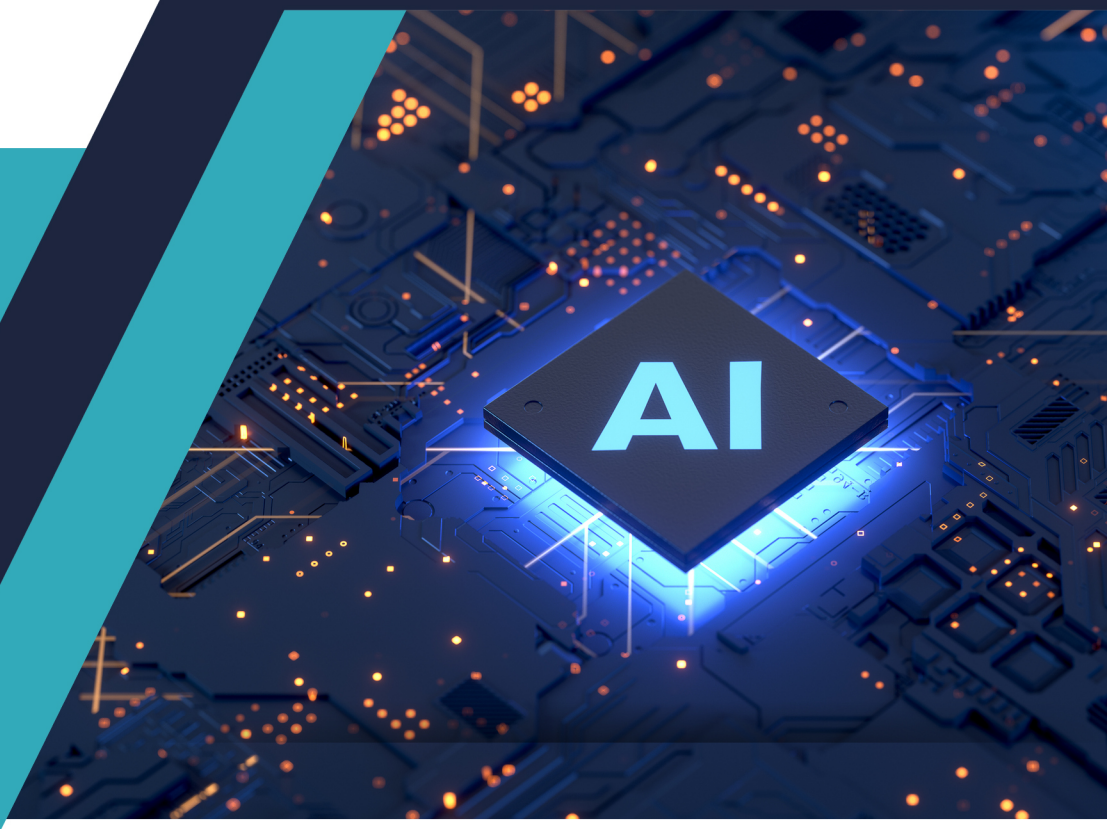
NEW HORIZON
COLLEGE OF ENGINEERING

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year 2024 - 2025



5th and 6th Semesters
Scheme & Syllabus

BATCH: 2022 - 2026
CREDITS: 160
[2022 Scheme]

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year
2024 - 2025

[2022 Scheme]

5th and 6th Semesters
Scheme & Syllabus

BATCH: 2022 - 2026
CREDITS: 160

INSTITUTION

Vision

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

Mission

To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.

To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.

To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

Quality Policy

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level

Values

- Academic Freedom
- Innovation
- Integrity
- Professionalism
- Inclusiveness
- Social Responsibility

DEPARTMENT OF AI & ML

Vision

To develop an outstanding AI and ML professionals with profound practical, research & managerial skills to meet ever changing Industrial Social and Technological needs of the Society

Mission

To provide strong theoretical foundations and hands-on competence in Artificial Intelligence and Machine Learning, fostering research, innovation, and technical excellence in alignment with industry and national needs.

To establish sustainable academia–industry collaboration for curriculum enrichment, real-time problem solving, internships, and emerging AI technology implementation.

To develop ethically responsible, socially conscious, and environmentally aware AI professionals through holistic learning and active participation in co-curricular and professional activities.

Program Educational Objectives (PEOs)

PEO1	Graduates will build successful careers in Artificial Intelligence and Machine Learning by applying strong theoretical foundations, analytical skills, and modern tools to solve complex industrial and societal problems.
PEO2	Graduates will pursue higher education, research, entrepreneurship, or leadership roles in emerging AI technologies through continuous learning, innovation, and industry collaboration.
PEO3	Graduates will demonstrate ethical responsibility, environmental awareness, and social consciousness while developing and deploying AI solutions for sustainable societal impact.

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3
To provide strong theoretical foundations and hands-on competence in Artificial Intelligence and Machine Learning, fostering research, innovation, and technical excellence in alignment with industry and national needs.	✓	✓	-
To establish sustainable academia–industry collaboration for curriculum enrichment, real-time problem solving, internships, and emerging AI technology implementation	✓	✓	-
To develop ethically responsible, socially conscious, and environmentally aware AI professionals through holistic learning and active participation in co-curricular and professional activities.	-	-	✓

Program Outcomes (POs) with Graduate Attributes

PO1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems in reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **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.

PO4 **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.

PO5 **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **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.

PO7 **Environment and Sustainability**: Understand the impact of the professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the Engineering practice.

PO9 **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication Skills**: Communicate effectively on complex engineering activities with the engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **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.

PO12 **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.

Program Specific Outcomes (PSOs)

A graduate of the Artificial Intelligence and Machine Learning Program will demonstrate:

PSO1: Ability to design, develop, and deploy intelligent systems using machine learning algorithms, deep learning architectures, data analytics, and AI frameworks to address real-world applications.

PSO2: Ability to analyze large-scale data, interpret model outcomes, and implement responsible, secure, and ethical AI solutions aligned with industry standards and societal needs.

NEWHORIZON COLLEGE OF ENGINEERING

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations for 2022-2026BATCH (2022 Scheme)

III Semester														
Sl. No.	**Course andCourse Code**		**CourseTitle**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hours**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	BSC	22MAC31	Mathematical Foundation for Computing Sciences	BS	3	0	0	0	3	3	50	50	**100**
2	PCC	22AIM32	Data Structure and Algorithms	AIML	3	0	0	0	3	3	50	50	**100**
3	PCCL	22AIL32	Data Structure and Algorithms Lab	AIML	0	0	1	0	1	2	50	50	**100**
4	PCC	22AIM33	Object Oriented Programming with Java	AIML	3	0	0	0	3	3	50	50	**100**
5	PCCL	22AIL33	Object Oriented Programming with Java Lab	AIML	0	0	1	0	1	2	50	50	**100**
6	PLC	22AIM34X	Programming Language Course	AIML	2	0	1	0	3	4	50	50	**100**
7	AEC	22AIM35X	Ability Enhancement Course –III	AIML	0	0	1	0	1	2	50	50	**100**
8	BSC	22BIK36	Bio Inspired Design and Innovation	Any Dept	3	0	0	0	3	3	50	50	**100**
9	UHV	22SCK37	Social Connect and Responsibility	AIML	0	0	1	0	1	2	50	--	**50**
10	NCMC	22NSS30	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED30	Physical Education (PE) (Sports andAthletics)	PE Director									
		22YOG30	Yoga	Yoga Teacher									
Total									**19**	**26**	**500**	**400**	**900**

12	NCMC	22DMAT31*	Basic Applied Mathematics-I	BS	0	0	0	0	0	2	50	--	50

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S : SDA**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming LanguageCourse, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

22DMAT31*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Programming Language Course (PLC)			
22AIM341	Linux Programming	22AIM 343	Programming for IoT
22AIM342	Perl Programming	22AIM 344	Java Script Programming
Ability Enhancement Course–III (all are Laboratory Courses 0-0-1-0)			
22AIM351	Problem solving using Prolog	22AIM353	Data Analysis using MSExcel
22AIM352	Python for Data Analytics	22AIM354	Exploratory Data Analysis

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the coursesnamely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with theconcerned coordinator of the course during the first week of III semesters. Activities shall be carried out betweenIII semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIEscore is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and thesame shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not beconsidered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courseismandatoryfortheawardofdegree.

Credit Definition: 1-hour Lecture (L) per week=1Credit2-hours Tutorial(T) per week=1 Credit 2-hoursPractical/ Drawing(P)per week=1Credit 2-hous Self Study for Skill Development (SDA) per week= 1 Credit	03-Creditscoursesaretobedesignedfor40hoursinTeaching-LearningSession 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING

B.E.in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations for 2022-2026 BATCH (2022 Scheme)

IV Semester														
Sl. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Over allCr**	**Cont actH**	**Marks**			
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**	
1	BSC/PCC	22MAC41	Discrete Mathematics and Graph Theory	BS	3	0	0	0	3	3	50	50	**100**	
2	PCC	22AIM42	Database Management System	AIML	3	0	0	0	3	3	50	50	**100**	
3	PCCL	22AIL42	Database Management System Lab	AIML	0	0	1	0	1	2	50	50	**100**	
4	PCC	22AIM43	Design and Analysis of Algorithm	AIML	3	0	0	0	3	3	50	50	**100**	
5	PCCL	22AIL43	Design and Analysis of Algorithm Lab	AIML	0	0	1	0	1	2	50	50	**100**	
6	PCC	22AIM44	Data Science	AIML	3	0	0	0	3	3	50	50	**100**	
7	PCCL	22AIL44	Data Science Lab	AIML	0	0	1	0	1	2	50	50	**100**	
8	PLC	22AIM45X	Programming Language Course	AIML	2	0	1	0	3	4	50	50	**100**	
9	AEC	22AIM46X	Ability Enhancement Course –IV	AIML	0	0	1	0	1	2	50	50	**100**	
11	UHV	22UHK47	Universal Human Values and Life Skills	Any Dept	1	0	0	0	1	2	50	50	**100**	
12	PROJ	22AIM48	Mini Project-I	AIML	0	0	1	0	1	2	50	50	**100**	
12	NCMC	22NSS40	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**	
		22PED40	Physical Education (PE) (Sports and Athletics)	PE Director										
		22YOG40	Yoga	Yoga Teacher										
Total									**21**	**30**	**600**	**550**	**1150**	

13	NCMC	22DMAT41*	Basic Applied Mathematics-II	BS	0	0	0	0	0	2	50	--	50

2DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral Students

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PROJ**: Mini Project work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Programming Language Course (PLC)			
22AIM451	Ruby Programming	22AIM453	R Programming
22AIM452	C#and.Net Framework	22AIM454	Advanced Python Programming

AbilityEnhancementCourse–IV (all are Laboratory Courses 0-0-1-0)			
22AIM461	Database Programming using Casandra	22AIM463	GoLang Programming
22AIM462	DataVisualization	22AIM464	Haskell programming

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to studentsto enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can dominiprojectas

(i) A group of 2 if mini project work is single discipline (applicable to all IT allied branches)

(ii) Agroup of 2-4 if mini project work is single discipline (applicable to all Core Branches)

(iii) A group of 2 -4 students if the Mini Project work isa multi disciplinary (Applicable to all Branches)

CIE procedure forMini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concernedDepartment and two faculty members of the Department, one of them being the Guide. The CIE marks awarded forthe Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all thebatchesmates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participationof alltheguidesofthe project.

TheCIEmarksawardedfortheMini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project reportshallbethe sameforallthebatchmates

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) withthe concerned coordinator of the course during the first week of III semesters. Activities shall be carried outbetween III semester to the VI semester (for 4 semesters). Successful completion of the registered course andrequisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, butcompletionof the course ismandatoryforthe awardof degree.

CreditDefinition: 1-hour Lecture (L) per week=1Credit2-hours Tutorial(T) per week=1 Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week= 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02-Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Artificial Intelligence and Machine Learning
Scheme of Teaching and Examinations for 2022- 2026 BATCH (2022 Scheme)

V Semester													
Sl. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hrs**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	HSMS	22AIM51	Software Engineering and Project Management	AIML	3	0	0	0	3	3	50	50	**100**
2	PCC	22 AIM 52	Machine Learning	AIML	3	0	0	0	3	3	50	50	**100**
3	PCCL	22AIlL52	Machine Learning Lab	AIML	0	0	1	0	1	2	50	50	**100**
4	PCC	22 AIM 53	Natural Language Processing	AIML	3	0	0	0	3	3	50	50	**100**
5	PCCL	22AILL53	Natural Language Processing Lab	AIML	0	0	1	0	1	2	50	50	**100**
6	PEC	22AIM54X	Professional Elective Course-I	AIML	3	0	0	0	3	3	50	50	**100**
7	AEC	22RMK55	Research Methodology and IPR	AIML	1	1	0	0	2	3	50	50	**100**
8	AEC	22SDK56	Critical and Creative Thinking Skills	AIML	0	0	1	0	1	2	50	--	**50**
9	UHV	22ESK57	Environmental Studies	Any Dept	1	0	0	0	1	1	50	50	**100**
10	PROJ	22AIM58	Mini Project-II	AIML	0	0	1	0	1	0	50	50	**100**
11	NCMC	22NSS50	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED50	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG50	Yoga	Yoga Teacher									
Total									**19**	**24**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

Professional Elective Course-I			
22AIM541	Architecting AI Systems & Operating Systems	22AIM544	Information Storage and Retrieval
22AIM542	Internet of Things (IoT)	22AIM545	Computational Intelligence
22AIM543	Advanced Java Programming		

22XXX51(HSMS)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.
For IT allied Branches: Software Product Management
For Core Branches: Engineering Economics and Management / Industrial Management and Entrepreneurship

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can do mini project as

A group of 2 if mini project work is single discipline (applicable to all IT allied branches)

(ii) A group of 2- 4 if mini project work is single discipline (applicable to all Core Branches)

(iii) A group of 2 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses can be added to supplement the latest trend and advanced technology in the selected stream of engineering.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Credit Definition:	03-Credits courses are to be designed for 40 hrs. in Teaching-Learning Session
1-hr. Lecture (L) per week=1Credit	
2-hrs.Tutorial (T) per week=1Credit	02- Credits courses are to be designed for 25 hrs. of Teaching-Learning Session
2-hrs. Practical / Drawing (P) per week=1Credit	
2-hous Self Study for Skill Development (SDA) per week = 1 Credit	01-Credit courses are to be designed for 15 hrs. of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Artificial Intelligence and Machine Learning
Scheme of Teaching and Examinations for 2022- 2026 BATCH (2022 Scheme)

VI Semester													
Sl. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hrs.**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	PCC	22AIM61	Deep Learning	AIML	3	0	0	0	3	3	50	50	**100**
2	PCCL	22AIL61	Deep Learning Lab	AIML	0	0	1	0	1	2	50	50	**100**
3	PCC	22AIM62	Big Data & Cloud Technologies	AIML	3	0	0	0	3	3	50	50	**100**
4	PCCL	22AIL62	Big Data & Cloud Technologies Lab	AIML	0	0	1	0	1	2	50	50	**100**
5	PCC	22AIM63	Ethical Cyber Security	AIML	2	1	0	0	3	4	50	50	**100**
6	PEC	22AIM64X	Professional Elective Course-II	AIML	3	0	0	0	3	3	50	50	**100**
7	PROJ	22AIM65	Project Phase I	AIML	0	0	2	0	2	0	50	50	**100**
8	AEC	22SDK66	Problem Solving Skills	AIML	0	0	1	0	1	2	50	--	**50**
9	AEC	22AIM67X	Ability Enhancement Course – V	AIML	0	0	1	0	1	2	50	50	**100**
10	OEC	23NHOP6XX	Industrial Open Elective Course-I	Offering Dept.	3	0	0	0	3	3	50	50	**100**
11	NCMC	22NSS60	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED60	Physical Education (PE) (Sports and Athletics)	PE Director									
		22YOG60	Yoga	Yoga Teacher									
Total									**21**	**26**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **OEC**: Open Elective Course, **PROJ**: Project work**, L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, C**IE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

Professional Elective Course-II			
22AIM641	Computer Networks	22AIM644	Augmented and Virtual Reality
22AIM642	Computer Vision	22AIM645	Randomized Algorithms
22AIM643	Embedded Systems		

Ability Enhancement Course – V			
22AIM671	AI powered UI design	22AIM674	Mobile Application Development
22AIM672	API and Microservices	22AIM675	Software Testing and Quality Assurance
22AIM673	Web Frameworks		

Industrial Open Elective Courses-I: Credit for OEC is 03 (L: T:P:S) can be considered as (3:0:0:0). The teaching and learning of these Courses will be based on hands-on. The Assessment will be based on CIE and

SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses can be added to supplement the latest trend and advanced technology in the selected stream of engineering.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III to VI semesters (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Credit Definition: 1-hr. Lecture (L) per week=1Credit 2-hrs. Tutorial (T) per week=1Credit 2-hrs. Practical / Drawing (P) per week=1Credit 2-hrs. Self Study for Skill Development (SDA) per week = 1 Credit	03-Credit courses are to be designed for 40 hrs. in Teaching-Learning Sessions 02-Credit courses are to be designed for 25 hrs. of Teaching-Learning Sessions 01-Credit courses are to be designed for 15 hrs. of Teaching-Learning Sessions

V SEMESTER

SOFTWARE ENGINEERING AND PROJECT MANAGEMENT			
Course Code	**22AIM51**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM51.1	Understand the principles of software Engineering and project management involved in developing large projects.
22AIM51.2	Apply a comprehensive project plan and estimation strategies.
22AIM51.3	Illustrate the importance of Requirement Mangement process.
22AIM51.4	Design innovative software solutions, utilizing modeling and all architecture techniques.
22AIM51.5	Evalute the project progress and manage using different project & process metrics.
22AIM51.6	Create an appropriate risk management plan based on risk register.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
22AIM51.1	2	-		-	-	-	-		-		-	-	-	-
22AIM51.2	3	-	-	-	-	-	-	-	-	-	-	3	2	-
22AIM51.3	-	3	-	-	-	-	-	-	-	-	-	-	2	-
22AIM51.4	-	-	3-	-	3							3	2	-
22AIM51.5	-	3	-	-	-	-	-	-	-	-	-	3	2	-
22AIM51.6	-		3	-	3	-	-	-	-	-	-	-	2	-

MODULE-1	**SOFTWARE ENGINEERING – INTRODUCTION**	22AIM51.1	**8 Hours**

Software Engineering – Definition, Software life cycle activities, Challenges in System Development, Software process models: Waterfall, Prototyping, spiral, and agile model, Software development methodology.

