE3	Conducted for 20 marks and reduced to 10 marks											10	
Activity Details		Activity 1	Infosys Springboard Certification (Big Data – 201)											8	
		Activity 2	Micro Project Base Learning											12	
Total Marks													50		
Micro Project Base Learning (sample)															
1	Collect datasets from multiple sources (text, images, videos, sensor logs, and social media) and classify them based on the characteristics of Big Data (Volume, Velocity, Variety, Veracity, and Value). Present suitable visual representations														
2	Install Hadoop in a single-node or pseudo-distributed environment and perform file management operations by creating directories, uploading files, listing contents, retrieving files, and deleting resources using HDFS commands.														
3	Create a MongoDB database for a real-world application (e.g., library management, hospital records, online shopping, or employee management). Perform CRUD operations and execute queries to retrieve meaningful information.														
Course Articulation matrix															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	
CO4	-	-	3	-	3	-	-	3	3	-	-	-	2	-	

Course Title		CLOUD COMPUTING			
Course Code		23CS753	(L-T-P) C		(3-0-0) 3
Exam Hrs.		3	Hours/Week		3
CIE		50 Marks	Total Hours		42
SEE		50 Marks			
Course Objective: To expose students to the frontier areas of cloud computing service models and applications.					
Course Outcomes (COs): Upon completion of the course, students shall be able to:					
#	Course Outcomes			Mapping to POs	Mapping to PSOs
1.	Apply cloud computing concepts, service models, deployment models, virtualization techniques, and cloud platforms to develop and deploy cloud-based solutions.			1	-
2.	Analyze cloud architectures, resource management, scheduling algorithms, cloud security challenges, and virtualization techniques to identify efficient and secure cloud computing solutions.			2	-
3.	Design cloud-based applications by integrating virtualization, cloud resource management, security mechanisms, and cloud deployment strategies to address real-world computing requirements.			3	-
4.	Work collaboratively and demonstrate cloud computing technologies and services using cloud platforms and tools for application deployment, performance evaluation through clear documentation and presentation			5, 8, 9, 11	1
Course Contents:					
MODULE – 1					11 Hrs
Introduction: Cloud computing: An old idea whose time has come, Cloud computing delivery models and services, Ethical issues in cloud computing, Cloud vulnerabilities, Major challenges faced by cloud computing. Cloud Infrastructure: Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock in, Energy use and ecological impact of Large-Scale Data Centers,Service- and Compliance level agreements, User experience and software licensing.					
MODULE – 2					11 Hrs
Cloud Computing: Applications and Paradigms: Challenges of cloud computing, Architectural styles for cloud applications, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, Clouds for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, social computing, Digital Content, and Cloud Computing.					
MODULE – 3					10 Hrs
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization. Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing.					
MODULE – 4					10 Hrs
Cloud Security: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS. Cloud Application Development: Amazon web services: EC2 instances, connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, Cloud-based simulation of a distributed trust algorithm.					
Pre-requisite: Fundamentals of Computer Networks, Operating Systems, Database Management Systems, and Programming.					
Text Books					
Sl. No	Book Title	Authors	Edition	Publisher	Year

1.	Cloud Computing: Theory and Practice	Dan C Marinescu	1 st	Elsevier (MK)	2013
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Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Cloud Computing- A practical approach	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter	1 st	McGraw Hill	

EBOOKS/MOOC:

1. <https://eclass.uoa.gr/modules/document/file.php/D416/CloudComputingTheoryAndPractice.pdf>
2. <https://books.google.co.in/books?id=mf0LMXve2gEC&printsec=frontcover#v=onepage&q&f=false>
3. <https://www.javatpoint.com/cloud-computing-tutorial>
4. https://www.tutorialspoint.com/cloud_computing/index.html
5. <https://www.digimat.in/nptel/courses/video/106105167/L01.html> (Video Lectures)

Online Courses and Video Lectures:

Sl. No.	Course Name	Course offered by	Year	URL
1.	Cloud Computing	Coursera	2026	https://www.coursera.org/browse/information-technology/cloud-computing
2.	Cloud Computing	Coursera	2026	https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs14

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks		Marks
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks	10
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks	10
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks	10
Activity Details	Activity	Group Activity will be conducted using various cloud platforms	20

