J.N.N INSTITUTE OF ENGINEERING

AUTONOMOUS

NAAC 'A' Grade | Approved by AICTE | Affiliated to Anna University

ACADEMIC CURRICULUM
(REGULATION 2022)

FOR

B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

UNDER GRADUATE PROGRAMMES
CHOICE BASED CREDIT SYSTEM
(Applicable to the students admitted from the Academic Year 2022 – 2023 onwards)

ABOUT THE COLLEGE

J.N.N Institute of Engineering was founded to not only graduate engineering innovators who will be leaders in solving the pressing global challenges of today and tomorrow but also as a resource to other colleges and universities across the world seeking to broaden and rethink their educational approaches and learning environments. We are fully responsive to the local/regional needs and aware of our contribution not only to education but to the social and economic development of the region. From improving the life of the elderly in a nearby village to building new technology in faraway developing countries, our students connect their engineering education to the reality of making a difference in the world. Students tackle actual engineering challenges in a manner very similar to the global teams assembled by today's leading companies. This hands-on approach enables them to learn the reality of what it's like to work within financial or other resource constraints, and how innovative thinking is required to solve real-world problems. Our innovative educational approach is aimed at changing how students learn engineering; if something doesn't work, students and faculty revise the model until it does. J.N.N is committed to collaborating with others to make the changes necessary to attract, retain and graduate engineers with the right mind- and skill-set. J.N.N's Industry Institute Partnership Cell was founded to co-design educational transformation between the industry and institution. The effort is taking hold, and thousands are visiting J.N.N, attending workshops, seeking immersive experiences and intensely working to bring about innovation in their learning environments.

Vision Statement

Lead the transformation of engineering and management learning experience to educate the next generation of innovators and entrepreneurs who want to make the world a better place.

Mission Statement

- To develop the required resources and infrastructure and to establish a conducive ambience for the teaching-learning process.
- To nurture professional and ethical values in the students and to instil in them a spirit of innovation and entrepreneurship.
- To encourage a desire for higher learning and research in the students and to equip them to face global challenges.
- To provide opportunities for students to learn job-relevant skills to make them industry ready.
- To interact with industries and other organisations to facilitate transfer of knowledge and know-how.

ACADEMIC CURRICULUM
REGULATIONS 2022
B. Tech ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

ABOUT THE DEPARTMENT:

B.Tech.- Artificial intelligence and Data science programme was established in the year 2020 with intake of 60 students. The department provides quality and excellent education in the field of Artificial Intelligence and Data Science to the students. Artificial intelligence (AI) is wide-ranging branch of computer science concerned with creating smart machines capable of performing tasks that typically require human intelligence. Data science (DS) is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge with insights from structured & unstructured data. It is also used to actionable insights from data across a broad range of application domains. The job market for data science and AI professionals is booming across the world, making it a desirable career choice. Hence, the demand for the programmes in Artificial Intelligence and Data Science (AI & DS) areas has increased. To meet out the expectations of the companies and corporates JNNIE is offering the specialization in Artificial Intelligence and Data Science. This Programme mainly covers Computer science, Mathematics, Generative Artificial Intelligence, Cloud Computing, Machine Learning, Data Science and their applications in various domains.

VISION:

To impart quality-education, inculcate professionalism and enhance the problem- solving skills of the students in the domain of Artificial Intelligence & Data Science by applying recent technological tools and incorporating collaborative principles with a focus to make them industry ready.

MISSION:

1. To enhance the knowledge of the students with most recent advancements and refresh their insights in the field of Artificial Intelligence and Data Science.
2. To equip the students with strong fundamental concepts, analytical capability, programming and problem-solving skills.
3. To make the students industry ready and to enhance their employability through training, internships and real-time projects.
4. To guide the students to perform research on Artificial Intelligence and Data Science, with the aim to provide solutions to the problems of the industry.

PROGRAMME EDUCATIONAL OBJECTIVES:

Bachelor of Artificial Intelligence and Data Science curriculum is designed to prepare the graduates having attitude and knowledge to

PEO 1-To provide graduates with the proficiency to utilize the fundamental knowledge of basic sciences, mathematics, Artificial Intelligence, data science and statistics to build systems that require management and analysis of large volume of data.

PEO 2-To enrich graduates with necessary technical skills to pursue pioneering research in the field of AI and Data Science and create disruptive and sustainable solutions for the welfare of ecosystems.

PEO 3-To enable graduates to think logically, pursue lifelong learning and collaborate with an ethical attitude in a multidisciplinary team

PROGRAMME OUTCOMES (POs):

Artificial Intelligence and Data Science Graduates will be able to:

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

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.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO-1: Exhibit design and programming skills to build and automate business solutions using cutting edge technologies.

PSO-2: Strong theoretical foundation leading to excellence and excitement towards research, to provide elegant solutions to complex problems.

PSO-3: Ability to work effectively with various engineering fields as a team to design, build and develop system applications.

B.TECH- ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
CURRICULUM FOR SEMESTERS I TO VIII AND
SYLLABI FOR SEMESTERS I TO VIII

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
MANDATORY COURSE										
*	22IP100	Induction Programme	-	-	-	-	-	03 Weeks	0	-
THEORY COURSE										
1		Language Elective I	L+P	3	0	2	0	5	4	HSMC
2	22HSM101	Heritage Of Tamils	L	1	0	0	0	1	1	HSMC
3	22BST101	Basic Mathematics For Engineers	L	3	1	0	0	4	4	BSC
4	22BST102	Engineering Physics	L	3	0	0	0	3	3	BSC
5	22BST103	Engineering Chemistry	L	3	0	0	0	3	3	BSC
6	22EST101	Problem Solving and Python Programming/ICC1	L	3	0	0	0	3	3	ESC
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EET101	Engineering and Professional Skills	L+P	1	0	2	0	3	2	EEC
PRACTICAL COURSE										
8	22ESP101	Problem Solving and Python Programming Laboratory	P	0	0	4	0	4	2	ESC
9	22BSP101	Physics and Chemistry Laboratory	P	0	0	4	0	4	2	BSC
10	22EEP101	Product Tinkering Laboratory	P	0	0	2	0	2	1	EEC
			TOTAL	**17**	**01**	**14**	**00**	**32**	**25**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category ICC- Industry Core Course

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSE										
1		Language Elective II	L+P	3	0	2	0	5	4	HSMC
2	22HSM201	Tamils and Technology	L	1	0	0	0	1	1	HSMC
3	22BST201	Statistics and Transforms	L	3	1	0	0	4	4	BSC
4	22ADT201	Data Structures	L	3	0	0	0	3	3	PCC
5	22ADT202	Computer Architecture/ICC2	L	3	0	0	0	3	3	PCC
6	22EST205	Basic Electrical and Electronics Engineering	L	3	0	0	0	3	3	ESC
7	22EST202	Engineering Graphics	L+P	1	0	4	0	5	3	ESC
EMPLOYABILITY ENHANCEMENT COURSE										
8	22EET201	Innovation and Design Thinking*	L	2	0	0	0	2	2	EEC
PRACTICAL COURSE										
9	22ADP201	Data Structures Laboratory	P	0	0	3	0	3	1.5	PCC
10	22ESP201	Engineering Product Laboratory	P	0	0	3	0	3	1.5	ESC
11	22NXP201	NCC/NSS/YRC Credit Course Level- I#	-	1	0	0	0	1	1#	-
			TOTAL	**19**	**01**	**12**	**00**	**32**	**26**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category ICC- Industry Core Course
 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
***Common for all branches**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSE										
1	22BST301	Discrete Mathematics	L	3	1	0	0	4	4	BSC
2	22CST301	System Software	L	3	0	0	0	3	3	PCC
3	22ADT302	Design and Analysis of Algorithms	L+P	2	0	2	0	4	3	PCC
4	22ADT306	Database Systems	L	3	0	0	0	3	3	PCC
5	22ADT304	Software Engineering /ICC3	L	3	0	0	0	3	3	PCC
6	22ADT305	Artificial Intelligence	L	3	0	0	0	3	3	PCC
7	22HST301	Entrepreneurship and startups*	L	2	0	0	0	2	2	HSMC
EMPLOYABILITY ENHANCEMENT COURSE										
8	22EEP301	Soft Skills*	P	0	0	2	0	2	1	EEC
PRACTICAL COURSE										
9	22ADP301	Artificial Intelligence Laboratory	P	0	0	3	0	3	1.5	PCC
10	22ADP303	Database Systems Laboratory	P	0	0	3	0	3	1.5	PCC
			TOTAL	**19**	**01**	**10**	**00**	**30**	**25**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category ICC- Industry Core Course
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK L	T	P	J	TCP	C	CAT
THEORY COURSE										
1	22BST401	Probability and Statistics	L	3	1	0	0	4	4	BSC
2	22ADT401	Operating Systems/ICC4	L+P	3	0	2	0	5	4	PCC
3	22ADT402	Machine Learning	L	3	0	0	0	3	3	PCC
4	22ADT403	Fundamentals of Data Science and Analytics	L	3	0	0	0	3	3	PCC
MANDATORY COURSE										
5	22EST401	Environmental Sciences and Sustainability	L	2	0	0	0	2	2	BSC
PRACTICAL COURSE										
6	22ADP401	Machine Learning Laboratory	P	0	0	4	0	4	2	PCC
7	22NXP401	NCC/NSS/YRC Credit Course Level-II#	-	1	0	0	0	1	1#	-
EMPLOYABILITY ENHANCEMENT COURSE										
8	22EEP401	Quantitative Aptitude and Logical Reasoning-I	P	0	0	2	0	2	1	EEC
			TOTAL	**14**	**01**	**08**	**00**	**23**	**19**	

L- Lecture   T- Tutorial   P- Practical   J- Project   TCP- Total Contact Periods
C- Credits   CAT- Category   ICC- Industry Core Course
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**
 # NCC Credit Course level II is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSE										
1	22ADT501	Deep Learning	L	3	0	0	0	3	3	PCC
2	22ADT502	Big data Analytics/ICC5	L	3	0	0	0	3	3	PCC
3	22ADT503	Cloud Computing	L+P	2	0	2	0	4	3	PCC
PROFESSIONAL ELECTIVE										
4		Professional Elective I	L+P	2	0	2	0	4	3	PEC
5		Professional Elective II	L+P	2	0	2	0	4	3	PEC
MANAGEMENT ELECTIVE										
6		Management Elective	L	3	0	0	0	3	3	PEC
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EET501	Engineering Economics and Financial Management*	L	3	0	0	0	3	3	HSMC
8	22EEP501	Internship*	P	0	0	0	0	0	1	EEC
MANDATORY COURSE										
9		Mandatory Course – I	L	3	0	0	0	3	0	MCC
ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
10		Minor/Honour/remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES										
11	22ADP501	Deep Learning Laboratory	P	0	0	4	0	4	2	PCC
			TOTAL	**21**	**00**	**10**	**00**	**31**	**24**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category ICC- Industry Core Course
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22ADT601	Distributed Systems	L	3	0	0	0	3	3	PCC
2	22ADT602	Multimedia and Animation/ICC6	L+J	3	0	0	2	5	4	PCC
OPEN ELECTIVE										
3		Open Elective-I	L	3	0	0	0	3	3	OEC
PROFESSIONAL ELECTIVE										
4		Professional Elective – III	L+P	2	0	2	0	4	3	PEC
5		Professional Elective – IV	L+P	2	0	2	0	4	3	PEC
MANDATORY COURSE										
6		Mandatory Course – II	L	3	0	0	0	3	0	MCC
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
7		Minor/Honour/remedial class**		3	0	0	0	3	3**	PEC**
EMPLOYABILITY ENHANCEMENT COURSE										
8	22NXP601	NCC/NSS/YRC Credit Course Level- III#	L	1	0	0	0	1	1#	-
9	22EEP601	Quantitative Aptitude and Logical Reasoning-II*	P	0	0	2	0	2	1	EEC
10	22EEP602	Comprehensive Assessment*	P	0	0	2	0	2	1	EEC
			TOTAL	**16**	**00**	**08**	**02**	**26**	**18**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category ICC- Industry Core Course
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**
 # NCC Credit Course level III is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSE										
1	22HSM701	Human values and ethics	L	3	0	0	0	3	3	HSMC
2	22ADT701	Internet of Things	L+P	3	0	2	0	5	4	PCC
3	22ADT702	Software Testing and Automation / ICC7	L	3	0	0	0	3	3	PCC
OPEN ELECTIVE										
4		Open Elective-II	L	3	0	0	0	3	3	OEC
PROFESSIONAL ELECTIVE										
5		Professional Elective-V	L+P	2	0	2	0	4	3	PEC
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
6		Minor/Honour/remedial class **	L	3	0	0	0	3	3**	PEC**
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EEP701	Product Design and Development*	J	0	0	0	4	4	2	EEC
8	22EEP702	Internship*	P	0	0	0	0	0	1	EEC
			TOTAL	**14**	**00**	**04**	**04**	**22**	**19**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category ICC- Industry Core Course
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
1		Minor/Honour/remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
2	22ADJ801	Project Work/ Internship	J	0	0	0	16	16	08	EEC
			TOTAL	**00**	**00**	**00**	**16**	**16**	**08**	

L- Lecture **T- Tutorial** **P- Practical** **J- Project** **TCP- Total Contact Periods**
C- Credits **CAT- Category**

**** Common to all branches, selection from one minor vertical/approved honors subjects**

Following is the Industry Core Courses (ICC) which will be offered as Choice Based Courses in the following semesters

S.No	COURSE CODE	SEMESTER	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
					L	T	P	J			
1	ICC1	I	Python programming	L	3	0	0	0	3	3	ICC
2	ICC2	II	Data Visualization with R, Watson	L	3	0	0	0	3	3	ICC
3	ICC3	III	Business Intelligence with Cognos BI	L	3	0	0	0	3	3	ICC
4	ICC4	IV	Predictive Modelling using SPSS Modeler	L+P	3	0	2	0	5	4	ICC
5	ICC5	V	Design Thinking / Devops / Agile	L	3	0	0	0	3	3	ICC
6	ICC6	VI	Spark and Scala fundamentals	L+J	3	0	0	2	5	4	ICC
7	ICC7	VII	AI Analyst	L	3	0	0	0	3	3	ICC
				TOTAL	**21**	**0**	**02**	**02**	**25**	**23**	

CREDIT DISTRIBUTION

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	EEC	MC	TOTAL	Total PER %
I	05	12	05	-	-	-	03	-	**25**	**14**
II	05	04	7.5	7.5	-	-	02	-	**26**	**15**
III	02	04	-	18	-	-	01	-	**25**	**14**
IV	-	06	-	12	-	-	01	-	**19**	**12**
V	03	-	-	11	09	-	01	√	**24**	**14**
VI	-	-	-	07	06	03	02	√	**18**	**12**
VII	03	-	-	07	03	03	03	-	**19**	**13**
VIII	-	-	-	-		-	08	-	**08**	**6**
TOTAL	**18**	**26**	**12.5**	**62.5**	**18**	**06**	**21**	**-**	**164**	**100**

CATEGORY		Breakup of Credits	PER % in Total
HSMC	Humanities & Social Science Including Management	**18**	**9**
BSC	Basic Science Courses	**26**	**18**
ESC	Engineering Science Courses	**12.5**	**7**
PCC	Professional Core Courses	**62.5**	**38**
PEC	Professional Elective Courses	**18**	**9**
OEC	Open Elective Courses	**06**	**4**
EEC	Employment Enhancement Courses	**21**	**15**
MCC	Mandatory Courses	**-**	**-**
	Total Credits	**164**	**100**

PROFESSIONAL ELECTIVES COURSES: VERTICALS

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6
Full Stack Development for IT	**Cloud Computing and Data Center Technologies**	**Cyber Security and Data Privacy**	**Creative Media**	**Emerging Technologies**	**Human Bond AI**
App Development with Swift Programming	Soft Computing	Computer Networks	Computer Vision	Knowledge Engineering	Image and video analytics
Cloud Services Management	Recommender Systems	Social Network Security	Visual Effects	Business Analytics	Bio-Inspired Optimization Techniques
UI and UX Design	Data Warehousing	Modern Cryptography	Video Creation and Editing	Neural Networks and Deep Learning	Health Care Analytics
Principles of programming Languages	Storage Technologies	Engineering Secure Software Systems	Digital marketing	Cyber Security	Text and Speech Analysis
Web Application Security	Software Defined Networks	Digital and Mobile Forensics	Multimedia Data Compression and Storage	Quantum Computing	Cognitive Science
DevOps	Security and Privacy in Cloud	Data Mining for Business Intelligence	Game Development	Cryptocurrency and Blockchain Technologies	Ethics and AI

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V, VI and VII. These courses are listed in groups called verticals that represent a Particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2022

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICALS -I Full Stack Development for IT								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22CSE002	App Development with Swift Programming	2	0	2	0	4	3
2	22CSE008	Cloud Services Management	2	0	2	0	4	3
3	22CSE003	UI and UX Design	2	0	2	0	4	3
4	22CSE006	Principles of programming Languages	2	0	2	0	4	3
5	22CSE005	Web Application Security	2	0	2	0	4	3
6	22ADE001	DevOps	2	0	2	0	4	3

VERTICALS -II Cloud Computing and Data Center Technologies								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ADE002	Soft Computing	2	0	2	0	4	3
2	22ADE003	Recommender Systems	2	0	2	0	4	3
3	22CSE009	Data Warehousing	2	0	2	0	4	3
4	22CSE010	Storage Technologies	2	0	2	0	4	3
5	22CSE011	Software Defined Networks	2	0	2	0	4	3
6	22CSE016	Security and Privacy in Cloud	2	0	2	0	4	3

VERTICALS -III Cyber Security and Data Privacy								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ADE022	Computer Networks	2	0	2	0	4	3
2	22CSE014	Social Network Security	2	0	2	0	4	3
3	22CSE015	Modern Cryptography	2	0	2	0	4	3
4	22ADE004	Engineering Secure Software Systems	2	0	2	0	4	3
5	22CSE013	Digital and Mobile Forensics	2	0	2	0	4	3
6	22ADE005	Data Mining for Business Intelligence	3	0	0	0	3	3

VERTICALS -IV Creative Media								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ADE006	Computer Vision	2	0	2	0	4	3
2	22ADE007	Visual Effects	2	0	2	0	4	3
3	22ADE008	Video Creation and Editing	2	0	2	0	4	3
4	22ADE009	Digital marketing	2	0	2	0	4	3
5	22ADE010	Multimedia Data Compression and Storage	2	0	2	0	4	3
6	22ADE011	Game Development	2	0	2	0	4	3

VERTICALS –V Emerging Technologies								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ADE012	Knowledge Engineering	2	0	2	0	4	3
2	22ADE013	Business Analytics	2	0	2	0	4	3
3	22ADE014	Neural Networks and Deep Learning	2	0	2	0	4	3
4	22CSE019	Cyber Security	2	0	2	0	4	3
5	22ADE015	Quantum Computing	2	0	2	0	4	3
6	22CSE024	Cryptocurrency and Blockchain Technologies	2	0	2	0	4	3

VERTICALS –VI Human Bond AI								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ADE016	Image and video analytics	2	0	2	0	4	3
2	22ADE017	Bio-Inspired Optimization Techniques	3	0	0	0	3	3
3	22ADE018	Health Care Analytics	3	0	0	0	3	3
4	22ADE019	Text and Speech Analysis	2	0	2	0	4	3
5	22ADE020	Cognitive Science	2	0	2	0	4	3
6	22ADE021	Ethics and AI	2	0	2	0	4	3

Management Elective (Semester V)								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22EMT001	Principles of Management	3	0	0	0	3	3
2	22EMT002	Total Quality Management	3	0	0	0	3	3
3	22EMT003	Engineering Economics and Financial Accounting	3	0	0	0	3	3
4	22EMT004	Human Resource Management	3	0	0	0	3	3
5	22EMT005	Knowledge Management	3	0	0	0	3	3
6	22EMT006	Industrial Management	3	0	0	0	3	3

LANGUAGE ELECTIVE COURSES

(Semester I)

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22LET101	Japanese Language Level I	3	0	2	0	5	4
2	22LET102	French Language Level I	3	0	2	0	5	4
3	22LET103	German Language Level I	3	0	2	0	5	4
4	22HST101	Professional English	3	0	2	0	5	4

(Semester II)

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22LET201	Functional English	3	0	2	0	5	4
2	22LET202	French Language Level II	3	0	2	0	5	4
3	22LET203	German Language Level II	3	0	2	0	5	4
4	22LET205	Japanese Language Level II	3	0	2	0	5	4

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVE I

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22ADO001	Fundamentals of Machine Learning	3	0	0	0	3	3
2	22ADO002	Fundamentals of Data Science	3	0	0	0	3	3
3	22ADO003	Basics of Cloud Computing	3	0	0	0	3	3
4	22ADO004	Basics of Multimedia and Animation	3	0	0	0	3	3
5	22ADO005	Basics of Ethical Hacking	3	0	0	0	3	3
6	22ADO006	Fundamentals of Data Mining	3	0	0	0	3	3

OPEN ELECTIVE II

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22ADO007	Introduction to Deep Learning	2	0	2	0	4	3
2	22ADO008	Programming for Data Science	2	0	2	0	4	3
3	22ADO009	Introduction to Cloud Services Management	2	0	2	0	4	3
4	22ADO010	Introduction to Digital Marketing	2	0	2	0	4	3
5	22ADO011	Ethics in AI for Engineers	2	0	2	0	4	3
6	22ADO012	Introduction to Business Analytics	2	0	2	0	4	3

MANDATORY COURSES I (Non Credit Course)

(Semester V)

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22MCT001	Introduction to Women and Gender Studies	3	0	0	0	3	0
2	22 MCT002	Elements of Literature	3	0	0	0	3	0
3	22 MCT003	Film Appreciation	3	0	0	0	3	0
4	22MCT004	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	3	0	0	0	3	0
5	22MCT005	Indian Constitution	3	0	0	0	3	0
6	22MCT006	Industrial Safety	3	0	0	0	3	0

MANDATORY COURSES II (Non Credit Course)

(Semester VI)

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22 MCT007	Ethics and Values	3	0	0	0	3	0
2	22 MCT008	History of Science and Technology in India	3	0	0	0	3	0
3	22MCT009	Political and Economic Thought for a Human Society	3	0	0	0	3	0
4	22MCT010	State, Nation Building and Politics in India	3	0	0	0	3	0
5	22MCT011	Disaster Management	3	0	0	0	3	0

VERTICALS FOR MINOR DEGREE
(In addition to all the verticals of other programmes)

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4
Cloud Computing and Data Center Technologies	**Creative Media**	**Emerging Technologies**	**Human Bond AI**
Soft Computing	Computer Vision	Knowledge Engineering	Image and video analytics
Recommender Systems	Visual Effects	Business Analytics	Bio-Inspired Optimization Techniques
Data Warehousing	Video Creation and Editing	Neural Networks and Deep Learning	Health Care Analytics
Storage Technologies	Digital marketing	Cyber Security	Text and Speech Analysis
Software Defined Networks	Multimedia Data Compression and Storage	Quantum Computing	Cognitive Science
Security and Privacy in Cloud	Game Development	Cryptocurrency and Blockchain Technologies	Ethics and AI

(choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

SEMESTER I

Course Code	Course Title	L	T	P	J	C
		3	0	2	0	4
22LET101	**JAPANESE LANGUAGE LEVEL I**	Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To train the students to learn basic Japanese including three writing systems
2. To teach them to learn basic grammar and vocabulary
3. To train them to converse in Japanese in day-to-day scenarios

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Acquire familiarity in all 3 Japanese alphabet & basic vocabulary (Understand)
CO2. Listen and identify individual sounds of Japanese (Understand)
CO3. Use basic sounds and words while speaking (Apply)
CO4. Read and understand simple advertisements, brochures and invitations (Apply)
CO5. Use basic grammar and appropriate vocabulary in completing language tasks (Apply)

UNIT-1	**INTRODUCTION TO JAPANESE**	**9 HOURS**

Japanese written system - Japanese sounds - Hiragana (あ、い、う、え、お…) -Hiragana variations - Katakana - Katakana variations

UNIT-2	**MYSELF**	**9 HOURS**

Countries - Languages - Occupations - Self-introduction - Family - People - Numbers - My family - wa…desu - mo particle- to particle - ni particle - no particle.

UNIT-3	**FOOD**	**9 HOURS**

Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch.

UNIT-4	**HOME**	**9 HOURS**

Home - Furniture - 4 kanjis - Places to visit nearby - Rooms - Things in the room - ni + ga + arimasu- ni + ga + imasu - general counter - My home - My room

UNIT-5	**DAILY LIFE**	**9 HOURS**

Daily routines - Time - 10 kanjis - Free-time activities - Places - Calendar - telling time - ni particle - kara… made… - time expression - ii adjective.

	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	独立行政法人国際交流基金, 来嶋, 柴原 & 八田. Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Competences / まるごと日本のことばと文化 入門 A1 りかい 2023.

REFERENCE BOOKS:	
1	Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
2	Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
3	www.japaneselifestyle.com
4	www.learn-japanese.info/
5	www.kanjisite.com/ & www.learn-hiragana-katakana.com/typing-hiragana-characters/
LIST OF EXPERIMENTS :	
1. Give a simple self-introduction	
2. Tell someone about your family, using a family photo	
3. Talk about your favorite foods	
4. Offer someone a drink	
5. Talk about your breakfast	
6. Say what your favorite dish is	
7. Order food and drinks at a hamburger shop	
8. Say what kind of home you live in	
9. Say what you have in your home	
10. Write an E-mail inviting someone to your home	
11. Talk about your daily routine	
12. Write a birthday card	
	TOTAL HOURS: 30 HOURS

<table>
<tr><td rowspan="1">Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr>
<tr><td rowspan="2">22LET102</td><td rowspan="2">FRENCH LANGUAGE LEVEL I</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To acquire an understanding of basic French language parts of speech
2. To facilitate learner’s ability to learn the French language grammar.
3. To nurture learner’s ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Read and write technical basic French language parts of speech
CO2. Speak appropriately learner’s ability to learn the French language grammar.
CO3. Listen and comprehend lectures learner’s ability to understand the sentence structure
CO4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
CO5. Prepare self-introduction comprehend various lectures and talks</td></tr>
<tr><td>UNIT-1</td><td>PARTS OF SPEECH</td><td colspan="5">9 + 6 HOURS</td></tr>
<tr><td colspan="7">1. inviter et répondre à une invitation, Pronomssujets 2. L'articledéfinis, l'articleindéfinis 3. Conjugation :présent, adjectifspossessifs 4. interrogation, décrire les personnes 5. La vie de quatreparisiens de professions différentes</td></tr>
<tr><td>UNIT-2</td><td>ELEMENTS OF GRAMMAR</td><td colspan="5">9 + 6 HOURS</td></tr>
<tr><td colspan="7">1. Exprimerl'ordre et l'obligation demander et commander 51
2. l'adjectifpossessifs, l‟articlepartitif, l'articledémonstratif, négation ne
3. pas, l'articlecontracté 4. verbepronominaux 5. prepositions</td></tr>
<tr><td>UNIT-3</td><td>SENTENCE STRUCTURE</td><td colspan="5">9 + 6 HOURS</td></tr>
<tr><td colspan="7">1. Raconter et reporter-donner son avis
2. Futur simple, pronomcomplètementd'objet direct, passé composé
3. plusieursrégion de France, imparfait, pronom y/en, imparfait</td></tr>
<tr><td>UNIT-4</td><td>HOME</td><td colspan="5">9 + 6 HOURS</td></tr>
<tr><td colspan="7">1. Demander l'autorisation-passé récent, futurproche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport</td></tr>
<tr><td>UNIT-5</td><td>DAILY LIFE</td><td colspan="5">9 + 6 HOURS</td></tr>
<tr><td colspan="7">1. le discoursrapporté, décrire un lieu, exprimersespréférences 2. décrire la carrière, discuterd ‟systèmeéducation de France 3. parler de la technologie de l‟information</td></tr>
<tr><td colspan="2">TOTAL HOURS:</td><td colspan="5">45 + 30 HOURS</td></tr>
</table>

TEXT BOOK(S):	
1	Christine Andantétal "À propos (livre de l'élève", LANGER., NEW DELHI,2012
2	Myrna Bell Rochester "Easy French Step By Step", MCGraw Hill Companies., USA, 2008
REFERENCE BOOKS:	
1	Michael D. Oates "Entre Amis: An Interactive Approach", 5 th Edition, Houghton Mifflin., 2005
2	Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French"
3	Simone Renaud, Dominique van Hooff "En bonne forme

Course Code	Course Title	L	T	P	J	C
22LET103	GERMAN LANGUAGE LEVEL I	3	0	2	0	4
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To train the students to learn basic German
2. To teach them to learn basic grammar and vocabulary.
3. To train them to converse in German in day-to-day scenarios

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. help students acquire familiarity in the German alphabet & basic vocabulary

CO2. listen and identify individual sounds of German

CO3. use basic sounds and words while speaking

UNIT-1	**INTRODUCTION TO GERMANY AND ITS REGIONS –GERMAN BASIC PHRASES, ALPHABETS, NUMBERS, COUNTRIES AND NATIONALITY**	**9 + 6 HOURS**

Grammaire – Verbs – sein, haben, definite and indefinite articles

Communication – Greetings, Self-Introduction

UNIT-2	**BASIC VOCABULARY, COLOURS, MONTHS AND DAYS**	**9 + 6 HOURS**

Grammaire - Verbes - Conjugation: Present tense (regular verbs) – Adjective possessive

Communication – Talk about family and friends, date, time etc

UNIT-3	**HOBBIES, INTERESTS AND DAILY ROUTINE**	**9 + 6 HOURS**

Grammaire – Irregular verbs

Communication – Talking about hobbies and interests.

