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

VII Semester & VIII Semester

(2023-24 Admitted Batch)

Academic Year 2026-2027

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 lear

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

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-CreditCourse)	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
PCC	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	23OECS6X	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.	23OECS61	Introduction to Cloud Computing
2.	23OECS62	Introduction to JAVA programming
3.	23OECS63	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**		**Sl. No.**	**Professional Elective Course - IV**	
	Course Code	**Course Title**		**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

Sl No	Subject Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
1.	23CS701	✔	✔	✔		✔								✔	
2.	23CS702	✔	✔	✔		✔	✔	✔	✔	✔					
3.	23CS703			✔	✔	✔	✔			✔	✔	✔	✔	✔	✔
4.	23SW01														
5.	23SW02														
6.	23INT														

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 >= 10).

b) Write a YACC Program to recognize the grammar ($a^n b^m c^k$, m,n,k >=0 and m=n+k).

Text Books

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	System Software – An Introduction to Systems Programming	Leland Beck, D. Manjula	3rd	Pearson Education	2013
2.	Compilers- Principles, Techniques and Tools	Alfred V Aho, Ravi Sethi, Jeffrey D Ullman	2nd	Addison-Wesley	2014

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Systems Programming and Operating Systems	D. M. Dhamdhere	2nd	Tata McGraw Hill Company	2009
2.	Lex and Yacc	John. R. Levine, Tony Mason and Doug Brown		O'Reilly, SPD	2012
3.	Principles of Compiler Design	S. V. Raghavan		Tat McGraw Hill Education	2010

EBOOKS/MOOC:

https://freecomputerbooks.com/Compiler-Design-Theory-Tools-and-Examples.html
https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs07

Video tutorials:

https://www.coursera.org/learn/formal-languages-and-applications-odc

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	Develop two pass assembler for a given program using Simulator.	10
	Activity 2	Implement and execute programs using Lex and Yacc for Lexical and Syntactic analysis.	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	-	-	2	-		-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	3	-	-	-	-	-	-	-	2	-

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	3rd	McGraw Hill Education	2017
2.	Cryptography, Network Security and Cyber Laws	Bernard Menezes	1st	Cengage Learning	2010

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Cryptography:	Hans Delfs, Helmut Knebl	1st	Springer	-

	Principles and Applications				
2.	Number theory and cryptography	Neal Koblitz	1st	Springer	2007
3.	Cryptography and Network Security	William Stallings	5th	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/KSCST/Any Proposal Submitted (Granted) to VGST/DST/University/ 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, $\ell 1$ and $\ell 2$ 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	2nd	O'Reilly	2019

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	1st	MIT Press, ISBN: 978-0262035613	2016
2.	Python Machine Learning	Sebastian Raschka and Vahid Mirjalili	3rd	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_013094438031630336256 6_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, IP packet delivery, Agent discovery, Registration, Tunnelling and encapsulation, Optimizations; Dynamichost 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 wirelessnetworks, 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:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Mobile Computing- Technology, Applications and ServiceCreation,	Asoke K. Talkukder, Roopa R Yavagal		Tata McGraw Hill	2012
2.	Mobile Computing Principles – Designing and Developing Mobile Applications with UML and XML,	Reza B'Far	5th Edition,	Cambridge University press	2013
3.	Wireless Communications: Principles and Practice	Theodore S. Rappaport	2nd	Prentice Hall (Pearson)	2002

EBOOKS/MOOC:

https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee159

Video tutorials:

https://www.coursera.org/specializations/5g-mobile-networks-technology-architecture-and-protocols

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 of a Wireless/Mobile Communication Network for a given scenario	10
	Activity 2	Implementation Mobile Network Protocols using simulation 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	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	-	-	-	-	-	-	-	2	-

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

Programming Shared Address Space Platforms: Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs
OpenMP: A Standard for Directive Based Parallel Programming Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Solving a System of Linear Equations
Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort.

Text Book :

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Parallel Computing	Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar,	2nd	Addison-Welsey	2003

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	An Introduction to Parallel Computing, Design and Analysis of Algorithms	Grama, A. Gupta, G. Karypis, V. Kumar,	2nd	Addison-Wesley	2003
2.	Parallel Scientific Computing in C++ and MPI: A Seamless Approach to Parallel Algorithms and their Implementation	G.E. Karniadakis, R.M. Kirby II		Cambridge University Press	2003
3.	Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers	Wilkinson and M. Allen	2nd	Prentice Hall	2005

e-Book:
1.https://github.com/vineethshankar/pagerank/blob/master/Introduction%20to%20Parallel%20Computing%2C%20Second%20Edition-Ananth%20Grama%2C%20Anshul%20Gupta%2C%20George%20Karypis%2C%20Vipin%20Kumar.pdf

MOOCs:
1. https://onlinecourses.nptel.ac.in/noc24_cs63/preview

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	Demonstration, Presentation, Report on a course related topic Each student will present a topic related to parallel computing paradigms, tools (such as OpenMP and MPI) real-world applications, demonstrating conceptual clarity and relevance.	20
		Total Marks	**50**

Course Articulation matrix

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

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**

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 Ecosystsem.
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	2nd	Wiley India	2019

		Subhashini Chellappan			
	Reference Books:				
Sl. No	**Book Title**	**Authors**	**Edition**	**Publisher**	**Year**
1.	"Hadoop: The Definitive Guide"	Tom White	4th	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	1st	Elsevier (MK)	2013

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Cloud Computing- A practical approach	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter	1st	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-Labelling 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	1st	Wiley& IEEE	2017

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Green IT Strategies and Applications-Using Environmental Intelligence	BhuvanUnhelkar	1st	CRC Press	2011
2.	Green Communications: Principles, Concepts and Practice	Konstantinos Samdanis, Peter Rost, Andreas Maeder, Michela Meo, Christos Verikoukis	1st	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	Mappingto POs	Mappingto 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, Standford 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**

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**

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**

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**

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

1.	Data Analysis with Python A Modern Approach	David Taieb	1st	Packt Publishing, ISBN-9781789950069	2018
2.	Python Data Analysis	Armando Fandango	2nd	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	1st	CENGAGE Leaning India	2017
3.	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet of Things: Key Applications and Protocols	2nd	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

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