Total Marks
50
Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2		3	-	-	-	-	-	-	-	-	-	-	-	-
CO3			3	-	-	-	-	-	-	-	-	-	-	-
CO4				-	3	-	-	2	2	-	3	-	2	-

Course Title	GREEN COMPUTING		
Course Code	23CS754	(L-T-P) C	(3-0-0) 3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	Total Hours	42
SEE	50 Marks		
Course Objective: To enable students to design, manufacture, and dispose computing devices in a way that reduces their environmental impact.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply green computing practices to enhance energy efficiency and ensure environmentally sustainable business operations.	1	-
2.	Analyze sustainability challenges and evaluate strategies to reduce the environmental impact of computing systems.	2	-
3.	Design sustainable Green IT solutions by integrating Green Computing technologies, Green Cloud architectures, Semantic Web technologies, and enterprise sustainability strategies	3	-
4.	Work collaboratively and demonstrate green computing concepts and sustainable IT practices and technical documentation to communicate environmentally responsible computing solutions effectively.	5, 8, 9, 11	-
Course Contents:			
MODULE – 1			11 Hrs
Green IT: An Overview, Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green IT, Holistic Approach to Greening IT, Greening IT, Applying IT for enhancing Environmental sustainability, Green IT Standards and Eco-Labeling of IT, Enterprise Green IT strategy, Green IT: Burden or Opportunity, Green Devices and Hardware: Introduction, Life Cycle of a device or hardware, Reuse, Recycle and Dispose. Green Software: Introduction, Energy-saving software techniques, Evaluating and Measuring software Impact to platform power. Sustainable Software Development: Introduction, Current Practices, Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics			
MODULE – 2			11 Hrs
Green Data Centres: Data Centres and associated energy challenges, Data centre IT infrastructure, Data Centre facility infrastructure: Implications for energy efficiency, IT infrastructure management. Green Networks and Communications: Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards. Enterprise Green IT Strategy: Introduction, Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Organizational Considerations in a Green IT Strategy, Steps in Developing a Green IT Strategy. Green Enterprises and Role of IT: Introduction, Organization and Enterprise Greening, Information systems in Greening Enterprises, Greening Enterprise: IT Usage and Hardware, Inter-Organizational Enterprise activities and Green Issues.			
MODULE – 3			10 Hrs
Managing Green IT: Introduction, Strategizing Green Initiatives, Implementation of Green IT, Information Assurance. Regulating Green IT: Laws, Standards and Protocols: Introduction, The regulatory environment and IT manufacturers, Non regulatory government initiatives, Industry associations and standards bodies, Green building standards, Green data centres, Social movements and Greenpeace Green Cloud Computing and Environmental Sustainability: Introduction, what is Cloud Computing? Cloud Computing and Energy Usage Model: A Typical Example, Features of Clouds Enabling Green Computing, Towards Energy Efficiency of Cloud Computing, Green Cloud Architecture			
MODULE – 4			10 Hrs
Harnessing Semantic Web Technologies for the Environmental: Introduction, Information Management for Environmental Sustainability, Ecosystem of Software Tools, Examples of Managing Data. Green IT-An Outlook: Introduction, Awareness to implementations, Greening by IT, Green IT: A megatrend, A seven-step approach to creating green IT strategy, Research and Development directions.			

Pre-requisite: Fundamentals of Computer Systems and Computer Organization, Operating Systems and Computer Networks. Basic environmental sustainability and energy-efficient computing practices.															
Text Books															
Sl. No	Book Title				Authors				Edition	Publisher			Year		
1.	Harnessing Green IT: Principles and Practices				San Murugesan, G. R. Gangadharan				1 st	Wiley& IEEE			2017		
Reference Books:															
Sl. No	Book Title				Authors				Edition	Publisher			Year		
1.	Green IT Strategies and Applications-Using Environmental Intelligence				BhuvanUnhelkar				1 st	CRC Press			2011		
2.	Green Communications: Principles, Concepts and Practice				Konstantinos Samdanis, Peter Rost, Andreas Maeder, Michela Meo, Christos Verikoukis				1 st	Wiley			2015		
3.															
EBOOKS/MOOC:															
1. https://books.google.co.zm/books?id=xAtJK2L7O5UC&printsec=frontcover#v=onepage&q&f=false															
2. https://www.routledge.com/Green-IT-Strategies-and-Applications-Using-Environmental-Intelligence/Unhelkar/p/book/9781439837801															
Online Courses and Video Lectures:															
Sl. No.	Course Name				Course offered by		Year	URL							
1.	Green Computing				NPTEL		2026	https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg230							
2.	Emerging Technologies: Green Computing				Future learn		2026	https://www.futurelearn.com/microcredentials/greencomputing							
Proposed Assessment Plan (for 50 marks of CIE):															
Tool		Remarks										Marks			
CIE		CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks										10		
		CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks										10		
		CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks										10		
Activity Details		Activity	Group based activity										20		
Total Marks												50			
Course Articulation matrix															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	
CO4	-	-	-	-	3	-	-	2	2	-	3	-	-	-	