UNIT-4	**VOCABULARY OF PLACES AND TRANSPORT**	**9 + 6 HOURS**

Grammaire – Cases, adjective demonstrative, past tense, propositions

Communication – Narrating an incident or story

UNIT-5	**VOCABULARY OF FOOD, SERVICES, MONEY**	**9 + 6 HOURS**

Grammaire – Negation, Verbs – kaufen, essen, bezahlen

Communication – Accept andrefuse an invitation, situation in a restaurant

TOTAL HOURS:	**45 + 30 HOURS**

TEXT BOOK(S):

1	Mit ErfogZum Goethe-Zertifikat A1

REFERENCE BOOKS:

1	Studio d - Deutsch alsFremdsprache - Grundstufe - A1
2	Fit Fur Goethe-Zertifikat A1 (Start Deutsch 1)

SOFTWARE:

1	All internet tools

Course Code	Course Title	L	T	P	J	C
22HST101	**PROFESSIONAL ENGLISH**	**3**	**0**	**2**	**0**	**4**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Provide learners with basic vocabulary and grammar to recognize and use in real time contexts
2. Improve communicative competence
3. Help use the language effectively in academic /work contexts
4. Build language skills by engaging in listening, speaking, vocabulary and grammar learning activities relevant to authentic contexts
5. Develop the ability to read and write complex texts, summaries, articles, blogs, definitions, essays, and user manuals

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Become accustomed to the basic vocabulary and grammar

CO2. Listen and comprehend complex academic texts

CO3. Read and infer the denotative and connotative meanings of technical texts

CO4. Write definitions, descriptions, narrations, and essays on various topics

CO5. Speak fluently and accurately in formal and informal communicative contexts

UNIT-1	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	6 HOURS

Reading – Newspaper- sports/health; technical Brochures

Writing – Professional emails; Formal letters

Grammar – Word formation, Parts of speech, Framing questions

Vocabulary – Synonyms and Antonyms, One-word substitution, Abbreviations and Acronyms

UNIT-2	NARRATION AND SUMMATION	6 HOURS

Reading – Biographies/ Travelogues

Writing - Guided writing- Paragraph; Short Report on an event (field trip etc.)

Grammar – Tenses; Subject-Verb Agreement; Prepositions

Vocabulary – Narrative vocabulary; Phrasal verbs

UNIT-3	DESCRIPTION OF A PROCESS / PRODUCT	6 HOURS

Reading – Gadget reviews; Advertisements

Writing - Product description, Process description; Instruction writing

Grammar – Imperatives; Degrees of comparison

Vocabulary – Compound words; Homonyms, homophones; discourse markers- Connectives and Sequence words

UNIT-4	CLASSIFICATION ND RECOMMENDATIONS	6 HOURS
Reading – Newspaper articles; journal reports **Writing –** Note-making; Interpretation of charts; Recommendations **Grammar –** Articles; Modal verbs **Vocabulary -** Collocations; Fixed / Semi fixed expressions.		
UNIT-5	**EXPRESSION**	**6 HOURS**
Reading – Editorials; opinion blogs **Writing –** Reports – Accident & Survey; Business letters **Grammar –** Punctuation; Negations; Simple, Complex and Compound sentences **Vocabulary -** Cause & Effect Expressions; Content vs Function words		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1.	Hewings, Martin Advanced Grammar In Use. New Delhi: CUP,2008 MLA Handbook for Writers of Research Papers, 7th Edition
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1	Ian wood, Anne Williams with Anna Cowper, “Pass Cambridge BEC Preliminary”, 2nd edition, Cengage Learning, 2015.
2	Technical Communication – Principles And Practices, Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
3	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
4	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.

LIST OF EXPERIMENTS :

1. Listening to introductions of successful people
2. Self-Introduction and introducing a friend
3. Listening and filling out a form
4. Narrating a story using hints
5. Listening to telephone conversation
6. Telephonic Interview- Role play
7. Listening to podcasts, anecdotes/event narration

8. Narrating personal experiences/ events
9. Listening to celebrity interviews
10. Conversation Skills- Politeness strategies
11. Listening to process descriptions
12. Describing a process
13. Listening to travelogues
14. Narrating travel experiences
15. Listening to educational videos
16. Group discussion
17. Listening to TED Talks
18. Mini Presentations
19. Listening to description of art work
20. Picture description
21. Listening to scientific lectures
22. Summarizing a lecture
23. Listening to definitions/ descriptions of objects
24. One minute speech - Describing an object
25. Listening to Tv shows
26. Anchoring a reality show
27. Listening to advertisements
28. Adzap
29. Listening to autobiography
30. Visume
TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22HSM101</td><td rowspan="2">HERITAGE OF TAMILS</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the tamil language and various literatures
2. To know ancient rock art paintings and modern art sculpture
3. To understand folk and martial arts
4. To know about the thinai concepts through Sangam Literature
5. To value the Contribution of tamils to Indian Natioanl movement and culture

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the tamil language and various literatures
CO2. Know ancient rock art paintings and modern art sculpture
CO3. Understand folk and martial arts
CO4. Know about the thinai concepts through Sangam Literature
CO5. Value the Contribution of tamils to Indian Natioanl movement and culture

Unit-1	**LANGUAGE AND LITERATURE**	**03 hours**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Unit-2	**HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**	**03 hours**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

Unit-3	**FOLK AND MARTIAL ARTS**	**03 hours**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Unit-4	**THINAI CONCEPT OF TAMILS**	**03 hours**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

Unit-5	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	03 hours
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books		
	Total Lecture hours:	**15 hours**

TEXT BOOK(S)	
1.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
2.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
3.	Tamilaga Varalaru, Makalum Panpadum- Dr. K.K. Pillai
4.	Kanini Tamil- Munaivar L. Sundaram
REFERENCE BOOKS	
1.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3.	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4.	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
5.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22BST101</td><td rowspan="2">BASIC MATHEMATICS FOR ENGINEERS</td><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to:

1. To develop the use of matrix algebra techniques those are needed by engineers for practical applications.
2. To acquaint the students with differential calculus.
3. To explain the student with functions of several variables.
4. To make the students understand various techniques of integration and its applications.
5. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1. Use the matrix algebra methods for solving practical problems.

CO2. Apply differential calculus tools in solving various application problems.

CO3. Able to use differential calculus ideas on several variable functions.

CO4. Apply different methods of integration in solving practical problems.

CO5. Apply multiple integral ideas in solving areas, volumes and other practical problems.

UNIT-1	**MATRICES**	**9+3 HOURS**

Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation

UNIT-2	**DIFFERENTIAL CALCULUS**	**9+3 HOURS**

Representation of functions - Limit of a function- Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Logarithmic differentiation - Maxima and Minima of functions of one variable.

UNIT-3	**FUNCTIONS OF SEVERAL VARIABLES**	**9+3 HOURS**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT-4	**INTEGRAL CALCULUS**	**9+3 HOURS**

Definite and Indefinite integrals - Substitution rule - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction

UNIT-5	**MULTIPLE INTEGRALS**	**9+3 HOURS**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids

TOTAL LECTURE HOURS:	**60 HOURS**

TEXT BOOK(S):	
1.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2.	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition , 2018.
3.	James Stewart, " Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
REFERENCE BOOKS:	
1.	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2.	Bali. N., Goyal. M. and Watkins. C., " Advanced Engineering Mathematics ", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3.	Jain . R.K. and Iyengar. S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi, 5th Edition, 2016.
4.	Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6.	Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.
7.	Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus ", 14th Edition, Pearson India, 2018.

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22BST102</td><td rowspan="2">ENGINEERING PHYSICS</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To make the students effectively achieve an understanding of mechanics.
2. To enable the students to gain knowledge of electromagnetic waves and its applications.
3. To introduce the basics of oscillations, optics and lasers.
4. To equip the students to successfully understand the importance of quantum physics.
5. To motivate the students towards the applications of quantum mechanics.

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1. Understand the importance of mechanics.

CO2. Express their knowledge in electromagnetic waves.

CO3. Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4. Understand the importance of quantum physics.

CO5. Comprehend and apply quantum mechanical principles towards the formation of energy bands

UNIT I	**MECHANICS**	**9 HOURS**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - MI of a diatomic molecule - theorems of MI – moment of inertia of continuous bodies –- torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule.

UNIT II	**ELECTROMAGNETIC WAVES**	**9 HOURS**

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure – basic introduction to Satellite Communication (qualitative treatment)

UNIT III	**OSCILLATIONS, OPTICS AND LASERS**	**9 HOURS**

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave -– interference–Michelson interferometer – Theory of laser – characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV	BASIC QUANTUM MECHANICS	9 HOURS
Photons and light waves - Electrons and matter waves – Photoelectric effect - The Schrodinger equation (Time dependent and time independent forms) - interpretation of wave function_–Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization and probabilities – Bohr's correspondence principle (concept only).		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9 HOURS**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunnelling (qualitative)- Tunnelling microscope - Resonant diode – Principle of quantum superposition – concept of quantum entanglement – concepts of quantum communication and quantum teleportation		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)	
1.	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2.	E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
REFERENCE BOOKS	
1.	R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2.	2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3.	K. Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4.	D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5.	N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer Verlag, 2012.

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22BST103</td><td rowspan="2">ENGINEERING CHEMISTRY</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To inculcate a sound understanding of water quality parameters and water treatment techniques.
2. To impart knowledge on the basic principles and preparatory methods of nanomaterials.
3. To introduce the different polymers and composites for engineering applications.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1. Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2. Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3. Analyze the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness and composites for material selection requirements.

CO4. Recommend suitable fuels for engineering processes and applications.

CO5. Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

UNIT-1	**WATER AND ITS TREATMENT**	**9 HOURS**

Water: Sources and impurities, Requirements of water for municipal use, Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Requirements of water for industrial use, Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and and External treatment -Ion exchange demineralization and zeolite process. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination).

UNIT-2	**NANOCHEMISTRY**	**9 HOURS**

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation

of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
UNIT-3	**POLYMERS AND COMPOSITES**	**9 HOURS**
Definition of biodegradable polymers- Classification of biodegradable Polymers – Advantages, conducting polymers- examples - Mechanism of conduction – applications, recycling of e-plastic waste (waste to wealth). Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer, matrix, metal matrix and ceramic matrix) and Reinforcement (fibre, particulates, flakes and whiskers). Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.		
UNIT-4	**FUELS AND COMBUSTION**	**9 HOURS**
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil-cetane number; Power alcohol and biodiesel. Combustion of fuels: Calorific value - higher and lower calorific values, Flue gas analysis - ORSAT Method. CO2 emission and carbon footprint.		
UNIT-5	**COMPUTATIONAL CHEMISTRY AND STORAGE DEVICES**	**9 HOURS**
Computational chemistry-molecular dynamics and chemical reactivity. Cheminformatics and Green IOT in biomedical applications, Artificial intelligence and machine learning methods to predict physicochemical properties. Batteries: a brief introduction to electrochemical cell (Daniel cell), Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; battery used in Electric vehicles; Fuel cells: H2-O2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)	
1.	P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2.	Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3.	S.S. Dara, “A Text book of Engineering Chemistry”, S. Chand Publishing, 12th Edition.
REFERENCE BOOKS	
1.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Textbook of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

2.	O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3.	Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
4.	ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5.	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

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<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EST101</td><td rowspan="2">PROBLEM SOLVING AND PYTHON PROGRAMMING</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of algorithmic problem solving.
2. To learn to solve problems using Python conditionals and loops.
3. To define Python functions and use function calls to solve problems.
4. To use Python data structures - lists, tuples, dictionaries to represent complex data.
5. To do input/output with files in Python.

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1. Develop algorithmic solutions to simple computational problems

CO2. Write simple Python programs using conditionals and loops for solving problems.

CO3. Decompose a Python program into functions.

CO4. Represent compound data using Python lists, tuples, dictionaries etc.

CO5. Read and write data from files in Python programs.

UNIT-1	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9 HOURS

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT-2	DATA TYPES, EXPRESSIONS, STATEMENTS	9 HOURS

Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-3	CONTROL FLOW, FUNCTIONS, STRINGS	9 HOURS

Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT-4	LISTS, TUPLES, DICTIONARIES	9 HOURS
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT-5	**FILES, MODULES, PACKAGES**	**9 HOURS**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):	
1.	Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017
REFERENCE BOOKS:	
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition,2021.
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

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<tr><td rowspan="2">22EET101</td><td rowspan="2">ENGINEERING AND PROFESSIONAL SKILLS</td><td>1</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To understand the characteristics of ‘engineering’ and the quality engineers have played in shaping engineering up to the present and into the future
2. To understand a range of principles in science, mathematics, and engineering in order to make well-founded decisions as part of a design process
3. To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the present ability and overall utility value of content
4. To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
5. To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, present ability, aesthetics, using media elements and enhance the overall quality of presentations

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1. Understand the basic knowledge in evolution of engineering
CO2. Understand the basic knowledge in Engineering approach
CO3. Use the MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
CO4. Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
CO5. Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

UNIT-1	EVOLUTION OF ENGINEERING	3 HOURS

Evolution of Engineering: Description of Engineering, Early stages of Engineering, Outline of Ancient Engineering, Case studies of historic engineers.

Introduction to Engineering Career: Engineering as a career and common qualities of employable engineers History of Engineering Domains Impact of engineering on society. Roles of Engineers and Career Paths.

UNIT-2	ENGINEERING APPROACH	3 HOURS

Introduction, problem statement: Detailing Customer Requirements, Setting Objectives, Identifying Constraints, Establishing Functions, generating solution Alternatives and Choosing a solution. Steps in problem-solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. seven steps in solving engineering problems, reverse engineering, forward engineering, concurrent engineering, and Value Engineering.

UNIT-3	MS WORD	3 HOURS
Create and format a document, Working with tables, Working with Bullets and Lists, Working with styles, shapes, smart art, charts Inserting objects, charts and importing objects from other office tools, Creating and Using document templates, Inserting equations, symbols and special characters, Working with Table of contents and References, citations Insert and review comments, Create bookmarks, hyperlinks, endnotes footnote, Viewing document in different modes, Working with document protection and security, Inspect document for accessibility.		
UNIT-4	**MS EXCEL**	**3 HOURS**
Create worksheets, insert and format data, Work with different types of data: text, currency, date, numeric etc. Split, validate, consolidate, Convert data Sort and filter data Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,) Work with Lookup and reference formulae, Create and Work with different types of charts, Use pivot tables to summarize and analyse data, Perform data analysis using own formulae and functions, Combine data from multiple worksheets using own formulae and built-in functions to generate results, Export data and sheets to other file formats, Working with macros, Protecting data and Securing the workbook		
UNIT-5	**MS POWERPOINT**	**3 HOURS**
Hours Select slide templates, layout and themes, Formatting slide content and using bullets and numbering, Insert and format images, smart art, tables, charts Using Slide master, notes and handout master, Working with animation and transitions, Organize and Group slides Import or create and use media objects: audio, video, animation, Perform slideshow recording and Record narration and create presentable videos.		
	TOTAL LECTURE AND LAB HOURS:	**15 HOURS**

TEXT BOOK(S):

1.	Remesh S., Vishnu R. G., Life Skills for Engineers, Ridhima Publications, 1 stEdition,2016.
2.	Barun K. Mitra, Personality Development & Soft Skills, Oxford Publishers, Third impression, 2017.
3.	Dorothy House, Microsoft Word, Excel, and PowerPoint: Just for Beginners, Import, 29 January 2015

REFERENCE BOOKS:

1.	Paul H .Wright, Introduction to Engineering, School of Civil and Environmental Engineering, 3rd Edition, John Wiley & Sons, Inc,

LIST OF EXPERIMENTS:

1. Create a Bio – Data by using MS-Word.
2. Create a Time Table by using MS-Word.
3. Create an Agenda by using MS-Word.
4. Create a mail merge by using MS-Word.
5. Create a Piechart by using MS-Word.
6. Paragraph Formatting, Line Spacing And Sorting, Bullets And Numbering
7. Create an Interactive form in MS-Word

8. Create a Resume by using MS-Word templates.
9. Calculate student mark details by using MS-Excel.
10. Create an employee work details list by using MS-Excel.
11. Create two types of charts by using MS-Excel.
12. Create a presentation using MS POWERPOINT.
13. Create an advertisement by using PowerPoint presentation
14. Create an organization chart by using PowerPoint.
15. Create an organization chart for college results by using MS PowerPoint templates.
16. Create an advertisement for TV channel by using Power Point.
Total Laboratory hours: 30 Hours

Course Code	Course Title	L	T	P	J	C
22ESP101	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**0**	**0**	**4**	**0**	**2**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the problem solving approaches.
2. To learn the basic programming constructs in Python.
3. To practice various computing strategies for Python-based solutions to real world problems.
4. To use Python data structures - lists, tuples, dictionaries.
5. To do input/output with files in Python.

COURSE OUTCOME:

After completion of this course, the students should be able to:

CO1. Develop algorithmic solutions to simple computational problems

CO2. Develop and execute simple Python programs.

CO3. Implement programs in Python using conditionals and loops for solving problems.

CO4. Deploy functions to decompose a Python program and process compound data using Python data structures.

CO5. Utilize Python packages in developing software applications.

LIST OF EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing

characters) 8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy) 9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word) 10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation) 11. Exploring Pygame tool. 12. Developing a game activity using Pygame like bouncing ball, car race etc.	
Total Laboratory hours:	**60 HOURS**

Course Code	Course Title	L	T	P	J	C
22BSP101	**PHYSICS AND CHEMISTRY LABORATORY (CHEMISTRY)**	**0**	**0**	**4**	**0**	**2**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

The course enables the learner to

1. To impart practical skills in the estimation of water quality parameters by volumetry and gravimetry.
2. To familiarize the students with the estimation of impurities in aqueous solutions through electro-analytical techniques such as pH metre, potentiometry and conductometry.
3. To demonstrate the analysis of metals by UV-Visible spectroscopy.

COURSE OUTCOMES:

After completion of this course, the students should be able to:

CO1. Independently estimate the water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, chloride and copper contents by appropriate wet chemical analyses.

CO2. Quantitatively analyze the impurities in aqueous solution by electro-analytical techniques.

CO3. Determine the amount of metal ions in aqueous samples by spectroscopic techniques.

LIST OF EXPERIMENTS: ANY SEVEN

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of TDS of a water sample by gravimetry.
7. Determination of strength of given hydrochloric acid using pH meter.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
10. Estimation of iron content of the given solution using potentiometer.
11. Estimation of iron content of the water sample using spectrophotometer (1,10-
12. Phenanthroline / thiocyanate method).

Total Laboratory hours:	**30hours**

Course Code	Course Title	L	T	P	J	C
22BSP101	**PHYSICS AND CHEMISTRY LABORATORY (PHYSICS)**	**0**	**0**	**4**	**0**	**2**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

The course enables the learner to

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear manner.
3. To learn problem solving skills related to physics and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student an active participant in each part of all lab exercises.

COURSE OUTCOMES:

After completion of this course, the students should be able to:

CO1. Understand the functioning of various physics laboratory equipment.

CO2. Use graphical models to analyze laboratory data.

CO3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4. Access, process and analyze scientific information.

CO5. Solve problems individually and collaboratively.

LIST OF EXPERIMENTS (Any Seven Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wavelength of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

Total Laboratory hours:	**30hours**

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EEP101</td><td rowspan="2">PRODUCT TINKERING LABORATORY</td><td>0</td><td>0</td><td>2</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 2.0</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To apply hands on practical training, maintenance and troubleshooting on mechanical and electrical appliances in day-to-day life.
2. To analyse single phase and three phase residential building wiring (Energy meter, fuse, earthing)
3. To understand the internal structure and layout of the computer system.
4. To learn to diagnose minor problems with the computer functioning.
5. To know the proper usage and threats of the world wide web.

COURSE OUTCOMES:

After completion of this course, the students should be able to:

CO1. Apply hands on practical training, maintenance and troubleshooting on mechanical and electrical appliances in day-to-day life.

CO2. Analyse single phase and three phase residential building wiring (Energy meter, fuse, earthing)

CO3. Understand the internal structure and layout of the computer system.

CO4. Learn to diagnose minor problems with the computer functioning.

CO5. Know the proper usage and threats of the world wide web.

LIST OF EXPERIMENTS:

1. MECHANICAL EQUIPMENT STUDY

(a) Hand drilling machine, Screw Jack and centrifugal pump

(b) Two wheeler, Refrigeration and Air Conditioning system.

2. ELECTRICAL EQUIPMENT STUDY

Light fittings, LED, Stabilizer, UPS, Iron box, calling bell, Fan regulator

3. ELECTRONIC EQUIPMENT STUDY

a) Study the elements of a smart phone.

b) Assembly and dismantle of LED TV.

c) Assembly and dismantle of computer/ laptop

4. COMPUTER PERIPHERALS STUDY

PC HARDWARE Identification of the peripherals of a computer, components in a CPU and its functions. Block diagram of the CPU along with the configuration of each peripheral. Functions of Motherboard. Assembling and Disassembling of PC. System Software and application software installation.

5. BIOMEDICAL EQUIPMENT

a) Assembly and dismantle of Electrocardiogram (ECG)

b) Assembly and dismantle of ventilator.

c) Assembly and dismantle of Doppler Ultra sound Scanner.

6.TROUBLESHOOTING

Hardware Troubleshooting: Students are to be given a PC which does not boot due to proper assembly or defective peripherals and the students should be taught to identify and correct the problem.

Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition.

Internet: Web Browsers, Access of websites, Surfing the Web, Search Engines, Customization of web browsers, proxy settings, bookmarks, search toolbars, pop-up blockers. Antivirus downloads, Protection from various threats.

Total Laboratory hours:	**30 HOURS**

SEMESTER II

Course Code	Course Title	L	T	P	J	C
22LET201	FUNCTIONAL ENGLISH	3	0	2	0	4
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to:

1. To gain confidence to respond in English in both academic and professional contexts
2. To improve presentation skills to make effective presentations
3. To foster the ability to write effectively in all contexts
4. To strengthen the skills related to teamwork and leadership roles in society as well as in the workplace
5. To present effective Profile in the context of job search

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Communicate fluently in professional situations
CO2. Express flexibility and appropriate in Technical Events
CO3. Demonstrate complex forms and sentence structures with adequate vocabulary
CO4. Report events and the processes of technological & Industrial firms.
CO5. Present effective Profile in the context of job search

UNIT-1	COMMUNICATIVE COMPETENCE	9 HOURS

Speaking: Interactive skills- Initiation & turn taking; relevance to the topic, puzzles & riddles
Reading – Skimming, Scanning, Churning & Assimilation
Writing – Paragraphs; Free writing & opinion paragraphs
Grammar – Order of Adjectives, Primary Auxiliary Verbs
Vocabulary – Phonetics – sounds and symbols; Vocabulary used in letters and emails

UNIT-2	SITUATIONAL CONVERSATIONS	9 HOURS

Speaking – Practicing fluency- cohesion, coherence, and speed of delivery
Reading – Reading social media messages
Writing – Checklist; Letter to the editor
Grammar – Infinitives, Gerunds and Participles, Interrogative and Reflexive Pronoun
Vocabulary – Verbal Analogies, Same words used as different parts of speech

Unit-3	REPORT ON TECHNICAL EVENTS	9 hours

Speaking –Mock TV news Reading/ anchoring
Reading – Motivational essays on famous Engineers and Technologists
Writing – Dialogue writing; Minutes of Meeting
Grammar – Reported Speech, Modal Verbs
Vocabulary – Technical Vocabulary, Jargon

Unit-4	DEVELOPING DISCUSSION SKILLS	9 hours
Speaking – Giving short talks on technical topics **Reading** - Descriptive passages – magazines/ articles **Writing** – Recommendations; Job application **Grammar** – If conditional sentences, Articles **Vocabulary** - Purpose statements		
Unit-5	**PRESENTATION SKILLS**	**9 hours**
Speaking – Presentations using visual aids-Visume using appropriate body language and gestures; stating and asking for opinions and clarifications **Reading** – Predicting the content, speed reading techniques **Writing** – Precis Writing, Profile Writing **Grammar** – Mixed Tenses, Embedded Clause **Vocabulary** – Error Spotting, Sentence Completion		
	TOTAL LECTURE HOURS:	**45 HOURS**
LIST OF EXPERIMENTS :		
1. Initiation and turn taking		
2. Writing opinion paragraph		
3. Situational conversations		
4. Writing Checklists		
5. Mock TV news reading		
6. Writing the project proposal or Project report		
7. Short talk on technical topics		
8. Writing recommendations		
9. PPT Presentation		
10. Profile writing		
	TOTAL PRACTICAL HOURS:	**30 HOURS**
TEXT BOOK(S)		
1.	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University	
2.	Functional English for Communication (2022 edition) Ujjwala Kakarla, Guru Nanak Institutions Technical Campus (Autonomous), Hyderabad.	
REFERENCE BOOKS		
1.	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.	
2.	Hewings, Martin. Advanced Grammar In Use. New Delhi: CUP,2008 MLA Handbook for Writers of Research Papers, 7th Edition	
3.	Klaus Bruhn Jensen. A handbook of Media and Communication Research. Routledge, 2003	

<table>
<tr><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr>
<tr><td rowspan="2">22LET202</td><td rowspan="2">FRENCH LANGUAGE LEVEL II</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to:
1. To acquire an understanding of basic French language parts of speech
2. To facilitate learner’s ability to learn the French language grammar.
3. To nurture learner’s ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Read and write technical basic French language parts of speech
CO2. Speak appropriately learner’s ability to learn the French language grammar.
CO3. Listen and comprehend lectures learner’s ability to understand the sentence structure
CO4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
CO5. Prepare self-introduction comprehend various lectures and talks</td></tr>
<tr><td>UNIT-1</td><td colspan="5">UNITE-I</td><td>9 + 6 HOURS</td></tr>
<tr><td colspan="7">1. Le Xvi Siècle 2. Ode À Cassandre. Grammaire: Present</td></tr>
<tr><td>UNIT-2</td><td colspan="5">UNITE-II</td><td>9 + 6 HOURS</td></tr>
<tr><td colspan="7">3. Gargantua 4. Ceux Qui Sont Amoureux, Grammaire: Imparfait</td></tr>
<tr><td>UNIT-3</td><td colspan="5">UNITE-III</td><td>9 + 6 HOURS</td></tr>
<tr><td colspan="7">5. Le Xvii Siècle 6. Le Cid 7. L’avare, Grammaire: Futur</td></tr>
<tr><td>UNIT-4</td><td colspan="5">UNITE-IV</td><td>9 + 6 HOURS</td></tr>
<tr><td colspan="7">8. Le Xviii Siècle 9. Lettres Persanes Grammaire: Futur Proche</td></tr>
<tr><td>UNIT-5</td><td colspan="5">UNITE-V</td><td>9 + 6 HOURS</td></tr>
<tr><td colspan="7">10. Le Mariage De Figaro Grammaire: Passé Récent</td></tr>
<tr><td colspan="6">TOTAL LECTURE AND LABORATORY HOURS:</td><td>45+30 HOURS</td></tr>
<tr><td colspan="7">TEXT BOOK(S)</td></tr>
<tr><td>1.</td><td colspan="6">“Littérature Progressive du français »-Niveau intermédiaire (2e Édition)-Nicole Blondeau, Ferroudja Allouache, Marie-Françoise Né.</td></tr>
<tr><td>2.</td><td colspan="6">« Conjugaison progressive du français »-Michèle Boularès, Odile Grand-Clément (CLE international)</td></tr>
<tr><td colspan="7">REFERENCE BOOKS</td></tr>
<tr><td>1.</td><td colspan="6">Michael D. Oates "Entre Amis: An Interactive Approach", 5 th Edition, Houghton Mifflin., 2005</td></tr>
</table>

2.	Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French"
3.	Simone Renaud, Dominique van Hooff "En bonne forme

Course Code	Course Title	L	T	P	J	C
22LET203	GERMAN LANGUAGE LEVEL II	3	0	2	0	4
		Syllabus version		v. 1.0		

COURSE OBJECTIVES:

The course enables the learner to:

1. To acquire an understanding of basic German language parts of speech
2. To facilitate learner's ability to learn the German language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Equip the students in greeting forms to greet the person in the first encounter

CO2. Develop and use familiar, everyday expressions and very simple sentences, which relate to the satisfying of concrete needs.

CO3. Introduce him/herself and others as well as ask others about themselves – e.g. where they live, who they know and what they own – and can respond to questions of this nature

CO4. Make use of familiarizing with the days of the week, months, and dates

CO5. Evaluate the basics of German grammar and practice it in the real time situations

UNIT-1	MODULE I	9 + 6 HOURS
Alphabet, Pronunciation (vowels, consonants), Verb conjugation and Personal Pronouns, Greetings, Introduce oneself and others, Numbers up to 20		
UNIT-2	**MODULE II**	**9 + 6 HOURS**
Interrogative sentence, Yes or No Questions, The verb 'haben' (to have) and 'sein' (to be)- Definite Articles "der, das, die", Nouns (singular, plural), Week days and Months, Jobs, Hobbies		
UNIT-3	**MODULE III**	**9 + 6 HOURS**
Indefinite Articles „ein, ein, eine", - Negation, Imperative with ‚Sie", Strong verbs		
UNIT-4	**MODULE IV**	**9 + 6 HOURS**
Verbs with Accusative, Food and Life in Germany, Conversations on Shopping		
UNIT-5	**MODULE V**	**9 + 6 HOURS**
Time, Adverb of time, Possessive Pronouns, Modal verbs, Separable Verbs, Prepositions, Personal Pronouns in accusative, Past tense of "haben" and "sein", Conversations in a Restaurant, To write an Invitation Letter / E-mail		
	TOTAL LECTURE AND LABORATORY HOURS:	**45+30 HOURS**

REFERENCE BOOKS

1. Lernziel Deutsch I – Deutsch als Fremdsprache. Max Hueber Verlag, München.
2. Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2011
3. Themen Aktuell 1, Hartmurt Aufderstrasse, Heiko Bock, Mechthild Gerdes, Jutta Müller

Course Code	Course Title	L	T	P	J	C
22LET205	JAPANESE LANGUAGE LEVEL II	3	0	2	0	4
		Syllabus version		v. 1.0		

COURSE OBJECTIVES:

The course enables the learner to:

1. To train the students to learn basic Japanese including three writing systems
2. To teach them to learn basic grammar and vocabulary
3. To train them to converse in Japanese in day-to-day scenarios.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Acquire familiarity in all 3 Japanese alphabet & basic vocabulary (Understand)

CO2. Listen and identify individual sounds of Japanese (Understand)

CO3. Use basic sounds and words while speaking (Apply)

CO4. Read and understand simple advertisements, brochures and invitations (Apply)

CO5. Use basic grammar and appropriate vocabulary in completing language tasks (Apply)

UNIT-1	HOLIDAYS	9 HOURS
Hobbies (sports. films, music, etc.) - Places - 18 kanjis - Events - Calendar - ga particle – dekimasu - de particle - masen ka - Shall we go together?		
UNIT-2	**TOWNS**	**9 HOURS**
Countries - Languages - Occupations - Self-introduction - Family - People - Numbers - My family - wa…desu - mo particle- to particle - ni particle - no particle.		
UNIT-3	**SHOPPING**	**9 HOURS**
Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch.		
UNIT-4	**TRAVEL**	**9 HOURS**
Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch.		
UNIT-5	**JLPT PREPARATION**	**9 HOURS**
Daily routines - Time - 10 kanjis - Free-time activities - Places - Calendar - telling time - ni particle - kara… made… - time expression - ii adjective.		
	TOTAL LECTURE AND LABORATORY HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	独立行政法人国際交流基金, 来嶋, 柴原 & 八田. Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Competences / まるごと 日本のことばと文化 入門 A1 りかい 2023.