Case Study	Investigate the Challenges of System Development, Compare any two Modern software development paradigms
Text Book	Text Book 2: 1.1-1.16, 2.1 - 2.16

MODULE-2	**SYSTEM ENGINEERING**	22AIM51.3, 22AIM51.4	**8 Hours**

Requirement Engineering - Initiating the Requirements Engineering process, Eliciting Requirements, developing use cases, Building the analysis model, Software Requirement Document, System Architectural design, Subsystems development, System integration testing and deployment, System configuration management.

Case Study	Investigate Architectural design and compare any two testing techniques
Text Book	Text Book 2: 3.1 - 3.9, 4.1 - 4.9

MODULE-3	**DOMAIN MODELLING**	22AIM51.4	**8 Hours**

Definition, Object-Orientation and Class diagram - class and object, Object and Attribute, Association, Multiplicity of Role, Aggregation, Inheritance and Polymorphism, Visualizing domain model

Case Study	Explore the class diagram for any domestic application development, Explore tools for UML class diagram
Text Book	Text Book 2: 5.1- 5.10

MODULE-4	**MANAGING SOFTWARE PROJECT (MSP)**	22AIM51.2, 22AIM51.5	**8 Hours**

Project Management Concepts, Process and Project Metrics-Estimation for Software Projects, Decomposition Techniques, Empirical Estimation models, Project Scheduling- Maintenance and Reengineering.

Case Study	Numerical Problems and case studies on: 1.Basic Effort Estimation 2. Function Points Estimation 3. CoCoMo II Estimation 4. Cost Benefit Analysis 5. Agile Estimation
Text Book	Text Book 4: Ch:24-29

MODULE-5	RISK MANAGEMENT	22AIM51.5 22AIM51.6	8 Hours

Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

Case Study	**Numerical problems and case studies on:** 1. PERT/ CPM 2. Monte Carlo Simulation
Text Book	Text Book 1: 7.1-7.14,11.1-11.9

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test	Assessment(s) *	MCQ
		25	**15**	**10**
L1	**Remember**	5		**5**
L2	**Understand**	5	**-**	**5**
L3	**Apply**	10	**5**	
L4	**Analyze**	5	**10**	
L5	**Evaluate**	-	**-**	
L6	**Create**	-	**-**	

*Assessments are to be selected from the assessment list attached to **Appendix A.**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1. Software Project Management by Bob Hughes, Mike Cotterell and Rajib Mall, Fifth Edition, Tata McGraw Hill, New Delhi, 2017. ISBN: 9780077122799, 0077122798
2. Object Oriented Software Engineering, By David Kung, McGraw Hill, 2013, ISBN: 9781259080791, 125908079X.
3. Software Engineering by Ian Sommerville,9th edition, 2016, PearsonEdu. ISBN: 9780133943030, 0133943038
4. Software Engineering – A Practitioner's Approach by Roger S Pressman,7thedition, 2014, ISBN: 007769774X, 9780077697747

Reference Books:

1. "Software Project Management: A Unified Framework" by Walker Royce,1998. ISBN: 9780321734020.
2. Managing Global Software Projects McGraw Hill Education (India), Gopalaswamy Ramesh, Fourteenth Reprint 2013. ISBN: 9781283922418
3. Effective Software Project Management by Robert K. Wysocki – Wiley Publication, 2011. ISBN: 9780470446539
4.Software Project Management in Practice by Pankaj Jalote, 5thedition 2015. ISBN: 9789352868827, 935286882X

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_cs68/preview
- https://onlinecourses.nptel.ac.in/noc19_cs70/preview

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Visit to any software development organization
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

Machine Learning			
Course Code	**22AIM52**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM52.1	Understand the fundamental principles of Machine Learning and its applications.
22AIM52.2	Apply logistic regression as a classification algorithm to demonstrate the proficiency in modelling binary and multi-class classification problems.
22AIM52.3	Analyze the decision tree algorithm, its strengths and weaknesses in modeling complex decision boundaries and handling categorical and numerical data.
22AIM52.4	Evaluate ML model performance (supervised and unsupervised algorithms) using advanced metrics such as precision, recall, F1 score, and ROC-AUC curve for effectiveness and robustness.
22AIM52.5	Create effective classification models using supervised and unsupervised algorithms.
22AIM52.6	Synthesize ethical considerations in Machine Learning (Algorithms), proposing strategies to address fairness, accountability, and transparency in model development

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM52.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM52.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22AIM52.3	-	3	-	-	-	-	-	-	-	-	-	2	3	2
22AIM52.4	-	3	-	-	-	-	-	-	-	-	-	2	3	2
22AIM52.5	-	-	3	-	-	-	-	-	-	-	-	2	3	2
22AIM52.6	-	-	3	3	3	-	-	3	-	-	-	2	3	-

MODULE-1	**Introduction to Machine Learning**	22AIM52.1, 22AIM52.2	**8 Hours**

Understanding Machine Learning: Definition and Types of Machine Learning-Application of Machine Learning- Machine Learning Algorithms: Supervised, Unsupervised, and Semi-Supervised Learning Algorithms. Machine Learning Models-**Model Evaluation Metrics:** Confusion Matrix, Precision, Recall, F1 Score -ROC Curve and AUC-ROC. **Advanced Techniques:** Feature Scaling and Normalization -Encoding Categorical Variables-Train-test Split and Cross-validation.

Text Book	Text Book 1: Ch 1,4

MODULE-2	**Supervised Learning Regression and Classification Algorithms**	22AIM52.3	**8 Hours**

Regression: Introduction to Regression- Regression Models- Linear Regression, Polynomial Regression-. **Decision Trees:** Introduction to Decision Trees-Tree Construction, Splitting Criteria, and Pruning-Handling Missing Values and Categorical Features- Gini Index-ID3-CART.

Case study	Predicting salaries with Decision Tree.
Text Book	Text Book 1: Ch 4

MODULE-3	**Similarity based Models**	22AIM52.4, 22AIM52.5	**8 Hours**

k-Nearest Neighbors (k-NN): Introduction to k-Nearest Neighbors Algorithm-Distance Metrics and Choosing 'k' -k-NN for Classification. Logistic Regression- Multiclass Classification with Logistic Regression.

Text Book	Text book 1: Ch 8

MODULE-4	**Probabilistic based Models**	22AIM52.5, 22AIM52.6	**8 Hours**

Naive Bayes: Introduction to Naive Bayes Classifier-Bayes' Theorem and Conditional Probability-Gaussian, Multinomial, and Bernoulli Naive Bayes. Bayesian Belief Network-EM algorithm.

Text Book	Text Book 1: Ch 6

MODULE-5	**Unsupervised Algorithms**	22AIM52.5, 22AIM52.6	**8 Hours**

Introduction to Rule Based learning and Association rules- Apriori Algorithm, FP-Growth. Introduction to unsupervised Algorithms- types of clustering algorithms- k-means clustering algorithms-DBSCAN clustering algorithm.

Case Study	Using Super market dataset, analysis the frequent Item sets (Association Rules algorithms)
Text Book	Text Book 1: Ch 6. Text Book 2: Ch 4,6

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	5	**-**	**5**
L2	**Understand**	5	**-**	**5**
L3	**Apply**	10	5	
L4	**Analyze**	5	10	-
L5	**Evaluate**	-	-	**-**
L6	**Create**	**-**	**-**	**-**

*Assessments are to be selected from the assessment list attached to **Appendix A.**.

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 1997. ISBN 9780071154673, 0071154671
2. Charu C. Aggarwal, "Data Mining", Springer, 2015. ISBN: 9783319141428, 3319141422

Reference Books:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Müller and Sarah Guido, 2016. ISBN: 9781449369903
2. Charu C. Aggarwal, "Data Mining", Springer, 2015. ISBN: 9783319141428

Web links and Video Lectures (e-Resources):

- https://towardsdatascience.com/the-fp-growth-algorithm-1ffa20e839b8
- https://www.analyticsvidhya.com/blog/2021/08/decision-tree-algorithm/
- https://ocw.mit.edu/courses/15-097-prediction-machine-learning-and-statistics-spring-2012/eb02afbd0a9c32637dd64cdb6b76c2f1_MIT15_097S12_lec01.pdf

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
- Organizing Group discussions on real-world problems
- Seminars

MACHINE LEARNING LAB			
Course Code	**22AIL52**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

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

22AIL52.1	Understand the implementation of procedures for machine learning algorithms.
22AIL52.2	Analyze various machine learning models with appropriate data sets to improve the accuracy in real world problem.
22AIL52.3	Evaluate the performance of different Learning models.
22AIL52.4	Design Java/Python programs for various Learning algorithms.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL52.1	2	-	-	-	-	-	-	-	-	-	-	3	3	3
22AIL52.2		3	-	-	-	-	-	-	-	-	-	3	3	3
22AIL52.3		3	3	-	3	-	-	-	-	-	-	3	3	3
22AIL52.4			3	-	3	-	-	-	-	-	-	3	3	3

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Basic Python program using libraries • Read and write a CSV file using python	2	NA
	PART-A		
1	Develop a python program to perform binary classification and evaluate performances using Confusion matrix, ROC Curve, Precision, Recall and F1 Score for any given dataset.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
2	Develop models for Ridge regression and Lasso regression for the given dataset and evaluate its performance then compare above two methods.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
3	Develop a multiple regression model for the given data set and evaluate its performance	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
4	Write a program to demonstrate the working of the decision tree Based CART algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new Sample.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
5	Develop a program for logistics regression model for the given data and compare performance with other regression model	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
6	Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
	PART-B		
7	Write a program to implement *k*-Nearest Neighbour algorithm to classify the data set. Print both correct and wrong predictions.	2	22AIL52.1, 22AIL52.2,

	Java/Python ML library classes can be used for this problem.		22AIL52.3, 22AIL52.4
8	Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
9	Write a program to construct a **Bayesian network** for given dataset. Java/Python ML library classes/API can be used to construct the model.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
10	Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
11	Apply k-means and DBSCAN Clustering algorithms to generate clusters for the given dataset and evaluate its performance and compare.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4
12	Write a Python program to implement the Apriori algorithm using a given transaction dataset stored as a .CSV file. Identify frequent item sets and association rules from data file.	2	22AIL52.1, 22AIL52.2, 22AIL52.3, 22AIL52.4

PART-C

Beyond Syllabus Virtual Lab Content

1. K-means algorithm: https://vlab.spit.ac.in/ai/#/experiments/3
2. Linear Regressions methods: https://vlab.spit.ac.in/ai/#/experiments/10
3. K-nearest neighbors (KNN) algorithm: https://vlab.spit.ac.in/ai/#/experiments/4
4. Logistics Regression method: https://vlab.spit.ac.in/ai/#/experiments/11

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s) (20)	Weekly Assessment (30)
L1	**Remember**	**-**	**-**
L2	**Understand**	5	10
L3	**Apply**	**5**	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**		-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1.Tom Mitchell, "Machine Learning", McGraw Hill, 1997 ISBN: 9780071154673

2. E. Alpaydin, "Introduction to Machine Learning", MIT Press, 2020. ISBN: 9780262043793

NATURAL LANGUAGE PROCESSING			
Course Code	**22AIM53**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM53.1	Understand basics of linguistics, probability and statistics associated with NLP.
22AIM53.2	Analyze the semantic of natural language.
22AIM53.3	Design an end-to-end NLP application by integrating preprocessing, feature extraction, and model-building techniques.
22AIM53.4	Evaluate the performance of advanced transformer models (e.g., BERT, GPT-3) in various NLP tasks such as text classification, summarization, and topic modeling.
22AIM53.5	Demonstrate the working of sequence models for text processing.
22AIM53.6	Implement the NLP applications on emerging trends with ethical implications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM53.1	2	-	-	-	-	-	-	-	-	-	-	-	---	-
22AIM53.2	-	3	-	-	-	-	-	-	-	-	-	2	3	2
22AIM53.3	-	-	3	-	-	-	-	-	-	-	-	2	3	2
22AIM53.4	-	-	3	-		-	-	-	-	-	-	2	3	2
22AIM53.5	-	-	3	-		-	-	-	-	-	-	2	3	2
22AIM53.6	-	-	3	-	3	-	-	2		-	-	2	3	2

MODULE-1	**Natural Language Processing**	22AIM53.1	**8 Hours**

Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology: Inflectional Morphology - Derivational Morphology. Finite-State Morphological Parsing - Porter Stemmer.

Case Study	Case studies of NLP applications in various industries.
Text Book	Text Book 1: Ch 2,3,4

MODULE-2	**Semantic Analysis**	**2**2AIM53.2	**8 Hours**

Representing Meaning-Meaning Structure of Language-First Order Predicate Calculus Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis - Semantic Attachments -Syntax-Driven Analyzer. Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval

Text Book	Text Book 1: 13,14,18

MODULE-3	**WORD REPRESENTATION AND PART OF SPEECH**	22AIM53.2, 22AIM53.3	**8 Hours**

N-grams and Language models –Smoothing- Evaluating Language Model -Text classification- Naïve Bayes classifier –- Vector Semantics – TF-IDF – Word Embeddings: Word2Vec, Glove and Fast Text-Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging-Conditional Random Fields(CRFs).

Text Book	Text Book 1: Ch 4,5,10,17,19

MODULE-4	**Transformer and Topic Models**	22AIM53.4, 22AIM53.5	**8 Hours**

Introduction to transformer architecture-BERT (Bidirectional Encoder Representations from Transformers)-GPT-3 (Generative Pre-trained Transformer 3)-Fine-tuning transformer models for NLP tasks. **Topic Modeling:** Introduction to topic modeling-Latent Dirichlet Allocation (LDA)-Non-Negative Matrix Factorization (NMF).

Text Book	Text Book 1:16,18

MODULE-5	**Applications and Future Directions in NLP**	22AIM53.5, 22AIM53.6	**8 Hours**

Applications and Implementation of NLP: Sentiment Analysis - Text Classification- Text

Summarization- Named Entity Recognition code- Chatbots and Dialogue systems. **Future Trends in NLP-**Emerging trends and research areas-AI-driven NLP tools and services.

Case Study	Using NLP for Healthcare summaries
Text Book	**Text Book 1: 17-20**

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test	Assessment(s) *	MCQ
		25	**15**	**10**
L1	**Remember**	5		**5**
L2	**Understand**	5	**-**	**5**
L3	**Apply**	10	**5**	
L4	**Analyze**	5	**10**	
L5	**Evaluate**	-	**-**	
L6	**Create**	-	**-**	

*Assessments are to be selected from the assessment list attached to **Appendix A.**.

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1) Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition (Prentice Hall Series in Artificial Intelligence), 2017. ISBN: 0133252930, 9780133252934

2) Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019. ISBN: 9780262042840 https://web.stanford.edu/~jurafsky/slp3/(Updated Text book content available link)

Reference Books:

1) Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019. ISBN: 9781699028452, 1699028451

2) Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009. ISBN: 9780262303798, 0262303795

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/106/106106211/
- https://www.nptelvideos.com/course.php?id=424
- https://www.youtube.com/watch?v=rmVRLeJRkl4

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Online Class using Jeopardy
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to read research topics on NLP
  - Class Presentation.

NATURAL LANGUAGE PROCESSING LAB			
Course Code	**22AIL53**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

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

22AIL53.1	Apply the concept of natural language processing (NLP) using Natural Language Toolkit (NLTK).
22AIL53.2	Build text corpora with tokenization, Stemming, Lemmatization using visualization techniques.
22AIL53.3	Utilize word embedding models (e.g., Word2Vec, GloVe), part-of-speech tagging, named entity recognition to capture linguistic features and semantic relationships in text.
22AIL53.4	Apply advanced NLP models, transformers and topic modeling techniques, to perform text classification, summarization, and topic discovery, and integrate these methods into end-to-end NLP applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL53.1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
22AIL53.2	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
22AIL53.3	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
22AIL53.4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Python Programming/ Basic Packages • Basics of Automata Theory concepts	2	NA
	PART-A		
1	Choose an English word, and see how it is used in the different example texts by making concordances.	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
2	Counting Vocabulary: a) How many words (tokens) are there in the given text. b) How many different words (types) are there in the given text c) How many times does the word the occur in the text d) What is this as a percentage of all the words in the text?	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
3	Write a program to perform Tokenization, stemming to carry out the analysis with text corpora.	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
4	Write a code to remove stop words with NLTK in Python	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
5	Write a program for N-gram model with NLTK in Python	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
6	Implement Wordnet Lemmatizer with appropriate POS tag.	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
	PART-B		

7	Develop a python program for word embedding using Word2Vec for a given word corpus.	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
8	Develop a python program to implement named entity recognition on text.	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
9	Develop a program to implement text summarization methods (Simple abstractive text summarization)	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
10	Develop a python program to fine-tune a BERT model for text classification task.	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
11	Build Bag of Words model (BoW) in NLP using Python	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4
12	Build language translator using Python	2	22AIL53.1, 22AIL53.2, 22AIL53.3, 22AIL53.4

PART-C

Beyond Syllabus Virtual Lab Content

1. Word Analysis : https://nlp-iiith.vlabs.ac.in/exp/word-analysis/
2. Word Generation: https://nlp-iiith.vlabs.ac.in/exp/word-generation/
3. Morphology : https://nlp-iiith.vlabs.ac.in/exp/morphology/
4. N-grams: https://nlp-iiith.vlabs.ac.in/exp/n-grams/
5. N-grams smoothing: https://nlp-iiith.vlabs.ac.in/exp/n-grams-smoothing/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)(20)	Weekly Assessment (30)
L1	**Remember**	**-**	**-**
L2	**Understand**	5	10
L3	**Apply**	**5**	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**		-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin, Pearson, 2nd Edition, 2014. ISBN: 0133252930, 9780133252934

ARCHITECTING AI SYSTEMS AND OPERATING SYSTEMS			
Course Code	**22AIM541**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM541.1	Understand the Basics of AI System Architecture and Operating Systems concepts.
22AIM541.2	Explain how instruction level, data level and thread level parallelism is utilized in architecture.
22AIM541.3	Optimizing the cache performance using various techniques.
22AIM541.4	Analyze communication between inter process communication, deadlocks and synchronization techniques.
22AIM541.5	Implement CPU Scheduling algorithm, Page Replacement algorithm and memory management problems.
22AIM541.6	Evaluate the performance virtual memory and disk storage devices with different methods.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM541.1	3	-	-	-	-	-	-	-	-	-	-	-	-	
22AIM541.2	-	3	-	-	-	-	-	-	-	-	-	2	-	2
22AIM541.3	-	-	3	-	-	-	-	-	-	-	-	2	-	-
22AIM541.4	-	3	-	-	3	-	-	-	-	-	-	2	-	-
22AIM541.5	-	-	-	3	3	-	-	-	-	-	-	2	-	-
22AIM541.6	-	-	-	3	3	-	-	-	-	-	-	2	-	-

MODULE-1	**Basics for System Architecture**	22AIM541.1, 22AIM541.3	**8 Hours**

Introduction to architecture-CISC and RISC Architecture-Instruction set: Instruction Set Architecture, Instruction formats, Instruction set categories - Addressing modes. Performance metrics: Execution time calculation, MIPS, MFLOPS. Memory systems hierarchy: Design of scalable memory using RAM's- ROM's chips. Cache memory: principles, Cache memory management techniques, Types of caches, caches misses, Mean memory access time evaluation of cache.