Course Title		NATURAL LANGUAGE PROCESSING			
Course Code	23CS755	L-T-P-C		(3-0-0) 3	
Exam Hrs.	3	Hours / Week		3	
CIE	50 Marks	Total Hours		42	
SEE	50 Marks				
Course Objective: Introduce major language models and their applications to solve real world problems.					
Course Outcomes (COs) : At the end of the course, student will be able to:					
#	Course Outcomes		Mapping to POs	Mapping to PSOs	
1.	Apply information retrieval techniques and machine translation		1	-	
2.	Analyze the natural language text and parse the grammar.		2	-	
3.	Design the Language models to real time applications		3, 5	1	
4.	Collaborate in teams and demonstrate the working of language models		4, 5, 8, 9	-	
Course Contents:					
MODULE – 1				11 Hrs	
Introduction to Natural Language Processing: Basic Text Processing ,string manipulation, remove numbers, punctuation removal , remove whitespace, Regular expression, find and replace, data extraction using API, Removal of Stop words, Spelling Correction, stemming [Porter Stemmer, Lancaster Stemmer, Snowball Stemmer] Lemmatization, Counter Vectorization, TF-IDF Score, Introduction to Word Embedding using Neural Language Model and its architecture Word2vec, Skip-Gram, CBOW					
MODULE – 2				11 Hrs	
Traditional approaching NLP: POS (Parts-Of-Speech) tagging, Purpose of Named Entity Recognition, Type of NER [Lexicon based NER, Rules Based, ML Based, Deep learning Based]. Tools for NER Extraction, Spacy, Stanford NER Tagger, Information extraction and Text summarisation using NER. Introduction to Topic Modelling , difference between Topic modelling vs topic classification , Document clustering using LDA					
MODULE – 3				10 Hrs	
Unfolding ML and NW in NLP: Differences between Feedforward and Recurrent Neural Networks, types of RNNs One to One, One to Many, Many to One, Many to Many. Language Translation with RNNs, Next word prediction using RNNs, Text classification using machine learning technique and LSTM					
MODULE – 4				10 Hrs	
Advancement in NLP: Transformers architecture [attention is all you need], Many to Many RNN, Large Language Models, BERT, GPT-3, T5, NLP Using Hugging face.					
Text Book:					
Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Deep Learning for Natural Language Processing Creating Neural Networks with Python	Palash Goyal, Sumit Pandey, Karan Jain	1st	Apress	2018
2.	Natural Language Processing with Python	Steven Bird, Ewan Klein and Edward Loper	9th	O'Reilly	2019
Reference Books:					
Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Speech Communications: Human and Machine	D. O'Shaughnessy	2nd	WILEY INDIA	2000
2.	Introduction to Data Compression	K. Sayood	2nd	Morgan Kaufmann Publishers	2000

3.	Information Storage and Retrieval systems	Gerald J. Kowalski and Mark.T. Maybury	2nd	Kluwer academic	2000
4.	Natural Language Processing and Text Mining	Anne Kao and Stephen R. Poteet (Eds)	1st	Springer- Verlag London Limited	2007

EBooks and online course materials:

1. <https://www ldc.upenn.edu/>
2. <https://ocw.mit.edu/courses/6-864-advanced-natural-language-processing-fall-2005/pages/lecture-notes/>
3. <https://www.nltk.org/> 4. <https://opennlp.apache.org/>

Online Courses and Video Lectures:

1. <https://www.coursera.org/specializations/natural-language-processing>

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE1	Conducted for 20 marks & reduced to 10 marks	10
	CIE2	Conducted for 20 marks & reduced to 10 marks	10
	CIE3	Conducted for 20 marks & reduced to 10 marks	10
Activity Details		Details of activities to be conducted - Project based Learning	20
Total			50

Teaching - Learning – Evaluation Scheme

Sl. No	Teaching - Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Class Room Teaching	3	14	42
2.	Self-Learning	1	14	14
3.	Activity Based Learning	-	-	28
4.	Evaluation of Learning Process	-	-	6
Total Learning Hours / Semester				90

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	2	-	-	-	-	-	-	-	2	-
CO4	-	-	-	2	2	-	-	2	2	-	-	-	-	-

Course Title	CYBER SECURITY				
Course Code	23CS756	(L-T-P) C	(3-0-0) 3		
Exam Hrs.	3	Hours/Week	3		
CIE	50 Marks	Total Hours	42		
SEE	50 Marks				
Course Objective: To analyze threat mechanisms across cyber-incidents, cyber-crimes, and cyber-physical systems, and evaluate socio-legal impacts to implement robust cyber security countermeasures.					
Course Outcomes (COs): Upon the completion of the course the students will be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Explore the origins, classifications, and threat actors of cybercrimes, and apply defensive counteract cyber methods to assess their impact from Indian (IT Act) and global legal perspectives.	1	-		
2.	Analyze cyber-attack planning techniques.	2	-		
3.	Develop solutions to detect and combat malware, spam, financial fraud, and other cybercrimes	3	-		
4.	Demonstrate effective communication and collaboration through case studies, presentations, and team-based analysis of cybersecurity incidents	5, 8, 9, 11	-		
Course Contents:					
MODULE – 1			11 Hrs		
Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, Cybercrimes: An Indian Perspective, Hacking and the Indian Laws, A Global Perspective on Cybercrimes.					
MODULE – 2			10 Hrs		
Cyber offenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector.					
MODULE – 3			11 Hrs		
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks.					
MODULE – 4			10 Hrs		
Phishing and Identity Theft: Introduction, Methods of Phishing, Phishing Techniques, Spear Phishing, Types of Phishing Scams, Phishing Toolkits and Spy Phishing, Phishing Countermeasures, Identity Theft (ID Theft)					
Pre-requisite: Candidates should possess a foundational understanding of computer network architectures, standard communication protocols, and basic operating system administration principles.					
Tutorial/Lab programs/Activity (if any)					
Text Books					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Sunit Belapure, Nina Godbole	1st	Wiley-India	2018
Reference Books:					
Sl. No	Book Title	Authors	Edition	Publisher	Year

1.	Cybersecurity: Managing Systems, Conducting Testing, and Investigations	Thomas J. Mowbray	1st	John Wiley & Sons	2014
2.	Cyber Security Essentials	James Graham, Richard Howard, Ryan Olson	1st	CRC Press, Taylor & Francis Group	2011

EBOOKS/MOOC:

https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_cs04
https://onlinecourses.swayam2.ac.in/e-learning/preview/nou19_cs08

Video tutorials:

https://www.youtube.com/playlist?list=PL_RcVnBPGmSLAGyNa6wiAf8bbVwxYYzCi
<https://www.udemy.com/course/certified-secure-netizen/>

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks		Marks
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks	10
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks	10
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks	10
Activity Details	Activity 1	Details of activities to be conducted: Project based Learning	20
Total Marks			50

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	3	3	-	3	-	-	-

Course Title	INTRODUCTION TO DATA SCIENCE		
Course Code	23OECS71	L-T-P	(3-0-0) 3
Exam Hrs.	3	Hours/Week	3
CIE	50 Marks	Total Hours	42
SEE	50 Marks		

Course Objective: Introduce major data science approaches and their applications to solve realworld problems.

Course Outcomes: At the end of the course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply Python data operations and descriptive statistics to obtain solutions for data analysis problems.	1	-
2.	Identify and analyse statistical inference and supervised and un-supervised learning techniques suitable for the given data.	2	-
3.	Develop regression and clustering models to solve real life problems	3,5	-
4.	Conduct experiments to demonstrate data analysis, machine learning, network analysis and recommender system techniques.	4, 5, 8, 9	-

MODULE-1	11 Hrs
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Introduction, Toolboxes: Python, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.