REFERENCE BOOKS	
1.	Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
2.	Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
3.	www.japaneselifestyle.com
4.	www.learn-japanese.info/
5.	www.kanjisite.com/ & www.learn-hiragana-katakana.com/typing-hiragana-characters/
EXPERIMENTS	
1	Talk about what you want to buy
2	Talk about where to shop for something you want
3	Say briefly what you thought about your days off
4	Write a short blog about your days off
5	Say what you did on your travels
6	Say where you want to go next time
7	Talk about where to shop for something you want
8	Say briefly what you thought about your days off
9	Write a short blog about your days off
10	Say what you did on your travels
11	Say where you want to go next time
12	Presentation about your favorite city
	TOTAL PRACTICAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th colspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22HSM201</td><td colspan="2" rowspan="2">TAMILS AND TECHNOLOGY</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="8">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="8">The course enables the learner to
1. To understand the weaving and ceramic technology during sangam age
2. To know the design and construction technology during sangam age
3. To understand the art of manufacturing technology during sangam age
4. To know about agriculture and irrigation technology during sangam age
5. To understand about Tamil computing and scientific technology</td></tr>
<tr><td colspan="8">COURSE OUTCOMES:</td></tr>
<tr><td colspan="8">After the completion of this course, the students should be able to
CO1. Understand the weaving and ceramic technology during sangam age
CO2. Know the design and construction technology during sangam age
CO3. Understand the art of manufacturing technology during sangam age
CO4. Know about agriculture and irrigation technology during sangam age
CO5. Understand about Tamil computing and scientific technology</td></tr>
<tr><td>UNIT-1</td><td colspan="2">WEAVING AND CERAMIC TECHNOLOGY</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.</td></tr>
<tr><td>UNIT-2</td><td colspan="2">DESIGN AND CONSTRUCTION TECHNOLOGY</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.</td></tr>
<tr><td>UNIT-3</td><td colspan="2">MANUFACTURING TECHNOLOGY</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.</td></tr>
<tr><td>UNIT-4</td><td colspan="2">AGRICULTURE AND IRRIGATION TECHNOLOGY</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.</td></tr>
</table>

UNIT-5	SCIENTIFIC TAMIL & TAMIL COMPUTING	3 HOURS
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
	TOTAL HOURS:	**15 HOURS**

TEXT BOOK(S):	
1	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
2	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
3	Tamilaga Varalaru, Makalum Panpadum- Dr. K.K. Pillai
4	Kanini Tamil- Munaivar L. Sundaram
5	Porunai- Attrangarai Nagarigam
REFERENCE BOOKS:	
1	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
5	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book

<table>
<tr><th>Course Code</th><th colspan="3">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22BST201</td><td rowspan="2" colspan="3">STATISTICS AND TRANSFORMS</td><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="9">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="9">The course enables the learner to:
1. To provide the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
3. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
4. To familiarize the student with Fourier, transform techniques used in wide variety of situations.
5. To explain the student with Z, transform techniques used in wide variety of situations.</td></tr>
<tr><td colspan="9">COURSE OUTCOMES:</td></tr>
<tr><td colspan="9">After the completion of this course, the students should be able to
CO1. Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2. Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO3. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
CO4. Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
CO5. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.</td></tr>
<tr><td colspan="2">UNIT-1</td><td colspan="2">TESTING OF HYPOTHESIS</td><td colspan="5">9+3 HOURS</td></tr>
<tr><td colspan="9">Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit</td></tr>
<tr><td colspan="2">UNIT-2</td><td colspan="2">DESIGN OF EXPERIMENTS</td><td colspan="5">9+3 HOURS</td></tr>
<tr><td colspan="9">One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design.</td></tr>
</table>

UNIT-3	FOURIER SERIES	9+3 HOURS
Dirichlet's conditions — General Fourier series — Odd and even functions — Half range sine series — Half range cosine series — Parseval's identity — Harmonic analysis.		
UNIT-4	**FOURIER TRANSFORMS**	**9+3 HOURS**
Fourier transform pair — Fourier sine and cosine transforms — Properties — Transforms of simple functions — Convolution theorem- Parseval's identity		
UNIT-5	**Z — TRANSFORMS**	**9+3 HOURS**
Z-transforms — Elementary properties — Inverse Z-transform (using partial fraction and residues)— Convolution theorem.		
	TOTAL LECTURE HOURS:	**60 HOURS**

TEXT BOOK(S)	
1.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2.	Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
3.	Narayanan S., Manicavachagom Pillay. T. K and Ramanaiah. G "Advanced Mathematics for Engineering Students", Vol. II & III, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCE BOOKS	
1.	Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014
3.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
4.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010
5.	Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
6.	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
7.	Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
8.	James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
9.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi,2016.
10.	Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Course Code	Course Title	L	T	P	J	C
22ADT201	**DATA STRUCTURES**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the concepts of Abstract Data Types
2. To design linear data structures – lists, stacks, and queues
3. To understand sorting, searching and hashing algorithms
4. To apply Tree structures
5. To evaluate graph ADT and minimum spanning trees

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the concepts of Abstract Data Types
CO2. Design linear data structures – lists, stacks, and queues
CO3. Understand sorting, searching and hashing algorithms
CO4. Apply Tree structures
CO5. Evaluate graph ADT and minimum spanning trees

UNIT-1	ABSTRACT DATA TYPES	9 HOURS

Abstract Data Types (ADTs) – ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying
Introduction to analysis of algorithms – asymptotic notations – recursion – analyzing recursive algorithms

UNIT-2	LINEAR STRUCTURES	9 HOURS

List ADT – array-based implementations – linked list implementations – singly linked lists – circularly linked lists – doubly linked lists – applications of lists – Stack ADT – Queue ADT – double ended queues

UNIT-3	SORTING AND SEARCHING	9 HOURS

Bubble sort – selection sort – insertion sort – merge sort – quick sort – linear search – binary search – hashing – hash functions – collision handling – load factors, rehashing, and efficiency.

UNIT-4	TREE STRUCTURES	9 HOURS

Tree ADT – Binary Tree ADT – tree traversals – binary search trees – AVL trees – heaps – multiway search trees

UNIT-5	GRAPH STRUCTURES	9 HOURS

Graph ADT – representations of graph – graph traversals – DAG – topological ordering – shortest paths – minimum spanning trees

	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, “Data Structures and Algorithms in Python” (An Indian Adaptation), Wiley, 2021
2	Lee, Kent D., Hubbard, Steve, “Data Structures and Algorithms with Python” Springer Edition 2015.
3	Narasimha Karumanchi, “Data Structures and Algorithmic Thinking with Python” Careermonk, 2015.
REFERENCE BOOKS:	
1	Rance D. Necaise, “Data Structures and Algorithms Using Python”, John Wiley & Sons, 2011.
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms", Third Edition, PHI Learning, 2010.
3	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Fourth Edition, Pearson Education, 2014
4	Aho, Hopcroft, and Ullman, “Data Structures and Algorithms”, Pearson Education India, 2002

Course Code	Course Title	L	T	P	J	C
22ADT202	COMPUTER ARCHITECTURE	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To make students understand the basic structure and operation of digital computer.
2. To familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
3. To expose the students to the concept of pipelining.
4. To familiarize the students with hierarchical memory system including cache memories and virtual memory.
5. To expose the students with different ways of communicating with I/O devices and standard I/O interfaces.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the basic structure and operation of digital computer.
CO2. Familiarize with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
CO3. Understand the concept of pipelining.
CO4. Apply hierarchical memory system including cache memories and virtual memory.
CO5. Expose with different ways of communicating with I/O devices and standard I/O interfaces.

UNIT-1	OVERVIEW & INSTRUCTIONS	9 HOURS

Eight ideas – Components of a computer system – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Logical operations – control operations – Addressing and addressing modes.

UNIT-2	ARITHMETIC OPERATIONS	9 HOURS

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations – Subword parallelism.

UNIT-3	PROCESSOR AND CONTROL UNIT	9 HOURS

Basic MIPS implementation – Building datapath – Control Implementation scheme – Pipelining – Pipelined datapath and control – Handling Data hazards & Control hazards – Exceptions.

UNIT-4	PARALLELISM	9 HOURS

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors.

UNIT-5	MEMORY AND I/O SYSTEMS	9 HOURS
Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1	David A. Patterson and John L. Hennessey, "Computer organization and design", Morgan Kauffman / Elsevier, Fifth edition, 2014.

REFERENCE BOOKS:

1	V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", VI th edition, Mc Graw-Hill Inc, 2012.
2	William Stallings "Computer Organization and Architecture" , Seventh Edition , Pearson Education, 2006.
3	Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", Second Edition, Pearson Education, 2005.
4	Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", first edition, Tata McGraw Hill, New Delhi, 2005.
5	John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata Mc Graw Hill, 1998.

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EST205</td><td rowspan="2">BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To introduce the basics of electric circuits and analysis
2. To impart knowledge in the basics of working principles and application of electrical machines
3. To introduce analog devices and their characteristics
4. To educate on the fundamental concepts of digital electronic
5. To introduce the functional elements and working of measuring instruments.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Compute the electric circuit parameters for simple problems

CO2. Explain the working principle and applications of electrical machines

CO3. Analyze the characteristics of analog electronic devices

CO4. Explain the basic concepts of digital electronics

CO5. Explain the operating principles of measuring instruments.

UNIT-1	**ELECTRICAL CIRCUITS**	**9 HOURS**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT-2	**ELECTRICAL MACHINES**	**9 HOURS**

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT-3	**ANALOG ELECTRONICS**	**9 HOURS**

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

UNIT-4	DIGITAL ELECTRONICS	6 HOURS
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).		
UNIT-5	**MEASUREMENTS AND INSTRUMENTATION**	**6 HOURS**
Functional elements of an instrument, Standards and calibration, Operating Principle , types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT,DSO- Block diagram- Data acquisition		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020.
2	S.K.Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017

REFERENCE BOOKS:

1	Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019.
2	Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.
3	Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7 th edition, 2017

Course Code	Course Title	L	T	P	J	C
22EST202	**ENGINEERING GRAPHICS**	**1**	**0**	**4**	**0**	**3**
		Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To develop students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To Familiarize with basic geometrical constructions and orthographic projections.
3. To make the students to draw the different projections of the solids.
4. To view the true shape and apparent shape of the sectioned solids and their developments.
5. To get an idea about 3D views through isometric projections.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Perform basic geometrical constructions and principles of orthographic projections.

CO2. Project orthographic projections of lines and plane surfaces.

CO3. Draw projections of solids and development of surfaces.

CO4. Visualize and to project isometric views and conversion of Isometric views to Orthographic views.

CO5. Understand the basics of AUTO CAD and fundamentals of perspective projections.

UNIT-0	CONCEPTS AND CONVENTIONS (Not for Examination)	(9+3) HOURS

Importance of graphics in engineering applications — Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT-1	PLANE CURVES, PROJECTIONOF POINTS AND LINES	(9+3) HOURS

Conic Sections - Construction of Ellipse, Parabola & hyperbola by eccentricity method – Construction of cycloid. Introduction of Orthographic projection.

First angle projection - projection of points and Projection of Lines (only for understanding)

UNIT-2	PROJECTION OF PLANES AND SOLIDS	(9+3) HOURS

Projection of simple planes (Square, circular, Hexagon, Pentagon) inclined to both the principal planes by rotating object method. Projection of simple solids like Prism, Pyramid, Cylinder& Cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT-3	SECTION AND DEVELOPMENT SURFACES OF SOLIDS	(9+3) HOURS

Sectioning of simple solids (Prism, Pyramid, Cylinder& Cone) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of surfaces of right regular sectioned solids

UNIT-4	ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS	(9+3) HOURS
Principles of Isometric Projections-Isometric scale- Isometric Views of simple and truncated solids. Conversion of Isometric views of the objects to Orthographic views Exercises using free hand sketching.		
UNIT-5	**COMPUTER AIDED DRAFTING (Only for Internal Evaluation)**	**(9+3) HOURS**
Introduction to engineering graphics CAD tools, Drawing Orthographic views from Isometric views using CAD tools--Floor plans of simple buildings- Exercise of circuit diagram (2D Orthographic Views) and 3D modeling (Isometric Views) using AutoCAD Software. Special points applicable to University Examinations on Engineering Graphics: 1. There will be five questions, each of either or type covering all units of the syllabus. 2. All questions will carry equal marks of 20 each making a total of 100. 3. The answer paper shall consist of drawing sheets of A3 size only. 4. The students will be permitted to use appropriate scale to fit solution within A3 size 5. The examination will be conducted in appropriate sessions on the same day		
	TOTAL HOURS:	**60 HOURS**

TEXT BOOK(S):

1	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2	Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3	Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCE BOOKS:

1	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edit ion, 2019.
2	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3	Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5	Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
6	Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

LIST OF EQUIPMENTS		
S. NO	**DESCRIPTION OF EQUIPMENT**	**QUANTITY**
1.	Computer nodes or systems with suitable graphics facility	30 Nos
2.	Software for Drafting and Modelling	30 Nos
3.	Laser Printer or Plotter to print / plot drawings	1 No

LIST OF EXPERIMENTS :

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software.
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola
3. Drawing orthographic view of simple solids like Prism, Pyramids, Cylinder, Cone, etc, and dimensioning.
4. Drawing of simple solids like prism and pyramids when the axis is inclined to HP.
5. Drawing of simple solids like cylinder and cone when the axis is inclined to HP.
6. Drawing isometric projection of simple solids.
7. Drawing of star –delta starter circuit
8. Drawing an electrical circuit of three-point starter.
9. Drawing of an electrical power supply circuit.
10. Drawing of Hartley oscillator.

Course Code	Course Title	L	T	P	J	C
22EET201	**INNOVATION AND DESIGN THINKING**	**2**	**0**	**0**	**0**	**2**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Learn design thinking concepts and principles
2. Use design thinking methods in every stage of the problem
3. Learn the different phases of design thinking
4. Apply various methods in design thinking to different problems

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Innovation of the new environmental conditions

CO2. Define key concepts of design thinking

CO3. Practice design thinking in all stages of problem-solving

CO4. Apply design thinking approach to real-world problems

UNIT-1	**INNOVATIONS**	**6 HOURS**

Introduction, innovation in current environment, types of innovation, schools of innovation, analyzing the current business scenario, challenges of innovation, steps of innovation management, experimentation in innovation management, participation for innovation, co-creation for innovation, prototyping to incubation. blue ocean strategy –I, blue ocean strategy-II. marketing of innovation, technology innovation process.

UNIT-2	**DESIGN THINKING**	**6 HOURS**

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment, System Thinking, Product Thinking

UNIT-3	**UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM**	**6 HOURS**

Search field determination - Problem clarification - Understanding of the problem - Problem analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

UNIT-4	**IDEATION AND PROTOTYPING**	**6 HOURS**

Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.

UNIT-5	TESTING AND IMPLEMENTATION	6 HOURS
Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking. Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing tomorrow.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Christian Mueller-Rotenberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2	Designing for Growth: a design thinking tool kit for managers by Jeanne Liedtka and Tim Ogilvie.
3	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown
4	John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage Learning (International edition) Second Edition, 2013
REFERENCE BOOKS:	
1	Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
2	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011 4. http://ajjuliani.com/design-thinking-activities/
4	Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, second Edition, 2011.
5	https://venturewell.org/class-exercises

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADP201</td><td rowspan="2">DATA STRUCTURES LABORATORY</td><td>0</td><td>0</td><td>3</td><td>0</td><td>1.5</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the concepts of Abstract Data Types
2. To design linear data structures – lists, stacks, and queues
3. To understand sorting, searching and hashing algorithms
4. To apply Tree structures
5. To evaluate graph ADT and minimum spanning trees

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the concepts of Abstract Data Types
CO2. Design linear data structures – lists, stacks, and queues
CO3. Understand sorting, searching and hashing algorithms
CO4. Apply Tree structures
CO5. Evaluate graph ADT and minimum spanning trees

LIST OF EXPERIMENTS :

1. Implement simple ADTs as Python classes
2. Implement recursive algorithms in Python
3. Implement List ADT using Python arrays
4. Linked list implementations of List
5. Implementation of Stack and Queue ADTs
6. Applications of List, Stack and Queue ADTs
7. Implementation of sorting and searching algorithms
8. Implementation of Hash tables
9. Tree representation and traversal algorithms
10. Implementation of Binary Search Trees
11. Implementation of Heaps
12. Graph representation and Traversal algorithms
13. Implementation of single source shortest path algorithm
14. Implementation of minimum spanning tree algorithms

TOTAL HOURS: 60 HOURS

Course Code	Course Title	L	T	P	J	C
22ESP201	ENGINEERING PRODUCT LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2. Wire various electrical joints in common household electrical wire work.

CO3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES PLUMBING WORK

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

PART II ELECTRICAL ENGINEERING PRACTICES

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring with introduction to CFL and LED types.
3. Stair case wiring
4. Residential house wiring using fuse, switch, indicator, lamp and energy meter.
5. Measurement of energy using single phase energy meter.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

Demonstrating welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

BASIC MACHINING WORK:

Demonstrating of a) (simple)Turning. b) (simple)Drilling. c) (simple)Tapping.

3D PRINITNG:

Demonstrating of working principle of 3D Printer machine.

FOUNDRY WORK:

a) Demonstrating basic foundry operations

SHEET METAL WORK:

b) Making of a square tray
c) Making of a cone

FITTING EXERCISE:

Make a model by using fitting exercise

PART IV ELECTRONIC ENGINEERING PRACTICES

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.

TOTAL HOURS: 60 HOURS

Course Code	COURSE TITLE	L	T	P	J	C
22NXP201	NCC Credit Course Level 1*(ARMY WING)	1	0	0	0	1
		Syllabus version		v. 1.0		

UNIT-I	NCC GENERAL	3 HOURS
NCC 1 Aims, Objectives & Organization of NCC NCC 2 Incentives NCC 3 Duties of NCC Cadet NCC 4 NCC Camps: Types & Conduct		
UNIT-II	**NATIONAL INTEGRATION AND AWARENESS**	**3 HOURS**
NI 1 National Integration: Importance & NecessityNI 2 Factors Affecting National Integration NI 3 Unity in Diversity & Role of NCC in Nation Building NI 4 Threats to National Security		
UNIT-III	**PERSONALITY DEVELOPMENT**	**3 HOURS**
PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem SolvingPD 2 Communication Skills PD 3 Group Discussion: Stress & Emotions		
UNIT-IV	**LEADERSHIP**	**2 HOURS**
L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour CodeL 2 Case Studies: Shivaji, Jhasi Ki Rani		
UNIT-V	**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**	**4 HOURS**
SS 1 Basics, Rural Development Programmes, NGOs, Contribution o YouthSS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel SafetySS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness		
	TOTAL LECTURE HOURS	**15 HOURS**

Course Code	COURSE TITLE	L	T	P	J	C
22NXP201	NCC Credit Course Level 1*(AIR FORCE WING)	1	0	0	0	1
		Syllabus version		v. 1.0		

UNIT-I	NCC GENERAL	3 HOURS
NCC 1 Aims, Objectives & Organization of NCCNCC 2 Incentives NCC 3 Duties of NCC Cadet NCC 4 NCC Camps: Types & Conduct		
UNIT-II	**NATIONAL INTEGRATION AND AWARENESS**	**3 HOURS**
NI 1 National Integration: Importance & NecessityNI 2 Factors Affecting National Integration NI 3 Unity in Diversity & Role of NCC in Nation Building NI 4 Threats to National Security		
UNIT-III	**PERSONALITY DEVELOPMENT**	**3 HOURS**
PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem SolvingPD 2 Communication Skills PD 3 Group Discussion: Stress & Emotions		
UNIT-IV	**LEADERSHIP**	**2 HOURS**
L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour CodeL 2 Case Studies: Shivaji, Jhasi Ki Rani		
UNIT-V	**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**	**4 HOURS**
SS 1 Basics, Rural Development Programmes, NGOs, Contribution o YouthSS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel SafetySS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness		
	TOTAL LECTURE HOURS	**15 HOURS**

SEMESTER III

Course Code	Course Title	L	T	P	J	C
22BST301	**DISCRETE MATHEMATICS**	**3**	**1**	**0**	**0**	**4**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:
The course enables the learner to 1. To extend student's logical and mathematical maturity and ability to deal with abstraction. 2. To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems. 3. To understand the basic concepts of combinatorics and graph theory. 4. To familiarize the applications of algebraic structures. 5. To understand the concepts and significance of lattices and Boolean algebra which are widely used in computer science and engineering.
COURSE OUTCOMES:
After the completion of this course, the students should be able to CO1. Have knowledge of the concepts needed to test the logic of a program. CO2. Have an understanding in identifying structures on many levels. CO3. Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science. CO4. Be aware of the counting principles. CO5. Be exposed to concepts and properties of algebraic structures

UNIT-1	**LOGIC AND PROOFS**	**12 HOURS**
Propositional logic – Propositional equivalences - Predicates and quantifiers – Rules of inference - Introduction to proofs		
UNIT-2	**COMBINATORICS**	**12 HOURS**
Mathematical induction --The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Inclusion and exclusion principle and its applications.		
UNIT-3	**GRAPHS**	**12 HOURS**
Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.		
UNIT-4	**ALGEBRAIC STRUCTURES**	**12 HOURS**
Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's– Lagrange's theorem		

<table>
<tr><td>UNIT-5</td><td colspan="2">LATTICES AND BOOLEAN ALGEBRA</td><td>12 HOURS</td></tr>
<tr><td colspan="4">Partial ordering – Po-sets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra</td></tr>
<tr><td colspan="3" align="right">TOTAL HOURS:</td><td>60 HOURS</td></tr>
<tr><td colspan="4">TEXT BOOK(S):</td></tr>
<tr><td>1</td><td colspan="3">Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.</td></tr>
<tr><td>2</td><td colspan="3">Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.</td></tr>
<tr><td colspan="4">REFERENCE BOOKS:</td></tr>
<tr><td>1</td><td colspan="3">Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5thEdition, Pearson Education Asia, Delhi, 2013.</td></tr>
<tr><td>2</td><td colspan="3">Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.</td></tr>
<tr><td>3</td><td colspan="3">Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum’s Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.</td></tr>
</table>

Course Code	Course Title	L	T	P	J	C
22CST301	**SYSTEM SOFTWARE**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the relationship between system software and machine architecture.
2. To know the design and implementation of assemblers
3. To know the design and implementation of linkers and loaders.
4. To have an understanding of macro processors.
5. To have an understanding of system software tools.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Design various combinational digital circuits using logic gates
CO2. Design sequential circuits and analyze the design procedures
CO3. State the fundamentals of computer systems and analyze the execution of an instruction
CO4. Analyze different types of control design and identify hazards
CO5. Identify the characteristics of various memory systems and I/O communication

UNIT-1	**INTRODUCTION**	**9 HOURS**
System software and machine architecture – The Simplified Instructional Computer (SIC) - Machine architecture - Data and instruction formats - addressing modes - instruction sets - I/O and programming.		

UNIT-2	**ASSEMBLERS**	**9 HOURS**
Basic assembler functions - A simple SIC assembler – Assembler algorithm and data structures- Machine dependent assembler features - Instruction formats and addressing modes – Program relocation - Machine independent assembler features - Literals – Symbol-defining statements – Expressions - One pass assemblers and Multi pass assemblers - MASM assembler.		

UNIT-3	**LOADERS AND LINKERS**	**9 HOURS**
Basic loader functions - Design of an Absolute Loader – A Simple Bootstrap Loader - Machine dependent loader features - Relocation – Program Linking – Algorithm and Data Structures for Linking Loader - Machine-independent loader features - Automatic Library Search – Loader Options - Loader design options - Linkage Editors – Dynamic Linking – Bootstrap Loaders - MSDOS linker.		

UNIT-4	**MACRO PROCESSORS**	**9 HOURS**
Basic macro processor functions - Macro Definition and Expansion – Macro Processor Algorithm and data structures - Machine-independent macro processor features - Concatenation of Macro Parameters – Generation of Unique Labels – Conditional Macro Expansion – Keyword Macro Parameters-Macro within Macro.		

UNIT-5	SYSTEM SOFTWARE TOOLS	9 HOURS
Text editors - Overview of the Editing Process - User Interface – Editor Structure. - Interactive debugging systems - Debugging functions and capabilities – Relationship with other parts of the system – User-Interface Criteria.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2006.

REFERENCE BOOKS:

1	D.M. Dhamdhere,"Systems Programming Operating Systems", Second and Revised and Edition, Tata McGraw-Hill, 2000.
2	John J. Donovan "Systems Programming", Tata McGraw-Hill Edition, 2000.
3	John R. Levine, Linkers & Loaders – Harcourt India Pvt. Ltd., Morgan Kaufmann Publishers, 2000

Course Code	Course Title	L	T	P	J	C
22ADT302	DESIGN AND ANALYSIS OF ALGORITHMS	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To critically analyze the efficiency of alternative algorithmic solutions for the same problem
2. To illustrate brute force and divide and conquer design techniques.
3. To explain dynamic programming and greedy techniques for solving various problems.
4. To apply iterative improvement technique to solve optimization problems
5. To examine the limitations of algorithmic power and handling it in different problems.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Analyze the efficiency of recursive and non-recursive algorithms mathematically

CO2. Analyze the efficiency of brute force, divide and conquer, decrease and conquer, Transform and conquer algorithmic techniques

CO3. Implement and analyze the problems using dynamic programming and greedy algorithmic techniques.

CO4. Solve the problems using iterative improvement techniques for optimization.

CO5. Compute the limitations of algorithmic power and solve the problems using back tracking and branch and bound techniques.

UNIT-1	INTRODUCTION	6 HOURS

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework - Asymptotic Notations and their properties – Empirical analysis - Mathematical analysis of Recursive and Non-recursive algorithms – Visualization.

UNIT-2	BRUTE FORCE AND DIVIDE AND CONQUER	6 HOURS

Brute Force – String Matching - Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Multiplication of Large Integers and Strassen's Matrix Multiplication – Closest-Pair and Convex - Hull Problems. Decrease and Conquer: - Topological Sorting – Transform and Conquer: Presorting – Heaps and Heap Sort.

UNIT-3	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	6 HOURS

Dynamic programming – Principle of optimality - Coin changing problem – Warshall's and Floyd's algorithms – Optimal Binary Search Trees - Multi stage graph - Knapsack Problem and Memory functions. Greedy Technique – Dijkstra's algorithm - Huffman Trees and codes - 0/1 Knapsack problem.

UNIT-4	ITERATIVE IMPROVEMENT	6 HOURS
The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs- The Stable Marriage Problem.		
UNIT-5	**LIMITATIONS OF ALGORITHM POWER**	**6 HOURS**
Lower - Bound Arguments - P, NP, NP- Complete and NP Hard Problems. Backtracking – N-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Traveling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Traveling Salesman problem – Knapsack problem.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.
2	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
3	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.

REFERENCE BOOKS:

1	S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.

LIST OF EXPERIMENTS :

1. Implement recursive and non-recursive algorithms and study the order of growth from log2n to n!.
2. Divide and Conquer - Strassen's Matrix Multiplication
3. Decrease and Conquer - Topological Sorting
4. Transform and Conquer - Heap Sort
5. Dynamic programming - Coin change Problem, Warshall's and Floyd's algorithms, Knapsack Problem
6. Greedy Technique – Dijkstra's algorithm, Huffman Trees and codes
7. Iterative improvement - Simplex Method
8. Backtracking – N-Queen problem, Subset Sum Problem
9. Branch and Bound - Assignment problem, Traveling Salesman Problem

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADT303</td><td rowspan="2">DATABASE SYSTEMS</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To introduce database development life cycle and conceptual modelling
2. To learn SQL for data definition, manipulation and querying a database
3. To learn relational database design using conceptual mapping and normalization
4. To learn transaction concepts and serializability of schedules
5. To learn data model and querying in object-relational and No-SQL databases

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the database development life cycle and apply conceptual modelling

CO2. Apply SQL and programming in SQL to create, manipulate and query the database

CO3. Apply the conceptual-to-relational mapping and normalization to design relational database

CO4. Determine the serialize ability of any non-serial schedule using concurrency techniques

CO5. Apply the data model and querying in Object-relational and No-SQL databases.

UNIT-1	**DATA MODELING**	**9 HOURS**
Database architecture – Database system development lifecycle – Requirements collection – Database design -- Entity-Relationship model – Enhanced-ER model		
UNIT-2	**RELATIONAL MODEL AND SQL**	**9 HOURS**
Relational model concepts -- Integrity constraints -- SQL Data manipulation – SQL Data definition – Views -- SQL programming.		
UNIT-3	**RELATIONAL DATABASE DESIGN AND NORMALIZATION**	**9 HOURS**
Functional dependencies – Update anomalies -Inference rules –Minimal cover – Properties of relational decomposition – Normalization (up to BCNF).		
UNIT-4	**TRANSACTION MANAGEMENT**	**9 HOURS**
Transaction concepts – ACID properties – Schedules – Serial, Non Serial and Conflict Serializability – Serializability – types of Serializability – Concurrency Control –Two-phase locking techniques.		
UNIT-5	**QUERY PROCESSING**	**9 HOURS**
File organization: – File organization – various kinds of indexes. Query Processing – Measures of query cost - Selection operation – Projection operation, - Join operation – set operation and aggregate operation – Relational Query Optimization – Transacting SQL queries – Estimating the cost – Equivalence Rules- Indexing and Hashing.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Abraham Silberschatz, Henry F Korth, S Sudharshan, “Database System Concepts", 6th Edition, Tata Mc Graw Hill, 2011.
2	Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Pearson, 2017
REFERENCE BOOKS:	
1	Toby Teorey, Sam Lightstone, Tom Nadeau, H. V. Jagadish, “DATABASE MODELING AND DESIGN - Logical Design”, Fifth Edition, Morgan Kaufmann Publishers, 2011.
2	Carlos Coronel, Steven Morris, and Peter Rob, Database Systems: Design, Implementation, And Management, Ninth Edition, Cengage learning, 2012
3	Thomas M. Connolly, Carolyn E. Begg, Database Systems – A Practical Approach to Design, Implementation, and Management, Sixth Edition, Global Edition, Pearson Education, 2015.
4	Hector Garcia-Molina, Jeffrey D Ullman, Jennifer Widom, "Database Systems:The Complete Book", 2nd edition, Pearson.
5	Raghu Ramakrishnan, “Database Management Systems", 4th Edition, Tata Mc Graw Hill, 2010.