Text Book	Text Book 1: Ch 2

MODULE-2	**Parallelism**	22AIM541.2	**8 Hours**

Parallelism: Instruction -Levels Parallelism: Concepts and Challenges- Basic Compiler Technique for Exposing ILP-overcoming Data Hazards with Dynamic Scheduling. Data-Level parallelism: Vector Architecture-SIMD instruction Set Extensions for Multimedia- Graphics Processing Units Architectures. Thread-Level parallelism: Centralized Shared-Memory Architecture-Distributed Shared-Memory and Directory-Based Coherence.

Text Book	Text Book 1: Ch 3,4,5
Case Study	TPU Architecture

MODULE-3	**Operating Systems - Process Management**	22AIM541.1, 22AIM541.4	**8 Hours**

Operating Systems Services- user and Operating system interface- System call- System services-Linker and Loader- Operating System Structure. Process: Process Concept- Operation on Processes- Process Scheduling- CPU Scheduling: Pre-emptive, non-pre-emptive-Multiprocessor scheduling.

Text Book	Text Book 2: Ch 2,5

MODULE-4	**Concurrency**	22AIM541.4, 22AIM541.5	**8 Hours**

Threads- Multithreading models- Threading Issues. Deadlocks- Resource allocation and management- Deadlock handling mechanisms: prevention, avoidance, detection, recovery from deadlock. Inter-process communication, Synchronization- Implementation of synchronization primitives: Peterson's solution, Bakery algorithm-Semaphores-Classical synchronization problems.

Text Book	Text book 2: Ch 4,6,8
Case Study	Producer -Consumer problem

MODULE-5	**Memory and Storage management**	22AIM541.5. 22AIM541.6	**8 Hours**

Main Memory: Contiguous Memory allocation- paging- structure of the page table-Swapping. Virtual Memory: Demand Paging – Copy-on-Write- Page Replacement- Allocation of Frames- Thrashing. Disk structure and attachment- Disk Scheduling algorithms: Seek Time- Rotational latency based. RAID Levels.

Text Book	Text Book 2: Ch 9,10

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment (s)/NPTEL
		25	**25**
L1	**Remember**	5	**-**
L2	**Understand**	5	**5**
L3	**Apply**	10	10
L4	**Analyze**	5	10
L5	**Evaluate**	-	-
L6	**Create**	**-**	**-**

*Assessments are to be selected from the assessment list attached to **Appendix A.**.

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Computer Architecture: A Quantitative Approach By John L. Hennessy, David A. Patterson , 2017. ISBN: 9780128119068, 0128119063
2. Operating System Concepts Abraham Silberschatz, Peter B. Galvin, Greg Gagne, , Wiley ,2018. ISBN: 9781119124894, 1119124891

Reference Books:

1. "Designing Data-Intensive Applications" by Martin Kleppmann,2011. ISBN: 9781491903117
2. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig,2011. ISBN: 9781292401171

Web links and Video Lectures (e-Resources):

- https://www.cse.iitb.ac.in/~mythili/os/
- https://www.youtube.com/watch?v=mXw9ruZaxzQ
- https://medium.com/@harishramkumar/comparing-gpu-vs-tpu-vs-lpu-the-battle-of-ai-processors-2cf4548c4a62

INTERNET OF THINGS			
Course Code	**22AIM542**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**03**

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

22AIM542.1	Understanding of the fundamental concepts of IoT.
22AIM542.2	Explore techniques for managing real-time data in IoT applications.
22AIM542.3	Analyze the principles of connecting devices in IoT.
22AIM542.4	Evaluate protocols with best practices to ensure efficient communication in IoT ecosystems.
22AIM542.5	Design the mechanisms and key technologies in the IoT.
22AIM542.6	Implement the latest technologies that are standards of the IoT.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM542.1	2	-	-	-	-	--	-	-	-	-	-	-	-	-
22AIM542.2	3	-	-	-	-	-	-	-	-	-	-	2	3	-
22AIM542.3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
22AIM542.4	-	3	-	-	-	-	-	-	-	-	-	3	3	-
22AIM542.5	-	-	3	-	-	-	-	-	-	-	-	3	3	-
22AIM542.6	-	-	-3	-	3	-	-	-	-	-	-	3	3	-

MODULE-1	**INTRODUCTION**	22AIM542.1 22AIM542.2	**8 Hours**

An Overview: IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, Examples of IoT. Emergence of IoT: Evolution of IoT, Enabling IoT and Complex Interdependence Technologies, IoT Networking Components, Addressing Strategies in IoT.

Application	IoT Application Layer
Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7. Text Book 2: 4.1, 4.2, 4.3, 4.4, 4.5.

MODULE-2	**DESIGN PRINCIPLES FOR CONNECTED DEVICES**	22AIM542.2 22AIM542.3 22AIM542.6	**8 Hours**

IoT Sensing and Actuation: Sensors, Sensor Characteristics, Sensing Types, Actuators, Actuator types, Actuator Characteristics. IoT/M2M System Layers and Design Standardisation, Communication Technologies, Data Enrichment, Data consolidation and Device management at Gateway, Ease of designing and affordability.

Text Book	Text Book 1: 2.1, 2.2, 2.3, 2.4, 2.5 Text Book 2: 5.2, 5.3, 5.5, 5.6, 5.7, 5.8, 5.9

MODULE-3	**DATA ACQUIRING, ORGANISING, PROCESSING AND ANALYTICS**	22AIM542.2 22AIM542.5 22AIM542.6	**8 Hours**

Introduction, Data acquiring and storage, Organising the data, Transactions, business process, Integration and Enterprise Systems, Analytics, Knowledge acquiring, Managing and Storing Process.

Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6

MODULE-4	**IoT COMMUNICATION TECHNOLOGIES**	22AIM542.4,22AIM542.5 ,22AIM542.6	**8 Hours**

Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols.

Text Book	Text Book 2: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7

MODULE-5	**IoT SECURITY AND CASE STUDIES**	**2**2AIM542.5,22AIM542.6	**8 Hours**

Introduction, Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases,IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT.
IoT Case Studies: IoT/ IIoT Applications in the premises, supply chain and customer monitoring, Connected Car and its applications and services, Smart city streetlights control and monitoring.

Text Book	Text Book 1: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 12.3, 12.4, 12.6

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	Qualitative Assessment(s) */ NPTEL
		25	25
L1	Remember	5	5
L2	Understand	10	10
L3	Apply	10	10
L4	Analyze	-	-
L5	Evaluate	-	-
L6	Create	-	-

*Assessments are to be selected from the assessment list attached to **Appendix A.**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	15
L2	Understand	15
L3	Apply	20
L4	Analyze	--
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Dr. Raj Kamal, "Internet of Things: Architecture and Design Principles," McGraw Hill, 2022 ISBN: 978-9390727384

2) Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press, 2021. ISBN: 9781108842952, 110884295X

Reference Books:

1) Callaway EH, "Wireless Sensor Networks: Architecture and Protocols," Auerbach Publications, 2003. ISBN: 9780849318238

2)Michael Miller, "The Internet of Things", First Edition, Pearson, 2015. ISBN: 9780789754004

3) ArshdeepBahga, Vijay Madisetti," Internet of Things: A Hands-on Approach" Universities Press., 2015. ISBN: 9780996025515

Web links and Video Lectures (e-Resources):

- https://www.educba.com/introduction-to-iot/
- https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
- https://onlinecourses.nptel.ac.in/noc22_cs53/preview
- https://www.simplilearn.com/iot-devices-article

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to any open source IOT lab
- Demonstration of Thermal sensors, Strain gauge sensors
- Video demonstration of the latest IOT applications
- Contents-related activities (Activity-based discussions)
  - Organizing Group discussions on real-time issues
  - Seminars

ADVANCED JAVA PROGRAMMING			
Course Code	**22AIM543**	**CIE Marks**	**50**
L: T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM543.1	Understand basics of server-side and TCP/IP socket programing.
22AIM543.2	Analyze the need for advanced Java concepts like enumerations and annotations in developing modules in projects.
22AIM543.3	Evaluate the functioning of graphical programming using AWT.
22AIM543.4	Design server-side scripts (servlets) and JSPs that fit into a Java-based web application architecture.
22AIM543.5	Examine how the JDBC API can be used to access databases and manage connections.
22AIM543.6	Justify the use of collection frameworks and graphics programming to increase performance.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM543.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM543.2	-	3	-	-	-	-	-	-	-	-	-	2	3	2
22AIM543.3	-	3	-	-	-	-	-	-	-	-	-	2	2	2
22AIM543.4	-	-	3	-	3	-	-	-	-	-	-	3	2	2
22AIM543.5	-	3	-	-	-	-	-	-	-	-	-	3	3	3
22AIM543.6	-	3	-	-	3	-	-	-	-	-	-	2	3	-

MODULE-1	**Java Networking**	22AIM543.1	8 Hours

Network Basics and Socket overview, TCP/IP client sockets, URL, TCP/IP server sockets, Datagrams, java.net package Socket, ServerSocket, InetAddress, URL, URLConnection

Case Study	URL, URLConnection
Text Book	Text Book 1: chapter 22

MODULE-2	**Enumerations, Autoboxing and Annotations**	22AIM543.2	8 Hours

Enumerations, Enumeration fundamentals, the values() and valueOf() Methods, Java enumerations are class types, enumerations Inherits Enum, example, type wrappers, Autoboxing, Autoboxing and Methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of Warning. Annotations, Annotation basics, specifying retention policy, Obtaining Annotations at run time by use of reflection, Annotated element Interface

Case Study	Autoboxing in expressions
Text Book	Text Book 1: chapter 12

MODULE-3	**Collection Framework and Graphics Programming**	22AIM543.3,22AIM543.6	8 Hours

The collections and Framework: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, accessing a collection via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, The Collection Algorithms, Graphics programming using AWT.

Text Book	Textbook 1 - chapter 18

MODULE-4	**Servlet Concepts**	22AIM543.4	8 Hours

Background; The Life Cycle of a Servlet; Using Tomcat for Servlet development; A simple Servlet; The Servlet API; The javax.servlet. package; Reading Servlet Parameter; The Javax.servlet.http

package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects			
Case Study	Session tracking using servlets		
Text Book	Textbook 1 - Ch 38 Textbook 3- Ch 37,38		
MODULE-5	**The Concept of JDBC**	22AIM543.5 22AIM543.6	**8 Hours**
The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data types; Exceptions.			
Text Book	Textbook 2- Chapter 2		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment (s)/NPTEL
		25	**25**
L1	**Remember**	5	**-**
L2	**Understand**	5	**5**
L3	**Apply**	5	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**15**
L4	**Analyze**	**15**
L5	**Evaluate**	**-**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1. Herbert Schildt: JAVA the Complete Reference, 9th Edition, Tata McGraw Hill, 2014. ISBN: :9780071808552, 0071808558.
2. Jim Keogh: J2EE-TheCompleteReference, McGraw Hill, 2007.ISBN: 9780072224726, 007222472X

Reference Books:

1. Stephanie Bodoff et al: The J2EE Tutorial, 2nd Edition, Pearson Education,2004. ISBN: 9780321245755.
2. Y. Daniel Liang: "Introduction to JAVA Programming", 10th Edition, Pearson Education, 2007.ISBN: 9780136012672, 0136012671.

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview
2. https://www.codecademy.com/learn/learn-advanced-java

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Visit to software industry
- Organizing hands-on sessions on JSP and servlets.

INFORMATION STORAGE AND RETRIEVAL														
Course Code	**22AIM544**							**CIE Marks**				**50**		
L:T:P:S	**3:0:0:0**							**SEE Marks**				**50**		
Hrs. / Week	**3**							**Total Marks**				**100**		
Credits	**03**							**Exam Hours**				**03**		
Course outcomes: At the end of the course, the student will be able to:														
22AIM544.1	Understand the fundamental concept of Information retrieval.													
22AIM544.2	Apply advanced Information retrieval techniques and strategies in practical scenarios and systems.													
22AIM544.3	Analyze the performance and effectiveness of Information retrieval systems using metrics and evaluation methods.													
22AIM544.4	Design information retrieval systems using distributed, multimedia concepts.													
22AIM544.5	Investigate emerging trends, challenges, and advancements in Information retrieval through research and experimentation.													
22AIM544.6	Discover insights and complexities of web Information retrieval.													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22AIM544.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM544.2	3	-	-	-	-	-	-	-	-	-	-	3	2	2
22AIM544.3	-	3	--	-	-	-	-	-	-	-	-	3	3	-
22AIM544.4	-	-	3	-	-	-	-	-	-	--	-	3	3	2
22AIM544.5	-	3	-	-	-	-	-	-	-	--	-	3	3	2
22AIM544.6	-	-	-	3	3	-	-	-	-	--	-	2	2	2
MODULE-1	**Introduction To Information Retrieval**									22AIM544.1				**8 Hours**
Basic Concepts of IR, Data Retrieval & Information Retrieval, Text mining and IR relation, IR system block diagram. Automatic Text Analysis: Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighing, Probabilistic Indexing Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing, Clustered files														
Application	Cultural Heritage Information Retrieval													
Text Book	Text Book 1: Ch 1													
MODULE-2	**Advanced Retrieval Strategies**									22AIM544.2				**8 Hours**
Retrieval strategies: Vector Space model, Probabilistic retrieval strategies, Language models, Inference networks, Boolean retrieval, Latent semantic indexing, Neural networks, Fuzzy set retrieval Retrieval utilities: Relevance feedback, Cluster Hypothesis, Clustering Algorithms: Single Pass Algorithm, Single Link Algorithm.														
Text Book	Text Book 2: Ch 2													
MODULE-3	**Assessing Performance And Visualizing Information Systems**									22AIM544.3				**8 Hours**
Performance evaluation: Precision and recall, MRR, F-Score, NDCG, user oriented measures, cross fold evaluation. Visualisation in Information System: Starting points, document context, User relevance judgment, Interface support for search process														
Text Book	Text Book 1: Ch:3													
MODULE-4	**Distributed Information Retrieval**									22AIM544.4, 22AIM544.5				**8 Hours**
Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, web issues. MULTIMEDIA IR: Introduction, Data Modeling, Query languages, Generic multimedia indexing approach, One dimensional time series, two-dimensional color images, Automatic feature extraction														
Case Study	Automatic feature extraction in Multimedia IR													
Text Book	Text Book 1: Ch:4													
MODULE-5	**Web Information Retrieval**							22AIM544.6						**8 Hours**
Searching the Web: Challenges, Characterizing the Web, Search Engines, Browsing, Web crawlers, Web														

data mining, Searching using Hyperlinks, Web Graph, Page ranking algorithms	
Text Book	Text Book 1: Ch 5

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment (s)/NPTEL
		25	**25**
L1	**Remember**	5	**-**
L2	**Understand**	5	**-**
L3	**Apply**	10	15
L4	**Analyze**	**5**	5
L5	**Evaluate**	-	=
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**15**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1) David A. Grossman, Ophir Frieder, Information Retrieval – Algorithms and Heuristics, Springer, 2nd Edition (Distributed by Universal Press), 2004. ISBN: 9781402030055, 1402030053

Reference Books:

1.Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan – Kaufmann Publishers, 2002. ISBN: 9781558607545

2.Gerald J Kowalski, Mark T Maybury Information Storage and Retrieval Systems: Theory and Implementation, Springer, 2004. ISBN: 9780792379249

Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/what-is-information-retrieval/
- https://cse.iitkgp.ac.in/~pabitra/course/ir06/ir06.html

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Organizing Group wise discussions on issues
- Seminars
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to read research papers on deep learning and have a discussion.
  - Presentations

COMPUTATIONAL INTELLIGENCE			
Course Code	**22AIM545**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM545.1	Understand the fundamentals of computational intelligence and its applications.
22AIM545.2	Apply the knowledge of evolutionary algorithms and their applications in optimization and search problems.
22AIM545.3	Analyze the principles of fuzzy logic and its applications in decision-making and control systems.
22AIM545.4	Evalute performance of intelligence algorithms using metrics.
22AIM545.5	Design a model for pattern recognition and classification using Neural Network.
22AIM545.6	Create a solution for real-world problems (complex problem) using intelligence algorithms.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM545.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM545.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22AIM545.3	-	-3-	-	-	-	-	-	-	-	-	-	2	3	2
22AIM545.4	-	3	-	-	-	-	-	-	-	-	-	2	3	3
22AIM545.5	-	-	3	-	-	-	-	-	-	-	-	2	2	2
22AIM545.6	-	-	3	3	-	-	-	-	-	-	-	2	2	2

MODULE-1	**Introduction to Computational Intelligence**	22AIM545.1	**8 Hours**

Definition and scope of computational intelligence, history and evolution, Adaptation, Self-organization, Computational Intelligence Vs Artificial Intelligence and hard computing, Over-view of Evolutionary computations.

Text Book	Text Book 2: Ch 2, 3

MODULE-2	**Evolutionary Algorithms**	22AIM545.1, 22AIM545.2	**8 Hours**

Genetic algorithms, Genetic programming, Evolution programming, Evolutionary strategies.

Case study	Route optimization problem using GA.
Text Book	Text Book 2: Ch 3.

MODULE-3	**Fuzzy Systems**	22AIM545.3, 22AIM545.4	**8 Hours**

Fuzzy set, fuzzy logic, Theory of Fuzzy Sets, Approximate Reasoning, fuzzy control systems, fuzzy clustering.

Text Book	Text book 2: Ch 7.

MODULE-4	**Neural Networks**	22AIM545.5	**8 Hours**

Neural Networks-components and terminology-Topologies- Neural Network Adaptation-Perceptron, Multilayer perceptron (MLP), Back propagation, Self-Organizing Maps (SOMs).