Descriptive statistics: data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score.

MODULE-2	11 Hrs
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Statistical Inference: Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p-values

Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples

MODULE-3	10 Hrs
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Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model.

Unsupervised learning: Introduction, Clustering, similarity and distances, quality measures of clustering, case study.

MODULE-4	10 Hrs
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Network Analysis: Basic Definitions in Graphs, Social Network Analysis, Centrality, drawing centrality of Graphs, PageRank, Ego-Networks, Community Detection.

Recommender Systems: Introduction, Works: Content-Based Filtering, Collaborative Filtering, Hybrid Recommenders, Modeling User Preferences, Evaluating Recommenders, Practical Case.

Pre-requisite: Basic programming skills and knowledge of elementary probability, statistics, and linear algebra.

Text Book :

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Data Science a Python approach to concepts Techniques and Applications	Laura Igual and Santi Segui	2st	Springer, ISBN:978-3-31950016-4	2024

Reference Books:

Sl. No.	Book Title	Authors	Edition	Publisher	Year
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1.	Data Analysis with Python A Modern Approach	David Taieb	1st	Packt Publishing, ISBN-9781789950069	2018
2.	Python Data Analysis	Armando Fandango	2 nd	Packt, ISBN: 9781787127487	2017

EBOOKS/MOOC:

1. <https://dokumen.pub/introduction-to-data-science-a-python-approach-to-concepts-techniques-and-applications-9783319500171-3319500171.html>
2. <https://www.lewagon.com/events/data-science-foundations-free-online-course>
3. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool		Remarks	Marks
CIE	CIE	Conducted for 20 marks and reduced to 10 marks	10
	CIE	Conducted for 20 marks and reduced to 10 marks	10
	CIE	Conducted for 20 marks and reduced to 10 marks	10
Activity Details		Team-based mini data science project involving dataset selection, EDA, model building, and demonstration will be evaluated as activity.	20
Total			50

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	2	2	-	-	2	2	-	-	-	-	-

Course Title	IOT AND ITS APPLICATIONS				
Course Code	23OECS72	L-T-P-C	(3-0-0) 3		
Exam Hrs.	3	Hours / Week	3		
CIE	50 Marks	Total Hours	42		
SEE	50 Marks				
Course Objective: Explore the interconnection and integration of the physical world and design IOT applications.					
Course Outcomes (COs): Upon the completion of the course the students will be able to:					
#	Course Outcomes	Mapping to POs	Mapping to PSOs		
1.	Apply IoT principles, M2M communication, and system management techniques to develop efficient IoT solutions..	1	-		
2.	Analyze IoT architectures, enabling technologies, communication models, and domain-specific applications to address real-world problems.	2	-		
3.	Design IoT applications using Raspberry Pi, Python programming, and appropriate networking technologies	3	-		
4.	Develop end-to-end IoT solutions by integrating sensing, communication, computing, and IoT development tools for real-world applications.	3,5,8,9			
Course Contents:					
MODULE – 1			11 Hrs		
Introduction & Concepts- Introduction of IoT; Physical Design of IoT; Logical Design of IoT; IoT Enabling Technologies; IoT Levels & Deployment Templates. Domain Specific IoTs- Introduction, Home Automation; Cities; Environment; Energy; Retail; Logistics; Agriculture; Industry; Health & Lifestyle					
MODULE – 2			10 Hrs		
IoT and M2M-Introduction; M2M; Difference between IoT and M2M; SDN and NFV for IoT; IoT System management with NETCONF-YANG- Need for IoT Systems management; SNMP; Network Operator Requirements; NETCONF; YANG; IoT Systems management with NETCONF-YANG; NETOPEER IoT Platforms Design Methodology; Introduction; IoT Design Methodology; Case Study on IoT System for Weather Monitoring; Motivating for using Python.					
MODULE – 3			11 Hrs		
IoT Systems- Logical Design using Python- Introduction; Installing Python; Python Data Types & Data structures; Control Flow; Functions; Modules; Packages; File Handling; Date/Time Operations; Classes. What is an IoT Device; Exemplary Device: Raspberry Pi; About the Board; Linux on Raspberry Pi; Raspberry Pi Interfaces ; Programming Raspberry Pi with Python					
MODULE – 4			10 Hrs		
Case Studies Illustrating IoT: Introduction; Home Automation; Cities; Environment. Environment; Agriculture ; Productivity Applications					
Pre-requisite: Knowledge of Devices and its connectivity					
Tutorial/Lab programs/Activity (if any)					
Text Books					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Internet of Things - A Hands-on Approach	Arshdeep Bahga and Vijay Madisetti		Universities Press	2015
Reference Books:					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Technologies, Protocols, and Use Cases for the Internet of Things	Grossetete, Robert Barton, Jerome Henry		(Cisco Press Indian Reprint)	