Course Code	Course Title	L	T	P	J	C
22ADT304	**SOFTWARE ENGINEERING**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To identify the key activities in managing a software project.
2. To compare different process models.
3. To concepts of requirements engineering and Analysis Modeling.
4. To apply systematic procedure for software design and deployment.
5. To compare and contrast the various testing and maintenance.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Identify the key activities in managing a software project.
CO2. Compare different process models.
CO3. Concepts of requirements engineering and Analysis Modeling.
CO4. Apply systematic procedure for software design and deployment.
CO5. Compare and contrast the various testing and maintenance.

UNIT-1	**SOFTWARE PROCESS AND PROJECT MANAGEMENT**	**9 HOURS**

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Software Project Management: Project Scheduling – Scheduling, Earned Value Analysis – Risk Management

UNIT-2	**REQUIREMENTS ANALYSIS AND SPECIFICATION**	**9 HOURS**

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements Management-Classical analysis: Data Dictionary.

UNIT-3	**SOFTWARE DESIGN**	**9 HOURS**

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, - User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT-4	TESTING AND IMPLEMENTATION	9 HOURS
Software testing Fundamentals-Internal and external views of Testing-white box testing- control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging -Refactoring.		
UNIT-5	**PROJECT MANAGEMENT**	**9 HOURS**
Estimation – FP Based, LOC Based, Make/Buy Decision, – Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, RMMM – Scheduling and Tracking –Relationship between people and effort, Task Set & Network, Scheduling, EVA – Process and Project Metrics		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Roger S. Pressman, “Software Engineering – A Practitioner‟s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.

REFERENCE BOOKS:

1	Ian Sommerville, “Software Engineering”, 9th Edition, PearsonEducation Asia, 2011.
2	Rajib Mall, “Fundamentals of Software Engineering”, Third Edition,PHI Learning PrivateLimited ,2009.
3	Pankaj Jalote, “Software Engineering, A Precise Approach”, WileyIndia, 2010.
4	Kelkar S.A., “Software Engineering”, Prentice Hall of India Pvt Ltd,2007.
5	Stephen R.Schach, “Software Engineering”, Tata McGraw-HillPublishing Company Limited,2007.

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADT305</td><td rowspan="2">ARTIFICIAL INTELLIGENCE</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To explain intelligent agent frameworks
2. To apply problem solving techniques
3. To apply game playing and CSP techniques
4. To perform logical reasoning
5. To perform probabilistic reasoning under uncertainty.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain intelligent agent frameworks
CO2. Apply problem solving techniques
CO3. Apply game playing and CSP techniques
CO4. Perform logical reasoning
CO5. Perform probabilistic reasoning under uncertainty.

UNIT-1	INTELLIGENT AGENTS	9 HOURS

Introduction to AI – Agents and Environments – concept of rationality – nature of environments –structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

UNIT-2	PROBLEM SOLVING	9 HOURS

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments

UNIT-3	GAME PLAYING AND CSP	9 HOURS

Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

UNIT-4	LOGICAL REASONING	6 HOURS

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution.

UNIT-5	**PROBABILISTIC REASONING**	**9 HOURS**
Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”,Fourth Edition, Pearson Education, 2021.
REFERENCE BOOKS:	
1	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007
2	Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4	Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.
5	http://nptel.ac.in/

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22HST301</td><td rowspan="2">ENTREPRENEURSHIP AND STARTUPS</td><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To provide practical, proven tools for transforming an idea into a product or service that creates value for others
2. To build a winning strategy, how to shape a unique value proposition, prepare a business plan
3. To impart practical knowledge on business opportunities
4. To inculcate the habit of becoming an entrepreneur
5. To know the financing, growth, and new venture & its problems

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Transform ideas into real products, services, and processes by validating the idea, testing it, and turning it into a growing, profitable, and sustainable business.

CO2. Identify the major steps and requirements to estimate the potential of an innovative ideas the basis of an innovative project.

CO3. Reach creative solutions via an iteration of a virtually endless stream of world-changing ideas and strategies, integrating feedback and learning from failures along the way.

CO4. Apply the ten entrepreneurial tools in creating a business plan for a new innovative venture.

CO5. Apply methods and strategies learned from interviews with start-up entrepreneurs and Innovators

UNIT-1	ENTREPRENEURIAL COMPETENCE	6 HOURS

Introduction to Entrepreneurship & Entrepreneur Meaning and concept of Entrepreneurship, the history of Entrepreneurship development, Myths of Entrepreneurship, the role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management, and the Future of Entrepreneurship. The Entrepreneur: Means the skills required to be an entrepreneur, the entrepreneurial decision process, Role models, Mentors and Support system.

UNIT-2	BUSINESS PLAN PREPARATION AND PROTOTYPING	6 HOURS

Business Opportunity Identification and Preparing a Business Plan Business ideas, methods of generating ideas, and opportunity recognition, Idea Generation Process, Feasibility study, preparing a Business Plan: Meaning and significance of a business plan, components of a business plan. Experimentation and incubation, Participation in Innovation & Co-creation, and Prototyping

UNIT-3	ENTREPRENEURIAL ENVIRONMENT	6 HOURS
Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations		
UNIT-4	**LAUNCHING OF SMALL BUSINESS**	**6 HOURS**
Financing & Launching the New Venture Importance of new venture financing, types of ownership, venture capital, types of debt securities, determining ideal debt-equity mix, and financial institutions and banks. Launching the New Venture: Choosing the legal form of the new venture, protection of intellectual property, and formation of the new venture.		
UNIT-5	**MANAGEMENT OF SMALL BUSINESS**	**6 HOURS**
Managing Growth & Rewards in New Venture Characteristics of high growth new ventures, strategies for growth, and building the new ventures. Managing Rewards: Exit Strategies for Entrepreneurs, Mergers and acquisitions, Succession and exit strategy, managing failures – bankruptcy - Business Sickness - Effective Management of Small Business - Case Studies.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Stephen Key, “One Simple Idea for Start-ups and Entrepreneurs: Live Your Dreams and Create Your Own Profitable Company”, 1st Edition, Tata Mc Graw hill Company, New Delhi, 2013.
2	Charles Bamford and Garry Bruton, “ENTREPRENEURSHIP: The Art, Science, and Process for Success”, 2nd Edition, Tata Mc Graw hill Company, New Delhi,2016.

REFERENCE BOOKS:

1	Philip Auerswald, “The Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy”, Oxford University Press, 2012.
2	Janet Kiholm Smith; Richard L. Smith; Richard T. Bliss, “Entrepreneurial Finance: Strategy, Valuation, and Deal Structure, Stanford Economics and Finance”, 2011.

Course Code	Course Title	L	T	P	J	C
22EEP301	SOFT SKILLS	**0**	**0**	**2**	**0**	**1**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To do self-introspection and develop right attitude
2. To understand the self-motivation and mange his abilities with time
3. To understand the inter personal skills
4. To know the leader's qualities and develop as a leader
5. To understand the conflict at work and make right decisions

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Do self-introspection and develop right attitude
CO2. Understand the self-motivation and mange his abilities with time
CO3. Understand the inter personal skills
CO4. Know the leader's qualities and develop as a leader
CO5. Understand the conflict at work and make right decisions

UNIT-1	SELF ANALYSIS	6 HOURS

Introduction, SWOT analysis, self-introspection, self confidence and self-esteem, Creativity - Out ofthe box thinking, Creative thinking and Lateral thinking, Factors influencing attitude, Influence of attitude on behaviour, Synergy between knowledge, skill and attitude,

UNIT-2	GROWTH FACTORS	6 HOURS

Motivation, Motivational factors, Self-motivation, Intrinsic and extrinsic motivators, Goal setting, SMART goals, Short, long, life time goals, Time management, Value of time, Test your Time management skill, Prioritizing work, Time management matrix

UNIT-3	INTERPERSONAL SKILLS	6 HOURS

Gratitude, Secret of happiness, Understanding the integration of leadership, networking and teamwork, situation analysis, Importance of teamwork, Teamwork activity, Stress Management- Causes of stress and its impact, how to manage and de-stress

UNIT-4	LEADERSHIP	6 HOURS

Skills needed for a good leader, Types of leadership style, Assessment of leadership skills, Wheel of leadership, Personal, social and professional etiquette
Emotional intelligence, Emotional quotient and intelligence quotient, Emotion scale, Managing Emotions

UNIT-5	CONFLICT RESOLUTION AND DECISION MAKING	6 HOURS
Conflicts in human relations, Self-assessment test for conflict management, Approaches to conflict resolution, Case study Decision making- Importance of decision making, Impact of decision in life, Process and practical way of decision making.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	SOFT SKILLS, 2015, Career Development Centre, Green Pearl Publications.
REFERENCE BOOKS:	
1	Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
2	Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.
3	Thomas A Harris, I am ok, You are ok, New York-Harper and Row, 1972.
4	Daniel Coleman, Emotional Intelligence, Bantam Book, 2006.
5	Carnegie Dale, How to stop worrying and start living, New York: Simon & Schuster, 1985.
6	http://empower.srmuniv.ac.in (online LMS)

Course Code	Course Title	L	T	P	J	C
22ADP301	**ARTIFICIAL INTELLIGENCE LABORATORY**	**0**	**0**	**3**	**0**	**1.5**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To design and implement search strategies.
2. To implement game playing techniques
3. To implement CSP techniques
4. To develop systems with logical reasoning
5. To develop systems with probabilistic reasoning

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Design and implement search strategies.
CO2. Implement game playing techniques
CO3. Implement CSP techniques
CO4. Develop systems with logical reasoning
CO5. Develop systems with probabilistic reasoning

LIST OF EXPERIMENTS :

1. Implement basic search strategies– 8-Puzzle, 8 - Queens
2. Implement A* and memory bounded A* algorithms
3. Implement Minimax algorithm for game playing (Alpha-Beta pruning)
4. Solve constraint satisfaction problems
5. Implement propositional model checking algorithms
6. Implement forward chaining, backward chaining, and resolution strategies
7. Build naïve Bayes models
8. Implement Bayesian networks and perform inferences
9. Mini-Project

TOTAL HOURS: 45 HOURS

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<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADP302</td><td rowspan="2">DATABASE SYSTEMS LABORATORY</td><td>0</td><td>0</td><td>3</td><td>0</td><td>1.5</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To understand the database development life cycle
2. To learn database design using conceptual modelling, Normalization
3. To implement database using Data definition, Querying using SQL manipulation and SQL programming
4. To implement database applications using IDE/RAD tools
5. To learn querying Object-relational databases

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the database development life cycle

CO2. Learn database design using conceptual modelling, Normalization

CO3. Implement database using Data definition, Querying using SQL manipulation and SQL programming

CO4. Implement database applications using IDE/RAD tools

CO5. Learn querying Object-relational databases

LIST OF EXPERIMENTS :

1. Database Development Life cycle: Problem definition and Requirement analysis, Scope and Constraints
2. Database design using Conceptual modeling (ER-EER) – top-down approach Mapping conceptual to relational database and validate using Normalization
3. Implement the database using SQL Data definition with constraints, Views
4. Query the database using SQL Manipulation
5. Querying/Managing the database using SQL Programming
6. Stored Procedures
7. Stored Functions
8. Constraints using Triggers
9. Security using Triggers
10. Database design using Normalization – bottom-up approach

TOTAL HOURS: 45 HOURS

SEMESTER IV

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22BST401</td><td rowspan="2">PROBABILITY AND STATISTICS</td><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. This course aims at providing the required skill to apply the statistical tools in engineering problems.
2. To introduce the basic concepts of probability and random variables.
3. To introduce the basic concepts of two-dimensional random variables.
4. To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems?
5. To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.

CO2. Understand the basic concepts of one- and two-dimensional random variables and apply in engineering applications.

CO3. Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO4. Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.

CO5. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

UNIT-1	**PROBABILITY AND RANDOM VARIABLES**	**12 HOURS**

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions

UNIT-2	**TWO- DIMENSIONAL RANDOM VARIABLES**	**12 HOURS**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables

UNIT-3	**ESTIMATION THEORY**	**12 HOURS**

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances

UNIT-4	NON- PARAMETRIC TESTS	12 HOURS
Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.		
UNIT-5	**STATISTICAL QUALITY CONTROL**	**12 HOURS**
Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.		
	TOTAL HOURS:	**60 HOURS**

TEXT BOOK(S):	
1	Johnson. R.A., Miller. I.R and Freund. J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016
2	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007
3	John E. Freund, "Mathematical Statistics", Prentice Hall, 5th Edition, 1992.

REFERENCE BOOKS:	
1	Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3	Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5thEdition, Elsevier, 2014.
4	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2010.

Course Code	Course Title	L	T	P	J	C
22ADT401	**OPERATING SYSTEMS**	**3**	**0**	**2**	**0**	**4**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To analyze various scheduling algorithms and process synchronization.
2. To explain deadlock, prevention and avoidance algorithms.
3. To compare and contrast various memory management schemes.
4. To explain the functionality of file systems I/O systems, and Virtualization
5. To compare iOS and Android Operating Systems.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Analyze various scheduling algorithms and process synchronization.
CO2. Explain deadlock, prevention and avoidance algorithms.
CO3. Compare and contrast various memory management schemes.
CO4. Explain the functionality of file systems I/O systems, and Virtualization
CO5. Compare iOS and Android Operating Systems.

UNIT-1	**INTRODUCTION**	**9 HOURS**

Operating System Overview – Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services User Operating System Interface - System Calls – System Programs :Types of OS - Interrupt handling Basic architectural concepts of an OS-Resource Manager view-process view - hierarchical view of an OS.

UNIT-2	**PROCESS MANAGEMENT**	**9 HOURS**

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter- process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The critical-section problem -Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT-3	**MEMORY MANAGEMENT**	**9 HOURS**

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames – Thrashing.

UNIT-4	**STORAGE MANAGEMENT**	**9 HOURS**

Mass Storage system – Disk Structure - Disk Scheduling and Management; File- System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.

UNIT-5	VIRTUAL MACHINES AND MOBILE OS	9 HOURS
Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "OperatingSystem Concepts", 9th Edition, John Wiley and Sons Inc., 2018.

REFERENCE BOOKS:

1	Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2	William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.
3	Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

LIST OF EXPERIMENTS :

1. Installation of Operating system : Windows/ Linux
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls : Fork, Exec, Getpid, Exit, Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphores
7. Write a C program to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program
11. Write C programs to implement the following Memory Allocation Methods
12. First Fit
13. Write C programs to implement the various Page Replacement Algorithms
14. Write C programs to Implement the various File Organization Techniques
15. Implement the following File Allocation Strategies using C programs

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADT402	MACHINE LEARNING	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basic concepts of machine learning.
2. To understand and build supervised learning models.
3. To understand and build unsupervised learning models.
4. To evaluate the algorithms based on corresponding metrics identified

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the basic concepts of machine learning.
CO2. Construct supervised learning models.
CO3. Construct unsupervised learning algorithms.
CO4. Evaluate and compare different models

UNIT-1	INTRODUCTION TO MACHINE LEARNING	9 HOURS

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik- Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT-2	SUPERVISED LEARNING	9 HOURS

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree,
Random Forests

UNIT-3	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	9 HOURS

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K- means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT-4	NEURAL NETWORKS	9 HOURS

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.

UNIT-5	DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS	9 HOURS
Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition,2020.
2	Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "SecondEdition", CRC Press, 2014.

REFERENCE BOOKS:

1	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer,2006.
2	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018
4	Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016
5	Sebastain Raschka, Vahid Mirjalili , "Python Machine Learning", Packt publishing,3rd Edition, 2019.

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADT403</td><td rowspan="2">FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To understand the techniques and processes of data science
2. To apply descriptive data analytics
3. To visualize data for various applications
4. To understand inferential data analytics
5. To analysis and build predictive models from data</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Explain the data analytics pipeline
CO2. Describe and visualize data
CO3. Perform statistical inferences from data
CO4. Analyze the variance in the data
CO5. Build models for predictive analytics</td></tr>
<tr><td>UNIT-1</td><td colspan="2">INTRODUCTION TO DATA SCIENCE</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.</td></tr>
<tr><td>UNIT-2</td><td colspan="2">DESCRIPTIVE ANALYTICS</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2– multiple regression equations – regression toward the mean.</td></tr>
<tr><td>UNIT-3</td><td colspan="2">INFERENTIAL STATISTICS</td><td colspan="4">9HOURS</td></tr>
<tr><td colspan="7">Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size.</td></tr>
<tr><td>UNIT-4</td><td colspan="2">ANALYSIS OF VARIANCE</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two factor experiments – three f-tests – two-factor ANOVA – Introduction to chi-square tests.</td></tr>
</table>

UNIT-5	PREDICTIVE ANALYTICS	9 HOURS
Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (first two chapters for Unit I).
2	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017
3	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCE BOOKS:

1	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.
2	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, “Fundamentals ofData Science”, CRC Press, 2022.
3	Chirag Shah, “A Hands-On Introduction to Data Science”, Cambridge UniversityPress, 2020.
4	Vineet Raina, Srinath Krishnamurthy, “Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice”,

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EST401</td><td rowspan="2">ENVIRONMENTAL SCIENCES AND SUSTAINABILITY</td><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To find and implementing scientific, technological, economic and political solutions to environmental problems.
2. To study the interrelationship between living organism and environment.
3. To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
4. To study the dynamic processes and understand the features of the earth‟s interior and surface.
5. To study the integrated themes and biodiversity, natural resources, pollution control and waste management

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection.

CO2. One will obtain knowledge on the following after completing the course.

CO3. Public awareness of environmental is at infant stage.

CO4. Ignorance and incomplete knowledge has lead to misconceptions

CO5. Development and improvement in std. of living has lead to serious environmental Disasters

UNIT-1	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**	**6 HOURS**

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation
hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man- wildlife conflicts endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT-2	**ENVIRONMENTAL POLLUTION**	**6HOURS**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts

UNIT-3	NATURAL RESOURCES	6 HOURS
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.		
UNIT-4	**SOCIAL ISSUES AND THE ENVIRONMENT**	**6 HOURS**
Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols- Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study		
UNIT-5	**HUMAN POPULATION AND THE ENVIRONMENT**	**6 HOURS**
Population growth, variation among nations – population explosion – family welfare Programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and humanhealth –Case studies.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, NewAge International Publishers ,2018.
2	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCE BOOKS:

1	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses", Orient Blackswan Pvt. Ltd. 2013.

Course Code	Course Title	L	T	P	J	C
22ADP401	**MACHINE LEARNING LABORATORY**	**0**	**0**	**4**	**0**	**2**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
2. To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance.
3. To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
4. To build the graph based learning models for standard data sets.
5. To compare the performance of different ML algorithms and select the suitable one based on the application

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Apply suitable algorithms for selecting the appropriate features for analysis.

CO2. Implement supervised machine learning algorithms on standard datasets and evaluate the performance.

CO3. Apply unsupervised machine learning algorithms on standard datasets and evaluate the performance.

CO4. Build the graph based learning models for standard data sets.

CO5. Assess and compare the performance of different ML algorithms and select the suitable one based on applications.

LIST OF EXPERIMENTS :

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2. 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.
3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file and compute the accuracy with a few test data sets.
5. Implement naïve Bayesian Classifier model to classify a set of documents and measure the accuracy, precision, and recall.

6.	Write a program to construct a Bayesian network to diagnose CORONA infection using standard WHO Data Set.
7.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results ofthese two algorithms.
8.	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
9.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select an appropriate data set for your experiment and draw graphs.
	TOTAL HOURS: 60 HOURS

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<tr><td rowspan="2">22EEP401</td><td rowspan="2">QUANTITATIVE APTITUDE AND LOGICAL REASONING -1</td><td>0</td><td>0</td><td>2</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. This module would train the students on the quick ways to solve quantitative aptitude problems and questions applying logical reasoning, within a short time span given during the placement drives.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Mock interviews

CO2. Quantitative aptitude

CO3. Logical Reasoning

LIST OF EXPERIMENTS :

1. Mock interviews on one-on-one basis
2. Quantitative aptitude
3. Partnership
4. Simple Interest, Compound Interest
5. Profit and Loss
6. Problems on Clock, Calendar and Cubes
7. Permutation and Combination
8. Allegation and mixtures
9. Logical Reasoning
10. Letter and Symbol series
11. Number series
12. Analyzing arguments
13. Making judgments

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22NXP401	**(ARMY WING) NCC Credit Course Level – II***	**1**	**0**	**0**	**0**	**1**
Pre-requisite		Syllabus version		v. 1.0		

PERSONALITY DEVELOPMENT	**02 HOURS**
PD 3 Group Discussion: Change your mindset, Time Management, Social Skills PD 5 Public Speaking	
LEADERSHIP	**02 HOURS**
L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	
DISASTER MANAGEMENT	**02 HOURS**
DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation DM 2 Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters DM 3 Fire Service & Fire Fighting	
ENVIRONMENTAL AWARENESS & CONSERVATION	**03 HOURS**
EA 1 Environmental Awareness and Conservation	
GENERAL AWARENESS	**03 HOURS**
GA 1 General Knowledge	
ARMED FORCES	**01 HOURS**
AF 1 Armed Forces, Army, CAPF, Police	
ADVENTURE	**01 HOUR**
AD 1 Introduction to Adventure Activities	
BORDER & COASTAL AREAS	**01 HOURS**
BCA 1 History, Geography & Topography of Border/Coastal areas	
TOTAL PRACTICAL HOURS:	**15 HOURS**

SEMESTER V

Course Code	Course Title	L	T	P	J	C
22ADT501	DEEP LEARNING	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand and need and principles of deep neural networks
2. To understand CNN and RNN architectures of deep neural networks
3. To comprehend advanced deep learning models
4. To learn the evaluation metrics for deep learning models
5. To apply auto encoders and generative models for suitable applications

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the basics in deep neural networks
CO2. Apply Convolution Neural Network for image processing
CO3. Apply Recurrent Neural Network and its variants for text analysis
CO4. Apply model evaluation for various applications
CO5. Apply autoencoders and generative models for suitable applications

UNIT-1	DEEP NETWORKS BASICS	9 HOURS

Linear Algebra: Scalars -- Vectors -- Matrices and tensors; Probability Distributions -- Gradientbased Optimization – Machine Learning Basics: Capacity -- Overfitting and underfitting -- Hyperparameters and validation sets -- Estimators -- Bias and variance -- Stochastic gradient descent -- Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization -- Optimization.

UNIT-2	CONVOLUTIONAL NEURAL NETWORKS	9 HOURS

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers --Gradient Computation.

UNIT-3	RECURRENT NEURAL NETWORKS	9 HOURS

Unfolding Graphs -- RNN Design Patterns: Acceptor -- Encoder --Transducer; Gradient Computation -- Sequence Modeling Conditioned on Contexts -- Bidirectional RNN -- Sequence to Sequence RNN – Deep Recurrent Networks -- Recursive Neural Networks -- Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.

UNIT-4	MODEL EVALUATION	9 HOURS

Performance metrics -- Baseline Models -- Hyperparameters: Manual Hyperparameter – Automatic Hyperparameter -- Grid search -- Random search -- Debugging strategies.

UNIT-5	AUTOENCODERS AND GENERATIVE MODELS	9 HOURS
Auto encoders: Under complete auto encoders -- Regularized auto encoders -- Stochastic encoders and decoders -- Learning with auto encoders; Deep Generative Models: Variational auto encoders – Generative adversarial networks		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016.
2	Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021.

REFERENCE BOOKS:

1	Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.
2	Yoav Goldberg, ``Neural Network Methods for Natural Language Processing", synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
3	Francois Chollet, ``Deep Learning with Python", Manning Publications Co, 2018
4	Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.
5	Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

Course Code	Course Title	L	T	P	J	C
22ADT502	BIG DATA ANALYTICS	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand big data.
2. To learn and use NoSQL big data management.
3. To learn mapreduce analytics using Hadoop and related tools.
4. To work with map reduce applications
5. To understand the usage of Hadoop related tools for Big Data Analytics

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Describe big data and use cases from selected business domains.

CO2. Explain NoSQL big data management.

CO3. Install, configure, and run Hadoop and HDFS.

CO4. Perform map-reduce analytics using Hadoop.

CO5. Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT-1	UNDERSTANDING BIG DATA	9 HOURS

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT-2	NOSQL DATA MANAGEMENT	9 HOURS

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model –Cassandra examples – Cassandra clients

UNIT-3	MAP REDUCE APPLICATIONS	9 HOURS

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN –job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT-4	BASICS OF HADOOP	9 HOURS

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT-5	HBASE	9 HOURS
Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3	Sadalage, Pramod J. "NoSQL distilled", Pearson 2013

REFERENCE BOOKS:	
1	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4	Alan Gates, "Programming Pig", O'Reilley, 2011

Course Code	Course Title	L	T	P	J	C
22ADT503	CLOUD COMPUTING	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

6. To understand the principles of cloud architecture, models and infrastructure.
7. To understand the concepts of virtualization and virtual machines.
8. To gain knowledge about virtualization Infrastructure.
9. To explore and experiment with various Cloud deployment environments.
10. To learn about the security issues in the cloud environment.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO6. Understand the design challenges in the cloud.
CO7. Apply the concept of virtualization and its types.
CO8. Experiment with virtualization of hardware resources and Docker.
CO9. Develop and deploy services on the cloud and set up a cloud environment.
CO10. Explain security challenges in the cloud environment.

UNIT-1	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	6 HOURS

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT-2	VIRTUALIZATION BASICS	6 HOURS

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

UNIT-3	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	6 HOURS

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT-4	CLOUD DEPLOYMENT ENVIRONMENT	6 HOURS

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT-5	CLOUD SECURITY	6 HOURS
Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012
2	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3	Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.
REFERENCE BOOKS:	
1	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

LIST OF EXPERIMENTS :
10. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
11. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
12. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
13. Use the GAE launcher to launch the web applications
14. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
15. Find a procedure to transfer the files from one virtual machine to another virtual machine.
16. Install Hadoop single node cluster and run simple applications like wordcount.
17. Creating and Executing Your First Container Using Docker
18. Run a Container from Docker Hub
TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EET501</td><td rowspan="2">ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. Examine the application of microeconomics theory as applied to the manager's responsibilities in an organization.
2. Explain the basic principles of managerial economics, accounting and current business environment underlying business decision making.
3. Emphasize the quantitative and qualitative applications of economic principle to business analysis
4. Be proficient in assessing capital requirements, identifying sources of finance, and to evaluate investment proposals effectively for informed financial decision-making.
5. possess the ability to effectively perform financial accounting tasks and analysing financial data using various ratios of engineering enterprises and projects.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Evaluate various forms of business entities, forecast demand, and interpret elasticity within the business environment

CO2. Analyse production functions, cost structures, and perform break-even analysis to make informed decisions.

CO3. Analyse market structures and pricing policies, understand the dynamics of competition, optimal pricing strategies, and to make strategic pricing decisions

CO4. Assess capital requirements, identifying sources of finance and to evaluate investment proposals effectively in engineering projects and enterprises.

CO5. Apply accounting principles for Performing financial accounting tasks and to analyse financial data using various ratios

UNIT-1	**ECONOMICS, COST AND PRICING CONCEPTS**	**9 HOURS**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting –Supply – Actual cost and opportunity cost – Incremental cost and sunk cost – Fixed and variable cost – Marginal costing – Total cost – Elements of cost – Cost curves – Breakeven point and breakeven chart – Limitations of breakeven chart – Interpretation of breakeven chart –Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies –Pricing methods.

UNIT-2	**CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES**	**9 HOURS**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration

UNIT-3	**NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT**	**9 HOURS**
National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization		
UNIT-4	**CONCEPTS OF FINANCIAL MANAGEMENT**	**9 HOURS**
Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital		
UNIT-5	**VACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS**	**9 HOURS**
Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Prasanna Chandra, — Financial Management (Theory & Practice) TMH
2	Weston & Brigham, — Essentials of Managerial Finance

REFERENCE BOOKS:	
1	Pandey, I. M., —Financial Management
2	Fundamentals of Financial Management - James C. Van Horne.
3	http://stanford.edu/dept/MSandE

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EEP501</td><td rowspan="2">INTERNSHIP</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To enhance the knowledge of the students in professional engineering practice sought through industrial training on different current technologies.
2. To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen.
3. To employ the students in industrial projects and strengthen the practical skills of the students.
4. To develop significant commitment in the students' profession and specialization.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Have an exposure to industrial practices & to work in teams & communicate effectively

CO2. Understand the impact of engineering solutions in a global, economic, environmental and societal context

CO3. Develop the ability to engage in research and to involve in life-long learning

CO4. Extend the knowledge through research and development in the chosen fields of specialization.

COURSE DESCRIPTION	**04 WEEKS**

1.Four weeks of work at industry site and Supervised by an expert at the industry.