Text Book	Text Book 2: Ch 5

MODULE-5	**Swarm Intelligence Algorithms**	22AIM545.5 ,22AIM545.6	**8 Hours**

Particle swarm optimization (PSO), Ant Colony Optimization (ACO), Bee Colony Optimization (BCO), artificial bee colony (ABC) algorithm.

Text Book	Text Book 1: Ch 1,2,4,20

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment (s)/ NPTEL
		25	**25**
L1	**Remember**	5	**-**
L2	**Understand**	5	**5**
L3	**Apply**	10	10
L4	**Analyze**	5	10
L5	**Evaluate**	-	-
L6	**Create**	**-**	**-**

*Assessments are to be selected from the assessment list attached to **Appendix A.**.

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Swarm intelligence Algorithms: A Tutorial, Adam Slowik, CRC Press, 2020. ISBN: 9780429749506, 0429749503
2. Russell C Eberhart and Yuhui Shi" Computational Intelligence: Concepts to Implementations", Maorgan Kaufmann publishers, 2007.ISBN: 978-1-55860-759-0

Reference Books:

1. "Softcomputing:Fundamentals, Techniques, Applications" , Saroj Kaushik, Sunita Tiwari by McGraw Hill Publishing, 2018. ISBN: 9789353160678
2. S N Sivanandam, SN Deepa, "Principles of Soft computing", 3rd Edition, Wiley Inida, 2008. ISBN: 9788126510757, 8126510757

Web links and Video Lectures (e-Resources):

- https://www.bing.com/videos/riverview/relatedvideo?q=computional+intelligence+video+NPTEL&mid=136E9B8085C8BBAE9CD0136E9B8085C8BBAE9CD0&FORM=VIRE(Simulated Annealing).
- https://scte-iitkgp.vlabs.ac.in/List%20of%20experiments.html(Fuzzy systems)
- https://www.youtube.com/playlist?list=PLxpgde9O2dpk5vAUIw52j11L9AWiVJZ2K

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
- Organizing Group discussions on real-world problems
- Seminars

RESEARCH METHODOLOGY AND IPR			
Course Code	**22RMK55**	**CIE Marks**	**50**
L: T: P: S	**1:1:0:0**	**SEE Marks**	**50**
Hours / Week	**03**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

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

22RMK55.1	Define a research problem and to formulate research questions.
22RMK55.2	Demonstrate the various processing techniques of research.
22RMK55.3	Choose appropriate methods to formulate research objectives.
22RMK55.4	Develop advanced critical thinking skills and enhance writing skills.
22RMK55.5	Understand the statutory provisions of different forms of IPRs in simple forms.
22RMK55.6	Identify the significance of practice and procedure of patents.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22RMK55.1	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.2	3	3	2	2	2	-	-	-	1	2	-	-
22RMK55.3	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.4	3	2	2	-	1	-	-	-	1	2	-	-
22RMK55.5	3	3	2	1	-	-	-	1	1	2	-	-
22RMK55.6	3	3	2	1	-	-	-	1	1	2	-	-

MODULE-1	**FORMULATION OF RESEARCH PROBLEM**	**22RMK55.1, 22RMK55.2**	**6 Hours**

Research– Meaning and Objectives – Criteria of Good Research–Problems Encountered by Researchers –Types of Research–Research Approaches-Research Process–Literature Review– Significance of Literature Review–Review of Selected Literature– Research Problem– Identification and Defining the Research Problem.

Text Book	Text Book 1: Ch. 1, 2

MODULE-2	**RESEARCH DESIGN PROCEDURES**	**22RMK55.2, 22RMK55.3**	**6 Hours**

Meaning of Research Design – Need for Research design – Features of a Good Design –Concepts Related to Research Design– Different Research Designs – Basic Principles of Experimental Designs.

Case Study	To find the solution for the given research problem using different types of research methods
Text Book	Text Book 1: Ch. 3

MODULE-3	**INTERPRETATION AND REPORT WRITING**	**22RMK55.4**	**6 Hours**

Meaning and Technique of Interpretation – Precautions in interpretation – Significance of Report Writing – Different Steps in Report Writing – Layout of a Research Report– Types of Report – Mechanics of Writing a Research Report –Conclusion-Referencing in Academic Writing –Bibliography.

Text Book	Text Book 2: Ch. 14

MODULE-4	**INTRODUCTION TO IPR**	**22RMK55.5**	**6 Hours**

Introduction and Significance of Intellectual Property Rights –Types of Intellectual Property Rights– Need for IPR –Rationale for Protection of IPR–IPR in India and Abroad–Forms of IPR – Royalty –

Copyright – Trademark – Patents – Industrial Designs – Trade Secrets – Geographical Indications – Application of Different Forms of IPR– Future Aspects of IPR– Some Examples of IPR.			
Text Book	Text Book 2: Ch. 1 and 2		
MODULE-5	**BASICS OF PATENTS**	**22RMK55.5, 22RMK55.6**	**6 Hours**
Patents and its Basics – Patentable and Non-Patentable Inventions–Patent Application Process (National and International level) – Searching a Patent-Drafting and Filing a Patent –Types of Patent Applications–Patent Documents– Specification and Claims–Assignment, Licensing, Infringement– Different Layers of International Patent System–Some Examples of Patent – forms requirement for patent application with charges			
Case Study	Analyze different domains of filed patents		
Text Book	Text Book 2: Ch. 1 and 2		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Kothari C R, "Research Methodology: Methods and Techniques", New Age International, 2018, ISBN-13: 978-8122436235
2) Ramakrishna Chintakunta, "A Text book of Intellectual Property rights", Blue Hill Publication, ASIN: B09T6YDB5N, 2022

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An Introduction to Research Methodology, RBSA Publishers. 2015, ISBN-13:978-8176111652
2) Ranjith Kumar, Research methodology, Saga publications,4th edition, 2014, ISBN-13- 978-9351501336
3) Sinha, S.C. and Dhiman, A.K., Research Methodology, EssEss Publications. 2 volumes, 2012. ISBN : 81-7000-324-5, 81-7000-334-2
4) Asha Vijay Durafe, Dhanashree K. Toradmalle , Intellectual Property Rights, Dreamtech Press,2020, ISBN:9390395917

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=nv7MOoHMM2k
- https://www.youtube.com/watch?v=BGSgZ1J8-yQ

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video Sessions
- Organizing Group Wise Discussions
- Seminars

CRITICAL AND CREATIVE THINKING SKILLS			
Course Code	**22SDK56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**01**

Course outcomes:

Upon successful completion of this course, the student will be able to:

22SDK56.1	Demonstrate proficiency in solving quantitative aptitude problems using fundamental concepts.
22SDK56.2	Apply advanced quantitative techniques to address and solve complex real-world problems.
22SDK56.3	Develop and enhance logical reasoning skills essential for problem-solving in various competitive examinations.
22SDK56.4	Cultivate critical and creative thinking skills necessary for analytical reasoning and problem-solving.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SDK56.1	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
22SDK56.2	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
22SDK56.3	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
22SDK56.4	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

MODULE-1	**CRITICAL THINKING THROUGH QUANTITATIVE ANALYSIS**	**22SDK56.1 22SDK56.2**	**6 Hours**

Number systems: LCM and HCF of numbers, Squaring and Cubing Techniques, Multiplication Tricks, Divisibility rules, Digit sum method, Speed Math, Simplifications, Approximations.

Percentages: Conversion of Fraction to Percentage Table, Percentage Change, Net percentage change/Effective percentage change, Successive Percentage, Concept of more/less percentage, Percentage of percentage, Product constancy, Increased/decreased by P%, Percentage Changes in Numerator and Denominator, Successive Percentage.

Averages: Basic concept, Consecutive Numbers, Non-Consecutive Numbers, Equation Concept, True/False concept, Including/Excluding concept, Replacement concept, Average Speed concept.

MODULE-2	**NUMERICAL TECHNIQUES FOR PROBLEM SOLVING**	**22SDK56.1 22SDK56.2**	**6 Hours**

Profit and Loss: Basic concept, Profit Percentage, Loss Percentage, Profit/Loss Percentage, Overall Profit/Loss, Dishonest shopkeeper, More/less loss concept.

Discounts: Successive discounts, Buy X and Get Y Free, Profit after allowing discount, True Discount, Difference between percentage profit and percentage discount.

Ratio and Proportion: Concept Explanation, Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratio in investment, Ratio in partnership, Ratio in averages, Ratio in profit and loss, Ratio in interest rates.

Time and Work: Unit work, Combined work, Individual efficiency, Group efficiencies, Time taken by an individual or a group, Work done by an individual or a group, Total work done, Chain Rule Concept, Pipes and Cisterns, 4 Rules of Pipes and Cistern.

MODULE-3	ADVANCED QUANTITATIVE TECHNIQUES	22SDK56.1 22SDK56.2	6 HOURS

Algebra: Simple Arithmetic Operations, Linear equation is one, Two and three variables, Methods of solving linear equations, Methods of solving quadratic equations, Surds and indices, Logarithms.

Series and Progressions: Arithmetic Sequences, Geometric Sequences, Harmonic Sequences, Fibonacci Numbers.

Geometry: Concepts of Angles, Different polygons like triangles, rectangle, square, right-angle triangle, Pythagorean Theorem, Perimeter and Area of Triangle, Rectangle, and circles.

Statistics: Mean, Median, Mode, Standard Deviation, Variance.

MODULE-4	ANALYTICAL REASONING AND CREATIVE PROBLEM SOLVING	22SDK56.3 22SDK56.4	6 Hours

Number Series - Missing numbers, Incomplete series - Odd-even series, primes, Fibonacci series, Arithmetic progression, Geometric progression, Harmonic progression, Squares and cubes, Operations on digits, Exponential series, Increasing multiplication, Hybrid series.

Alphabetical Series- Missing alphabets, incomplete letter series - series of words, series of letters, arrangement of words/letters, letters marked with corresponding numbers sequence, positions of letters, ranking of the word in dictionary; Mixed Series - Missing numbers and words/letters, complete the series.

Analogies: Alphabet Classification, Word Classification, Number Classification.

Coding and Decoding: Coding based on order, Letter to Letter Mapping, Letter to number mapping, Letter to digit mapping, Re-ordering sequences; Word sequencing, Match the word to code, Symbol Coding.

MODULE-5	PROBLEM SOLVING THROUGH LOGICAL ANALYSIS	22SDK56.3 22SDK56.4	6 Hours

Directions: Eight Directions, Distance, Displacement, Starting and ending points, Referential directions, Directions of shadows, Axis based problems, Actual and conditional directions.

Seating Arrangements: Linear arrangement, Square Arrangement, Rectangular Arrangement, Circular arrangement, Vertical arrangement, Seating arrangement in a photograph, Tabular arrangement, Hexagonal Seating Arrangement, Complex arrangement, Miscellaneous arrangements.

Blood Relations: Relations defined, Generation Verticals, Family Tree, Single Person Blood Relations, Mixed/Chain Blood Relations, Symbol based Blood Relation.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution
		Tests
		50
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

ENVIRONMENTAL STUDIES			
CourseCode	**22ESK57**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**1**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

22ESK57.1	Understand the concepts of Environment, ecosystem and biodiversity.
22ESK57.2	Explain the strategies for management of natural resources to achieve sustainability.
22ESK57.3	Analyze the control measures of Environmental pollution and global Environmental issues.
22ESK57.4	Apply the knowledge of Environment Impact Assessment, Technology, Environmental acts and laws in protecting Environment and human health.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO100	PO11	PO12
22ESK57.1	-	-	-	-	-	3	3	-	-	-		-
22ESK57.2	-	-	-	-	-	3	3	-	-	-	-	3
22ESK57.3	-	-	-	-	-	3	3	3	-	3	-	3
22ESK57.4	-	-	-	-	1	3	3	3	-	3	-	3

MODULE 1	**INTRODUCTION TO ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**22ESK57.1**	**3hrs**

Environment: Definition, Components of Environment; Ecosystem: Types & Structure of Ecosystem, Energy flow in the ecosystem; Biodiversity: Types, Hot-spots, Threats and Conservation of biodiversity.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 1 , 3 & 4

MODULE 2	**NATURAL RESOURCES**	**22ESK57.2**	**3hrs**

Advanced Energy resources (Hydrogen, Solar, OTEC, Tidal and Wind), merits and demerits, Water resources – cloud seeding, Mineral resources, Forest resources. Strategies of management, concept of sustainability.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 2

MODULE 3	**ENVIRONMENTAL POLLUTION**	**22ESK57.3**	**3hrs**

Definition, Causes, effects and control measures of Air Pollution, Water Pollution, soil Pollution and Noise pollution. Solid wastes and its management. Role of society, NGO and Govt. agencies in prevention of pollution

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 5,6, Text Book 2: Ch. 5

MODULE 4	**GLOBAL ENVIRONMENTAL ISSUES, ENVIRONMENT ACTS AND AMENDMENTS**	**22ESK57.3**	**3hrs**

Fluoride problem in drinking water, Acid Rain, Ozone layer depletion, Global warming and climate change. National forest policy, Environmental laws and acts. International agreements and protocols.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 6, Text Book 2: Ch. 6

MODULE 5	HUMAN POPULATION AND ENVIRONMENT IMPACT ASSESSMENT	22ESK57.4	3hrs

Population growth & explosion, Population pyramids. Negative impact of agriculture and urbanization, Role of Technology in protecting environment and human health. Environment Impact Assessment.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 7

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	10	5	5
L3	Apply	10	5	5
L4	Analyze		5	-
L5	Evaluate		-	-
L6	Create		-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	15
L2	Understand	15
L3	Apply	20
L4	Analyze	--
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1. "Environmental studies" by Benny Joseph, Tata McGraw Hill Education Private Limited, 2009, ISBN: 9870070648135.
2. "Environmental Studies: Basic Concepts" by Ahluwalia, V. K. The Energy and Resources Institute (TERI) Publication, 2nd edition, 2016. ISBN: 817993571X, 9788179935712.

Reference Books:

1. Handbook of Environmental Engineering by Rao Surampalli, Tian C. Zhang, Satinder Kaur Brar, Krishnamoorthy Hegde, Rama Pulicharla, Mausam Verma; McGraw Hill Professional, 2018. ISBN: 125986023X, 9781259860232
2. Environmental Science and Engineering by P. Venugopala, Prentice Hall of India Pvt. Ltd, New Delhi, 2012 Edition. ISBN: 978-81-203-2893-8.
3. Elements of Environmental Science and Engineering by P. Meenakshi, Prentice Hall of India Pvt. Ltd, 2005 Edition. ISBN: 8120327748, 9788120327740

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/120/108/120108004/
- https://archive.nptel.ac.in/courses/103/107/103107215/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to any company to study the initiative taken for environmental impact.
- Case studybased learning on engineering approaches for pollution prevention.
- Video/ model / chartsbased learning
- Activities/awareness program for preventing environmental pollution

MINI PROJECT -II			
Course Code	**22AIM58**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**-**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

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

22AIM58.1	Understand the technological needs and/or societal needs and sustainability of the environment.
22AIM58.2	Apply practical knowledge and the latest tools usage along with project development.
22AIM58.3	Analyze the outcome of the project.
22AIM58.4	Design applications using Big Data concepts/ techniques.
22AIM58.5	Implement the project and provide solutions within the context of the Legel framework, addressing social concerns and upholding ethical issues.
22AIM58.6	Present the Report for the implemented problem and its solutions as a team.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM58.1	2	-	-	-	-	-	--		-	-	-	-	-	-
22AIM58.2	3	-	-	-	3	-	-	-	-	-	-	-	-	-
22AIM58.3	-	3	-	-	3	-	-	-	-	-	-	-	-	-
22AIM58.4	-	-	3	-	-	-	-	-	-	-	-	3	3	2
22AIM58.5	-	-	-	3	3	2	2	3	3	3	-	3	3	2
22AIM58.6	-	-	-	3	3	-	-	3	3	3	-	3	-	-

Each team capable of identifying a problem and carry out a mini project on the problem defined. A panel of experts will review the code developed towards the project during the course of the semester. Plagiarized projects will automatically get an **"F" GRADE** and the student will be liable for further disciplinary action. At the completion of a project, the team will submit a project report, which will be evaluated by duly appointed examiner(s).

CIE Assessment Pattern (50 Marks)

RBT Levels		Review (50 marks)
		50
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

SEE Assessment Pattern (50 Marks)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

NATIONAL SERVICE SCHEME (NSS)			
Course Code	**22NSS50**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

22NSS50.1	Understand the importance of his / her responsibilities towards society.
22NSS50.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSS50.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
22NSS50.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22NSS50.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSS50.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSS50.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSS50.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 22NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.	22NSS30.1, 22NSS30.2, 22NSS30.3, 22NSS30.4	30 HRS
4TH 22NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	22NSS40.1, 22NSS40.2, 22NSS40.3, 22NSS40.4	30 HRS
5TH 22NSS50	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 HRS
6TH 22NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs).	22NSS60.1, 22NSS60.2,	30 HRS

	11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.3 , 22NSS60.4	

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and principal.
- At last report should be evaluated by the NSS officer of the institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 6th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.