2.	Internet of Things	Srinivasa K G, Siddesh G M Hanumantha Raju R	1 st	CENGAGE Learning India	2017
3.	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet of Things: Key Applications and Protocols	2 nd	Wiley ISBN: 978-1- 119- 99435-0	2012

EBOOKS/MOOC:

1. https://onlinecourses.nptel.ac.in/noc26_cs37/preview

Video tutorials:

2. https://www.youtube.com/playlist?list=PL_RcVnBPGmSIce3i6ayTgGjDaHxfVGBh1

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks		Marks
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks	10
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks	10
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks	10
Activity Details	Activity 1	Group Based Activity to implement IoT application	10
	Activity 2	Presentation and demonstration of application	10
Total Marks			50

	Course Articulation matrix													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	-	-	2	2	-	-	-	-	-

Course Title		INTRODUCTION TO BIG DATA			
Course Code	23OECs73	L-T-P-C		(3-0-0)3	
Exam Hrs.	3	Hours/Week		3	
CIE	50 Marks	Total Hours		42	
SEE	50 Marks				
Course Objective: Acquire the knowledge to handle Big Data.					
Course Outcomes(COs): Upon completion of the course the students will be able to:					
#	Course Outcomes		Mapping to POs	Mapping to PSOs	
1.	Apply Big Data analytics concepts and techniques to address data-driven problems		1	-	
2.	Analyze Big Data architecture components, analytics platforms, and data management strategies for effective large-scale data processing		2	-	
3.	Design Big Data solutions using MapReduce and distributed file systems for scalable data processing and analytics.		3	-	
4.	Implement Big Data solutions for scalable data processing ad analytics		3, 5, 8, 9	-	
Course Contents:					
MODULE-1				11Hrs	
Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization.					
Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.					
MODULE-2				11Hrs	
Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines.					
Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.					
MODULE-3				10Hrs	
Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels.					
Map-Reduce and the New Software Stack: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.					
MODULE-4				10Hrs	
Communication Cost Models: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate.					
Mining Data Streams, Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.					
Pre-requisite: Understanding of Data and its generation.					
Text Books:					
Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Big Data Analytics: Disruptive Technologies for Changing the Game	Dr. Arvind Sathi	First Edition	IBM Corporation	October 2012

2.	Mining of Massive Datasets	Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman	-	E-book	2013
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Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Big Data Imperatives	Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa		A press	2012
2.	Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business	Michael Minelli, Michehe Chambers	1st Edition	Ambiga Dhiraj, Wiely CIO Series	2013
3.	Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics	Bill Franks	1st Edition	Wiley and SAS Business Series	2012
4.	Big Data Imperatives	Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress		e-book	2012

MOOC:

<https://nptel.ac.in/courses/106/104/106104189>

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks		Marks
CIE	CIE1	Conducted for 20 marks(Module 1) & reduced to 10 marks	10
	CIE2	Conducted for 20 marks(Module 2) & reduced to 10 marks	10
	CIE3	Conducted for 20 marks(Module 3) & reduced to 10 marks	10
Activity	Activity	Group Based Activity to implement solutions using Big data tools	10
Total Marks			50

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	-	-	3	3	-	-	-	-	-

EIGHT SEMESTER												
Sl. No	Course Category	Course Code	Course Title	Teaching Hours per Semester					Exam Marks			Credits
				L	T	P	TW/SL	Total	CIE	SEE	Total	
4.	PEC	23SW01	Professional Elective (Online Course)	0	0	0	-	-	50	50	100	3
5.	OEC	23SW02	Open Elective (Online course)	0	0	0	-	-	50	50	100	3
6.	PI	23INT	Internship (Research / Industry)(14-16 weeks)	0	0	24	-	-	100	100	200	10
Total												16

Course Title	PROFESSIONAL ELECTIVE THROUGH NPTEL		
Course Code	23SW01	(L-T-P) C	(3-0-0) 3
Course Objective: To promote self-learning ability.			
Guideline: Students must register for one course from the bucket of courses announced by the department in Swayam NPTEL portal. The selected course must be an 8 week /12-week, 3-credit course. There will be direct credit transfer of 3 credits. Students are permitted to complete this course anytime between their second to fourth years of the program. The result will be entered in eighth semester grade card.			