2.Mode of Evaluation: Internship Report, Presentation and Project Review

3.The students individually undertake training in reputed Artificial Intelligence, Data Science and full stack engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

4.If a student not gone for internship, he may attend a certification/Nptel course for 4 weeks

TOTAL WEEKS:	**04**

<table>
<tr><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr>
<tr><td rowspan="2">22ADP501</td><td rowspan="2">DEEP LEARNING LABORATORY</td><td>0</td><td>0</td><td>4</td><td>0</td><td>2</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To understand the tools and techniques to implement deep neural networks
2. To apply different deep learning architectures for solving problems
3. To implement generative models for suitable applications
4. To learn to build and validate different models
5. To develop real-world solutions using suitable deep neural networks</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Apply deep neural network for simple problems
CO2. Apply Convolution Neural Network for image processing
CO3. Apply Recurrent Neural Network and its variants for text analysis
CO4. Apply generative models for data augmentation
CO5. Develop real-world solutions using suitable deep neural networks</td></tr>
<tr><td colspan="7">LIST OF EXPERIMENTS :</td></tr>
<tr><td colspan="7">1. Solving XOR problem using DNN</td></tr>
<tr><td colspan="7">2. Character recognition using CNN</td></tr>
<tr><td colspan="7">3. Face recognition using CNN</td></tr>
<tr><td colspan="7">4. Language modeling using RNN</td></tr>
<tr><td colspan="7">5. Sentiment analysis using LSTM</td></tr>
<tr><td colspan="7">6. Parts of speech tagging using Sequence to Sequence architecture</td></tr>
<tr><td colspan="7">7. Machine Translation using Encoder-Decoder model</td></tr>
<tr><td colspan="7">8. Image augmentation using GANs</td></tr>
<tr><td colspan="7">9. Mini-project on real world applications</td></tr>
<tr><td colspan="7" align="right">TOTAL HOURS: 60 HOURS</td></tr>
</table>

SMESTER VI

Course Code	Course Title	L	T	P	J	C
22ADT601	DISTRIBUTED SYSTEMS	3	0	0	0	3
		Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To introduce the computation and communication models of distributed systems
2. To illustrate the issues of synchronization and collection of information in distributed systems
3. To describe distributed mutual exclusion and distributed deadlock detection techniques
4. To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
5. To explain the cloud computing models and the underlying concepts

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the foundations of distributed systems

CO2. Solve synchronization and state consistency problems

CO3. Use resource sharing techniques in distributed systems

CO4. Apply working model of consensus and reliability of distributed systems

CO5. Explain the fundamentals of cloud computing

UNIT-1	**INTRODUCTION TO DISTRIBUTED SYSTEMS**	**9 HOURS**

Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

UNIT-2	**LOGICAL TIME AND GLOBAL STATE**	**9 HOURS**

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT-3	**DISTRIBUTED MUTEX AND DEADLOCK**	**9 HOURS**

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart- Agrawala's Algorithm –– Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT-4	DISTRIBUTED SYSTEMS: CONSENSUS	9 HOURS
Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures;		
UNIT-5	**DISTRIBUTED SYSTEMS:RECOVERY**	**9 HOURS**
Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm - Algorithm for Asynchronous Checkpointing and Recovery		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011
2	Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating systems", Mc-Graw Hill Publishers, 1994.
REFERENCE BOOKS:	
1	George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2	Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3	Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
4	Liu M L, "Distributed Computing: Principles and Applications", Pearson Education, 2004.
5	Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003.
6	Arshdeep Bagga, Vijay Madisetti, " Cloud Computing: A Hands-On Approach", Universities Press, 2014

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADT602</td><td rowspan="2">MULTIMEDIA AND ANIMATION</td><td>3</td><td>0</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To grasp the fundamental knowledge of Multimedia elements and systems
2. To get familiar with Multimedia file formats and standards
3. To learn the process of Authoring multimedia presentations
4. To learn the techniques of animation in 2D and 3D and for the mobile UI
5. To explore different popular applications of multimedia

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Get the bigger picture of the context of Multimedia and its applications

CO2. Use the different types of media elements of different formats on content pages

CO3. Author 2D and 3D creative and interactive presentations for different target multimedia applications.

CO4. Use different standard animation techniques for 2D, 21/2 D, 3D applications

CO5. Understand the complexity of multimedia applications in the context of cloud, security, bigdata streaming, social networking, CBIR etc.,

UNIT-1	**INTRODUCTION TO MULTIMEDIA**	**9 HOURS**

challenges: security, sharing / distribution, storage, retrieval, processing, computing, Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, , Multimedia metadata, Multimedia databases.

UNIT-2	**MULTIMEDIA FILE FORMATS AND STANDARDS**	**9 HOURS**

Multimedia data and file formats for the web, Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models.

UNIT-3	**MULTIMEDIA TOOLS**	**9 HOURS**

Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, and simulations.

UNIT-4	**MULTIMEDIA ANIMATION**	**9 HOURS**

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning AR/VR.

UNIT-5	MULTIMEDIA APPLICATIONS	9 HOURS
Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)

REFERENCE BOOKS:

1	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.
2	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018.
3	Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.
4	Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
5	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
6	Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.
7	Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.

WEB REFERENCES:

1	https://itsfoss.com/
2	https://www.ucl.ac.uk/slade/know/3396
3	https://handbrake.fr/
4	https://opensource.com/article/18/2/open-source-audio-visual-production-tools
5	https://developer.android.com/training/animation/overview (UNIT-IV)
6	https://camstudio.org/
7	https://developer.android.com/training/animation/overview

LIST OF PROJECTS :

1. **Working with Image Editing tools:**

Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations:

Ø Use different selection and transform tools to modify or improve an image

Ø Create logos and banners for home pages of websites.

2.	**Working with web/mobile authoring tools:** Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web: Ø Design simple Home page with banners, logos, tables quick links etc Ø Provide a search interface and simple navigation from the home page to the inside pages of the website. Ø Design Responsive web pages for use on both web and mobile interfaces
3.	**Working with Animation tools:** Install tools like, Krita, Wick Editor, Blender: Ø Perform a simple 2D animation with sprites Ø Perform simple 3D animation with keyframes, kinematics Ø Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,
4.	**Working with E-Learning authoring tools:** Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN: Ø Demonstrate screen recording and further editing for e-learning content. Ø Create a simple E-Learning module for a topic of your choice.
5.	**Creating VR and AR applications:** Ø Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc
Note: all tools listed are open source. Usage of any proprietary tools in place of open source tools is not restricted	
TOTAL HOURS: 30 HOURS	

Course Code	Course Title	L	T	P	J	C
22EEP601	QUANTITATIVE APTITUDE AND LOGICAL REASONING II	0	0	2	0	1
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1. The objective of this course is to provide the students with a solid foundation of quantitative aptitude and logical reasoning concepts. This course aims to help students develop their analytical and problem-solving skills, which are essential for success in various competitive exams and real-life situations.

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1. Understand the basic concepts of quantitative aptitude and logical reasoning.

CO2. Apply quantitative techniques in solving real-world problems related to profit & loss, SI & CI etc.

CO3. Apply logical reasoning skills to analyze and solve complex problems work and time, time and distance etc.

CO4. Interpret and analyze data using various mathematical and statistical techniques

UNIT-I	PROFIT AND LOSS	05 HOURS

Concept Explanation, Profit, Loss, Cost Price, Selling Price, Marked Price, Formula, Examples, Tricks.

UNIT-II	COMMERCIAL MATHEMATICS	07 HOURS

Simple Interest, Compound Interest, basic formulas, equal annual installment, Difference between simple interest & compound interest, Application of digital sum in SI & CI, Successive percentages in SI & CI, Population formula, growth rate, Offering Loan on a Discount, Shortcut methods.

UNIT-III	AVERAGE, MIXTURE & ALLIGATION	08 HOURS

Concept Explanation, Average Formula to calculate the Mean, Median, Mode, Average formula for An AP Series, Mixtures & Alligation, Rule of weighted averages, Rule of alligation, Alligation cross, Alligation line, Successive replacement.

UNIT-IV	WORK AND TIME	05 HOURS

Unit Work, Combined Work, basic formulas, Efficiency Vs Time taken, Chain Rule Concept, 8 rules of Time and Work, Pipes and Cisterns, 4 Rules of Pipes and Cistern.

UNIT-V	TIME SPEED DISTANCE	05 HOURS

Basic formulas, Basic speed when Time is constant, Average speed when Speed is constant relationships, Concept of average speed, Average speed when Distance is constant, Average, Acceleration & deceleration, Concept of relative speed, Concept of resultant speed.

Applications-Application of relative speed in train problems, boats & streams problems, basic formulas, shortcut methods, 4 rules of boats & streams, The escalator problems, circular motion tips, concept of races

TOTAL PRACTICAL HOURS:	30 HOURS

Course Code	Course Title	L	T	P	J	C
22EEP602	COMPREHENSIVE ASSESSMENT	0	0	2	0	1
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To learn to prepare for a competitive examination
2. To comprehend the questions in the Artificial Intelligence and Data Science field and answer them with confidence
3. To communicate effectively with faculty in scholarly environments
4. To analyze the comprehensive knowledge gained in basic courses in the field of Artificial Intelligence and Data Science

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Learn to prepare for a competitive examination

CO2. Comprehend the questions in the Artificial Intelligence and Data Science field and answer them with confidence

CO3. Communicate effectively with faculty in scholarly environments

CO4. Analyze the comprehensive knowledge gained in basic courses in the field of Artificial Intelligence and Data Science

LIST OF EXPERIMENTS :

Probability and Statistics: Counting (permutation and combinations), probability axioms, Sample space, events, independent events, mutually exclusive events, marginal, conditional and joint probability, Bayes Theorem, conditional expectation and variance, mean, median, mode and standard deviation, correlation, and covariance, random variables, discrete random variables and probability mass functions, uniform, Bernoulli, binomial distribution, Continuous random variables and probability distribution function, uniform, exponential, Poisson, normal, standard normal, t-distribution, chi-squared distributions, cumulative distribution function, Conditional PDF, Central limit theorem, confidence interval, z-test, t-test, chi-squared test.

Linear Algebra: Vector space, subspaces, linear dependence and independence of vectors, matrices, projection matrix, orthogonal matrix, idempotent matrix, partition matrix and their properties, quadratic forms, systems of linear equations and solutions; Gaussian elimination, eigenvalues and eigenvectors, determinant, rank, nullity, projections, LU decomposition, singular value decomposition.

Calculus and Optimization: Functions of a single variable, limit, continuity and differentiability, Taylor series, maxima and minima, optimization involving a single variable.

Programming, Data Structures and Algorithms: Programming in Python, basic data structures: stacks, queues, linked lists, trees, hash tables; Search algorithms: linear search and binary search, basic sorting algorithms: selection sort, bubble sort and insertion sort; divide and conquer: merge sort, quicksort; introduction to graph theory; basic graph algorithms: traversals and shortest path. **Database Management and Warehousing:** ER-model, relational model: relational algebra, tuple calculus, SQL, integrity constraints, normal form, file organization, indexing, data types, data transformation such as normalization, discretization, sampling, compression; data warehouse modelling: schema for multi-dimensional data models, concept hierarchies, measures: categorization and computations. **Machine Learning:** (i) Supervised Learning: regression and classification problems, simple linear regression, multiple linear regression, ridge regression, logistic regression, k-nearest neighbor, naive Bayes classifier, linear discriminant analysis, support vector machine, decision trees, bias-variance trade-off, cross-validation methods such as leave-one-out (LOO) cross-validation, k-folds cross validation, multi-layer perceptron, feed-forward neural network; (ii) Unsupervised Learning: clustering algorithms, k-means/k-medoid, hierarchical clustering, top-down, bottom-up: single-linkage, multiple linkage, dimensionality reduction, principal component analysis. **AI:** Search: informed, uninformed, adversarial; logic, propositional, predicate; reasoning under uncertainty topics - conditional independence representation, exact inference through variable elimination, and approximate inference through sampling.
TOTAL HOURS: 30 HOURS

<table>
<tr><th colspan="2">COURSE CODE</th><th>COURSE TITLE</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td colspan="2" rowspan="2">22NXP601</td><td rowspan="2">NCC Credit Course Level III*(NAVAL WING)</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td>UNIT-I</td><td colspan="2">NCC GENERAL</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">NCC 1 Aims, Objectives & Organization of NCC/NCC 2 Incentives
NCC 3 Duties of NCC Cadet
NCC 4 NCC Camps: Types & Conduct</td></tr>
<tr><td>UNIT-II</td><td colspan="2">NATIONAL INTEGRATION AND AWARENESS</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">NI 1 National Integration: Importance & NecessityNI 2
Factors Affecting National Integration
NI 3 Unity in Diversity & Role of NCC in Nation Building
NI 4 Threats to National Security</td></tr>
<tr><td>UNIT-III</td><td colspan="2">PERSONALITY DEVELOPMENT</td><td colspan="5">3 HOURS</td></tr>
<tr><td colspan="8">PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem SolvingPD 2 Communication Skills
PD 3 Group Discussion: Stress & Emotions</td></tr>
<tr><td>UNIT-IV</td><td colspan="2">LEADERSHIP</td><td colspan="5">2 HOURS</td></tr>
<tr><td colspan="8">L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour CodeL 2
Case Studies: Shivaji, Jhasi Ki Rani</td></tr>
<tr><td>UNIT-V</td><td colspan="2">SOCIAL SERVICE AND COMMUNITY DEVELOPMENT</td><td colspan="5">4 HOURS</td></tr>
<tr><td colspan="8">SS 1 Basics, Rural Development Programmes, NGOs, Contribution o YouthSS 2
Protection of Children and Women Safety
SS 3 Road / Rail Travel SafetySS 4
New Initiatives
SS 5 Cyber and Mobile Security Awareness</td></tr>
<tr><td colspan="3" align="right">TOTAL PRACTICAL HOURS</td><td colspan="5">15 HOURS</td></tr>
</table>

SEMESTER VII

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22HSM701</td><td rowspan="2">HUMAN VALUES AND ETHICS</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To introduce students to the fundamental concepts of ethics, morals, values, and integrity.
2. To develop an understanding of the role of attitudes and perceptions in shaping behavior.
3. To enhance emotional intelligence and its application in personal and professional life.
4. To create awareness about human rights and responsibilities.
5. To promote environmental ethics and sustainable development practices.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Differentiate between ethics, morals, and values, and apply them in ethical decision-making.

CO2. Develop a positive attitude and improve their perception skills, leading to better interpersonal relationships.

CO3. Enhance their emotional intelligence, enabling them to manage emotions effectively in personal and professional contexts.

CO4. Gain knowledge about human rights and their significance in promoting a just society.

CO5. Appreciate the importance of environmental ethics and adopt sustainable practices.

UNIT-1	ETHICS AND HUMAN VALUES	9 HOURS

Ethics - Morals, Values and Ethics – Integrity – Work Ethics - Service Learning – Evolution of Ethics – Role of Family, Society and Educational Institutions in inculcating values - Case studies

UNIT-2	ATTITUDE AND PERCEPTION	9 HOURS

Attitude: Components of attitude – Formation – Measurement - Changing attitude - Perception: Factors influencing perception – Perception process – Errors in perception - Enhancing perception skills - Case studies

UNIT-3	EMOTIONAL INTELLIGENCE	9 HOURS

Understanding emotions - Components of emotional intelligence - Emotional intelligence at work - Emotional competencies - Building emotional intelligence - Case studies

UNIT-4	HUMAN RIGHTS	9 HOURS

Universal Declaration of Human Rights (UDHR) - Civil, Political, Economic, Social and Cultural Rights - Human Rights Violation - Protecting Human Rights - Human Rights Education - Case studies

UNIT-5	ENVIRONMENTAL ETHICS	9 HOURS
Concept of Eco-centric development – Environmental Ethics and Human Responsibility - Climate Change and Sustainable Development - Corporate Social Responsibility (CSR) - Case studies		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	R. Subbaram, "Ethics in Engineering," Tata McGraw Hill, New Delhi, 2010.
2	R. K. S. Rathore, "Ethical Dimensions in Science, Technology, Engineering and Mathematics (STEM) Education and Research," Commonwealth Publishers, New Delhi, 2013.
REFERENCE BOOKS:	
1	Charles D. Fleddermann, "Engineering Ethics," Prentice Hall, New Jersey, 2004.
2	A. J. Veiga and J. A. Tan, "Professional Ethics and Civic Morals," Springer, 2019.

Course Code	Course Title	L	T	P	J	C
22ADT701	**INTERNET OF THINGS**	**3**	**0**	**2**	**0**	**4**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of IoT.
2. To get knowledge about the various services provided by IoT.
3. To familiarize themselves with various communication techniques and networking.
4. To know the implementation of IoT with different tools.
5. To understand the various applications in IoT

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Articulate the main concepts, key technologies, strength and limitations of IoT.

CO2. Identify the architecture, infrastructure models of IoT.

CO3. Analyze the networking and how the sensors are communicated in IoT .

CO4. Analyze and design different models for IoT implementation.

CO5. Identify and design the new models for market strategic interaction

UNIT-1	**INTRODUCTION TO INTERNET OF THINGS**	**9 HOURS**

Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates.

UNIT-2	**5G MIDDLEWARE AND PROTOCOLS OF IOT**	**9 HOURS**

Middleware technologies for IoT system, Middleware architecture–Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet,MODBUS - Challenges Introduced by 5G in IoT Middleware Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

UNIT-3	**IOT COMMUNICATION AND NETWORKING**	**9 HOURS**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks

UNIT-4	**IOT IMPLEMENTATION TOOLS**	**9 HOURS**

Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

<table>
<tr><td>UNIT-5</td><td colspan="2">APPLICATIONS AND CASE STUDIES</td><td>9 HOURS</td></tr>
<tr><td colspan="4">Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study</td></tr>
<tr><td colspan="3" align="right">TOTAL HOURS:</td><td>45 HOURS</td></tr>
<tr><td colspan="4">TEXT BOOK(S):</td></tr>
<tr><td>1</td><td colspan="3">Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.</td></tr>
<tr><td>2</td><td colspan="3">Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014</td></tr>
<tr><td colspan="4">REFERENCE BOOKS:</td></tr>
<tr><td>1</td><td colspan="3">Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.</td></tr>
<tr><td>2</td><td colspan="3">Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.</td></tr>
<tr><td>3</td><td colspan="3">Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.</td></tr>
<tr><td colspan="4">LIST OF EXPERIMENTS :</td></tr>
<tr><td colspan="4">1. Introduction to Arduino platform and programming</td></tr>
<tr><td colspan="4">2. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)</td></tr>
<tr><td colspan="4">3. Introduction to Raspberry PI platform and python programming</td></tr>
<tr><td colspan="4">4. Interfacing sensors with Raspberry PI</td></tr>
<tr><td colspan="4">5. Communicate between Arduino and Raspberry PI using any wireless medium</td></tr>
<tr><td colspan="4">6. Setup a cloud platform to log the data</td></tr>
<tr><td colspan="4">7. Log Data using Raspberry PI and upload to the cloud platform</td></tr>
<tr><td colspan="4">8. Design an IOT based system</td></tr>
<tr><td colspan="4" align="right">TOTAL HOURS: 30 HOURS</td></tr>
</table>

<table>
<tr><th>Course Code</th><th colspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADT702</td><td colspan="2" rowspan="2">SOFTWARE TESTING AND AUTOMATION</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="8">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="8">The course enables the learner to
1. To understand the basics of software testing
2. To learn how to do the testing and planning effectively
3. To build test cases and execute them
4. To focus on wide aspects of testing and understanding multiple facets of testing
5. To get an insight about test automation and the tools used for test automation</td></tr>
<tr><td colspan="8">COURSE OUTCOMES:</td></tr>
<tr><td colspan="8">After the completion of this course, the students should be able to
CO1. Understand the basic concepts of software testing and the need for software testing
CO2. Design Test planning and different activities involved in test planning
CO3. Design effective test cases that can uncover critical defects in the application
CO4. Carry out advanced types of testing
CO5. Automate the software testing using Selenium and TestNG</td></tr>
<tr><td>UNIT-1</td><td colspan="2">FOUNDATIONS OF SOFTWARE TESTING</td><td colspan="5">9 HOURS</td></tr>
<tr><td colspan="8">Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing</td></tr>
<tr><td>UNIT-2</td><td colspan="2">TEST PLANNING</td><td colspan="5">9 HOURS</td></tr>
<tr><td colspan="8">The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.</td></tr>
<tr><td>UNIT-3</td><td colspan="2">TEST DESIGN AND EXECUTION</td><td colspan="5">9 HOURS</td></tr>
<tr><td colspan="8">Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.</td></tr>
<tr><td>UNIT-4</td><td colspan="2">ADVANCED TESTING CONCEPTS</td><td colspan="5">9 HOURS</td></tr>
<tr><td colspan="8">Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.</td></tr>
</table>

UNIT-5	TEST AUTOMATION AND TOOLS	9 HOURS
Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Yogesh Singh, "Software Testing", Cambridge University Press, 2012
2	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018
REFERENCE BOOKS:	
1	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3	Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group.
4	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5	Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc.
6	Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.
7	Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EEP701</td><td rowspan="2">PRODUCT DESIGN AND DEVELOPMENT</td><td>0</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Upon the completion of this course the students will be able to CO1 design and Fabricate the machine element or the mechanical product. CO2 demonstrate the working model of the machine element or the mechanical product.</td></tr>
<tr><td colspan="4">COURSE DESCRIPTION</td><td colspan="3">30 HOURS</td></tr>
<tr><td colspan="7">• The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.</td></tr>
<tr><td colspan="4">TOTAL HOURS:</td><td colspan="3">60 HOURS</td></tr>
</table>

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EEP702</td><td rowspan="2">INTERNSHIP</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To enhance the knowledge of the students in professional engineering practice sought through industrial training on different current technologies.
2. To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen.
3. To employ the students in industrial projects and strengthen the practical skills of the students.
4. To develop significant commitment in the students' profession and specialization.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Have an exposure to industrial practices & to work in teams & communicate effectively

CO2. Understand the impact of engineering solutions in a global, economic, environmental and societal context

CO3. Develop the ability to engage in research and to involve in life-long learning

CO4. Extend the knowledge through research and development in the chosen fields of specialization.

COURSE DESCRIPTION	**04 WEEKS**

1.Four weeks of work at industry site and Supervised by an expert at the industry.

2.Mode of Evaluation: Internship Report, Presentation and Project Review

3.The students individually undertake training in reputed Artificial Intelligence, Data Science and full stack engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

4.If a student not gone for internship, he may attend a certification/Nptel course for 4 weeks

TOTAL WEEKS:	**04**

SEMESTER VIII

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADJ801</td><td rowspan="2">PROJECT WORK/INTERNSHIP</td><td>0</td><td>0</td><td>0</td><td>16</td><td>8</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Upon successful completion of the course, the student will be able to on Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

COURSE DESCRIPTION	300 HOURS

- The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
- Internship based projects are also highly encouraged and accepted

TOTAL HOURS:	300 HOURS

VERTICALS -I

Full Stack Development for IT

<table>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr></tr>
<tr><td rowspan="2">22CSE002</td><td rowspan="2">APP DEVELOPMENT WITH SWIFT PROGRAMMING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To understand the basics of swift programming.
2. To learn to solve problems using operators, conditional in Xcode.
3. To learn to build, test and debug an application.
4. To understand the concepts of strings and arrays in swift.
5. To develop applications with navigation and workflows.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Develop and execute simple Swift programs.
CO2. Develop simple swift programs using operators and control flow.
CO3. Develop simple swift programs using arrays and strings.
CO4. Develop an application with navigation and workflows.
CO5. Develop an application with swift OOPs</td></tr>
<tr><td>UNIT-1</td><td colspan="2">INTRODUCTION TO SWIFT</td><td colspan="4">6 HOURS</td></tr>
<tr><td colspan="7">Introduction to Swift and Playgrounds - Constants, Variables - Naming Constants and Variables, Data Types - Type Safety - Type Inference - Operators - Basic Arithmetic - Numeric Type Conversion - Logical and Comparison Operators</td></tr>
<tr><td>UNIT-2</td><td colspan="2">LOOPING STATEMENTS AND INTERFACE BUILDER</td><td colspan="4">6 HOURS</td></tr>
<tr><td colspan="7">Control Flow - If Statements - If Else Statements- Switch Statements - Xcode - Xcode Files Types - Xcode Preference - Building, Running, and Debugging an App - Interface Builder Basics - Storyboards - Interface Builder Layout - Outlets And Actions.</td></tr>
<tr><td>UNIT-3</td><td colspan="2">ARRAYS AND STRINGS</td><td colspan="4">6 HOURS</td></tr>
<tr><td colspan="7">Strings - Functions - Classes - Collections - Arrays - Loops - For Loops - Introduction to UIKit - Common System Views - View Controllers - Displaying Data Controls in Action.</td></tr>
<tr><td>UNIT-4</td><td colspan="2">NAVIGATIONS AND WORKFLOWS</td><td colspan="4">6 HOURS</td></tr>
<tr><td colspan="7">Optionals - Functions and Optionals - Type Casting and Inspection - Guard - Enumerations - Segues and Navigation Controllers - View Controller Life Cycle- View Did Load - View Event Management.</td></tr>
<tr><td>UNIT-5</td><td colspan="2">SWIFT OOPS</td><td colspan="4">6 HOURS</td></tr>
<tr><td colspan="7">Swift Structures - Properties and their Different Types – Methods - Typecasting in Swift - Repeating Timers in Swift - Optional Chaining in Swift - Singleton Class in Swift</td></tr>
</table>

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	The Swift Programming Language by Apple
2	The Swift 5.8 Programming Language and Reference Guide by Derrick Cassidy
3	The Swift Programming for App Development by Craig Grummitt
4	The Swift by Tutorials by Ray Wenderlich
5	The Swift Development with Xcode by Majid Jabrayilov

REFERENCE BOOKS:

1	The Swift - Resources - Apple Developer
2	The Swift - Apple Developer

LIST OF EXPERIMENTS :

1. Develop and execute simple swift programs using needs to keep track in order to display the right information to the user using constant and variable.
    i. Name: The user's name.
    ii. Age: The user's age.
    iii. Number of steps taken today: The number of steps that a user has taken today.
    iv. Goal number of steps: The user's goal for the number of steps to take each day.
    v. Average heart rate: The user's average heart rate over the last 24 hours.
2. Develop and execute swift programs for Target Heart Rate using control flow statements and logical operators and display the Heart Rate Zones using switch statements.
3. Develop and debug your First App
4. Develop and execute swift programs for Password Entry and User Search using strings
5. Develop and execute swift programs for Type Properties and Method using structures.
6. Develop and execute swift programs for SpaceShip Position using classes and inheritance.
7. Develop and execute swift programs for Calculating Temperature (Celsius, Fahrenheit and Kelvin) using structures.
8. Design and develop Basic Interaction of controls in action with UIKit.
9. Design and develop the Calculator App with controls in action.
10. Design and develop the Login App with navigation and workflows.

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22CSE008	**CLOUD SERVICES MANAGEMENT**	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To introduce Cloud Service Management terminology, definition & concepts
2. To compare and contrast cloud service management with traditional IT service management
3. To identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4. To select appropriate structures for designing, deploying and running cloud-based services in a business environment
5. To illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Introduce Cloud Service Management terminology, definition & concepts

CO2. Compare and contrast cloud service management with traditional IT service management

CO3. Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services

CO4. Select appropriate structures for designing, deploying and running cloud-based services in a business environment

CO5. Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT-1	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	6 HOURS

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT-2	CLOUD SERVICES STRATEGY	6 HOURS

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT-3	CLOUD SERVICE MANAGEMENT	6 HOURS

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT-4	CLOUD SERVICE ECONOMICS	6 HOURS
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models		
UNIT-5	**CLOUD SERVICE GOVERNANCE & VALUE**	**6 HOURS**
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCE BOOKS:

1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

LIST OF EXPERIMENTS :

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one

TOTAL HOURS: 30 HOURS

<table>
<tr><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td>22CSE003</td><td>UI and UX Design</td><td colspan="5"></td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To provide a sound knowledge in UI & UX
2. To understand the need for UI and UX
3. To understand the various Research Methods used in Design
4. To explore the various Tools used in UI & UX
5. Creating a wireframe and prototype

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Build UI for user Applications

CO2. Evaluate UX design of any product or application

CO3. Demonstrate UX Skills in product development

CO4. Implement Sketching principles

CO5. Create Wireframe and Prototype

UNIT-1	**FOUNDATIONS OF DESIGN**	**6 HOURS**

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT-2	**FOUNDATIONS OF UI DESIGN**	**6 HOURS**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles — Branding - Style Guides

UNIT-3	**FOUNDATIONS OF UX DESIGN**	**6 HOURS**

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT-4	**WIREFRAMING, PROTOTYPING AND TESTING**	**6 HOURS**

Sketching Principles - Sketching Red Routes - Responsive Design — Wire framing - Creating Wire flows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT-5	RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	6 HOURS
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Joel Marsh, "UX for Beginners", O'Reilly , 2022
2	Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021

REFERENCE BOOKS:

1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020
2	Steve Schoger, Adam Wathan "Refactoring UI", 2018
3	Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
4	https://www.nngroup.com/articles/
5	https://www.interaction-design.org/literature.

LIST OF EXPERIMENTS :

1. Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wire flow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping
12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22CSE006	**PRINCIPLES OF PROGRAMMING LANGUAGES**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand and describe syntax and semantics of programming languages
2. To understand data, data types, and basic statements
3. To understand call-return architecture and ways of implementing them
4. To understand object-orientation, concurrency, and event handling in programming languages
5. To develop programs in non-procedural programming paradigms

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Describe syntax and semantics of programming languages
CO2. Explain data, data types, and basic statements of programming languages
CO3. Design and implement subprogram constructs
CO4. Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog
CO5. Understand and adopt new programming languages

UNIT-1	SYNTAX AND SEMANTICS	6 HOURS

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

UNIT-2	DATA, DATA TYPES, AND BASIC STATEMENTS	6 HOURS

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT-3	SUBPROGRAMS AND IMPLEMENTATIONS	6 HOURS

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

UNIT-4	OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING	6 HOURS
Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling		
UNIT-5	**FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES**	**6 HOURS**
Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.
2	Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018.
3	R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.
4	Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.
5	W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003

LIST OF EXPERIMENTS :

1. Design and implement a lexical analyzer using C to tokenize a simple programming language.
2. Implement a recursive-descent parser in C for a subset of a programming language.
3. Construct parse tables and parse trees for example programs.
4. Implement a memory management system in C with manual memory allocation and deallocation using malloc, free, etc.
5. Explore different parameter passing mechanisms such as pass-by-value and pass-by-reference.
6. Simulate object-oriented programming concepts (classes, objects, inheritance) in C using structs and function pointers.
7. Create examples of producer-consumer and reader-writer problems to demonstrate thread synchronization using semaphores or mutex locks.
8. Develop a mechanism for handling exceptions (e.g., division by zero) using setjmp and longjmp or sigsetjmp and siglongjmp.
9. Implement functional programming concepts such as higher-order functions and recursion in C.
10. Develop a simplified Prolog interpreter in C for logic programming.