- Practice Session Description:
  - Lecture session by NSS Officer
  - Students Presentation on Topics
  - Presentation - 1, Selection of topic, PHASE – 1
  - Commencement of activity and its progress - PHASE – 2
  - Execution of Activity
  - Case study-based Assessment, Individual performance
  - Sector/ Team wise study and its consolidation
  - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
9.	Spreading public awareness under rural outreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

10.	Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
11.	Govt. school Rejuvenation andhelping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)			
Course Code	**22PED50**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

22PED50.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.
22PED50.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.
22PED50.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PED50.4	Understand the roles and responsibilities of organization and administration of sports and games.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22PED50.1	-	-	-	-	-	2	-	3	3	-	-	2
22PED50.2	-	-	-	-	-	2	-	3	3	-	-	2
22PED50.3	-	-	-	-	-	2	-	3	3	-	-	2
22PED50.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	22PED30.1 , 22PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash D. Agility – Shuttle Run E. Flexibility – Sit and Reach F. Cardiovascular Endurance – Harvard step Test	22PED30.2 , 22PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	22PED30.3 , 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	22PED40.1 , 22PED40.2	5 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw.	22PED40.3	20 HRS

	C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. E. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. F. Athletics (Track / Field Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration	22PED40.4	5 HRS
5TH 22PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	22PED50.1, 22PED50.2, 22PED50.3, 22PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 22PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations)use of Starting Block.	22PED60.1, 22PED60.2,	Total 30 Hrs/ Semester 2 Hrs/week

	• Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body. 7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance- kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. A. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 4. Penalty stroke practice. 5. Penalty corner practice. 6. Tackling: Simple Tackling, Slide Tackling. 7. Goal Keeping, Ball clearance- kicking, and deflecting. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials	22PED60.3 , 22PED60.4	

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15

Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course	**22YOG50**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

22YOG50.1	Understanding the origin, history, aim and objectives of Yoga.
22YOG50.2	Become familiar with an authentic foundation of Yogic practices.
22YOG50.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat.
22YOG50.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22YOG50.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOG50.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOG50.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOG50.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 22YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 22YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	22YOG40.1, 22YOG40.2, 22YOG40.3, 22YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 22YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3round **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation pos 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

4. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
5. Tiwari, O P: Asana Why and How
6. Ajitkumar: Yoga Pravesha (Kannada)
7. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
8. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
9. Nagendra H R: The art and science of Pranayama
10. Tiruka: Shatkriyegalu (Kannada)
11. Iyengar B K S: Yoga Pradipika (Kannada)
12. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- https://youtu.be/KB-TYlgd1wE
- https://youtu.be/aa-TG0Wg1Ls

SEMESTER VI

DEEP LEARNING			
Course Code	**22AIM61**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM61.1	Understand the fundamental principles of deep learning, including neural network architectures and training methods.
22AIM61.2	Apply convolutional neural network (CNN) architectures to image-related tasks for classification, object detection, and segmentation.
22AIM61.3	Analyze the architecture, principle of recurrent neural networks (RNNs), Long Short-Term Memory (LSTM) networks, and Gated Recurrent Units (GRUs).
22AIM61.4	Evaluate the principles and applications of generative adversarial networks (GANs) and variational autoencoders (VAEs).
22AIM61.5	Compare the architectures, applications of transformer networks such as BERT and GPT.
22AIM61.6	Create deep learning models using transfer learning, self-supervised learning techniques for complex problems by leveraging pre-trained models.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM61.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM61.2	3	-	-	-	-	-	-	-	-	-	-	2	3	3
22AIM61.3	-	3	--	-	-	-	-	-	-	-	-	2	3	2
22AIM61.4		3	-	-		-	-	-	-	-	-	2	3	2
22AIM61.5	-	3	3	-	-	-	-	-	-	-	-	2	3	-
22AIM61.6	-	-	3	-	3	-	-	-	-	-	-	2	-	-

MODULE-1	**Fundamentals of Deep Learning**	22AIM61.1	**8 Hours**

Introduction to Deep Learning**,** Applications of Deep Learning. **Feedforward Neural Networks (FNN):** Basics of Neural Networks-Activation Functions-Training Neural Networks: Backpropagation and Gradient Descent. **Deep Learning Frameworks:** TensorFlow, PyTorch.

Text Book	Text Book 1: Ch 8,9 . Textbook 2: Ch:16

MODULE-2	**Convolutional Neural Networks (CNNs) and Applications**	22AIM61.2	**8 Hours**

Convolutional Neural Networks (CNNs): Understanding Convolutional Layers-Pooling Layers and Fully Connected Layers-CNN Architectures (LeNet, AlexNet, VGG, ResNet). Types of CNNs. **Applications of CNNs:** Image Classification-Object Detection-Image Segmentation.

Applications	Online self-service solutions
Text Book	Text Book 1: ch:9 Text Book 2: Ch:10

MODULE-3	**Sequence Modeling with Recurrent Networks**	22AIM61.3	**8 Hours**

Recurrent Neural Networks (RNNs): Introduction to RNNs-Vanishing and Exploding Gradients Problem-Applications of RNNs. **Long Short-Term Memory (LSTM) Networks and Gated Recurrent Units (GRUs):** Architecture of LSTM Networks-GRU vs. LSTM: Comparative Analysis.

Text Book	Text Book 1: Ch10 Text Book:2: Ch 14
Cases Studies	Time Series Prediction with any data set

MODULE-4	**Advanced Generative Models**	22AIM61.4	**8 Hours**

Autoencoders: Autoencoders for feature extraction, classification-Denoising Autoencoders-Sparse Autoencoders. **Generative Adversarial Networks (GANs):** Introduction to GANs-Architecture: Generator and Discriminator-Training GANs and Applications (Image Generation, Style Transfer).

Case Study	Anomaly Detection
Text Book	Text Book 1: Ch 14 Text Book 2: Ch

MODULE-5	Cutting-Edge Techniques in Deep Learning	22AIM61.5, 22AIM61.6	8 Hours

Transformer Networks (BERT, GPT): Understanding the Transformer Architecture-Self-Attention Mechanism-Applications: BERT for NLP, GPT for Text Generation. **Transfer Learning:** Introduction to Transfer Learning-Pre-trained Models and Fine-Tuning-Use Cases: Medical Imaging, Natural Language Processing.

Text Book	Text Book 1: Ch 12 Text Book 2: Ch 11

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	10	5	
L4	Analyze	5	10	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

*Assessments are to be selected from the assessment list attached to **Appendix A.**.

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Ian Good Fellow, YeshuaBengio, Aaron Courville, "Deep Learning", MIT Press,2017. ISBN: 9780262035613, 0262035618
2. AndrewW.Trask," Grokking Deep Learning", Manning Publications ,2019, ISBN:9781617293702

Reference Books:

1. Dive into Deep Learning, Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Amazon Senior Scientists – Open source and Free Book, March 2022. ISBN:

2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt.Ltd, 2009. ISBN: 9788120312531
3. Golub, G., H., and Van Loan, C.F. Matrix Computations, JHU Press,2013. ISBN: 9781421407944

Web links and Video Lectures (e-Resources):

- https://www.bing.com/videos/riverview/relatedvideo?q=deeplearning+NPTEL&mid=5A13C67A49A513994C3D5A13C67A49A513994C3D&FORM=VIRE
- https://www.bing.com/videos/riverview/relatedvideo?q=deeplearning+video&mid=3811B084CCFB62FEF4743811B084CCFB62FEF474&FORM=VIRE

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
  Organizing Group discussions on real-world problems
  Seminars

DEEP LEARNING LAB			
Course Code	**22AIL61**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIL61.1	Apply the various deep learning algorithms in Python.
22AIL61.2	Analyse deep learning models like types of CNNs.
22AIL61.3	Build deep learning models in TensorFlow and interpret the results.
22AIL61.4	Evaluate different deep learning frameworks like Keras, Tensor flow, PyTorch.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL61.1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
22AIL61.2	-	3	-	-	-	-	-	-	-	-	-	3	3	2
22AIL61.3	-	-	3	-	3	-	-	-	-	-	-	3	3	3
22AIL61.4	-	3	-	-	3	-	-	-	-	-	-	2	-	3

Ex. No	Experiments	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basics of Machine learning Concepts and Python Programming	**2**	**NA**
	Part A		
1	Write a python program to implement XOR function using multi-layer Neural Network.	**2**	22AIL61.1 22AIL61.3
2	Write a program to implement 1D CNN for given timeseries data.	**2**	22AIL61.2 22AIL61.3
3	Develop a program for recognizing handwritten digits using Convolutional Neural Network (CNN).	**2**	22AIL61.1 22AIL61.2 22AIL61.3
4	Develop a LSTM-based model for an open-source dataset. Describe the architecture of LSTM model, including the number of LSTM layers, embedding dimensions. Also handle the sequence length variability in input texts.	**2**	22AIL61.1 22AIL61.3 22AIL61.4
5	Write a program to implement the steps to preprocess the images and augment the data for training a UNet model, also do necessary adjustment in the architecture design to handle different datasets. Collect image dataset for performing U-Net segmentation	**2**	22AIL61.1 22AIL61.2 22AIL61.3 22AIL61.4
6	Consider the task of annotating images for autonomous vehicle detection systems. Write a program to implement an approach labeling complex objects such as pedestrians, cyclists, and various types of vehicles using an image labeling tool, also export the annotations in JSON or CSV formats.	**2**	22AIL61.1 22AIL61.2 22AIL61.3 22AIL61.4
	Part B		
7	Experiment different hyperparameter and activation functions to find an optimal solution in the implementation of classifier model for given dataset using 3- layer neural network.	**2**	22AIL61.2
8	Develop a python code to implement Convolution Neural Network, visualize the feature maps generated and generalize the model using regularization.	**2**	22AIL61.3
9	Train two identical neural networks on suitable dataset, one with batch normalization and one without. Compare their	**2**	22AIL61.4

	performance metrics (accuracy, loss curves) on the test set and show the effect of batch normalization and drop out in neural network classifier.		
10	Develop a program for language modeling using RNN.	**2**	22AIL61.3 22AIL61.4
11	Write a program for Text generation using LSTM.	**2**	22AIL61.1 22AIL61.3 22AIL61.4
12	Develop a python code to implement autoencoder and visualize the generated images. Experiment the key hyperparameters learning rate, batch size and number of epochs.	**2**	22AIL61.1 22AIL61.2 22AIL61.3 22AIL61.4

Part C- Virtual Lab

1 Demonstrate the working of Back propagation. https://vlab.spit.ac.in/ai/#/experiments/1

2 YOLO CNN for Object Detection. https://vlab.spit.ac.in/ai/#/experiments/6

3 Handwritten Digit Recognition Using CNN. https://vlab.spit.ac.in/ai/#/experiments/2

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		**Test (s) (20)**	**Weekly Assessment (30)**
L1	**Remember**	**-**	**-**
L2	**Understand**	5	10
L3	**Apply**	**5**	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**		-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	**-**

Reference Books:

1)Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt.Ltd, 2009. ISBN: 9788120312531

2)Golub, G., H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013. ISBN: 9781421407944

BIG DATA & CLOUD TECHNOLOGIES			
Course Code	**22AIM62**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM62.1	Understand basic concepts, principles and paradigm of Cloud Computing and Big Data Technologies.
22AIM62.2	Apply the cloud platform architectures of virtualized data centers and Inter-cloud Resource Management.
22AIM62.3	Evaluate the performance of Iterative processing algorithms using Spark.
22AIM62.4	Design a model for real time problem using MAP REDUCE.
22AIM62.5	Manage the data using Dataframe and RDD concepts.
22AIM62.6	Create a method or model to handle data in cloud environment using big data technologies.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM62.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM62.2	3	-	-	-	-	-	-	-	-	-	-	3	3	2
22AIM62.3	-	3	-	-	-	-	-	-	-	-	-	3	3	2
22AIM62.4	-	-	3	-	-	-	-	-	-	-	-	3	3	2
22AIM62.5	-	-	3	-	3	-	-	-	-	-	-	3	3	2
22AIM62.6	-	-	3		3	-	-	-	-	-	-	3	3	2

MODULE-1	**Introduction to Cloud Computing**	22AIM62.1	**8 Hours**

Defining Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Distributed Systems, Cloud Service Models, Computing Platform and services: AWS, GOOGLE APP ENGINE, MICROSOFT AZURE, FORCE.COM, and ANEKA.

Text Book	Text Book 1: Ch 1 ,2 Text Book 2: Ch 4,9

MOD. LE-2	**Cloud Computing Architecture and Data Intense Computing**	22AIM62.1, 22AIM62.2	**8 Hours**

Types of Cloud, Cloud Interoperability and standards, Scalability and Fault Tolerance. Characterizing Data-Intensive Computations, Technologies for Data-intensive computing, storage systems, programming platforms. Virtualization.

Text Book	Text Book 1: Ch 3. Text Book 2: Ch 3,4,8

MODULE-3	**Introduction to Big Data and Hadoop**	22AIM62.1, 22AIM62.4	**8 Hours**

Introduction to Big Data, Data Storage and Analysis, Comparison with other systems, A brief History of Hadoop, Hadoop Release, Apache Hadoop and Eco Systems, Analyzing Data with Unix systems, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Pipes.

Text Book	Text book 3. Ch 1,2

MODULE-4	**HDFS and MAPREDUCE**	22AIM62.3, 22AIM62.4	**8 Hours**

HDFS Concepts, Hadoop file systems, interfaces, Data flow, Hadoop Archives. Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and sort, Task Execution, Map Reduce Types and Input and Output Formats, Map Reduce features.

Text Book	Text Book 3: Ch 3,6,7

MODULE-5	**Apache Spark**	22AIM62.3, 22AIM62.5, 22AIM62.6	**8 Hours**

Introduction to Apache Spark, Structured APIs: Data Frames, SQL and Data Sets. Low-Level APIs: Resilient Distributed Datasets (RDDs)-Advanced RDDs. Streaming Process fundamentals.

Case Study	Finding the most popular movie using RDD.
Text Book	Text Book 4: Ch 1,2,3, 4-13

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	**15**	**10**
L1	**Remember**	5	**-**	**5**
L2	**Understand**	5	**-**	**5**
L3	**Apply**	10	5	
L4	**Analyze**	5	10	-
L5	**Evaluate**	-	-	**-**
L6	**Create**	**-**	**-**	**-**

*Assessments are to be selected from the assessment list attached to **Appendix A.**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Douglas Comer, "The Cloud computing Book: The future of Computing Explained", 1st Edition by CRC Press, 2021.ISBN: 9781000384284, 1000384284
2. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi, "Mastering Cloud Computing: Foundations and Application Programming", Morgan Kaufmann (Elesiver),2013. ISBN: 9780124114548, 0124114547
3. Tom white, "Hadoop: The Definitive Guide" Third Edition, O'reily Media, 2012.ISBN: 9781449338770, 1449338771
4. Bill Chambers and Matei Zaharia, "Spark: The Definitive Guide" First Edition, O'reily Media,2018 ISBN 9781491912294, 1491912294

Reference Books:

1 Frank Kane," Taming Big Data with Apache Spark and Python", Packt Publishing, 2017. ISBN: 9781787288300

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=2LaAJq1lB1Q
- https://www.educative.io/blog/what-is-big-data
- https://medium.com/@tomhcorbin/understanding-apache-spark-part-1-spark-architecture-21c347bf622b
- https://sparkbyexamples.com/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)

  Organizing Group discussions on real-world problems

  Seminars

BIG DATA & CLOUD TECHNOLOGIES LAB			
Course Code	**22AIL62**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

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

22AIL62.1	Apply the knowledge of cloud computing to Configure virtualization tools Virtual Box, VMware workstation.
22AIL62.2	Design an application on cloud.
22AIL62.3	Develop data applications using Map Reduce Concept.
22AIL62.4	Create applications for Big Data Analytics using Spark.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL62.1	3	-	-	-	-	-	-	-	-	-	-	2	3	-
22AIL62.2		-	3	-	-	-	-	-	-	-	-	2	3	-
22AIL62.3	-	-	3	-	-	-	-	-	-	-	-	2	3	-
22AIL62.4	-	-	3	-	3	-	-	-	-	-	-	2	3	-

Ex. No	Experiments	Hours	COs
	Prerequisite Experiments / Programs / Demo		
a.	Install Virtual box/VMware Workstation with different flavors of Linux or windows OS on top of windows		
b.	Install a C compiler in the virtual machine created using virtual box and execute simple programs.		
c.	Describe a procedure to transfer the files from one virtual machine to another virtual machine		
	Part A		
1.	Deploy any application using cloud infrastructure services.	**2**	22AIL62.1 22AIL62.2
2.	Implement a data processing pipeline using cloud services (e.g., AWS Glue or Google Dataflow): Define data sources (e.g., files in S3 or Google Cloud Storage), set up ETL (Extract, Transform, Load) jobs using serverless services, and monitor job execution and data flow.	**2**	22AIL62.1 22AIL62.2
3.	Use GAE (Google App Engine) launcher to launch any web applications.	**2**	22AIL62.1 22AIL62.2
4.	By Installing Docker desktop and create a container then pull an image into container and then write a HTML program in Visual Studio Code and execute in Docker	**2**	22AIL62.1 22AIL62.2
5.	Implement the following file management tasks using Hadoop: i. Adding files and directories, ii. Retrieving files iii. Deleting files	**2**	22AIL62.3 22AIL62.4
6.	Implement the classic word count program using Hadoop MapReduce: Write Mapper and Reducer classes in Java, compile into a JAR file, upload input text files to HDFS, and run the MapReduce job to count occurrences of each word.	**2**	22AIL62.3 22AIL62.4
	Part B		
7.	Analyze with any standard dataset, to perform the data materialization using Map Reduce Hadoop.	**2**	22AIL62.3 22AIL62.4
8.	Write a program for read CSV file into Data Frame and write Data Frame to CSV file using Spark.	**2**	22AIL62.3 22AIL62.4
9.	Write a program for convert Spark RDD to Data Frame and Dataset.	**2**	22AIL62.3 22AIL62.4

10.	Write a program to read data and write data from/into MongoDB using Spark.	**2**	22AIL62.3 22AIL62.4
11.	Write a program for importing and exporting data from various databases using Spark.	**2**	22AIL62.3 22AIL62.4
12.	Write a program to manage data using Spark (Real-time health dataset).	**2**	22AIL62.3 22AIL62.4

PART-C

Beyond Syllabus/ Virtual Lab Content

- Spark and RDD Program: https://sparkbyexamples.com/spark/spark-rdd-transformations-2/ https://sparkbyexamples.com/pyspark-rdd/ https://www.bing.com/videos/search?q=spark+rdd+experiments+video&view=detail&mid=395879D64250FA3C2B47395879D64250FA3C2B47&FORM=VIRE
- Hive-Program: https://www.bing.com/videos/search?q=video+for+spark+RDD+programs+using+python&&view=detail&mi

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s) (20)	Weekly Assessment (30)
L1	**Remember**	**-**	**5**
L2	**Understand**	5	5
L3	**Apply**	**5**	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**		-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**20**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1) Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015. ISBN: 978-8126579518
2) Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press ,2013. ISBN: 9781466565784
3) Paul Zikopoulos, Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012. ISBN: 9780071808187

ETHICAL CYBER SECURITY			
Course Code	**22AIM63**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM63.1.	Understand the basics of cybercrime, Cyber Law and how to report these crimes through prescribed legal and Govt channels.
22AIM63.2	Apply different prevention methods to protect the system from Hackers/protect data from outsiders using known methods.
22AIM63.3	Analyse the type of attacks and tools to launch the attacks.
22AIM63.4	Evaluate the intrusion technique for its performance to detect intrusion.
22AIM63.5	Develop solution for prevent cyber security attacks.
22AIM63.6	Implement the Basic Ethics by Cyber Security Professionals.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM63.1	2	-	-	-	-	-	-	-	-	-	-	-	-	
22AIM63.2	3	-	-	-	-	--	-	-	-	-	-	3	2	-
22AIM63.3	-	3	-	-	-	-	-	-	-	-	-	3	2	-
22AIM63.4	-	3	-	-	-	-	-	-	-	-	-	3	2	-
22AIM63.5	-	-	3	-	3	-	-	-	-	-	-	3	2	-
22AIM63.6	-	-	3	-	-	3	-	3	-	-	-	3	2	-

MODULE-1	**Introduction to Cyber Security and Cyber Law**	22AIM63.1 22AIM63.2	**8 Hours**

Introduction to Cyber Security –– CIA Triad; Reason for Cyber Crime – Need for Cyber Security. History of Cyber Crime- Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment- Cyber Law-OWASP

Text Book	Text Book1: Ch 2 Text Book 2: Ch 1, 2,6
Case study	Analysis of High-Profile Cyber Security Incidents.