Course Title	OPEN ELECTIVE THROUGH NPTEL		
Course Code	23SW02	(L-T-P) C	(3-0-0) 3
Course Objective: To promote self-learning ability.			
Guideline: Students must register for one course from the bucket of courses announced by the department in Swayam NPTEL portal. The selected course must be an 8 week /12-week, 3-credit course. There will be direct credit transfer of 3 credits. Students are permitted to complete this course anytime between their second to fourth years of the program. The result will be entered in eighth semester grade card.			

Course Title	RESEARCH / INDUSTRY INTERNSHIP			
Course Code	23INT	(L-T-P) C	(0-0-24) 10	
Exam	3	Hours/Week	-	
CIE	100 Marks	Total Hours	-	
SEE	100 Marks			
Course Objective: To gain the perspective of work environment in Research organization/Industry or Complete MOOC Courses contributing to technical skill enhancement				
Course Outcomes (COs): Upon completion of the course the students will be able to:				
#	Course Outcomes	Mapping to POs	Mapping to PSOs	
1.	Apply the domain knowledge in solving the real world problems.	1,2	1,2	
2.	Work as a team member towards the chosen problem	9	1,2	
3.	Work with industry professionals and practice ethics in work environment.	8, 10	1,2	
4.	Document, publish and present the work carried out.	9,10,11	1,2	
The Internship work is to be evaluated in two stages:				
Phase I (50M) - First internal evaluation shall be taken up during this phase. This includes Topic Relevance, Application of Technology and Weekly Report (Dairy) & Presentation.				
Phase II (50 M) – Mid phase evaluation shall be taken up during this phase. This includes presentation, Internship Report, Update of the work dairy, Demonstration or Working Methodology (Write-up).				
Guideline: Students shall undergo In-house/ Research organization/Industry internship for a duration of one semester. Internal evaluation will be conducted in the phase manner according to the schedule announced at the beginning of the semester.				
Phase I Evaluation Rubrics for Industry/Research Internship (50 Marks Total) Includes:				
Topic Relevance, Application of Technology, Weekly Report (Diary), Presentation				
Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (20M)	16-20	11-15	6-10	0-5
Ability to demonstrate effective oral and written communication skills (10M)	8-10	6-7	3-5	0-2
Presentation & Weekly Report (10M)	8-10	6-7	3-5	0-2
Ethical behavior and integrity (10M)	8-10	6-7	3-5	0-2
Phase II Evaluation Rubrics for Industry/Research Internship (50 Marks Total) Includes:				
Presentation, Internship Report, Updated Work Diary, Demonstration/Working Methodology				
Criteria	Excellent	Good	Average	Poor
Ability to develop/implement solutions with appropriate techniques (20M)	16-20	11-15	6-10	0-5
Ability to work independently and in collaboration/multidisciplinary environment (10M)	8-10	6-7	3-5	0-2
Time management and task completion (10M)	8-10	6-7	3-5	0-2
Prototype of the Internship Project/Research Paper Presentation (10M)	8-10	6-7	3-5	0-2
OR				
FOUR MOOC Courses offered by VTU should be completed.				
Proposed Assessment Plan (for 100 marks of CIE):				
Tool	Remarks		Marks	
CIE	Phase-1	Conducted for 50 marks based on above 4 criteria	50	

	Phase-2		Conducted for 50 marks based on above 4 criteria											50	
Course Articulation matrix															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2	
CO2	-	-	-	-	-	-	-	-	3	-	-	-	3	2	
CO3	-	-	-	-	-	-	-	3	-	3	-	-	3	2	
CO4	-	-	-	-	-	-	-	-	3	3	3	-	3	2	