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE005</td><td rowspan="2">WEB APPLICATION SECURITY</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the fundamentals of web application security
2. To focus on wide aspects of secure development and deployment of web applications
3. To learn how to build secure APIs
4. To learn the basics of vulnerability assessment and penetration testing
5. To get an insight about Hacking techniques and Tools

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understanding the basic concepts of web application security and the need for it

CO2. Be acquainted with the process for secure development and deployment of web applications

CO3. Acquire the skill to design and develop Secure Web Applications that use Secure APIs

CO4. Be able to get the importance of carrying out vulnerability assessment and penetration testing

CO5. Acquire the skill to think like a hacker and to use hackers tool sets

<table>
<tr><td>UNIT-1</td><td>FUNDAMENTALS OF WEB APPLICATION SECURITY</td><td>6 HOURS</td></tr>
<tr><td colspan="3">The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation</td></tr>
<tr><td>UNIT-2</td><td>SECURE DEVELOPMENT AND DEPLOYMENT</td><td>6 HOURS</td></tr>
<tr><td colspan="3">Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)</td></tr>
<tr><td>UNIT-3</td><td>SECURE API DEVELOPMENT</td><td>6 HOURS</td></tr>
<tr><td colspan="3">API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.</td></tr>
<tr><td>UNIT-4</td><td>VULNERABILITY ASSESSMENT AND PENETRATION TESTING</td><td>6 HOURS</td></tr>
<tr><td colspan="3">Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.</td></tr>
</table>

UNIT-5	HACKING TECHNIQUES AND TOOLS	6 HOURS
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

REFERENCE BOOKS:

1	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

LIST OF EXPERIMENTS :

1. Install wireshark and explore the various protocols
   i. Analyze the difference between HTTP vs HTTPS
   ii. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
   a. GET
   b. PUSH
   c. POST
   d. DELETE
4. Install Burp Suite to do following vulnerabilities:
   a. SQL injection
   b. cross-site scripting (XSS)
5. Attack the website using Social Engineering method

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th colspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE001</td><td colspan="2" rowspan="2">DEVOPS</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="8">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="8">The course enables the learner to
1. To introduce DevOps terminology, definition & concepts
2. To understand the different Version control tools like Git, Mercurial
3. To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4. To understand Configuration management using Ansible
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems</td></tr>
<tr><td colspan="8">COURSE OUTCOMES:</td></tr>
<tr><td colspan="8">After the completion of this course, the students should be able to
CO1. Understand different actions performed through Version control tools like Git.
CO2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3. Ability to Perform Automated Continuous Deployment
CO4. Ability to do configuration management using Ansible
CO5. Understand to leverage Cloud-based DevOps tools using Azure DevOps</td></tr>
<tr><td>UNIT-1</td><td colspan="2">INTRODUCTION TO DEVOPS</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="8">Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.</td></tr>
<tr><td>UNIT-2</td><td colspan="2">COMPILE AND BUILD USING MAVEN & GRADLE</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="8">Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle</td></tr>
<tr><td>UNIT-3</td><td colspan="2">CONTINUOUS INTEGRATION USING JENKINS</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="8">Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.</td></tr>
</table>

UNIT-4	CONFIGURATION MANAGEMENT USING ANSIBLE	6 HOURS
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible		
UNIT-5	**BUILDING DEVOPS PIPELINES USING AZURE**	**6 HOURS**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2	Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

REFERENCE BOOKS:

1	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback — 1 January 2020 by Mitesh Soni
2	Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3	David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4	Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5	https://www.jenkins.io/user-handbook.pdf
6	https://maven.apache.org/guides/getting-started/

LIST OF EXPERIMENTS :

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

TOTAL HOURS: 30 HOURS

VERTICALS -II
Cloud Computing and Data Center Technologies

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE002</td><td rowspan="2">SOFT COMPUTING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
2. To provide the mathematical background for carrying out the optimization associated with neural network learning
3. To learn various evolutionary Algorithms.
4. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
5. To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing behavior of programs based on soft computing</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Understand the fundamentals of fuzzy logic operators and inference mechanisms
CO2. Understand neural network architecture for AI applications such as classification and clustering
CO3. Learn the functionality of Genetic Algorithms in Optimization problems
CO4. Use hybrid techniques involving Neural networks and Fuzzy logic
CO5. Apply soft computing techniques in real world applications</td></tr>
<tr><td>UNIT-1</td><td colspan="5">INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC</td><td>6 HOURS</td></tr>
<tr><td colspan="7">Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems</td></tr>
<tr><td>UNIT-2</td><td colspan="5">NEURAL NETWORKS</td><td>6 HOURS</td></tr>
<tr><td colspan="7">Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks</td></tr>
<tr><td>UNIT-3</td><td colspan="5">GENETIC ALGORITHMS</td><td>6 HOURS</td></tr>
<tr><td colspan="7">Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over — Mutation - Fitness Function — Maximizing function</td></tr>
<tr><td>UNIT-4</td><td colspan="5">NEURO FUZZY MODELING</td><td>6 HOURS</td></tr>
<tr><td colspan="7">ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling — Framework — Neuron functions for adaptive networks — Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability</td></tr>
</table>

UNIT-5	APPLICATIONS	6 HOURS
Modeling a two input sine function - Printed Character Recognition — Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction.		
	TOTAL HOURS:	**30HOURS**

TEXT BOOK(S):	
1	SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2	Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python
3	With Case Studies and Applications from the Industry, Apress, 2020
REFERENCE BOOKS:	
1	roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2	S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
3	Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
5	R.Eberhart, P.Simpson and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996

LIST OF EXPERIMENTS :
1. Implementation of fuzzy control/ inference system
2. Programming exercise on classification with a discrete perceptron
3. Implementation of XOR with backpropagation algorithm
4. Implementation of self-organizing maps for a specific application
5. Programming exercises on maximizing a function using Genetic algorithm
6. Implementation of two input sine function
7. Implementation of three input nonlinear function
TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE003	RECOMMENDER SYSTEMS	2	0	2	0	3
		Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the foundations of the recommender system.
2. To learn the significance of machine learning and data mining algorithms for Recommender systems
3. To learn about collaborative filtering
4. To make students design and implement a recommender system.
5. To learn collaborative filtering

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the basic concepts of recommender systems.

CO2. Implement machine-learning and data-mining algorithms in recommender systems data sets.

CO3. Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.

CO4. Design and implement a simple recommender system.

CO5. Learn about advanced topics of recommender systems applications

UNIT-1	INTRODUCTION	6 HOURS

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT-2	CONTENT-BASED RECOMMENDATION SYSTEMS	6 HOURS

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.
- Quiz of content-based filtering

UNIT-3	COLLABORATIVE FILTERING	6 HOURS
A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection Suggested Activities: ● Practical learning – Implement collaborative filtering concepts ● Assignment of security aspects of recommender systems Suggested Evaluation Methods: ● Quiz on collaborative filtering ● Seminar on security measures of recommender systems		
UNIT-4	**ATTACK-RESISTANT RECOMMENDER SYSTEMS**	**6 HOURS**
Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms. Suggested Activities: ● Group Discussion on attacks and their mitigation ● Study of the impact of group attacks ● External Learning – Use of CAPTCHAs Suggested Evaluation Methods: ● Quiz on attacks on recommender systems ● Seminar on preventing attacks using the CAPTCHAs		
UNIT-5	**EVALUATING RECOMMENDER SYSTEMS**	**6 HOURS**
Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design– Design Issues – Accuracy metrics – Limitations of Evaluation measures Suggested Activities: ● Group Discussion on goals of evaluation design ● Study of accuracy metrics Suggested Evaluation Methods: ● Quiz on evaluation design ● Problems on accuracy measures		
	TOTAL HOURS:	**30 HOURS**
TEXT BOOK(S):		
1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.	
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.	
3	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st edition, Springer (2011),	
REFERENCE BOOKS:		
1	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.	

LIST OF EXPERIMENTS :
1. Implement Data similarity measures using Python
2. Implement dimension reduction techniques for recommender systems
3. Implement user profile learning
4. Implement content-based recommendation systems
5. Implement collaborative filter techniques
6. Create an attack for tampering with recommender systems
7. Implement accuracy metrics like Receiver Operated Characteristic curves
TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE009</td><td rowspan="2">DATA WAREHOUSING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To know the details of data warehouse Architecture
2. To understand the OLAP Technology
3. To understand the partitioning strategy
4. To differentiate various schema
5. To understand the roles of process manager & system manager

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Design data warehouse architecture for various Problems
CO2. Apply the OLAP Technology
CO3. Analyse the partitioning strategy
CO4. Critically analyze the differentiation of various schema for given problem
CO5. Frame roles of process manager & system manager

UNIT-1	INTRODUCTION TO DATA WAREHOUSE	6 HOURS

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse — Data warehouse Architecture — Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT-2	ETL AND OLAP TECHNOLOGY	6 HOURS

What is ETL — ETL Vs ELT — Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

UNIT-3	META DATA, DATA MART AND PARTITION STRATEGY	6 HOURS

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting — Horizontal Partition

UNIT-4	DIMENSIONAL MODELING AND SCHEMA	6 HOURS

Dimensional Modeling- Multi-Dimensional Data Modeling — Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism — Datawarehouse Tools

UNIT-5	SYSTEM & PROCESS MANAGERS	6 HOURS
Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager — Warehouse Manager- Query Manager — Tuning — Testing		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw — Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.

REFERENCE BOOKS:

1	Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2	K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006

LIST OF EXPERIMENTS :

1. Data exploration and integration with WEKA
2. Apply weka tool for data validation
3. Plan the architecture for real time application
4. Write the query for schema definition
5. Design data ware house for real time applications
6. Analyse the dimensional Modeling
7. Case study using OLAP
8. Case study using OTLP
9. Implementation of warehouse testing.

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22CSE010	STORAGE TECHNOLOGIES	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Characterize the functionalities of logical and physical components of storage
2. Describe various storage networking technologies
3. Identify different storage virtualization technologies
4. Discuss the different backup and recovery strategies
5. Understand common storage management activities and solutions

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment

CO2. Illustrate the usage of advanced intelligent storage systems and RAID

CO3. Interpret various storage networking architectures - SAN, including storage subsystems and virtualization

CO4. Examine the different role in providing disaster recovery and remote replication technologies

CO5. Infer the security needs and security measures to be employed in information storage management

UNIT-1	STORAGE SYSTEMS	6 HOURS

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT-2	INTELLIGENT STORAGE SYSTEMS AND RAID	6 HOURS

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale-out storage Architecture.

UNIT-3	STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION	6 HOURS

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet

Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.		
UNIT-4	**BACKUP, ARCHIVE AND REPLICATION**	**6 HOURS**
Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).		
UNIT-5	**SECURING STORAGE INFRASTRUCTURE**	**6 HOURS**
Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	EMC Corporation, Information Storage and Management, Wiley, India
2	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017

REFERENCE BOOKS:

1	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained, Second Edition, Wiley, 2009

LIST OF EXPERIMENTS

1. Exploring Digital Data and Information Storage
2. Building a Virtual Data Center
3. Implementing Cloud Services
4. RAID Configuration and Performance Analysis
5. Storage Networking with Fibre Channel SAN
6. Learn about Internet Protocol iSCSI SAN Configuration
7. Implement a backup strategy and explore data deduplication.
8. Explore different data replication methods and their characteristics.
9. Understand the implementation and benefits of DRaaS.
10. Implement security measures to protect a storage infrastructure.

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE011</td><td rowspan="2">SOFTWARE DEFINED NETWORKS</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To understand the need for SDN and its data plane operations
2. To understand the functions of control plane
3. To comprehend the migration of networking functions to SDN environment
4. To explore various techniques of network function virtualization
5. To comprehend the concepts behind network virtualization</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Describe the motivation behind SDN
CO2. Identify the functions of the data plane and control plane
CO3. Design and develop network applications using SDN
CO4. Orchestrate network services using NFV
CO5. Explain various use cases of SDN and NFV</td></tr>
<tr><td>UNIT-1</td><td colspan="3">SDN: INTRODUCTION</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane</td></tr>
<tr><td>UNIT-2</td><td colspan="3">SDN DATA PLANE AND CONTROL PLANE</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers</td></tr>
<tr><td>UNIT-3</td><td colspan="3">SDN APPLICATIONS</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking</td></tr>
<tr><td>UNIT-4</td><td colspan="3">NETWORK FUNCTION VIRTUALIZATION</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture</td></tr>
<tr><td>UNIT-5</td><td colspan="3">NFV FUNCTIONALITY</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases — SDN and NFV</td></tr>
<tr><td colspan="4" align="right">TOTAL HOURS:</td><td colspan="3">30 HOURS</td></tr>
</table>

TEXT BOOK(S):	
1	William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.
REFERENCE BOOKS:	
1	Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Morgan Kauffman, 2016.
2	Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.
3	Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.
4	Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016
5	Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, 2nd Edition, O’Reilly Media, 2017.
LIST OF EXPERIMENTS :	
1. Setup your own virtual SDN lab a. Virtualbox/Mininet Environment for SDN - http://mininet.org b. https://www.kathara.org c. GNS3	
2. Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.	
3. Create a SDN application that uses the Northbound API to program flow table rules on the switch for various	
4. Create a simple end-to-end network service with two VNFs using vim-emu https://github.com/containernet/vim-emu	
5. Install OSM and onboard and orchestrate network service.	
TOTAL HOURS: 30 HOURS	

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE016</td><td rowspan="2">SECURITY AND PRIVACY IN CLOUD</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To Introduce Cloud Computing terminology, definition & concepts
2. To understand the security design and architectural considerations for Cloud
3. To understand the Identity, Access control in Cloud
4. To follow best practices for Cloud security using various design patterns
5. To be able to monitor and audit cloud applications for security

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the cloud concepts and fundamentals.
CO2. Explain the security challenges in the cloud.
CO3. Define cloud policy and Identity and Access Management.
CO4. Understand various risks and audit and monitoring mechanisms in the cloud.
CO5. Define the various architectural and design considerations for security in the cloud.

UNIT-1	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	6 HOURS

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT-2	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6 HOURS

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT-3	ACCESS CONTROL AND IDENTITY MANAGEMENT	6 HOURS

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT-4	CLOUD SECURITY DESIGN PATTERNS	6 HOURS

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT-5	MONITORING, AUDITING AND MANAGEMENT	6 HOURS
Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing — Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Raj Kumar Buyya , James Broberg, andrzejGoscinski, "Cloud Computing:", Wiley 2013
2	Dave shackleford, "Virtualization Security", SYBEX a wiley Brand 2013.
3	Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011

REFERENCE BOOKS:

1	Mark C. Chu-Carroll "Code in the Cloud",CRC Press, 2011
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

LIST OF EXPERIMENTS :

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. simulate resource management using cloud sim
3. simulate log forensics using cloud sim
4. simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario
9. implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud

TOTAL HOURS: 30 HOURS

VERTICALS –III

Cyber Security and Data Privacy

Course Code	Course Title	L	T	P	J	C
22ADE022	**COMPUTER NETWORKS**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the concept of layering in networks.
2. To know the functions of protocols of each layer of TCP/IP protocol suite.
3. To visualize the end-to-end flow of information.
4. To learn the functions of network layer and the various routing protocols
5. To familiarize the functions and protocols of the Transport layer

COURSE OUTCOMES:

After the completion of this course, the students should be able to

- CO1. Explain the basic layers and its functions in computer networks.
- CO2. Understand the basics of how data flows from one node to another.
- CO3. Analyze routing algorithms.
- CO4. Describe protocols for various functions in the network.
- CO5. Analyze the working of various application layer protocols.

UNIT-1	INTRODUCTION AND APPLICATION LAYER	6 HOURS
Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP		
UNIT-2	**TRANSPORT LAYER**	**6 HOURS**
Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service		
UNIT-3	**NETWORK LAYER**	**6 HOURS**
Switching: Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP		
UNIT-4	**ROUTING**	**6 HOURS**
Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.		
UNIT-5	**DATA LINK AND PHYSICAL LAYERS**	**6 HOURS**
Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.		

	TOTAL HOURS:	**30 HOURS**
TEXT BOOK(S):		
1	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.	
2	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022	
REFERENCE BOOKS:		
1	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.	
LIST OF EXPERIMENTS :		
1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.		
2. Write a HTTP web client program to download a web page using TCP sockets.		
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat		
4. Simulation of DNS using UDP sockets.		
5. Use a tool like Wireshark to capture packets and examine the packets		
6. Write a code simulating ARP /RARP protocols.		
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.		
8. Study of TCP/UDP performance using Simulation tool.		
9. Simulation of Distance Vector/ Link State Routing algorithm.		
10. Simulation of an error correction code (like CRC)		
		TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th colspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE014</td><td colspan="2" rowspan="2">SOCIAL NETWORK SECURITY</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="2">Syllabus version</td><td colspan="3">v. 1.1</td></tr>
<tr><td colspan="8">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="8">The course enables the learner to
1. To develop semantic web related simple applications
2. To explain Privacy and Security issues in Social Networking
3. To explain the data extraction and mining of social networks
4. To discuss the prediction of human behavior in social communities
5. To describe the Access Control, Privacy and Security management of social networks</td></tr>
<tr><td colspan="8">COURSE OUTCOMES:</td></tr>
<tr><td colspan="8">After the completion of this course, the students should be able to
CO1. Develop semantic web related simple applications
CO2. Address Privacy and Security issues in Social Networking
CO3. Explain the data extraction and mining of social networks
CO4. Discuss the prediction of human behavior in social communities
CO5. Describe the applications of social networks</td></tr>
<tr><td>UNIT-1</td><td colspan="5">FUNDAMENTALS OF SOCIAL NETWORKING</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="8">Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security</td></tr>
<tr><td>UNIT-2</td><td colspan="5">SECURITY ISSUES IN SOCIAL NETWORKS</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="8">The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world</td></tr>
<tr><td>UNIT-3</td><td colspan="5">EXTRACTION AND MINING IN SOCIAL NETWORKING DATA</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="8">Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy</td></tr>
<tr><td>UNIT-4</td><td colspan="5">PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="8">Understanding and predicting human behavior for social communities, User data
Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties</td></tr>
</table>

UNIT-5	ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT	6 HOURS
Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Peter Mika, "Social Networks and the Semantic Web, First Edition, Springer 2007.
2	BorkoFurht, "Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3	Learning Neo4j 3.x – Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4	David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.

REFERENCE BOOKS:

1	Easley D. Kleinberg J., "Networks, Crowds, and Markets — Reasoning about a Highly Connected World‖, Cambridge University Press, 2010.
2	Jackson, Matthew O., "Social and Economic Networks", Princeton University Press, 2008.
3	GuandongXu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking — Techniques and applications", First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
5	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling", IGI Global Snippet, 2009.
6	John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009

LIST OF EXPERIMENTS :

1. Design own social media application
2. Create a Network model using Neo4j
3. Read and write Data from Graph Database
4. Find "Friend of Friends" using Neo4j
5. Implement secure search in social media
6. Create a simple Security & Privacy detector

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE015</td><td rowspan="2">MODERN CRYPTOGRAPHY</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To learn about Modern Cryptography.
2. To focus on how cryptographic algorithms and protocols work and how to use them.
3. To build a Pseudorandom permutation.
4. To construct Basic cryptanalytic techniques.
5. To provide instruction on how to use the concepts of block ciphers and message authentication codes.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Interpret the basic principles of cryptography and general cryptanalysis.

CO2. Determine the concepts of symmetric encryption and authentication.

CO3. Identify the use of public key encryption, digital signatures, and key establishment.

CO4. Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.

CO5. Express the use of Message Authentication Codes

UNIT-1	**INTRODUCTION**	**6 HOURS**

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT-2	**FORMAL NOTIONS OF ATTACKS**	**6 HOURS**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model

UNIT-3	**RANDOM ORACLES**	**6 HOURS**

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudo-random Functions (PRF)

UNIT-4	BUILDING A PSEUDORANDOM PERMUTATION	6 HOURS
The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.		
UNIT-5	**MESSAGE AUTHENTICATION CODES**	**6 HOURS**
Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)
REFERENCE BOOKS:	
1	ShaffiGoldwasser ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3	William Stallings, “Cryptography and Network Security: Principles and Practice”, PHI 3rd Edition, 2006.

LIST OF EXPERIMENTS :
1. Implement Feige-Fiat-Shamir identification protocol.
2. Implement GQ identification protocol.
3. Implement Schnorr identification protocol.
4. Implement Rabin one-time signature scheme.
5. Implement Merkle one-time signature scheme.
6. Implement Authentication trees and one-time signatures.
7. Implement GMR one-time signature scheme.
TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE004	**ENGINEERING SECURE SOFTWARE SYSTEMS**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To know the importance and need for software security.
2. To know about various attacks.
3. To learn about secure software design.
4. To understand risk management in secure software development.
5. To know the working of tools related to software security.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Identify various vulnerabilities related to memory attacks.
CO2. Apply security principles in software development.
CO3. Evaluate the extent of risks.
CO4. Involve selection of testing techniques related to software security
CO5. Use tools for securing software

UNIT-1	**NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS**	**6 HOURS**

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software — Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT-2	**SECURE SOFTWARE DESIGN**	**6 HOURS**

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection — Policy Specification Languages — Vulnerability Trends — Buffer Overflow — Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT-3	**SECURITY RISK MANAGEMENT**	**6 HOURS**

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT-4	**SECURITY TESTING**	**6 HOURS**

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT-5	SECURE PROJECT MANAGEMENT	6 HOURS
Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice		
	TOTAL HOURS:	30 HOURS

TEXT BOOK(S):

1	Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
2	Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
3	Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006

REFERENCE BOOKS:

1	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2	Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4	Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5	Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6	Jason Grembi, "Developing Secure Software"

LIST OF EXPERIMENTS :

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.
5. Develop and test the secure test cases
6. Penetration test using kali Linux

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22CSE013	**DIGITAL AND MOBILE FORENSICS**	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand basic digital forensics and techniques.
2. To understand digital crime and investigation.
3. To understand how to be prepared for digital forensic readiness.
4. To understand and use forensics tools for iOS devices.
5. To understand and use forensics tools for Android devices.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Have knowledge on digital forensics.
CO2. Know about digital crime and investigations.
CO3. Understand how to be prepared for digital forensic readiness.
CO4. Investigate, identify and extract digital evidence from iOS devices.
CO5. Investigate, identify and extract digital evidence from Android devices.

UNIT	Title	Hours
UNIT-1	**INTRODUCTION TO DIGITAL FORENSICS**	**6 HOURS**

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT	Title	Hours
UNIT-2	**DIGITAL CRIME AND INVESTIGATION**	**6 HOURS**

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT	Title	Hours
UNIT-3	**DIGITAL FORENSIC READINESS**	**6 HOURS**

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT	Title	Hours
UNIT-4	**iOS FORENSICS**	**6 HOURS**

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

UNIT	Title	Hours
UNIT-5	**ANDROID FORENSICS**	**6 HOURS**

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Andre Arnes, “Digital Forensics”, Wiley, 2018
2	Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.
REFERENCE BOOKS:	
1	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

LIST OF EXPERIMENTS :
1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.
2. Data extraction from call logs using Sleuth Kit.
3. Data extraction from SMS and contacts using Sleuth Kit.
4. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.
5. Process and parse records from the iOS system.
6. Extract installed applications from Android devices.
7. Extract diagnostic information from Android devices through the adb protocol.
8. Generate a unified chronological timeline of extracted records
TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE005	**DATA MINING FOR BUSINESS INTELLIGENCE**	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To learn to apply various data mining techniques into various areas of different domains
2. To interact competently on the topic of data mining for business intelligence
3. To apply various prediction techniques
4. To learn about supervised and unsupervised learning technique
5. To develop and implement machine learning algorithms

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Learn to apply various data mining techniques into various areas of different domains
CO2. Be able to interact competently on the topic of data mining for business intelligence
CO3. Apply various prediction techniques
CO4. Learn about supervised and unsupervised learning technique
CO5. Develop and implement machine learning algorithms

UNIT-1	INTRODUCTION	9 HOURS
Data mining, Text mining, Web mining, Data ware house		
UNIT-2	**DATA MINING PROCESS**	**9 HOURS**
Datamining process – KDD, CRISP-DM, SEMMA, Prediction performance measures		
UNIT-3	**PREDICTION TECHNIQUES**	**9 HOURS**
Data visualization, Time series – ARIMA, Winter Holts		
UNIT-4	**CLASSIFICATION AND CLUSTERING TECHNIQUES**	**9 HOURS**
Classification, Association, Clustering		
UNIT-5	**MACHINE LEARNING AND AI**	**9 HOURS**
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm Optimization		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2	Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3	W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.

REFERENCE BOOKS:

1	Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition,2013.
2	Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011

VERTICALS –IV-Creative Media

Course Code	Course Title	L	T	P	J	C
22ADE006	**COMPUTER VISION**	**2**	**0**	**2**	**0**	**3**
		Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the fundamental concepts related to Image formation and processing.
2. To learn feature detection, matching and detection
3. To become familiar with feature based alignment and motion estimation
4. To develop skills on 3D reconstruction
5. To understand image based rendering and recognition

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. To understand basic knowledge, theories and methods in image processing and computer vision.

CO2. To implement basic and some advanced image processing techniques in OpenCV

CO3. To apply 2D a feature-based based image alignment, segmentation and motion estimations.

CO4. To apply 3D image reconstruction techniques

CO5. To design and develop innovative image processing and computer vision applications.

UNIT-1	**INTRODUCTION TO IMAGE FORMATION AND PROCESSING**	**6 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.

UNIT-2	**FEATURE DETECTION, MATCHING AND SEGMENTATION**	**6 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.

UNIT-3	**FEATURE-BASED ALIGNMENT & MOTION ESTIMATION**	**6 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.

UNIT-4	**3D RECONSTRUCTION**	**6 HOURS**

Shape from X - Active rangefinding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT-5	IMAGE-BASED RENDERING AND RECOGNITION	6 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.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
REFERENCE BOOKS:	
1	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

LIST OF EXPERIMENTS :
1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
6. Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid
8. Pose Estimation
9. 3D Reconstruction – Creating Depth map from stereo images
10. Object Detection and Tracking using Kalman Filter, Camshift
11. docs.opencv.org
12. https://opencv.org/opencv-free-course/
TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE007	VISUAL EFFECTS	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To get a basic idea on animation principles and techniques
2. To get exposure to CGI, color and light elements of VFX
3. To have a better understanding of basic special effects techniques
4. To have a knowledge of state of the art vfx techniques
5. To become familiar with popular compositing techniques

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Implement animation in 2D / 3D following the principles and techniques

CO2. Use CGI, color and light elements in VFX applications

CO3. Create special effects using any of the state of the art tools

CO4. Apply popular visual effects techniques using advanced tools

CO5. Use compositing tools for creating VFX for a variety of applications

UNIT-1	ANIMATION BASICS	6 HOURS

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths.

UNIT-2	CGI, COLOR, LIGHT	6 HOURS

CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model

UNIT-3	SPECIAL EFFECTS	6 HOURS

Special Effects – props, scaled models, animatronics, pyrotechniques, Schüfftan process, Particle effects – wind, rain, fog, fire

UNIT-4	VISUAL EFFECTS TECHNIQUES	6 HOURS

Motion Capture, Matt Painting, Rigging, Front Projection.Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination, 3D Match Moving

UNIT-5	COMPOSITING	6 HOURS

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2	Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3	John Gress, Digital Visual Effects and Compositing**,** New Riders Press, 1st Edition, 2014.
REFERENCE BOOKS:	
1	Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2	Robin Brinkman, The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics", Morgan Kauffman, 2008.
3	Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023.
4	Jasmine Katatikarn, Michael Tanzillo, "Lighting for Animation: The art of visual storytelling, Routledge, 1st Edition, 2016.
5	Eran Dinur, "The Complete guide to Photorealism, for Visual Effects, Visualization
6	Jeffrey A. Okun, Susan Zwerman, Christopher McKittrick, " The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures", Third Edition, 2020.and Games", Routledge, 1st Edition, 2022.
7	https://www.blender.org/features/vfx/
8	https://natrongithub.github.io/

LIST OF EXPERIMENTS :

1. Using Natron:
   - Understanding Natron Environment:
   - Working with color and using color grading
   - using Channels
   - Merging images
   - Using Rotopaint
   - performing Tracking and stabilizing
   - Transforming elements
   - Stereoscopic compositing
2. Using Blender:
   - Motion Tracking – camera and object tracking
   - Camera fx, color grading, vignettes
   - Compositing images and video files
   - Multilayer rendering

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE008	VIDEO CREATION AND EDITING	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To introduce the broad perspective of linear and nonlinear editing concepts.
2. To understand the concept of Storytelling styles.
3. To be familiar with audio and video recording.
4. To apply different media tools.
5. To learn and understand the concepts of AVID XPRESS DV 4.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Compare the strengths and limitations of Nonlinear editing.
CO2. Identify the infrastructure and significance of storytelling.
CO3. Apply suitable methods for recording to CDs and VCDs.
CO4. Address the core issues of advanced editing and training techniques.
CO5. Design and develop projects using AVID XPRESS DV 4

UNIT-1	FUNDAMENTALS	6 HOURS

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

UNIT-2	STORYTELLING	6 HOURS

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.

UNIT-3	USING AUDIO AND VIDEO	6 HOURS

Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.

UNIT-4	WORKING WITH FINAL CUT PRO	6 HOURS

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences.

UNIT-5	WORKING WITH AVID XPRESS DV 4	6 HOURS

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Avid Xpress DV 4 User Guide, 2007.
2	Final Cut Pro 6 User Manual, 2004.

3	Keith Underdahl, “Digital Video for Dummies”, Third Edition, Dummy Series, 2001.
REFERENCE BOOKS:	
1	Robert M. Goodman and Partick McGarth, “Editing Digital Video: The Complete Creative and Technical Guide”, Digital Video and Audio, McGraw — Hill 2003.
LIST OF EXPERIMENTS :	
1. Write a Movie Synopsis (Individual/Team Writing)	
2. Present team stories in class.	
3. Script/Storyboard Writing(Individual Assignment)	
4. Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements	
5. Production: Single camera production personnel & equipment, Documentary Production	
6. Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching	
7. Write Documentary & Animation Treatment	
8. Post-production: Editing, Sound design, Finishing	
TOTAL HOURS: 30 HOURS	

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE009</td><td rowspan="2">DIGITAL MARKETING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. To examine and explore the role and importance of digital marketing in today’s rapidly changing business environment.
2. To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
3. To know the key elements of a digital marketing strategy.
4. To study how the effectiveness of a digital marketing campaign can be measured
5. To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Examine and explore the role and importance of digital marketing in today’s rapidly changing business environment.
CO2. Focus on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
CO3. Know the key elements of a digital marketing strategy.
CO4. Study how the effectiveness of a digital marketing campaign can be measured
CO5. Demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.</td></tr>
<tr><td>UNIT-1</td><td colspan="3">INTRODUCTION TO ONLINE MARKET</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing</td></tr>
<tr><td>UNIT-2</td><td colspan="3">SEARCH ENGINE OPTIMISATION</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement</td></tr>
<tr><td>UNIT-3</td><td colspan="3">E- MAIL MARKETING</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting</td></tr>
<tr><td>UNIT-4</td><td colspan="3">SOCIAL MEDIA MARKETING</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing</td></tr>
</table>

UNIT-5	DIGITAL TRANSFORMATION	6 HOURS
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.		
	TOTAL HOURS:	30 HOURS

TEXT BOOK(S):

1	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
2	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
3	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
4	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.