MODULE-2	**Tools and methods used in Cyber crime**	22AIM63.2 22AIM63.3	**8 Hours**

Introduction- Proxy Servers-Phishing- password cracking- keyloggers and spywares-DoS and DDoS attacks-SQL injection and Buffer overflows- Attacks on wireless Networks-Trojan Horses and Backdoors-Social Engineering

Case study	Analysis of Network Security Incidents
Text Book	Text Book 2: Ch 3, 4 Text Book: Ch 2, 5,9

MODULE-3	**Intrusion Detection**	22AIM63.4,22AIM63.5	**8 Hours**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort

Text Book	Text Book 4: Ch 8

MODULE-4	**Intrusion Prevention**	22AIM63.4, 22AIM63.5	**8 Hours**

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products

Case Study	5G Technologies and its security measures.
Text Book	Text Book 4: Ch 9

MODULE-5	**Ethics in Cyber Security**	22AIM63.6	**8 Hours**

Important Ethical issues in Cyber Security-Common ethical challenges for cybersecurity professionals-Best practices in Cyber Security- Ethical framework guide for Cyber Security Professionals.

Text Book	Text book 5: Ch 1,2 Reference Book 1: Ch 1,2,3

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	10	5	
L4	Analyze	5	10	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

*Assessments are to be selected from the assessment list attached to **Appendix A.**.

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021. ISBN: 9781637816431
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011. ISBN: 978-8126521791
3. Kimberly Graves, "CEH Official Certified Ethical Hacker Review Guide", Wiley Publishers, 2007. ISBN: 9780470142356, 0470142359
4. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015.ISBN: 9781292066202
5. Daniel G Graham, "Ethical Hacking: A Hands-on Introduction to Breaking in, 2021. ISBN: 9781718501881, 1718501889.

Reference Books:

1) An Introduction to Cybersecurity Ethics MODULE AUTHOR: Shannon Vallor, Ph.D. William J. Rewak, S.J. Professor of Philosophy, Santa Clara University.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=U_P23SqJaDc
- https://www.upguard.com/blog/cybersecurity-ethics
- https://builtin.com/articles/cybersecurity-tools

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)

  Organizing Group discussions on real-world problems

  Seminars

COMPUTER NETWORKS			
Course Code	**22AIM641**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM641.1	Understand the basic structure of an abstract layered Network protocol model for any Networking environment.
22AIM641.2	Apply the functionality of OSI and TCP/IP reference models.
22AIM641.3	Analyse network layer protocols.
22AIM641.4	Evaluate Architecture for Application layer protocols.
22AIM641.5	Design appropriate protocol for desired communication service.
22AIM641.6	Implement a wide range of protocols to setup cryptography and firewalls.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM641.1	2	-	-	-	-	-	-	-	-	-	-	-	3	-
22AIM641.2	3		-	-	-	-	-	-	-	-	-	-	3	-
22AIM641.3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
22AIM641.4	-	3	-	-	-	-	-	-	-	-	-	-	3	-
22AIM641.5	-	-	3	-	-	-	-	-	-	-	-	-	3	-
22AIM641.6	-	-	3	3	3	-	-	-	-	-	-	-	3	-

MODULE-1	**INTRODUCTION**	22AIM641.1, 22AIM641.2	**8 Hours**
OSI, TCP/IP and other networks models, Network Topologies WAN, LAN, and MAN. Transmission media copper, twisted pair wireless, switching and Multiplexing and De-multiplexing, Networking Devices.			
Text Book	Text Book 1: 2.2,2.4 Text Book 2: 1.4,1.5		
MODULE-2	**DATA LINK LAYER**	22AIM641.1, 22AIM641.2	**8 Hours**
Framing, Error detection and correction, Flow Control. Multiple Access Protocols – Data Link Layer Addressing, ARP, RARP, DHCP, Ethernet standards. Media Access Control Protocols. MAC addresses. Wireless LANS. High Level Data Link Control, Asynchronous Transfer Mode.			
Text Book	Text Book 1:3.10-3.18 Text Book 2: 3.1,3.2,4.1-4.6		
MODULE-3	**NETWORK LAYER**	22AIM641.3	**8 Hours**
Internet Protocol (IP), IPv4 and IPv6, Sub-netting and Super-netting, ICMP, Unicast Routing Protocols: Link State Routing, Distance Vector Routing, Hierarchical Routing, RIP, OSPF, BGP Multicast Routing, Multicast Routing Protocols: DVMRP, MOSPF, CBT, PIM, MBONE, Mobile IP, IPsec.			
Text Book	Text Book 1:20.1-20.4, 21.2, 22.3,22.4		
MODULE-4	**TRANSPORT LAYER**	22AIM641.2, 22AIM641.3, 22AIM641.4	**8 Hours**
Transport Layer Services Connectionless Protocols: UDP, UDP segment, Reliable Data Transfer, Connection-Oriented Protocols: TCP Segment Structure, RTT estimation, Flow Control, Connection Management, Congestion Control, Integrated and Differentiated Services: Intserv– Diffserv.			
Self Study	Session Layer Protocols: RPC, PPTP, SCP, SDP; Function and Design Issues		
Text Book	Text Book 1: 23,24: Text Book 2: 6.1-6.4		
MODULE-5	**APPLICATION LAYER**	22AIM641.2, 22AIM641.3, 22AIM641.5, 22AIM641.6	**8 Hours**
Principles of Network Applications, The Web and HTTP, FTP, Electronic Mail, SMTP, Mail Message Formats and MIME, DNS, Socket Programming with TCP and UDP. Multimedia Networking: Internet Telephony, RTP, RTCP, RTSP. Network Security: Principles of Cryptography, Firewalls, Attacks and Counter measures.			
Case Study	Mentor Introductions and Follow-Up		
Text Book	Text Book 1:25-29, Text Book 2: 7. 1-7.7		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment (s)/NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Data Communications and Networking–Behrouz A. Forouzan, 2013, ISBN: 9780073376226.
2) Computer Networks—Andrew S Tanenbaum, 4thEdition. Pearson,2005, ISBN:8177581651

Reference Books:

1) James F. Kurose and Keith W. Ross, —Computer Networking: A Top-Down Approach Featuring The Internet, Pearson Education, Third edition, 2006. ISBN: 9780131365483
2) An Engineering Approach to Computer Networks-S. Keshav,2nd Edition,1997, Pearson Education. ISBN: 9788131711453

Web links and Video Lectures (e-Resources):

- https://youtu.be/O--rkQNKqls (nptel)
- https://youtu.be/lnU-Zw3NEEQ (nptel)
- https://youtu.be/aP346youQOk (nptel)
- Introduction to TCP/IP Course (YSU) (Coursera)
- https://youtu.be/qiQR5rTSshw (freecodecamp)

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of various networking devices.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare the model for various layers of OSI model.
  - Flipped classroom methodologyVideo demonstration of latest trends in mobility/robotics
  - Contents related activities (Activity-based discussions)
    - Organizing Group wise discussions on Netwok issues
    - Seminars

COMPUTER VISION			
Course Code	**22AIM642**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM642.1	Understand basic knowledge, theories and methods in image processing and computer vision.
22AIM642.2	Apply 2D feature-based image alignment, segmentation and motion estimations.
22AIM642.3	Evaluate the image recognition system using techniques.
22AIM642.4	Construct images using 3D image reconstruction techniques.
22AIM642.5	Develop an innovative system using image rendering.
22AIM642.6	Implement basic and advanced image processing techniques to solve real world problem.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM642.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22AIM642.2	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
22AIM642.3	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22AIM642.4	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
22AIM642.5	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
22AIM642.6	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**

MODULE-1	**INTRODUCTION TO IMAGE FORMATION AND PROCESSING**	22AIM642.1	**8 Hours**
Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.			
Text Book	Text Book 1; Ch 2,3		
MODULE-2	**FEATURE DETECTION, MATCHING AND SEGMENTATION**:	22AIM642.1, 22AIM642.3	**8 Hours**
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.			
Application	. Insurance Technology		
Text Book	Text Book 1: Ch 7		
MODULE-3	**FEATURE-BASED ALIGNMENT & MOTION ESTIMATION**	22AIM642.2, 22AIM642.4	**8 Hours**
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion. Ch 8,9 TB 1			
Case Study	Retail and visual search		
Text Book	Text Book 1: Ch 8,9		
MODULE-4	**3D RECONSTRUCTION**	22AIM642.4	**8 Hours**
Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps.			
Text Book	Text Book 1: Ch 13		
MODULE-5	**IMAGE-BASED RENDERING AND RECOGNITION**	22AIM642.5, 22AIM642.6	**8 Hours**

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

Case Study	Medical use cases for computer vision
Text Book	Text Book 1: Ch 14

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Test (s)	Qualitative Assessment (s)/NPTEL
		25	**25**
L1	**Remember**	5	**-**
L2	**Understand**	5	**5**
L3	**Apply**	10	10
L4	**Analyze**	5	10
L5	**Evaluate**	-	-
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**-**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1) Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022. ISBN: 9783030343729, 3030343723

2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015. ISBN: 013300192X, 9780133001921

Reference Books:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004. ISBN: 9780511184512
2. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012. ISBN: 9780123869081

Web links and Video Lectures (e-Resources):

- https://www.bing.com/videos/riverview/relatedvideo?q=computer%20vision%20videos%20lectures&mid=917C507226BC359F04DE917C507226BC359F04DE&ajaxhist=0
- https://www.bing.com/videos/riverview/relatedvideo?q=computer%20vision%20videos%20lectures&mid=28D3E71B7B5D5408E98D28D3E71B7B5D5408E98D&ajaxhist=0

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of various networking devices.
- Contents related activities (Activity-based discussions)
  - Flipped classroom methodologyVideo demonstration of latest trends in mobility/robotics
  - Contents related activities (Activity-based discussions)
    - Organizing Group wise discussions on issues

EMBEDDED SYSTEMS			
Course Code	**22AIM643**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM643.1	Understand the Fundamentals of embedded computer systems.
22AIM643.2	Apply knowledge about devices and buses used in embedded networking.
22AIM643.3	Analyze the working principle of device driver.
22AIM643.4	Investigate embedded software development process and its testing.
22AIM643.5	Design models using Real time operating systems.
22AIM643.6	Develop an innovative embedded application for real time complex problem.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM643.1	2	-	-	-	-	-	-	-	-	-	-	-	3	-
22AIM643.2	3	-	-	-	-	-	-	-	-	-	-	-		2
22AIM643.3		3	-	-	-	-	-	-	-	-	-	-		3
22AIM643.4		3		-	-	-	-	-	-	-	-	-	2	3
22AIM643.5			3	3	-	-	-	-	-	-	-	3	2	3
22AIM643.6			3	3	3	-	-	-	-	-	-	3	3	3

MODULE-1	**INTRODUCTION TO EMBEDDED SYSTEMS**	22AIM643.1	**8 Hours**

Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Classification of embedded systems

Text Book	Text Book 1: Ch 1

MODULE-2	**DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK**	22AIM643.2	**8 Hours**

IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols

Text Book	Text Book 2: Ch 2

MODULE-3	**DEVICE DRIVERS , INTERRUPTS AND SERVICE MECHANISM**	22AIM643.3	**8 Hours**

I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline

Text Book	Text Book 1: Ch:3

MODULE-4	**REAL-TIME OPERATING SYSTEMS**	22AIM643.4, 22AIM643.5	**8 Hours**

Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software, Debugging Techniques

Text Book	Text Book 1: Ch:6.12

MODULE-5	**EMBEDDED SYSTEM APPLICATION AND**	22AIM643.6	**8 Hours**

	DEVELOPMENT		

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera

Text Book	Text Book 1: Ch 13, Text Book 2: Ch 17

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test	Assessment(s) /NPTEL
		25	**25**
L1	**Remember**	5	
L2	**Understand**	5	**5**
L3	**Apply**	10	**10**
L4	**Analyze**	5	**10**
L5	**Evaluate**	-	**-**
L6	**Create**	-	**-**

*Assessments are to be selected from the assessment list attached to **Appendix A.**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1) Raj Kamal, "Embedded Systems: Architecture, Programming, and Design" 2nd / 3rd edition, Tata McGraw hill-2013.

2) An Embedded Software Primer, David E. Simon, Pearson Education,1999. ISBN: 9780201615692, 020161569X.

Reference Books:

1.Marilyn Wolf, "Computer as Components, Principles of Embedded Computing System Design" 3rd edition, 2012. ISBN: 9780123884428

Web links and Video Lectures (e-Resources):

- https://www.ibm.com/docs/it/rsar/9.5?topic=dm-designing-real-time-embedded-systems-by-using-model
- https://www.youtube.com/watch?v=y9RAhEfLfJs&list=PL90187D2B8F5AC28F

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Online Class using Jeopardy Lab
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to read research topics on Machine Learning
  - Class Presentation.

AUGMENTED AND VIRTUAL REALITY			
Course Code	**22AIM644**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM644.1	Understand the importance of Augmented reality and its applications.
22AIM644.2	Apply the computer vision for Augmented reality.
22AIM644.3	Analyze the importance of Tracking system.
22AIM644.4	Design virtual reality system using computer graphics concepts.
22AIM644.5	Create a augmentd and virtual reality system based on practical knowledge.
22AIM644.6	Implement basic concepts of virtual reality for innovative idea.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2
22AIM644.1	2	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM644.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM644.3		3	-	-	-	-	-	-	-	-	-	-	3	3
22AIM644.4	-	-	3	-	3	-	-	-	-	-	-	-	3	2
22AIM644.5	-	-	3	-	3	-	-	-	-	-	-	-	3	3
22AIM644.6	-	-	3	-	3				2	-		3	3	3

MODULE-1	**Introduction to Augmented Reality**	22AIM644.1, 22AIM644.2	**8 Hours**

What Is Augmented Reality - Defining augmented reality, history ofaugmented reality, Examples, Displays-Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model.

Case Study	**Understanding AR Fundamentals and** investigate visual perception and spatial display model.
Text Book	Text Book 1: 1-28,33-78

MODULE-2	**Tracking**	22AIM644.2, 22AIM644.3	**8 Hours**

Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors,Optical Tracking, Sensor Fusion

Case Study	Explore tracking method along with advantages and limitations, and the choice of tracking technology depends on factors such as the type of AR/VR application, device capabilities, user experience requirements, and environmental conditions.
Text Book	Text Book 1: 85-120

MODULE-3	**Computer Vision for Augmented Reality**	22AIM644.2, 22AIM644.3	**8 Hours**

Marker Tracking, Multiple- Camera Infrared Tracking, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and Mapping, Outdoor Tracking Calibration and Registration-Camera Calibration, Display Calibration, Registration

Case Study	Explore the **learning Image Processing and Analysis.**
Text Book	Text Book 1:121,122,123-190

MODULE-4	**Introduction to Virtual Reality**	22AIM644.4, 22AIM644.5	**8 Hours**

Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Multiple Models of Input and Output Interface in Virtual Reality: Input -Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input,

Case Study	**Investigate and explore Mastering VR Development Skills, Understanding Virtual Reality Fundamentals**.
Text Book	Text Book 2:1-46

MODULE-5	Visual Computation in Virtual Reality	22AIM644.5, 22AIM644.6	8 Hours

Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering. Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object Grasp Development Tools.

Case Study	Survey on Visual Computation and understanding object grasp development tools.
Text Book	Text Book 2:123-195

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s) (25)	Qualitative Assessment (s) /NPTEL
L1	**Remember**		**-**
L2	**Understand**	5	**5**
L3	**Apply**	10	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**-**
L6	**Create**	

Suggested Learning Resources:

Text Books:

1. Augmented Reality: Principles and Practice by Dieter Schmalstieg, Tobias Hollerer,2016. ISBN: 9780133153200, 0133153207
2. Virtual Reality Technology Burdea, G. C. P. Coffet Wiley-IEEE Press 2nd Edition 2003/2006. ISBN: 9780471360896, 0471360899

Reference Books:

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India;First edition (12 October 2016), ISBN-10: 9332578494
2. Developing Virtual Reality Applications, Foundations of Effective Design, Alan Craig WilliamSherman Jeffrey Will Morgan Kaufmann, 2009. ISBN: 9780080959085.

Web links and Video Lectures (e-Resources):

- https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/?v=c86ee0d9d7ed
- https://www.youtube.com/watch?v=04AMaTsXFJU
- https://www.youtube.com/watch?v=UgE6eG95ddw
- https://www.youtube.com/watch?v=UQpTJ_OTZe4

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Contents related activities (Activity-based discussions)
- **AR Scavenger Hunts**: Create scavenger hunts where students use AR-enabled devices to find and interact with virtual objects or landmarks overlaid onto the real-world environment.
- **Simulated Experiments:** Enable students to conduct science experiments or simulations in VR environments where they can manipulate variables, observe outcomes, and learn through hands-on exploration.

- **Collaborative Problem-Solving:** Facilitate collaborative problem-solving activities in VR environments where students work together to solve puzzles, overcome challenges, or complete tasks that require teamwork and communication.
- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Seminars

RANDOMIZED ALGORITHMS			
Course Code	**22AIM645**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM645.1	Understand the fundamental principles of randomized algorithms, including types of randomness and their applications.
22AIM645.2	Analyze the performance and properties of randomized data structures to evaluate their effectiveness in handling dynamic data and optimizing memory usage.
22AIM645.3	Evaluate the accuracy and efficiency of Monte Carlo methods for numerical integration and randomized matrix multiplication, measuring their applicability to solve complex numerical problems.
22AIM645.4	Assess the convergence properties and sampling efficiency of Markov Chain Monte Carlo (MCMC) methods to critique their performance in generating representative samples and exploring complex state spaces.
22AIM645.5	Design heuristic optimization solutions using metaheuristic algorithms to create effective strategies to address optimization problems in diverse domains.
22AIM645.6	Synthesize knowledge from modules to answer real-world problems using randomized algorithms.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM645.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM645.2	-	3	-	-	-	-	-	-	-	-	-	2	3	2
22AIM645.3	-	3		-	-	-	-	-	-	-	-	3	3	2
22AIM645.4	-	3	-	-	-	-	-	-	-	-	-	3	3	2
22AIM645.5	-	-	3	-		-	-	-	-	--	-	3	3	2
22AIM645.6	-	-	3	3	3	-	-	-	-	-	-	3	3	2

MODULE-1	**Introduction to Randomized Algorithms**	22AIM645.1	**8 Hours**

Introduction to Randomized Algorithms: Definition and importance of randomized algorithms-Types of randomness: Las Vegas vs. Monte Carlo algorithms -Applications of randomized algorithms. **Data Structures with Randomization:** Skip Lists: structure, operations, and performance -Treaps: structure, operations, and balancing properties.

Text Book	Text Book 2: Ch 1, 8
Case study	Classification and its Applications

MODULE-2	**Randomized Data Structures and Graph Algorithms**	22AIM645.1 22AIM645.2	**8 Hours**

Hashing and Bloom Filters: Bloom Filters: structure, operations, and false positive probability-Cuckoo Hashing: algorithm, analysis, and practical applications. **Randomized Graph Algorithms:** Randomized Minimum Spanning Tree (MST): algorithms and applications -Randomized Graph Traversal: techniques and performance analysis.

Text Book	Text Book 2: Ch 10 Text Book 1: Ch 5, 10

MODULE-3	**Monte Carlo Method**	22AIM645.3 22AIM645.4	**8 Hours**

Monte Carlo Method- Randomized Matrix Multiplication. **Approximate Counting**: Randomized Approximation Schemes- The DNF Counting Problem: The Naïve Approach- A fully Polynomial Randomized Scheme for DNF Counting -Approximating the permanent -Volume Estimation.

Text Book	Text Book 1: Ch 10 ,11

MODULE-4	**Marko Chain Monte Carlo Methods**	22AIM645.4	**8 Hours**

Markov Chain Monte Carlo (MCMC)- Introduction to MCMC: basic concepts -The Metropolis Algorithm – A 2-SAT Example- Marko Chains-Random Walks on Graphs: algorithms and applications in network analysis.

Text Book	Text Book 2: Ch 6		
MODULE-5	**Advance Algorithms**	22AIM645.5 22AIM645.6	**8 Hours**

Parallel and Distributed Algorithms: PRAM Model- Maximal Independent Sets- Perfect Matching-The Choice Coordination Problem- byzantine Agreement. Online Algorithms: The online paging Problem- Adversary Models- Paging against an Oblivious Adversary- The k-server Problem.

Case Study	Packing items into a container in a way that minimize transportation cost.
Text Book	Text Book 2: 12,13.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment (s)/NPTEL
		25	**25**
L1	**Remember**	-	**-**
L2	**Understand**	5	**5**
L3	**Apply**	10	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**	**-**	**-**

*Assessments are to be selected from the assessment list attached to **Appendix A.**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	10
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Probability and Computing: Randomization and Probabilistic Techniques in Algorithms and Data Analysis by Eli Upfal and Michael Mitzenmacher, Cambridge University,2005 (ISBN: 0521 83540 2)
2. "Randomized Algorithms" by Rajeev Motwani and Prabhakar Raghavan, Cambridge University Press,2000. ISBN: 0521 47465 5.

Reference Books:

1. Algorithm Design By Jon Kleinberg, Éva Tardos , Pearson Education,2006. ISBN: 9788131703106

Web links and Video Lectures (e-Resources):

- https://www.kindsonthegenius.com/how-bloom-filters-work/
- https://archive.nptel.ac.in/courses/106/103/106103187/
- https://www.youtube.com/watch?v=0r2D32esF3Y
- https://brilliant.org/wiki/randomized-algorithms-overview/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
  Organizing Group discussions on real-world problems
  Seminars

PROJECT PHASE I			
Course Code	**22AIM65**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**-**	**Total Marks**	**100**
Credits	**2**	**Exam Hours**	**03**

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

22AIM65.1	Identify a real life/engineering problem, utilize prior knowledge and conduct extensive investigation, across diverse sources, in addressing the solution.
22AIM65.2	Applying the software engineering principles in planning, formulating an innovative design/ approach, and computing the requirements.
22AIM65.3	Perform professionally—as a team member, accepting responsibility, taking initiative, and providing the leadership necessary to ensure project success.
22AIM65.4	Use formal and informal communications with team members and guide, make presentations and prepare technical documents.
22AIM65.5	Provide a solution within the legal framework addressing societal and environmental concerns and upholding ethical issues.
22AIM65.6	Present the Report for the implemented problem and its solutions as a team.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM65.1	3	3										3	3	3
22AIM65.2		3	3		3							3	3	3
22AIM65.3						2	2	2	3	2		2	3	3
22AIM65.4					3	2	2	2	3	3	3	2	3	3
22AIM65.5						3	3	3	3	2	2	2	3	3
22AIM65.6					3	-	-	2	2	2	-	3	-	-

This course will be conducted largely as group of 2-4student members under the direct supervision of a member of academic staff.

Students will be required to

1. Students should form teams to carry out the project. The size of the teams can comprise of a minimum of two students and maximum of four students.
2. Each team are free to choose their Internal Guide or will be assigned an Internal Guide by the Department Coordinator.
3. Teams can carry out their project in-house or in a reputed organization (which has to be approved by the Internal Guide). Students taking up industry projects can do so with the condition that they are allowed to demonstrate their project work on the college campus.
4. Identification of a problem which is feasible and innovative based on the current state of art technology and having relevance and social impact, considering the boundaries of societal, environmental and ethical issues.
5. Survey of literature related to the identified problem to make a feasibility study and identify the project requirements. Prepare and submit a synopsis of your project to your respective Guides.
6. Based on the literature review, preparation of review paper and publishing it.
7. Evolve a high-level design/system level architecture and identify the various implementable modules with their input/output needs.
8. Preparation and submission of Project Phase1 technical report.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Review (50 marks)
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

PROBLEM SOLVING SKILLS			
Course Code	**22SDK66**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**1**

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

22SDK66.1	Infer the complex problems using the concepts of data structures and C programming.
22SDK66.2	Apply object-oriented programming concepts in C++and Java to solve real time problem statements.
22SDK66.3	Solve real-world problem using python and C#.
22SDK66.4	Develop the skills of handling data base queries and procedures.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SDK66.1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.4	3	3	3	2	2	-	-	-	-	-	-	2	2	2

MODULE-1	PROBLEM SOLVING ON DATA STRUCTURES AND C	22SDK66.I	6 Hours

Data Structures using C: Stack and queues, list, graph, tree, sorting and searching, Hash functions
Advanced C programming: Pointers, Recursion, Functions, Structure, Union, C Preprocessor

MODULE-2	PROBLEM SOLVING ON OBJECT ORIENTED PROGRAMMING USING CPP	22SDK66.2	6 Hours

Object Oriented Programming: Inheritance, Polymorphism, Exception handling, File Handling, Predefined function, Void function, Name spaces, Input and output streams.

MODULE-3	PROBLEM SOLVING ON JAVA AND XML	22SDK66.2	6 Hours

Object oriented programming using Java: Inheritance, Polymorphism, Abstract class and Interface, Collections, Exception handling, Streams, Functional Interface.
XML: DTD, Schema, Server Path, DOM, XSLT, Name Space, AJAX.

MODULE-4	PROBLEM SOLVING USING C # AND PYTHON	22SDK66.3	6 Hours

Python: Functions, iterators, Object oriented Programming, Exception Handling, Packages, Frame works-Django, Collections.
C#: Object oriented Programming, Delegate, Collections and generic, Name space.

MODULE-5	SCENARIO BASED PROBLEMS ON DBMS	22SDK66.4	6 Hours

ER Model, SQL- DDL, DML, TCL, DCL, Joins, subquery, PL/SQL-Index, Sequence, procedures and functions, normalization, B tree, B+ tree, Forms.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)
		50
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Martin C Brown, "Python-The Complete Reference", Mc Graw Hill, 4th edition, 2020
2. Reema Tharega, "Data Structures using C", Oxford University Press, 2020
3. Ullakirch-Prinz, "A complete guide to program in C++", Jonas and Bartlett Learning, 2022
4. Kathy Sierra, "Headfirst Java", O'reilly Media, 2021
5. Andrew Stellman, "Headfirst C#", O'reilly Media, 2021

Web links and Video Lectures (e-Resources):

1. **https://www.learncpp.com/**
2. **https://www.programiz.com/dsa**
3. **https://code.visualstudio.com/Docs/languages/csharp**
4. **https://www.udemy.com/course/the-complete-java-course-from-basics-to-advanced/?couponCode=ST16MT70224**
5. **https://www.codecademy.com/learn/paths/c**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Analysis of industry relevant use cases
- Problem solving on scenario-based questions
- Placement portal practice sessions

AI POWRED UI DESIGN			
Course Code	**22AIM671**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIM671.1	Understand UI/UX Design Fundamentals.
22AIM671.2	Apply the user Interfaces to different devices and requirements.
22AIM671.3	Design interface for various applications.
22AIM671.4	Create high quality professional documents and artifacts related to the design process.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM671.1	2	-	-	-	--	-	-	-	-	-	-	-	-	-
22AIM671.2	3	-	-	-	-	-	-	-	-	-	-	2	-	2
22AIM671.3	-	-	3	-	-	-	-	-	-	-	-	2	-	2
22AIM671.4	-	-	3	3	3	-	-	-	-	-	-	2	-	2

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• **Knowledge about any Design Tools**	2	NA
	PART-A		
1	Write a program for various UI Interaction Patterns	2	22AIM671.1
2	Build an interface with proper UI Style Guides	2	22AIM671.2
3	Develop a Responsive layout for a societal application	2	22AIM671.3
4	Develop Wire flow diagram for application using open source software	2	22AIM671.3
5	Design a Logo for an E-Commerce app	2	22AIM671.3
6	Design Social media advertisement using online tools and applications	2	22AIM671.3
	PART-B		
7	Write program to solve the identified problem using UI/UX.	2	22AIM671.4
8	Create a working UI/UX prototype using prototyping tools.	2	22AIM671.4
9	Create a set of icons for a weather forecast app, considering factors such as clarity, consistency, and visual hierarchy.	2	22AIM671.4
10	Create a design System for an e-commerce app using Grid and Spacing, Typography, Colour System, and UI elements like icons, images, buttons, Inputs, Cards, Search Bar, Lists, etc.	2	22AIM671.4
11	Creating Social media advertisement using online tools and applications.	2	22AIM671.4
12	Conduct end to end user research for UI/UX design programming	2	22AIM671.4

PART-C

Beyond Syllabus /Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

1. Online UX design tools and tutorials: https://www.figma.com
2. free code camp on UI and UX design: https://www.freecodecamp.org/news/ui-ux-design-tutorial-from-zero-to-hero-with-wireframe-prototype-figma/
3. A Complete Roadmap of UI and UX design: https://www.geeksforgeeks.org/how-to-becoma-ui-ux-designer-a-complete-roadmap/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	**Remember**	**-**	**5**
L2	**Understand**	5	10
L3	**Apply**	10	10
L4	**Analyze**	5	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1. Visual Design: Creating Great UI/UX by Shaan,2023.

API & MICROSERVICES			
Course Code	**22AIM672**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIM672.1	Design RESTful APIs using Node.js including secure endpoints using JWT.
22AIM672.2	Manage databases with their APIs, performing CRUD operations and using environment variables for configuration
22AIM672.3	Deploy microservices using Docker and Docker Compose, and implement service discovery with Consul
22AIM672.4	Monitor microservices using the ELK stack for centralized logging and Hystrix for the circuit breaker pattern.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM672.1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
22AIM672.2	-	3	-	-	-	--	-	-	-	--	-	--	-	-
22AIM672.3	-	-	3	-	-	-	--	-	-	-	-	-	--	--
22AIM672.4	-	3	-	-	3	-	-	-	-	-	-	-	-	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic Java Programming/C Programming	2	NA
	PART-A		
1	**Building a RESTful API**: - Create a simple RESTful API using Node.js and Express. (T**asks**: Set up the project, define routes, implement CRUD operations for a resource (e.g., a to-do list), and test the API using Postman.)	2	22AIM672.1
2	**Securing APIs with JWT**: - Implement authentication and authorization using JSON Web Tokens (JWT). (**Tasks**: Create a user authentication system, generate and validate JWTs, protect routes using middleware, and test secured endpoints.).	2	22AIM672.1
3	**Connecting to a Database**: - Integrate a database (e.g., MongoDB or PostgreSQL) with your API. (**Tasks**: Set up the database connection, define models/schemas, perform CRUD operations on the database, and use environment variables for configuration.)	2	22AIM672.2
4	**API Documentation with Swagger**: - Generate and document API endpoints using Swagger.(T**asks**: Install Swagger, annotate API routes, generate interactive API documentation, and explore the documentation through the Swagger UI.).	2	22AIM672.2
5	**Building a GraphQL API**: - Create a GraphQL API to manage a set of resources (e.g., a book library). (**Tasks**: Set up a GraphQL server, define schemas and resolvers, implement queries and mutations, and test using GraphiQL or Apollo Client.).	2	22AIM672.3
6	**Microservices Architecture with Docker**: - Containerize multiple microservices using Docker. (**Tasks**: Create Dockerfiles for each service, build and run containers, set up Docker Compose	2	22AIM672.3

	for multi-container applications, and manage inter-service communication.).		
PART-B			
7	Consul. (**Tasks**: Set up Consul, register services, query service instances, and implement load balancing using Consul's DNS interface.).	2	22AIM672.3
8	**API Gateway with NGINX**: - Configure NGINX as an API Gateway to route requests to different microservices. (**Tasks**: Install and configure NGINX, define routing rules, implement rate limiting and caching, and test the API gateway functionality.).	2	22AIM672.3
9	**Monitoring and Logging with ELK Stack**: - Set up centralized logging and monitoring for microservices using the ELK stack (Elasticsearch, Logstash, Kibana). (**Tasks**: Install and configure ELK components, collect logs from microservices, visualize logs in Kibana, and set up basic monitoring dashboards.).	2	22AIM672.4
10	**Circuit Breaker Pattern with Hystrix**: - Implement the circuit breaker pattern to handle service failures gracefully using Hystrix. (**Tasks**: Set up Hystrix in your microservices, configure circuit breakers, simulate service failures, and observe the fallback mechanisms.).	2	22AIM672.4

PART-C

Beyond Syllabus /Virtual Lab Content

- https://kinsta.com/blog/microservices-vs-api/
- https://ninetailed.io/blog/microservices-vs-api/
- https://cloud.google.com/architecture/microservices-architecture-introduction

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	**Remember**	**-**	**-**
L2	**Understand**	-	10
L3	**Apply**	10	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books: 1 Microservices Patterns: With examples in Java" by Chris Richardson, Manning Publications,2018. ISBN 978-1617294549

WEB FRAMEWORK			
Course Code	**22AIM673**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIM673.1	Understand basics aspects of web framework.
22AIM673.2	Apply the basic concepts, principles and practices of Web-site development using server-side technologies (Django and Node JS).
22AIM673.3	Create the web application using Django and Node JS and mange its features.
22AIM673.4	Design a method for backup the site or application.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM673.1	2	-	-	-	-	-	-	-	-	-	-	2	2	-
22AIM673.2	3	-	-	-	-	-	-	-	-	-	-	2	2	-
22AIM673.3	-	-	3	-	3	-	-	-	-	-	-	2	2	-
22AIM673.4	-	-	3	-	3	-	-	-	-	-	-	2	2	-

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	Basic of Python, HTML, CSS and Javascript	**2**	**NA**
	PART-A		
1	Set up a new Django project. Create a new app within the project called books. Configure the project settings and set up the initial database (SQLite). Create a simple homepage view. **Note:** Create Virtual environment, Create Django project, App, Django views, URLs	**2**	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
2	Define models for Book, Author, and Publisher. Register these models in the Django admin site. Add some initial data via the admin interface. **Note:** Django Admin tool, Models, models registration, create user	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
3	Create views to list all books and display book details. Create templates for these views. Use Django's template language to display data	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
4	Create a form to add new books. Validate and process form data in views. Create a template for the form and handle form submissions. **Note:** Django Forms	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
5	Add static files (CSS, JavaScript) to the project. Use Bootstrap to style the templates. Enhance the user interface with basic styling. **Note:** Django static files	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
6	Implement user registration and login functionality. Use Django's built-in authentication system. Create templates for registration and login.	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
	PART-B		
7	Create a shopping cart model and views. Allow users to add and remove books from the cart. Display the cart contents and calculate the total price.	**2**	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
8	Set up Django Rest Framework (DRF) in the project. Create API endpoints for listing books and retrieving book details. Serialize the Book model for API responses. **Note:** Django REST framework	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4

9	Set up a Node.js project and create a simple Express server. Create an endpoint in Node.js to fetch book data from the Django API. Display the fetched data on a separate Node.js frontend. **Note:** NodeJS basics	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
10	Implement communication between the Django backend and Node.js service. Fetch data from Node.js service within the Django application. Display data fetched from Node.js in Django templates	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
11	Write unit tests for Django views and models. Write tests for the Node.js service. Debug and fix any issues in the application. **Note:** Django testing framework	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4
12	Deploy the Django application to a web server. Deploy the Node.js service to an application server. Ensure both services are running and communicating in the deployed environment.	2	22AIM673.1 22AIM673.2 22AIM673.3 22AIM673.4

PART-C

Beyond Syllabus/ Virtual Lab Content

- https://www.sencha.com/blog/a-comprehensive-guide-to-web-application-frameworks/
- https://developer.mozilla.org/en-US/docs/Learn/Tools_and_testing/Client-side_JavaScript_frameworks/Introduction

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		Test(s) - 20 marks	Weekly Assessments - (30) marks
L1	**Remember**	**-**	**-**
L2	**Understand**	05	10
L3	**Apply**	05	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**	-	

SEE Assessment Pattern (50 Marks–Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Weblinks and Video Lectures(e-Resources):

- https://youtu.be/Rp5vd34d-z4?si=AA5p_c-DKmNjxUMM
- https://www.coursera.org/learn/django-build-web-apps?specialization=django
- https://www.bing.com/videos/riverview/relatedvideo?q=nodeJS+videw&mid=4C29789F60B0A74FF8664C29789F60B0A74FF866&FORM=VIRE

Reference Books:

1. Web Development with Django, by Ben Shaw, Saurabh Badhwar, Andrew Bird,2021. ISBN: 9781839213779, 1839213779
2. Django for Beginners: Build Websites with Python and Django, by William S Vincent,2020. ISBN: 9781735467207, 1735467200.