REFERENCE BOOKS:

1	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
2	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

LIST OF EXPERIMENTS :

1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.
2. Demonstrate how to use the Google WebMasters Indexing API
3. Discuss an interesting case study regarding how an insurance company manages leads.
4. Discuss negative and positive impacts and ethical implications of using social media for political advertising.
5. Discuss how Predictive analytics is impacting marketing automation
6. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE010</td><td rowspan="2">MULTIMEDIA DATA COMPRESSION AND STORAGE</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of compression techniques
2. To understand the categories of compression for text, image and video
3. To explore the modalities of text, image and video compression algorithms
4. To know about basics of consistency of data availability in storage devices
5. To understand the concepts of data streaming services

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the basics of text, Image and Video compression
CO2. Understand the various compression algorithms for multimedia content
CO3. Explore the applications of various compression techniques
CO4. Explore knowledge on multimedia storage on disks
CO5. Understand scheduling methods for request streams

UNIT-1	**BASICS OF DATA COMPRESSION**	**6 HOURS**

Introduction —Lossless and Lossy Compression– Basics of Huffmann coding- Arithmetic coding- Dictionary techniques- Context based compression - Applications

UNIT-2	**IMAGE COMPRESSION**	**6 HOURS**

Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding

UNIT-3	**VIDEO COMPRESSION**	**6 HOURS**

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263.

UNIT-4	**DATA PLACEMENT ON DISKS**	**6 HOURS**

Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system

UNIT-5	**DISK SCHEDULING METHODS**	**6 HOURS**

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2	Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008
REFERENCE BOOKS:	
1	David Salomon, A concise introduction to data compression, 2008.
2	Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017.
3	Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
4	Irina Bocharova, Compression for Multimedia, Cambridge University Press; 1st edition, 2009

LIST OF EXPERIMENTS :
1. Construct Huffman codes for given symbol probabilities.
2. Encode run lengths with fixed-length code.
3. Lempel-Ziv algorithm for adaptive variable-length encoding
4. Compress the given word using arithmetic coding based on the frequency of the letters.
5. Write a shell script, which converts all images in the current directory in JPEG
6. Write a program to split images from a video without using any primitives
TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE011</td><td rowspan="2">GAME DEVELOPMENT</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To know the basics of 2D and 3D graphics for game development.
2. To know the stages of game development.
3. To understand the basics of a game engine.
4. To survey the gaming development environment and tool kits.
5. To learn and develop simple games using Pygame environment

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the concepts of 2D and 3d Graphics
CO2. Design game design documents.
CO3. Implementation of gaming engines.
CO4. Survey gaming environments and frameworks.
CO5. Implement a simple game in Pygame.

UNIT-1	**3D GRAPHICS FOR GAME DESIGN**	**6 HOURS**
Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.		
UNIT-2	**GAME DESIGN PRINCIPLES**	**6 HOURS**
Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.		
UNIT-3	**GAME ENGINE DESIGN**	**6 HOURS**
Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.		
UNIT-4	**OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS**	**6 HOURS**
Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.		
UNIT-5	**GAME DEVELOPMENT USING PYGAME**	**6 HOURS**
Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
2	Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.
REFERENCE BOOKS:	
1	Paul Craven, “Python Arcade games”, Apress Publishers,2016.
2	David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,2006.
3	Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.

LIST OF EXPERIMENTS :
1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game.
2. Character design, sprites, movement and character control
3. Level design: design of the world in the form of tiles along with interactive and collectible objects.
4. Design of interaction between the player and the world, optionally using the physics engine.
5. Developing a 2D interactive using Pygame
6. Developing a Puzzle game
7. Design of menus and user interaction in mobile platforms.
8. Developing a 3D Game using Unreal
9. Developing a Multiplayer game using unity
TOTAL HOURS: 30 HOURS

VERTICALS –V- Emerging Technologies

Course Code	Course Title	L	T	P	J	C
22ADE012	**KNOWLEDGE ENGINEERING**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of Knowledge Engineering.
2. To discuss methodologies and modeling for Agent Design and Development.
3. To design and develop ontologies.
4. To apply reasoning with ontologies and rules.
5. To understand learning and rule learning.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the basics of Knowledge Engineering.
CO2. Apply methodologies and modelling for Agent Design and Development.
CO3. Design and develop ontologies.
CO4. Apply reasoning with ontologies and rules.
CO5. Understand learning and rule learning.

UNIT-1	REASONING UNDER UNCERTAINTY	6 HOURS

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

UNIT-2	METHODOLOGY AND MODELING	6 HOURS

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT-3	ONTOLOGIES – DESIGN AND DEVELOPMENT	6 HOURS

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT-4	REASONIING WITH ONTOLOGIES AND RULES	6 HOURS

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT-5	LEARNING AND RULE LEARNING	6 HOURS
Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)

REFERENCE BOOKS:

1	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2	Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3	John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4	King , Knowledge Management and Organizational Learning , Springer, 2009.
5	Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

LIST OF EXPERIMENTS :

1. Perform operations with Evidence Based Reasoning.
2. Perform Evidence based Analysis.
3. Perform operations on Probability Based Reasoning.
4. Perform Believability Analysis.
5. Implement Rule Learning and refinement.
6. Perform analysis based on learned patterns.
7. Construction of Ontology for a given domain.

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE013</td><td rowspan="2">BUSINESS ANALYTICS</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the Analytics Life Cycle.
2. To comprehend the process of acquiring Business Intelligence
3. To understand various types of analytics for Business Forecasting
4. To model the supply chain management for Analytics.
5. To apply analytics for different functions of a business

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the real world business problems and model with analytical solutions.

CO2. Identify the business processes for extracting Business Intelligence

CO3. Apply predictive analytics for business fore-casting

CO4. Apply analytics for supply chain and logistics management

CO5. Use analytics for marketing and sales.

UNIT-1	INTRODUCTION TO BUSINESS ANALYTICS	6 HOURS

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT-2	BUSINESS INTELLIGENCE	6 HOURS

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT-3	BUSINESS FORECASTING	6 HOURS

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT-4	HR & SUPPLY CHAIN ANALYTICS	6 HOURS

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT-5	MARKETING & SALES ANALYTICS	6 HOURS

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
REFERENCE BOOKS:	
1	VSP RAO, "Human Resource Management", 3rd Edition, Excel Books, 2010.
2	Mahadevan B, "Operations Management -Theory and Practice", 3rd Edition, Pearson Education,2018.

LIST OF EXPERIMENTS :
1. Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations.
2. Students may be encouraged to bring their own real-time socially relevant data set.
3. I Cycle – MS Excel
4. Explore the features of Ms-Excel
5. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) ii) Perform data import/export operations for different file formats.
6. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis
7. Perform Z-test, T-test & ANOVA
8. Perform data pre-processing operations i) Handling Missing data ii) Normalization
9. Perform dimensionality reduction operation using PCA, KPCA & SVD
10. Perform bivariate and multivariate analysis on the dataset.
11. Apply and explore various plotting functions on the data set.
12. II Cycle – Power BI Desktop
13. Explore the features of Power BI Desktop
14. Prepare & Load data
15. Develop the data model
16. Perform DAX calculations
17. Design a report
18. Create a dashboard and perform data analysis
19. Presentation of a case study
TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE014</td><td rowspan="2">NEURAL NETWORKS AND DEEP LEARNING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics in deep neural networks
2. To understand the basics of associative memory and unsupervised learning networks
3. To apply CNN architectures of deep neural networks
4. To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
5. To apply autoencoders and generative models for suitable applications.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Apply Convolution Neural Network for image processing.
CO2. Understand the basics of associative memory and unsupervised learning networks.
CO3. Apply CNN and its variants for suitable applications.
CO4. Analyze the key computations underlying deep learning and use them to build and train deepneural networks for various tasks.
CO5. Apply auto encoders and generative models for suitable applications.

UNIT-1	**INTRODUCTION**	**6 HOURS**

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction- Evolution of Neural Networks-Basic Models of Artificial Neural Network-Important Terminologies of ANNs-Supervised Learning Network.

UNIT-2	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**6 HOURS**

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network

UNIT-3	**THIRD-GENERATION NEURAL NETWORKS**	**6 HOURS**

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT-4	DEEP FEEDFORWARD NETWORKS	6 HOURS
History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.		
UNIT-5	**RECURRENT NEURAL NETWORKS**	**6 HOURS**
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
2	Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications, 2021.

REFERENCE BOOKS:

1	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Oreilly,2018.
2	Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media,2017.
3	Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.

LIST OF EXPERIMENTS :

1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the Deep learning model by fine tuning hyper parameters.
7. Implement a Transfer Learning concept in Image Classification.
8. Using a pre trained model on Keras for Transfer Learning
9. Perform Sentiment Analysis using RNN
10. Implement an LSTM based Autoencoder in TensorFlow/Keras.
11. Image generation using GAN
12. Train a Deep learning model to classify a given image using pre trained model
13. Recommendation system from sales data using Deep Learning
14. Implement Object Detection using CNN
15. Implement any simple Reinforcement Algorithm for an NLP problem

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22CSE019</td><td rowspan="2">CYBER SECURITY</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1 To learn cybercrime and cyber law.
2 To understand the cyber-attacks and tools for mitigating them.
3 To understand information gathering.
4 To learn how to detect a cyber-attack.
5 To learn how to prevent a cyber-attack.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Explain the basics of cyber security, cybercrime and cyber law
CO2. Classify various types of attacks and learn the tools to launch the attacks
CO3. Apply various tools to perform information gathering
CO4. Apply intrusion techniques to detect intrusion
CO5. Apply intrusion prevention techniques to prevent intrusion</td></tr>
<tr><td>UNIT-1</td><td colspan="3">INTRODUCTION</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Cyber Security – History of Internet – Impact of Internet – 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.</td></tr>
<tr><td>UNIT-2</td><td colspan="3">ATTACKS AND COUNTERMEASURES</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.</td></tr>
<tr><td>UNIT-3</td><td colspan="3">RECONNAISSANCE</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="7">Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.</td></tr>
</table>

UNIT-4	INTRUSION DETECTION	6 HOURS
Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.		
UNIT-5	**INTRUSION PREVENTION**	**6 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.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021 (Unit 1)
2	Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011 (Unit 1)
3	https://owasp.org/www-project-top-ten/

REFERENCE BOOKS:

1	David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013 (Unit 2)
2	Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011 (Unit 3)
3	Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007 (Unit 3)
4	William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015 (Units 4 and 5)
5	Georgia Weidman, “Penetration Testing: A Hands-On Introduction to Hacking”, No Starch Press, 2014 (Lab)

LIST OF EXPERIMENTS :

1. Install Kali Linux on Virtual box
2. Explore Kali Linux and bash scripting
3. Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego
4. Understand the nmap command d and scan a target using nmap
5. Install metasploitable2 on the virtual box and search for unpatched vulnerabilities
6. Use Metasploit to exploit an unpatched vulnerability
7. Install Linus server on the virtual box and install ssh
8. Use Fail2banto scan log files and ban Ips that show the malicious signs
9. Launch brute-force attacks on the Linux server using Hydra.
10. Perform real-time network traffic analysis and data pocket logging using Snort

TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE015</td><td rowspan="2">QUANTUM COMPUTING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To know the background of classical computing and quantum computing.
2. To learn the fundamental concepts behind quantum computation.
3. To study the details of quantum mechanics and its relation to Computer Science.
4. To gain knowledge about the basic hardware and mathematical models of quantum computation.
5. To learn the basics of quantum information and the theory behind it.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the basics of quantum computing.
CO2. Understand the background of Quantum Mechanics.
CO3. Analyze the computation models.
CO4. Model the circuits using quantum computation. environments and frameworks.
CO5. Understand the quantum operations such as noise and error–correction.

UNIT-1	QUANTUM COMPUTING BASIC CONCEPTS	6 HOURS

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superpositions

UNIT-2	QUANTUM GATES AND CIRCUITS	6 HOURS

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

UNIT-3	QUANTUM ALGORITHMS	6 HOURS

Quantum parallelism - Deutsch’s algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover’s Algorithm

UNIT-4	QUANTUM INFORMATION THEORY	6 HOURS

Data compression - Shannon’s noiseless channel coding theorem - Schumacher’s quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT-5	QUANTUM CRYPTOGRAPHY	6 HOURS

Classical cryptography basic concepts - Private key cryptography - Shor’s Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Parag K Lala, Mc Graw Hill Education, “Quantum Computing, A Beginners Introduction”, First edition (1 November 2020).
2	Michael A. Nielsen, Issac L. Chuang, “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010.
3	Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), “Quantum Computing for Everyone”.
REFERENCE BOOKS:	
1	Scott Aaronson, “Quantum Computing Since Democritus”, Cambridge University Press, 2013.
2	N. David Mermin, “Quantum Computer Science: An Introduction”, Cambridge University Press, 2007.

LIST OF EXPERIMENTS :
1. Single qubit gate simulation - Quantum Composer
2. Multiple qubit gate simulation - Quantum Composer
3. Composing simple quantum circuits with q-gates and measuring the output into classical bits.
4. IBM Qiskit Platform Introduction
5. Implementation of Shor’s Algorithms
6. Implementation of Grover’s Algorithm
7. Implementation of Deutsch’s Algorithm
8. Implementation of Deutsch-Jozsa’s Algorithm
9. Integer factorization using Shor’s Algorithm
10. QKD Simulation
11. Mini Project such as implementing an API for efficient search using Grover’s Algorithms
TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22CSE024	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of Blockchain
2. To learn Different protocols and consensus algorithms in Blockchain
3. To learn the Blockchain implementation frameworks
4. To understand the Blockchain Applications
5. To experiment the Hyperledger Fabric, Ethereum networks

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand emerging abstract models for Blockchain Technology

CO2. Analyze different protocols and consensus algorithms in Blockchain

CO3. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.

CO4. Understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications

CO5. Apply hyperledger Fabric and Ethereum platform to implement the Block chain application.

UNIT-1	INTRODUCTION TO BLOCKCHAIN	6 HOURS

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT-2	BITCOIN AND CRYPTOCURRENCY	6 HOURS

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT-3	BITCOIN CONSENSUS	6 HOURS

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT-4	HYPERLEDGER FABRIC & ETHEREUM	6 HOURS

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT-5	BLOCKCHAIN APPLICATIONS	6 HOURS

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

	TOTAL HOURS:	30 HOURS

TEXT BOOK(S):	
1	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2	2.Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.
REFERENCE BOOKS:	
1	Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3	Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
4	Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing
5	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

LIST OF EXPERIMENTS :

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.
2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.
3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan

TOTAL HOURS: 30 HOURS

VERTICALS –VI-Human Bond AI

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE016</td><td rowspan="2">IMAGE AND VIDEO ANALYTICS</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of image processing techniques for computer vision.
2. To learn the techniques used for image pre-processing.
3. To discuss the various object detection techniques.
4. To understand the various Object recognition mechanisms.
5. To elaborate on the video analytics techniques.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the basics of image processing techniques for computer vision and video analysis.

CO2. Explain the techniques used for image pre-processing.

CO3. Develop various object detection techniques.

CO4. Understand the various face recognition mechanisms.

CO5. Elaborate on deep learning-based video analytics.

UNIT-1	INTRODUCTION	6 HOURS

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT-2	IMAGE PRE-PROCESSING	6 HOURS

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.

UNIT-3	OBJECT DETECTION USING MACHINE LEARNING	6 HOURS

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT-4	FACE RECOGNITION AND GESTURE RECOGNITION	6 HOURS
Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition-DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet-Gesture Recognition.		
UNIT-5	**VIDEO ANALYTICS**	**6 HOURS**
Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.
2	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

REFERENCE BOOKS:

1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London
2	Limited,2011.
3	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
4	D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
5	E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

LIST OF EXPERIMENTS :

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale
4. (c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e) Bilinear transform calculated from four pairs of corresponding points.
5. Develop a program to implement Object Detection and Recognition
6. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
7. Develop a program for Facial Detection and Recognition

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE017	**BIO-INSPIRED OPTIMIZATION TECHNIQUES**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand fundamental topics in bio-inspired optimization techniques
2. To Learn the collective systems such as ACO, PSO, and BCO
3. To develop skills in biologically inspired algorithm design with an emphasis on solving real world problems
4. To understand the most appropriate types of algorithms for different data analysis problems and to introduce some of the most appropriate implementation strategies.
5. To implement the Bio-inspired technique with other traditional algorithms

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Familiarity with the basics of several biologically inspired optimization techniques.

CO2. Familiarity with the basics of several biologically inspired computing paradigms.

CO3. Ability to select an appropriate bio-inspired computing method and implement for any application and data set.

CO4. Theoretical understanding of the differences between the major bio-inspired computing methods.

CO5. Learn Other Swarm Intelligence algorithms and implement the Bio-inspired technique with other traditional algorithms.

UNIT-1	INTRODUCTION	9 HOURS

Optimization Techniques: Introduction to Optimization Problems – Single and Muti- objective Optimization – Classical Techniques – Overview of various Optimization methods – Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept – encoding – representation – fitness function – Reproduction – differences between GA and Traditional optimization methods – Applications – Bio- inspired Computing (BIC): Motivation – Overview of BIC – usage of BIC – merits and demerits of BIC.

UNIT-2	SWARM INTELLIGENCE	9 HOURS

Introduction – Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization – Ant Colonies: Ant Foraging Behavior – Towards Artificial Ants – Ant Colony Optimization (ACO) – S-ACO – Ant Colony Optimization Metaheuristic: Combinatorial Optimization – ACO Metaheuristic – Problem solving using ACO – Other Metaheuristics – Simulated annealing – Tabu Search – Local search methods – Scope of ACO algorithms.

UNIT-3	**NATURAL TO ARTIFICIAL SYSTEMS**	**9 HOURS**
Biological Nervous Systems – artificial neural networks – architecture – Learning Paradigms – unsupervised learning – supervised learning – reinforcement learning – evolution of neural networks – hybrid neural systems – Biological Inspirations in problem solving – Behavior of Social Insects: Foraging –Division of Labor – Task Allocation – Cemetery Organization and Brood Sorting – Nest Building – Cooperative transport.		
UNIT-4	**SWARM ROBOTICS**	**9 HOURS**
Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics – Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle Swarms for Dynamic Optimization Problems – Artificial Bee Colony (ABC) Optimization biologically inspired algorithms in engineering.		
UNIT-5	**CASE STUDIES**	**9 HOURS**
Other Swarm Intelligence algorithms: Fish Swarm – Bacteria foraging – Intelligent Water Drop Algorithms – Applications of biologically inspired algorithms in engineering. Case Studies: ACO and PSO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems – Subset problems – Machine Learning Problems – Travelling Salesman problem.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	A. E. Elben and J. E. Smith, “Introduction to Evolutionary Computing”, Springer, 2010.
2	.Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3	Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
REFERENCE BOOKS:	
1	Eric Bonabeau, Marco Dorigo, Guy Theraulaz, “Swarm Intelligence: From Natural to Artificial Systems”, Oxford University press, 2000.
2	Christian Blum, Daniel Merkle (Eds.), “Swarm Intelligence: Introduction and Applications”, Springer Verlag, 2008.
3	Leandro N De Castro, Fernando J Von Zuben,
4	Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
5	C. Ebelhart et al., “Swarm Intelligence”, Morgan Kaufmann, 2001.
	TOTAL HOURS: 45 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE018	HEALTH CARE ANALYTICS	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the health data formats, health care policy and standards
2. To learn the significance and need of data analysis and data visualization
3. To understand the health data management frameworks
4. To learn the use of machine learning and deep learning algorithms in healthcare
5. To apply healthcare analytics for critical care applications

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Use machine learning and deep learning algorithms for health data analysis

CO2. Apply the data management techniques for healthcare data

CO3. Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications

CO4. Design health data analytics for real time applications

CO5. Design emergency care system using health data analysis

UNIT-1	INTRODUCTION TO HEALTHCARE ANALYSIS	9 HOURS

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach

UNIT-2	ANALYTICS ON MACHINE LEARNING	9 HOURS

Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection.

UNIT-3	HEALTH CARE MANAGEMENT	9 HOURS

IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

UNIT-4	HEALTHCARE AND DEEP LEARNING	9 HOURS

Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.

UNIT-5	CASE STUDIES	9 HOURS
Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT –Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.
2	Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
3	Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
REFERENCE BOOKS:	
1	Hui Jang, Eva K.Lee, “HealthCare Analysis : From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
2	Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.
	TOTAL HOURS: 45 HOURS

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADE019</td><td rowspan="2">TEXT AND SPEECH ANALYSIS</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">The course enables the learner to
1. Understand natural language processing basics
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Develop a speech recognition system
5. Develop a speech synthesizer</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After the completion of this course, the students should be able to
CO1. Explain existing and emerging deep learning architectures for text and speech processing
CO2. Apply deep learning techniques for NLP tasks, language modelling and machine translation
CO3. Explain coreference and coherence for text processing
CO4. Build question-answering systems, chatbots and dialogue systems
CO5. Apply deep learning models for building speech recognition and text-to-speech systems</td></tr>
<tr><td>UNIT-1</td><td>NATURAL LANGUAGE BASICS</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="7">Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop- words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model</td></tr>
<tr><td>UNIT-2</td><td>TEXT CLASSIFICATION</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="7">Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models</td></tr>
<tr><td>UNIT-3</td><td>QUESTION ANSWERING AND DIALOGUE SYSTEMS</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="7">Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems</td></tr>
<tr><td>UNIT-4</td><td>TEXT-TO-SPEECH SYNTHESIS</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="7">Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems</td></tr>
<tr><td>UNIT-5</td><td>AUTOMATIC SPEECH RECOGNITION</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="7">Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems</td></tr>
<tr><td colspan="2">TOTAL HOURS:</td><td colspan="5">30 HOURS</td></tr>
</table>

TEXT BOOK(S):	
1	Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.
REFERENCE BOOKS:	
1	Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
2	Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
3	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4	Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.
LIST OF EXPERIMENTS :	
1. Create Regular expressions in Python for detecting word patterns and tokenizing text	
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams	
3. Accessing Text Corpora using NLTK in Python	
4. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.	
5. Implement the Word2Vec model	
6. Use a transformer for implementing classification	
7. Design a chatbot with a simple dialog system	
8. Convert text to speech and find accuracy	
9.Design a speech recognition system and find the error rate	
	TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADE020	COGNITIVE SCIENCE	2	0	2	0	3
		Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To know the theoretical background of cognition.
2. To understand the link between cognition and computational intelligence.
3. To explore probabilistic programming language.
4. To study the computational inference models of cognition.
5. To study the computational learning models of cognition.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the underlying theory behind cognition.
CO2. Connect to the cognition elements computationally.
CO3. Implement mathematical functions through WebPPL.
CO4. Develop applications using cognitive inference model.
CO5. Develop applications using cognitive learning model.

UNIT-1	PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE	6 HOURS

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT-2	COMPUTATIONAL INTELLIGENCE	6 HOURS

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.

UNIT-3	PROBABILISTIC PROGRAMMING LANGUAGE	6 HOURS

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration

UNIT-4	INFERENCE MODELS OF COGNITION	6 HOURS

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

UNIT-5	LEARNING MODELS OF COGNITION	6 HOURS

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

	TOTAL HOURS:	30 HOURS

TEXT BOOK(S):	
1	Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2	Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
3	Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.
4	Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020
REFERENCE BOOKS:	
1	Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.
2	Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.
LIST OF EXPERIMENTS :	
1.Demonstration of Mathematical functions using WebPPL.	
2.Implementation of reasoning algorithms.	
3.Developing an Application system using generative model.	
4.Developing an Application using conditional inference learning model.	
5.Application development using hierarchical model.	
6.Application development using Mixture model.	
TOTAL HOURS: 30 HOURS	

Course Code	Course Title	L	T	P	J	C
22ADE021	ETHICS AND AI	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To study the morality and ethics in AI
2. To learn about the Ethical initiatives in the field of artificial intelligence
3. To study about AI standards and Regulations
4. To study about social and ethical issues of Robot Ethics
5. To study about AI and Ethics- challenges and opportunities

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Learn about morality and ethics in AI

CO2. Acquire the knowledge of real time application ethics, issues and its challenges.

CO3. Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems

CO4. Understand the concepts of Robo ethics and Morality with professional responsibilities.

CO5. Learn about the societal issues in AI with National and International Strategies on AI

UNIT-1	INTRODUCTION	6 HOURS

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT-2	ETHICAL INITIATIVES IN AI	6 HOURS

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT-3	AI STANDARDS AND REGULATION	6 HOURS

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT-4	ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS	6 HOURS

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT-5	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES	6 HOURS

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 — March 2020
2	Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.
REFERENCE BOOKS:	
1	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2	Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020
LIST OF EXPERIMENTS :	
1.Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense	
2.Exploratory data analysis on a 2 variable linear regression model	
3.Experiment the regression model without a bias and with bias	
4.Classification of a dataset from UCI repository using a perceptron with and without bias	
5.Case study on ontology where ethics is at stake	
6.Identification on optimization in AI affecting ethics	
	TOTAL HOURS:30 HOURS

MANAGEMENT ELECTIVE (V SEMESTER)

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EMT001</td><td rowspan="2">PRINCIPLES OF MANAGEMENT</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To sketch the Evolution of Management.
2. To extract the functions and principles of management.
3. To learn the application of the principles in an organization.
4. To study the various HR related activities.
5. To analyze the position of self and company goals towards business.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand managerial functions like planning, organizing, staffing, leading & controlling.
CO2. Have same basic knowledge on international aspect of management.
CO3. Ability to understand management concept of organizing.
CO4. Ability to understand management concept of directing.
CO5. Ability to understand management concept of controlling.

UNIT-1	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9 HOURS

Definition of Management — Science or Art — Manager Vs Entrepreneur- types of managers- managerial roles and skills — Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment — Current trends and issues in Management

UNIT-2	PLANNING	9 HOURS

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process

UNIT-3	ORGANISING	9 HOURS

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT-4	DIRECTING	9 HOURS
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.		
UNIT-5	**CONTROLLING**	**9 HOURS**
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998
2	Stephen P. Robbins and Mary Coulter, “ Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCE BOOKS:

1	Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008.
2	Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011
3	Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999

Course Code	Course Title	L	T	P	J	C
22EMT002	TOTAL QUALITY MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2. Explain the TQM Principles for application.
3. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
4. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniqueslike QFD, TPM, COQ and BPR.
5. Illustrate and apply QMS and EMS in any organization

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Ability to apply TQM concepts in a selected enterprise.

CO2. Ability to apply TQM principles in a selected enterprise.

CO3. Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4. Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5. Ability to apply QMS and EMS in any organization.

UNIT-1	INTRODUCTION	9 HOURS

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT-2	TQM PRINCIPLES	9 HOURS

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning-Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT-3	TQM TOOLS & TECHNIQUES I	9 HOURS

The seven traditional tools of quality - New management tools - Six-sigma Process Capability-Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the

findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
UNIT-4	**TQM TOOLS & TECHNIQUES II**	**9 HOURS**
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.		
UNIT-5	**QUALITY MANAGEMENT SYSTEM**	**9 HOURS**
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,Mary B.Sacre, Hemant Urdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
REFERENCE BOOKS:	
1	Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2	Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth Heinemann Ltd, 2016.
3	Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4	Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.

Course Code	Course Title	L	T	P	J	C
22EMT003	**ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Understanding the concept of Engineering Economics.
2. Implement various micro economics concept in real life.
3. Gaining knowledge in the field of macro economics to enable the students to have better
4. understanding of various components of macro economics.
5. Understanding the different procedures of pricing.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO2. Evaluate the economic theories, cost concepts and pricing policies

CO3. Understand the market structures and integration concepts

CO4. Understand the measures of national income, the functions of banks and concepts of globalization

CO5. Apply the concepts of financial management for project appraisal

UNIT-1	DEMAND & SUPPLY ANALYSIS	9 HOURS

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis.Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity

UNIT-2	PRODUCTION AND COST ANALYSIS	9 HOURS

Production function - Returns to scale - Production optimization - Least cost input – Isoquants Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT-3	PRICING	9 HOURS

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT-4	**FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)**	**9 HOURS**
Balance sheet and related concepts - Profit & Loss Statement and related concepts - - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.		
UNIT-5	**CAPITAL BUDGETING (ELEMENTARY TREATMENT)**	**9 HOURS**
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi,2001.
2	Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

REFERENCE BOOKS:

1	Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011
2	Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3	Zahid A khan: Engineering EconoDonald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
4	my, "Engineering Economy", Dorling Kindersley, 2012
5	Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

Course Code	Course Title	L	T	P	J	C
22EMT004	HUMAN RESOURCE MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To provide knowledge about management issues related to staffing,
2. To provide knowledge about management issues related to training,
3. To provide knowledge about management issues related to performance
4. To provide knowledge about management issues related to compensation
5. To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Students would have gained knowledge on the various aspects of HRM

CO2. Students will gain knowledge needed for success as a human resources professional.

CO3. Students will develop the skills needed for a successful HR manager.

CO4. Students would be prepared to implement the concepts learned in the workplace.

CO5. Students would be aware of the emerging concepts in the field of HRM

UNIT-1	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT	9 HOURS

The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager.

UNIT-2	HUMAN RESOURCE PLANNING	9 HOURS

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.

UNIT-3	TRAINING AND EXECUTIVE DEVELOPMENT	9 HOURS

Types of training and Executive development methods – purpose – benefits.

UNIT-4	EMPLOYEE COMPENSATION	9 HOURS

Compensation plan — Reward — Motivation — Career Development - Mentor — Protege relationships

UNIT-5	PERFORMANCE EVALUATION AND CONTROL	9 HOURS

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods

TOTAL HOURS:	45 HOURS

TEXT BOOK(S):	
1	Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2	John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.
REFERENCE BOOKS:	
1	Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.
2	Dessler, "Human Resource Management", Pearson Education Limited, 2007.
3	Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.