MOBILE APP DEVELOPMENT			
Course Code	**22AIM674**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIM674.1	Build an application using Flutter development environment.
22AIM674.2	Experiment with the method of storing, sharing and retrieving the data in Applications.
22AIM674.3	Examine responsive user interface across wide range of devices.
22AIM674.4	Develop a mobile Application by using various components like activity, views, services, content providers and receivers.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM674.1	-	-	3	-	-	-	-	-	-	-	-	2	3	-
22AIM674.2	-	3	-	-	-	-	-	-	-	-	-	2	2	-
22AIM674.3	-	3	-	-	3	-	-	-	-	-	-	2	2	-
22AIM674.4	-	-	3	-	3		-	-	-	-	-	2	2	-

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	Basic of HTML, CSS, and JavaScript	**2**	**NA**
	PART-A		
1	Create a new Flutter project named task_manager. Run the default Flutter app and familiarize yourself with the project structure. **Note:** Introduction to Flutter, Dart, architecture, create project	**2**	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
2	Create a home screen with a simple app bar and a floating action button (FAB) to add new tasks. Implement navigation to a new screen for adding tasks when the FAB is pressed. **Note:** UI Components, Routings	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
3	Define a Task class with properties like title, description, and dueDate. Create a form on the add task screen to input these details and save the task in a local list. **Note:** Forms	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
4	Retrieve the list of tasks and display them in a ListView on the home screen. Show basic information like task title and due date in the list items. **Note:** UI Components	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
5	Use a package like shared_preferences or hive to store the list of tasks. Save tasks to persistent storage when they are added, and load them when the app starts. **Note:** Connect to DB, Persist data into DB, Connect to DB and Get data	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
6	Implement navigation from the task list to a task details screen when a task is tapped. Display full task details on the task details screen.	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
	PART-B		
7	Add an edit button on the task details screen. Implement the functionality to edit the task and save the changes to persistent storage.	**2**	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
8	Add a delete button on the task details screen. Implement the functionality to delete the task and remove it from persistent storage.	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4

9	Add a checkbox to each task item to mark it as complete. Implement filtering options to show all tasks, only incomplete tasks, or only completed tasks	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
10	Use a package like firebase_auth to add user authentication to the app. Implement login and registration screens and ensure that only authenticated users can access the task manager features. **Note:** Use of firebase auth package	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
11	Use a package like flutter_local_notifications to schedule notifications for task due dates. Allow users to set reminders for tasks and receive notifications at the specified times. **Note:** local notification	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4
12	Write unit and widget tests for the app's functionality. Prepare the app for deployment by creating app icons, splash screens, and handling platform-specific requirements. Deploy the app to the Google Play Store and/or Apple App Store. **Note:** Flutter automated unit testing	2	22AIM674.1 22AIM674.2 22AIM674.3 22AIM674.4

PART-C

Beyond Syllabus/ Virtual Lab Content

- https://www.tutorialspoint.com/flutter/flutter_tutorial.pdf
- https://www.tutorialkart.com/pdf/flutter.pdf

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		Test(s) - 20 marks	Weekly Assessments - (30) marks
L1	**Remember**	**-**	**-**
L2	**Understand**	05	10
L3	**Apply**	05	10
L4	**Analyze**	10	10
L5	**Evaluate**	-	-
L6	**Create**	-	

SEE Assessment Pattern (50 Marks–Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1. Ultimate Flutter Handbook: Learn Cross-Platform App Development with Visually Stunning UIs and Real-World Projects, by Lahiru Rajeendra Mahagamage, 2023. ISBN: 978-9388590860
2. Flutter & Dart: Up & Running: Build native apps for both iOS and Android using a single codebase, by Deepti Chopra, Roopal Khurana,2023. ISBN: 978-9355513816
3. Flutter for Beginners, by Alessandro Biessek, Packt Publishing, 2021. ISBN: 978-1800565999

Weblinks and Video Lectures(e-Resources):

- https://alison.com/course/introduction-to-mobile-app-development-with-flutter
- https://youtu.be/F3JuuYuOUK4?si=nn81DgwP5htUsM-E
- https://alison.com/topic/learn/125818/getting-started-with-flutter-learning-outcomes.

SOFTWARE TESTING AND QUALITY ASSURANCE PROGRAMS			
Course Code	**22AIM675**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIM675.1	Analyze security testing tools (e.g., Acunetix) in term of the security posture of a software application.
22AIM675.2	Evalure functional testing tools (e.g., SoapUI, Postman), API testing principles and behavior of a software application.
22AIM675.3	Design an effective test strategy using industry-standard tools (e.g., Jira, TestRail) for various functionalities.
22AIM675.4	Improve the software application development skills using usability testing tools (e.g., Hotjar).

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM675.1	-	3	-	-	-	-	-	-	-	-	-	-	2	-
22AIM675.2	-	3	-	-	-	-	-	-	-	-	-	-	2	-
22AIM675.3	-	-	3	-	3	-	-	-	-	-	-	-	2	-
22AIM675.4	3	-	-	-	3	-	-	-	-	-	-	-	2	-

Exp. No. /	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• **Introduction about the Testing Tools**	2	NA
	PART-A		
1	Use Test Case Management Tools. Function: Organize, create, and manage test cases. Tools: Jira, TestRail, Zephyr	2	22AIM675.1
2	Use Test Automation Tools Implementation Function: Automate repetitive test cases for efficiency. Tools: Selenium, Cypress, Appium	2	22AIM675.1
3	Use Functional Testing Tools Implementation Function: Test core functionalities of the software application according to requirements. Tools: SoapUI, Postman, Rest Assured	2	22AIM675.1
4	Use API Testing Tools Implementation Function: Test Application Programming Interfaces (APIs) for functionality, security, and performance. Tools: Same as Functional Testing Tools (SoapUI, Postman, Rest Assured)	2	22AIM675.1
5	Use Performance Testing Tools Implementation Function: Evaluate the performance of the software under load, including speed, scalability, and stability. Tools: LoadRunner, JMeter, K6	2	22AIM675.1
6	Use Security Testing Tools Implementation Function: Identify vulnerabilities and security risks in the software. Tools: Acunetix, Netsparker, Burp Suite	2	22AIM675.2
	PART-B		
7	Use Mobile Testing Tools Implementation Function: Test mobile applications for functionality, usability, and performance on different devices and platforms. Tools: Appium (mentioned in Test Automation Tools),Robotium, Espresso	2	22AIM675.3
8	Use Web Usability Testing Tools	2	22AIM675.4

	Implementation Function: Evaluate the user experience and identify usability issues. Tools: Crazy Egg, Hotjar, UserTesting		
9	Use Test Data Management Tools Implementation Function: Manage and generate test data for testing purposes. Tools: Test Data Manager (TDM), Aequitas, Sqldata	2	22AIM675.4
10	Use Bug Tracking Tools. Implementation Function: Track and manage bugs (software defects) identified during testing. Tools: Jira (mentioned in Test Case Management Tools),Bugzilla, GitHub	2	22AIM675.4
11	Use Version Control Systems Implementation Function: Track changes to code and enable collaboration among developers. Tools: Git, Subversion, Mercurial	2	22AIM675.4
12	Use Project Management Tools. Implementation function: Manage software development projects, including tasks, deadlines, and communication. Tools: bJira (mentioned in Test Case Management Tools),Asana, Trello	2	22AIM675.4

PART-C

Beyond Syllabus /Virtual Lab Content

https://www.bing.com/videos/riverview/relatedvideo?&q=SOFTWARE+TESTING+AND+QUALITY+ASSURANCE+PROGRAMS+video+and+notes&qpvt=SOFTWARE+TESTING+AND+QUALITY+ASSURANCE+PROGRAMS+video+and+notes&mid=64EDFFD82E656FB1FE0164EDFFD82E656FB1FE01&&FORM=VRDGAR

https://www.bing.com/videos/riverview/relatedvideo?&q=SOFTWARE+TESTING+AND+QUALITY+ASSURANCE+PROGRAMS+video+and+notes&qpvt=SOFTWARE+TESTING+AND+QUALITY+ASSURANCE+PROGRAMS+video+and+notes&mid=8457EA03C6FC178E34428457EA03C6FC178E3442&&FORM=VRDGAR

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s) (20)	Weekly Assessment (30)
L1	**Remember**	**-**	**-**
L2	**Understand**	5	10
L3	**Apply**	10	10
L4	**Analyze**	5	10
L5	**Evaluate**		
L6	**Create**	-	

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	
L6	**Create**	

Suggested Learning Resources:

Reference Books:

1. Software Testing and Quality Assurance Paperback, by Deepak Gupta Rishabh Anand, Tariq Hussain Sheikh, 2016, Publisher : Bhavya Books; First 2016 edition ,2016, ISBN-13 : 978-9383992201.

NATIONAL SERVICE SCHEME (NSS)			
Course Code	**22NSS60**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

22NSS60.1	Understand the importance of his / her responsibilities towards society.
22NSS60.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSS60.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
22NSS60.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22NSS60.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSS60.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSS60.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSS60.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 22NSS30	12. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 13. Waste management–Public, Private and Govt organization, 5R's. 14. Setting of the information imparting club for women leading to contribution in social and economic issues.	22NSS30.1, 22NSS30.2, 22NSS30.3, 22NSS30.4	30 HRS
4TH 22NSS40	15. Water conservation techniques – Role of different stakeholders– Implementation. 16. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 17. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	22NSS40.1, 22NSS40.2, 22NSS40.3, 22NSS40.4	30 HRS
5TH 22NSS50	18. Developing Sustainable Water management system for rural areas and implementationapproaches. 19. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 20. Spreading public awareness under rural outreach programs. (minimum 5 programs).	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 HRS

6TH 22NSS60	21. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 22. Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.1 , 22NSS60.2 , 22NSS60.3 , 22NSS60.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and principal.
- At last report should be evaluated by the NSS officer of the institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

13. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
14. Government of Karnataka, NSS cell, activities reports and its manual.
15. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

4. Students should have a service-oriented mindset and social concern.
5. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
6. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 6th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

9.	Spreading public awareness under rural outreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
11.	Govt. school Rejuvenation andhelping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)			
Course Code	**22PED60**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

22PED60.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.
22PED60.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.
22PED60.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PED60.4	Understand the roles and responsibilities of organization and administration of sports and games.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22PED60.1	-	-	-	-	-	2	-	3	3	-	-	2
22PED60.2	-	-	-	-	-	2	-	3	3	-	-	2
22PED60.3	-	-	-	-	-	2	-	3	3	-	-	2
22PED60.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** F. Lifestyle, G. Fitness H. Food & Nutrition I. Health & Wellness J. Pre-Fitness test.	22PED30.1, 22PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness G. Warming up (Free Hand exercises) H. Strength – Push-up / Pull-ups I. Speed – 30 Mtr Dash J. Agility – Shuttle Run K. Flexibility – Sit and Reach L. Cardiovascular Endurance – Harvard step Test	22PED30.2, 22PED30.3	15 HRS
	Module 3: Recreational Activities E. Postural deformities. F. Stress management. G. Aerobics. H. Traditional Games.	22PED30.3, 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** C. Ethics in Sports D. Moral Values in Sports and Games	22PED40.1, 22PED40.2	5 HRS
	Module 2: Specific Games (Anyone to be selected by the student)	22PED40.3	20 HRS

	G. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. H. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. I. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. J. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. K. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. L. Athletics (Track / Field Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration	22PED40.4	5 HRS
5TH 22PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 4. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 5. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 6. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** B. Fundamental Skills 7. Catching, Throwing and Ball control, 8. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 9. Dribbling: High and low. 10. Attack and counter attack, simple counter attack, counter attack from two wings and center. 11. Blocking, Goal Keeping and Defensive skills. 12. Game practice with application of Rules and Regulations. C. Rules and their interpretations and duties of officials **Ball badminton:** B. Fundamental Skills 5. Basic Knowledge: Various parts of the Racket and Grip. 6. Service: Short service, Long service, Long-high service. 7. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	22PED50.1, 22PED50.2, 22PED50.3, 22PED50.4	Total 30 Hrs/ Semester 2 Hrs/week

6TH 22PED60	**Athletics**: 4. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations)use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 5. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 6. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 10. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 11. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 12. Heading: In standing, running and jumping condition. 13. Throw-in: Standing throw-in and Running throw-in. 14. Feinting: With the lower limb and upper part of the body. 15. Tackling: Simple Tackling, Slide Tackling. 16. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 17. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 9. Penalty stroke practice. 10. Penalty corner practice. 11. Tackling: Simple Tackling, Slide Tackling. 12. Goal Keeping, Ball clearance- kicking, and deflecting. 13. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials	22PED60.1, 22PED60.2, 22PED60.3, 22PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course	**22YOG60**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

22YOG60.1	Understanding the origin, history, aim and objectives of Yoga.
22YOG60.2	Become familiar with an authentic foundation of Yogic practices.
22YOG60.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
22YOG60.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22YOG60.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOG60.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOG60.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOG60.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 22YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 3. Suryanamaskar prayer and its meaning, Need, importance benefits of Suryanamaskar. 4. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 5. Sitting: Padmasana, Vajrasana, Sukhasana 6. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 7. Prone line: Bhujangasana, Shalabhasana 8. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 22YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 5. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 6. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 7. Prone line: Dhanurasana 8. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	22YOG40.1, 22YOG40.2, 22YOG40.3, 22YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 22YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 8. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3round **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Supine line: Setubandhasana, Shavasanaa (Relaxation pos 8. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- https://youtu.be/KB-TYlgd1wE
- https://youtu.be/aa-TG0Wg1Ls

APPENDIX A

	List of Assessment Pattern		
SNO	Tasks	Bloomscategory/Level	Remarks
1	Assignments	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
2	GroupDiscussions	Apply-L3, Analyse-L4	Group
3	CaseStudies/CaseLets	Apply-L3, Analyse-L4, Evaluate-L5	Individual/ Group
4	Practical Orientation on Designthinking	Analyse-L4, Create-L6	Creativity&Innovation
5	Participatory & Industry-IntegratedLearning	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
6	Practicalactivities/Problemsolvingexercises	Apply-L3, Analyse-L4, Evaluate-L5	Individual/ Group
7	ClassPresentations	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
8	Analysis of Industry/ Technical /BusinessReports	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
9	Reports on IndustrialVisit	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
10	Industrial/Social/RuralProjects	Analyse-L4, Create-L6	Individual/ Group
11	Participation in external seminars/workshops	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
12	Any other academic activity	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
13	Online/ Offline Quizzes	Understand-L2, Apply-L3	
	Note:		
	1.The choice or selection of appropriate Tasks for each Assessment Type by the course coordinator		
	2.Assign/fix the marks for each Assessment Type by course co-oridnator.		
	3.Students either submitthe report for Task or not, as determined by th ecourse coordinator.		
	4. Need to get final approval from the HoD/BOS Chairman once finalising the mark allocations for Tasks and Assessment types.		

APPENDIX B

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessmentin OBE; instead, classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation: Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in theircareer and in particular, what the graduates are expected to perform and achieve during thefirst few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the programcurriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcome:

APPENDIX C

The Graduate Attributes of NBA

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems in Computer Engineering.

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems in Computer Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.

PO3 **Design / Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes of Computer Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.

PO4 **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments in Computer Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complexEngineering activities in Computer Engineering with an understanding of the limitations.

PO6 **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 in Computer Engineering.

PO7 **Environment and Sustainability:** Understand the impact of the professional Engineering solutions of Computer Engineering in societal and Environmental contexts, demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the Engineering practice.

PO9 **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication Skills:** Communicate effectively on complex Engineering activities with the Engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

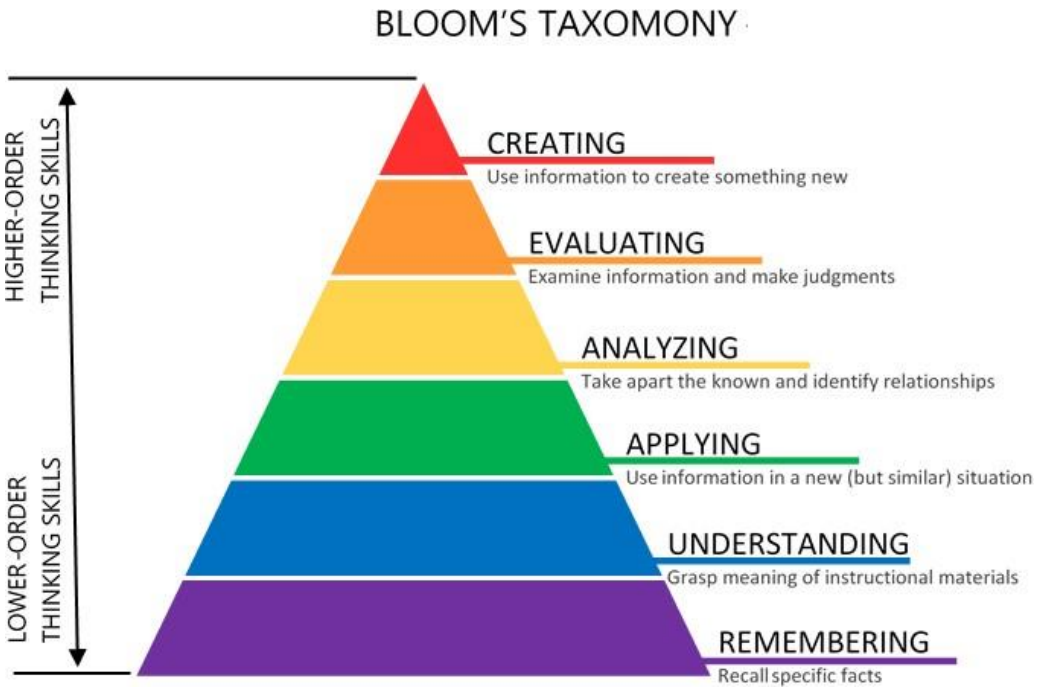
PO11 **Project Management and Finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.

PO12 **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.

APPENDIX D

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels ofhuman cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and otherevaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



www.newhorizonindia.edu

Ring Road, Bellandur Post, Near Marathahalli,
Bengaluru, Karnataka 560103, India.

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