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<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EMT005</td><td rowspan="2">KNOWLEDGE MANAGEMENT</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To understand the process of acquiry knowledge from experts
2. To understand the learning organization.
3. To use the knowledge management tools.
4. To develop knowledge management Applications.
5. To design and develop enterprise applications

COURSE OUTCOMES:

After the completion of this course, the students should be able to

- CO1. Understand the process of acquiry knowledge from experts
- CO2. Understand the learning organization.
- CO3. Use the knowledge management tools.
- CO4. Develop knowledge management Applications.
- CO5. Design and develop enterprise applications

UNIT-1	INTRODUCTION	9 HOURS

The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT-2	CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING	9 HOURS

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT-3	KNOWLEDGE MANAGEMENT-THE TOOLS	9 HOURS

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information

UNIT-4	KNOWLEDGE MANAGEMENT APPLICATION	9 HOURS

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT-5	FUTURE TRENDS AND CASE STUDIES	9 HOURS
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000.
REFERENCE BOOKS:	
1	Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.

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<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22EMT006</td><td rowspan="2">INDUSTRIAL MANAGEMENT</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2. Discuss the planning; organizing and staffing functions of management in professional organization.

CO3. Apply the leading; controlling and decision making functions of management in professional organization.

CO4. Discuss the organizational theory in professional organization.

CO5. Apply principles of productivity and modern concepts in management in professional organization.

UNIT-1	INTRODUCTION	9 HOURS

Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

UNIT-2	FUNCTIONS OF MANAGEMENT	9 HOURS
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.		
UNIT-3	**ORGANIZATIONAL BEHAVIOUR**	**9 HOURS**
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.		
UNIT-4	**GROUPDYNAMICS**	**9 HOURS**
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.		
UNIT-5	**MODERN CONCEPTS**	**9 HOURS**
Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, New Delhi, 2009
2	Koontz. H. and Weihrich. H., “Essentials of Management: An International Perspective”, 8th Edition, Tata McGrawhill, New Delhi, 2010

REFERENCE BOOKS:

1	Joseph J, Massie, “Essentials of Management”, 4th Edition, Pearson Education, 1987.
2	Saxena, P. K., “Principles of Management: A Modern Approach”, Global India Publications, 2009.

OPEN ELECTIVE-I (VI SEMESTER)

Course Code	Course Title	L	T	P	J	C
22ADO001	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basic concepts of machine learning.
2. To understand and build supervised learning models.
3. To understand and build unsupervised learning models.
4. To evaluate the algorithms based on corresponding metrics identified
5. To design and analyze various machine learning experiments

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the basic concepts of machine learning.
CO2. Construct supervised learning models.
CO3. Construct unsupervised learning algorithms.
CO4. Evaluate and compare different models
CO5. Design and analyze various machine learning experiments

UNIT-1	INTRODUCTION TO MACHINE LEARNING	9 HOURS

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik- Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning

UNIT-2	SUPERVISED LEARNING-I	9 HOURS

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm

UNIT-3	SUPERVISED LEARNING-II	9 HOURS

Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT-4	UNSUPERVISED LEARNING	9 HOURS

Unsupervised learning: K- means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT-5	NEURAL NETWORKS	9 HOURS

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU

TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition,2020.
2	Stephen Marsland, “Machine Learning: An Algorithmic Perspective, “SecondEdition”, CRC Press, 2014.
REFERENCE BOOKS:	
1	Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer,2006.
2	Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997.
3	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2012, 2018
4	Ian Good fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press,2016
5	Sebastain Raschka, Vahid Mirjalili , “Python Machine Learning”, Packt publishing,3rd Edition, 2019.

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<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADO002</td><td rowspan="2">FUNDAMENTALS OF DATA SCIENCE</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
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COURSE OBJECTIVES:

The course enables the learner to

1. To obtain fundamental knowledge on data science.
2. To demonstrate proficiency in data analytics.
3. To apply advanced tools to work on dimensionality reduction and mathematical operations.
4. To handle various types of data and visualize them using through programming for knowledge representation.
5. To demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Ability to obtain fundamental knowledge on data science.
CO2. Demonstrate proficiency in data analytics.
CO3. Apply advanced tools to work on dimensionality reduction and mathematical operations.
CO4. Handle various types of data and visualize them using through programming for knowledge representation.
CO5. Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.

UNIT-1	**DATA SCIENCE CONTEXT**	**9 HOURS**

Need for Data Science – What is Data Science - Data Science Process – Business Intelligence and Data Science – Prerequisites for a Data Scientist – Tools and Skills required.

UNIT-2	**DATABASES FOR DATA SCIENCE**	**9 HOURS**

Structured Query Language (SQL): Basic Statistics, Data Munging, Filtering, Joins, Aggregation, Window Functions, Ordered Data, preparing No-SQL: Document Databases, Wide-column Databases and Graphical Databases.

UNIT-3	**DATA SCIENCE METHODOLOGY**	**9 HOURS**

Analytics for Data Science – Examples of Data Analytics – Data Analytics Lifecycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results.

UNIT-4	**DATA ANALYTICS ON TEXT**	**9 HOURS**

Major Text Mining Areas – Information Retrieval – Data Mining – Natural Language Processing NLP) – Text analytics tasks: Cleaning and Parsing, Searching, Retrieval, Text Mining, Part-of-Speech Tagging, Stemming, Text Analytics Pipeline. NLP: Major components of NLP, stages of NLP, and NLP applications.

UNIT-5	PLATFORM FOR DATA SCIENCE	9 HOURS
Python for Data Science –Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset – Clustering with Python – Dimensionality Reduction. Python integrated Development Environments (IDE) for Data Science.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, 'Fundamentals of Data Science, CRC Press, 1st Edition, 2022.
2	Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Press, First Edition, 2020.
REFERENCE BOOKS:	
1	Ani Adhikari and John DeNero, 'Computational and Inferential Thinking: The Foundations of Data Science', GitBook, 2019.
2	Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 1st Edition, 2015.

Course Code	Course Title	L	T	P	J	C
		3	0	0	0	3
22ADO003	**BASICS OF CLOUD COMPUTING**	Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the principles of cloud architecture, models and infrastructure.
2. To understand the concepts of virtualization and virtual machines.
3. To gain knowledge about virtualization Infrastructure.
4. To explore and experiment with various Cloud deployment environments.
5. To learn about the security issues in the cloud environment.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the design challenges in the cloud.
CO2. Apply the concept of virtualization and its types.
CO3. Experiment with virtualization of hardware resources and Docker.
CO4. Develop and deploy services on the cloud and set up a cloud environment.
CO5. Explain security challenges in the cloud environment.

UNIT-1	**CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE**	**9 HOURS**

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models;

UNIT-2	**CLOUD INFRASTRUCTURE**	**9 HOURS**

Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT-3	**VIRTUALIZATION**	**9 HOURS**

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU

UNIT-4	**VIRTUALIZATION INFRASTRUCTURE**	**9 HOURS**

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines

UNIT-5	**CLOUD DEPLOYMENT ENVIRONMENT**	**9 HOURS**

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012
2	James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014.
3	Krutz, R. L., Vines, R. D, “Cloud security. A Comprehensive Guide to Secure Cloud Computing”, Wiley Publishing, 2010.
REFERENCE BOOKS:	
1	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: an enterprise perspective on risks and compliance”, O’Reilly Media, Inc., 2009.

Course Code	Course Title	L	T	P	J	C
22ADO004	**BASICS OF MULTIMEDIA AND ANIMATION**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:
The course enables the learner to 1. To grasp the fundamental knowledge of Multimedia elements and systems 2. To get familiar with Multimedia file formats and standards 3. To learn the process of Authoring multimedia presentations 4. To learn the techniques of animation in 2D and 3D and for the mobile UI 5. To explore different popular applications of multimedia
COURSE OUTCOMES:
After the completion of this course, the students should be able to CO1. Get the bigger picture of the context of Multimedia and its applications CO2. Use the different types of media elements of different formats on content pages CO3. Author 2D and 3D creative and interactive presentations for different target multimedia applications. CO4. Use different standard animation techniques for 2D, 21/2 D, 3D applications CO5. Understand the complexity of multimedia applications in the context of cloud, security, bigdata streaming, social networking, CBIR etc.,

UNIT-1	**INTRODUCTION**	**9 HOURS**
Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing.		
UNIT-2	**MULTIMEDIA FILE FORMATS**	**9 HOURS**
File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.		
UNIT-3	**BASICS OF ANIMATION**	**9 HOURS**
Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation		
UNIT-4	**ANIMATION TECHNIQUES**	**9 HOURS**
Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.		
UNIT-5	**MULTIMEDIA APPLICATIONS**	**9 HOURS**
Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology.		

TOTAL HOURS:	**45 HOURS**
TEXT BOOK(S):	
1	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)
REFERENCE BOOKS:	
1	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.
2	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018.
3	Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.
4	Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
5	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
6	Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.
7	Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.
WEB REFERENCES:	
1	https://itsfoss.com/
2	https://www.ucl.ac.uk/slade/know/3396
3	https://handbrake.fr/
4	https://opensource.com/article/18/2/open-source-audio-visual-production-tools
5	https://developer.android.com/training/animation/overview (UNIT-IV)
6	https://camstudio.org/
7	https://developer.android.com/training/animation/overview

Course Code	Course Title	L	T	P	J	C
22ADO005	**BASICS OF ETHICAL HACKING**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the basics of computer based vulnerabilities.
2. To explore different foot printing, reconnaissance and scanning methods.
3. To expose the enumeration and vulnerability analysis methods.
4. To understand hacking options available in Web and wireless applications.
5. To explore the options for network protection and practice tools to perform ethical hacking to expose the vulnerabilities.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Express knowledge on basics of computer based vulnerabilities

CO2. Gain understanding on different foot printing, reconnaissance and scanning methods.

CO3. Demonstrate the enumeration and vulnerability analysis methods

CO4. Gain knowledge on hacking options available in Web and wireless applications.

CO5. Acquire knowledge on the options for network protection and use tools to perform ethical hacking to expose the vulnerabilities.

UNIT-1	**INTRODUCTION**	**9 HOURS**

Ethical Hacking Overview - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT-2	**ENUMERATION ANALYSIS**	**9 HOURS**

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts

UNIT-3	**VULNERABILITY ANALYSIS**	**9 HOURS**

Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT-4	**SYSTEM HACKING**	**9 HOURS**

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT-5	**NETWORK PROTECTION**	**9 HOURS**

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers

	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.
REFERENCE BOOKS:	
1	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.

Course Code	Course Title	L	T	P	J	C
22ADO006	FUNDAMENTALS OF DATA MINING	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To learn to apply various data mining techniques into various areas of different domains
2. To interact competently on the topic of data mining for business intelligence
3. To apply various prediction techniques
4. To learn about supervised and unsupervised learning technique
5. To develop and implement machine learning algorithms

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Learn to apply various data mining techniques into various areas of different domains

CO2. Be able to interact competently on the topic of data mining for business intelligence

CO3. Apply various prediction techniques

CO4. Learn about supervised and unsupervised learning technique

CO5. Develop and implement machine learning algorithms

UNIT-1	**INTRODUCTION**	**9 HOURS**
Data mining, Text mining, Web mining, Data ware house		
UNIT-2	**DATA MINING & MAP REDUCE**	**9 HOURS**
Datamining process – KDD, CRISP-DM, SEMMA, Prediction performance measures, MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce		
UNIT-3	**PREDICTION TECHNIQUES**	**9 HOURS**
Data visualization, Time series – ARIMA, Winter Holts		
UNIT-4	**MACHINE LEARNING AND AI**	**9 HOURS**
Classification, Association, Clustering, Genetic algorithms, Neural network, Fuzzy logic		
UNIT-5	**NO SQL ANALYSIS**	**9 HOURS**
Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1	Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2	Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3	W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.

REFERENCE BOOKS:

1	Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition,2013.
2	Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011

OPEN ELECTIVE-II (VII SEMESTER)

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADO007</td><td rowspan="2">INTRODUCTION TO DEEP LEARNING</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
</table>

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. To identify and apply suitable deep learning approaches for given application.
3. To design and develop custom Deep-nets for human intuitive applications.
4. To design of test procedures to assess the efficiency of the developed model.
5. To evaluate the need for Reinforcement learning in real – time problems.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
CO2. Identify and apply suitable deep learning approaches for given application.
CO3. Design and develop custom Deep-nets for human intuitive applications.
CO4. Design of test procedures to assess the efficiency of the developed model.
CO5. Evaluate the need for Reinforcement learning in real – time problems.

UNIT-1	**INTRODUCTION**	**6 HOURS**
Neural Networks Basics - Functions in Neural networks – Activation function, Loss function Function approximation - Classification and Clustering problems.		
UNIT-2	**DEEP NEURAL NETWORKS**	**6 HOURS**
Deep networks basics Shallow neural networks – Activation Functions – Gradient Descent – Back Propagation – Deep Neural Networks – Forward and Back Propagation – Parameters – Hyperparameters		
UNIT-3	**CONVOLUTION NEURAL NETWORKS**	**6 HOURS**
Foundations of Convolutional Neural Networks – CNN operations – Architecture – Simple Convolution Network		
UNIT-4	**RECURRENT NETWORKS**	**6 HOURS**
Recurrent Neural Networks - Bidirectional RNNs, Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders		
UNIT-5	**RECURSIVE NEURAL NETWORKS**	**6 HOURS**
Long-Term Dependencies - Echo State Networks - Long Short-Term Memory and Other Gated RNNs - Optimization for Long-Term Dependencies - Explicit Memory.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Ian Goodfellow Yoshua Bengio Aaron Courville, Deep Learning, MIT Press, 2017.
2	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, first Edition, 2013.
3	N D Lewis, Deep Learning Step by Step with Python, 2016.
4	Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly Media, 2017.
REFERENCE BOOKS:	
1	Umberto Michelucci, Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Apress, 2018.
2	Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Deep Learning with TensorFlow: Explore neural networks with Python, Packt Publisher, 2017.
LIST OF EXPERIMENTS :	
1.	Hyper parameter tuning and regularization practice
2.	Multilayer Perceptron (BPN) • Mini-batch gradient descent, Convolution Neural Network application using TensorFlow and Keras
3.	Classification of MNIST Dataset using CNN, Face recognition using CNN, Object detection using Transfer Learning of CNN architectures
4.	Image denoising (Fashion dataset) using Auto Encoders
5.	Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising), Text processing, Language Modeling using RNN
6.	Transfer Learning models for classification problems
7.	Sentiment Analysis using LSTM
8.	Image generation using GAN
	TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADO008	**PROGRAMMING FOR DATA SCIENCE**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:		
The course enables the learner to 1. To engrave and use R language to solve problems. 2. To design a suitable form for analysis from real-time data. 3. To formulate insights from the data through statistical inferences. 4. To evaluate and visualize the results 5. To analyze the performance of the models.		
COURSE OUTCOMES:		
After the completion of this course, the students should be able to CO1. Engrave and use R language to solve problems. CO2. Design a suitable form for analysis from real-time data. CO3. Formulate insights from the data through statistical inferences. CO4. Evaluate and visualize the results CO5. Analyze the performance of the models.		
UNIT-1	**FUNCTIONS IN R**	**6 HOURS**
Programming with R- Running R Code - Including Comments - Defining Variables, Functions -Built-in R Functions - Loading Functions - Writing Functions - Using Conditional Statements.		
UNIT-2	**VECTORS AND LISTS**	**6 HOURS**
Vectorized Operations - Vector Indices - Vector Filtering - Modifying Vectors, Lists Creating Lists - Accessing List Elements - Modifying Lists- Applying Functions to Lists with lapply().		
UNIT-3	**DATA WRANGLING**	**6 HOURS**
Understanding Data - The Data Generation Process - Finding Data - Types of Data Interpreting Data - Using Data to Answer Questions - Data Frames - Working with Data Frames -Working with CSV Data.		
UNIT-4	**MANIPULATING DATA WITH DPLYR AND TIDYR**	**6 HOURS**
Data Manipulation - Core dplyr Functions- Performing Sequential Operations -Analyzing Data Frames by Group - Joining Data Frames Together - dplyr in Action: Analyzing Flight Data-Reshaping Data with tidyr -From Columns to Rows: gather() - From Rows to Columns: spread() - tidyr in Action: Exploring Educational Statistics.		
UNIT-5	**ACCESSING DATABASES AND WEB APIS**	**6 HOURS**
An Overview of Relational Databases -A Taste of SQL-Accessing a Database from R Accessing Web APIs -RESTful Requests -Accessing Web APIs from R -Processing JSON Data -APIs in Action: Finding Cuban Food in Seattle.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Michael Freeman and Joel Ross, Programming Skills for Data Science: Start Writing Code to Wrangle, Analyze, and Visualize Data with R, Addison-Wesley, 2018.
2	Benjamin S. Baumer, Daniel T. Kaplan and Nicholas J. Horton, Modern Data Science with R, Chapman and Hall/CRC, 2021.
REFERENCE BOOKS:	
1	John Mount and Nina Zumel, Practical Data Science with R, 2nd edition, Wiley, 2019.
LIST OF EXPERIMENTS :	
1. Functions in R 4 hours	
2. Vectors and Lists 2 hours	
3. Data Frames 4 hours	
4. Handling Missing Data 4 hours	
5. Manipulating Data with dplyr and tidyr 2 hours	
6. Processing JSON Data	
7. APIs	
8. Data Visualization	
9. Interactive Visualization in R	
	TOTAL HOURS: 30 HOURS

<table>
<tr><th>Course Code</th><th colspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22ADO009</td><td colspan="2" rowspan="2">INTRODUCTION TO CLOUD SERVICES MANAGEMENT</td><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.1</td></tr>
<tr><td colspan="8">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="8">The course enables the learner to
1. To introduce Cloud Service Management terminology, definition & concepts
2. To compare and contrast cloud service management with traditional IT service management
3. To identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4. To select appropriate structures for designing, deploying and running cloud-based services in a business environment
5. To illustrate the benefits and drive the adoption of cloud-based services to solve real world problems</td></tr>
<tr><td colspan="8">COURSE OUTCOMES:</td></tr>
<tr><td colspan="8">After the completion of this course, the students should be able to
CO1. Introduce Cloud Service Management terminology, definition & concepts
CO2. Compare and contrast cloud service management with traditional IT service management
CO3. Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
CO4. Select appropriate structures for designing, deploying and running cloud-based services in a business environment
CO5. Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems</td></tr>
<tr><td>UNIT-1</td><td colspan="2">CLOUD SERVICE MANAGEMENT FUNDAMENTALS</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="8">Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models</td></tr>
<tr><td>UNIT-2</td><td colspan="2">CLOUD SERVICES STRATEGY</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="8">Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management</td></tr>
<tr><td>UNIT-3</td><td colspan="2">CLOUD SERVICE MANAGEMENT</td><td colspan="5">6 HOURS</td></tr>
<tr><td colspan="8">Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management</td></tr>
</table>

UNIT-4	CLOUD SERVICE ECONOMICS	6 HOURS
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models		
UNIT-5	**CLOUD SERVICE GOVERNANCE & VALUE**	**6 HOURS**
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):	
1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour
REFERENCE BOOKS:	
1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

LIST OF EXPERIMENTS :
1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one
TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADO010	INTRODUCTION TO DIGITAL MARKETING	2	0	2	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
2. To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
3. To know the key elements of a digital marketing strategy.
4. To study how the effectiveness of a digital marketing campaign can be measured
5. To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Examine and explore the role and importance of digital marketing in today's rapidly changing business environment.

CO2. Focus on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

CO3. Know the key elements of a digital marketing strategy.

CO4. Study how the effectiveness of a digital marketing campaign can be measured

CO5. Demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

UNIT-1	INTRODUCTION	6 HOURS
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing		
UNIT-2	**SEARCH ENGINE OPTIMISATION**	**6 HOURS**
Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement		
UNIT-3	**E- MAIL MARKETING**	**6 HOURS**
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness.		
UNIT-4	**SOCIAL MEDIA MARKETING**	**6 HOURS**
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing		

UNIT-5	MOBILE MARKETING	6 HOURS
Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
2	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
3	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
4	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.

REFERENCE BOOKS:

1	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
2	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

LIST OF EXPERIMENTS :

1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.
2. Demonstrate how to use the Google WebMasters Indexing API
3. Discuss an interesting case study regarding how an insurance company manages leads.
4. Discuss negative and positive impacts and ethical implications of using social media for political advertising.
5. Discuss how Predictive analytics is impacting marketing automation
6. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.

TOTAL HOURS: 30 HOURS

Course Code	Course Title	L	T	P	J	C
22ADO011	ETHICS IN AI FOR ENGINEERS	2	0	2	0	3
		Syllabus version		v. 1.1		

COURSE OBJECTIVES:

The course enables the learner to

1. To study the morality and ethics in AI
2. To learn about the Ethical initiatives in the field of artificial intelligence
3. To study about AI standards and Regulations
4. To study about social and ethical issues of Robot Ethics
5. To study about AI and Ethics- challenges and opportunities

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Learn about morality and ethics in AI

CO2. Acquire the knowledge of real time application ethics, issues and its challenges.

CO3. Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems

CO4. Understand the concepts of Robo ethics and Morality with professional responsibilities.

CO5. Learn about the societal issues in AI with National and International Strategies on AI

UNIT	Title	Hours
UNIT-1	**INTRODUCTION**	**6 HOURS**
Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust		
UNIT-2	**ETHICAL INITIATIVES**	**6 HOURS**
International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.		
UNIT-3	**AI STANDARDS AND REGULATION**	**6 HOURS**
Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations		
UNIT-4	**ROBOETHICS**	**6 HOURS**
Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society		
UNIT-5	**AI ETHICS- CHALLENGES AND OPPORTUNITIES**	**6 HOURS**
Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 — March 2020

2	Patrick Lin, Keith Abney, George A Bekey,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014.
REFERENCE BOOKS:	
1	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2	Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020
LIST OF EXPERIMENTS :	
1.Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense	
2.Exploratory data analysis on a 2 variable linear regression model	
3.Experiment the regression model without a bias and with bias	
4.Classification of a dataset from UCI repository using a perceptron with and without bias	
5.Case study on ontology where ethics is at stake	
6.Identification on optimization in AI affecting ethics	
TOTAL HOURS:30 HOURS	

Course Code	Course Title	L	T	P	J	C
22ADO012	**INTRODUCTION TO BUSINESS ANALYTICS**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the Analytics Life Cycle.
2. To comprehend the process of acquiring Business Intelligence
3. To understand various types of analytics for Business Forecasting
4. To model the supply chain management for Analytics.
5. To apply analytics for different functions of a business

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Explain the real world business problems and model with analytical solutions.
CO2. Identify the business processes for extracting Business Intelligence
CO3. Apply predictive analytics for business fore-casting
CO4. Apply analytics for supply chain and logistics management
CO5. Use analytics for marketing and sales.

UNIT-1	INTRODUCTION	6 HOURS
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation		
UNIT-2	**DATA INTELLIGENCE**	**6 HOURS**
Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions		
UNIT-3	**BUSINESS FORECASTING**	**6 HOURS**
Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.		
UNIT-4	**HUMAN RESOURCE & SUPPLY CHAIN ANALYTICS**	**6 HOURS**
Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain.		
UNIT-5	**MARKETING & SALES ANALYTICS**	**6 HOURS**
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales.		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017

2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
REFERENCE BOOKS:	
1	VSP RAO, "Human Resource Management", 3rd Edition, Excel Books, 2010.
2	Mahadevan B, "Operations Management -Theory and Practice", 3rd Edition, Pearson Education,2018.
LIST OF EXPERIMENTS :	
1. Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations.	
2. Students may be encouraged to bring their own real-time socially relevant data set.	
3. I Cycle – MS Excel	
4. Explore the features of Ms-Excel	
5. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) ii) Perform data import/export operations for different file formats.	
6. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis	
7. Perform Z-test, T-test & ANOVA	
8. Perform data pre-processing operations i) Handling Missing data ii) Normalization	
9. Perform dimensionality reduction operation using PCA, KPCA & SVD	
10. Perform bivariate and multivariate analysis on the dataset.	
	TOTAL HOURS: 30 HOURS

MANDATORY COURSE I (NON CREDIT COURSE)

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT001</td><td rowspan="2">INTRODUCTION TO WOMEN AND GENDER STUDIES</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Syllabus version</td><td colspan="4">v. 1.0</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES: After studying this course, you should be able to:</td></tr>
<tr><td colspan="7">1. To study in detail about the introduction to women and gender studies.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES: After completion of this course, the students should be able to</td></tr>
<tr><td colspan="7">CO1. Will be able to understand the concept of the woman and gender studies.
CO2. Have in-depth knowledge of feminist theory.
CO3. Able to understand the women's motivation.
CO4. Able to know about the gender and language.
CO5. Able to know about the gender and representation.</td></tr>
<tr><td>UNIT-I</td><td colspan="2">CO6. CONCEPTS</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.</td></tr>
<tr><td>UNIT-II</td><td colspan="2">FEMINIST THEORY</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.</td></tr>
<tr><td>UNIT-III</td><td colspan="2">WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Rise of Feminism in Europe and America. Women's Movement in India.</td></tr>
<tr><td>UNIT-IV</td><td colspan="2">GENDER AND LANGUAGE</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Linguistic Forms and Gender. Gender and narratives.</td></tr>
<tr><td>UNIT-V</td><td colspan="2">GENDER AND REPRESENTATION</td><td colspan="4">9 HOURS</td></tr>
<tr><td colspan="7">Advertising and popular visual media.</td></tr>
<tr><td colspan="3" align="right">TOTAL LECTURE HOURS:</td><td colspan="4">45 HOURS</td></tr>
</table>

Course Code	Course Title	L	T	P	J	C
22MCT002	ELEMENTS OF LITERATURE	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1. To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1. Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

UNIT-I	COURSE CONTENTS	9 HOURS

Introduction to Elements of Literature

1. Relevance of literature

a) Enhances Reading, thinking, discussing and writing skills.

b) Develops finer sensibility for better human relationship.

c) Increases understanding of the problem of humanity without bias.

d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction

a) Fiction, fact and literary truth.

b) Fictional modes and patterns.

c) Plot character and perspective.

3. Elements of poetry , a) Emotions and imaginations.

b) Figurative language.

c) (Simile, metaphor, conceit, symbol, pun and irony).

d) Personification and animation. e) Rhetoric and trend.

UNIT-II	ELEMENTS OF DRAMA	9 HOURS

Elements of drama a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.

UNIT-III	READINGS:	9 HOURS

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

1.1 Textbook:

1.2 *Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

UNIT-IV	OTHER SESSION:	9 HOURS
4.1*Tutorials: 4.2*Laboratory: 4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature		
UNIT-V	**ASSESSMENT:**	**9 HOURS**
5.1HA: 5.2Quizzes-HA: 5.3Periodical Examination: one 5.4Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc. 5.5Final Exam:		
	TOTAL LECTURE HOURS:	**45 HOURS**

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT003</td><td rowspan="2">FILM APPRECIATION</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES: After studying this course, you should be able to:</td></tr>
<tr><td colspan="7">In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES: After completion of this course, the students should be able to</td></tr>
<tr><td colspan="7">The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.</td></tr>
<tr><td>UNIT-I</td><td colspan="3">Theme - A: The Component of Films</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film</td></tr>
<tr><td>UNIT-II</td><td colspan="3">Theme - B: Evolution of Film Language</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">B-1: Film language, form, movement etc.
B-2: Early cinema… silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies</td></tr>
<tr><td>UNIT-III</td><td colspan="3">Theme - C: Film Theories and Criticism/Appreciation</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation</td></tr>
<tr><td>UNIT-IV</td><td colspan="3">Theme – D: Development of Films</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system</td></tr>
<tr><td>UNIT-V</td><td colspan="3">Theme - E: Indian Films</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India</td></tr>
<tr><td colspan="4">TOTAL LECTURE HOURS:</td><td colspan="3">45 HOURS</td></tr>
</table>

Course Code	Course Title	L	T	P	J	C
22MCT004	WELL BEING WITH TRADITIONAL PRACTICES (YOGA,AYURVEDA AND SIDDHA)	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To enjoy life happily with fun filled new style activities that help to maintain health also

2.To adapt a few lifestyle changes that will prevent many health disorders

3.To be cool and handbill every emotion very smoothly in every walk of life

4.To learn to eat cost effective but healthy foods that are rich in essential nutrients

5.To develop immunity naturally that will improve resistance against many health disorders

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1. Learn the importance of different components of health

CO2. Gain confidence to lead a healthy life

CO3. Learn new techniques to prevent lifestyle health disorders

CO4. Understand the importance of diet and workouts in maintaining health

CO5. Learn new techniques of yoga.

UNIT-I	HEALTH AND ITS IMPORTANCE	9 HOURS

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT-II	DIET	9 HOURS

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

UNIT-III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	9 HOURS
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. **Secrets of traditional healthy living** - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life. **Principles of Siddha & Ayurveda systems** - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) - Udal Thathukkal **Prevention of illness with our traditional system of medicine** Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.		
UNIT-IV	**MENTAL WELLNESS**	**9 HOURS**
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.		
UNIT-V	**YOGA**	**9 HOURS**
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):	
1.	Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2.	Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California
REFERENCE BOOKS:	
1.	WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts
2.	A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

<table>
<tr><th>Course Code</th><th colspan="2">Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT005</td><td colspan="2" rowspan="2">INDIAN CONSTITUTION</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="8">COURSE OBJECTIVES: After studying this course, you should be able to:</td></tr>
<tr><td colspan="8">In this course on Indian Constitution, the students will be known about the Indian constitution and government structures and government systems.</td></tr>
<tr><td colspan="8">COURSE OUTCOMES: After completion of this course, the students should be able to</td></tr>
<tr><td colspan="8">CO1. Understand the functions of the Indian government
CO2. Understand and abide the rules of the Indian constitution
CO3. Understand and appreciate different government structures.
CO4. Understand and appreciate different structures and courts.
CO5. Understand the functions of government systems.</td></tr>
<tr><td>UNIT-I</td><td colspan="2">INTRODUCTION</td><td colspan="5">09 HOURS</td></tr>
<tr><td colspan="8">Historical Background – Constituent Assembly of India – Philosophical Foundations Of The Indian Constitution – Preamble.</td></tr>
<tr><td>UNIT-II</td><td colspan="2">INDIAN CONSTITUTION</td><td colspan="5">09 HOURS</td></tr>
<tr><td colspan="8">Fundamental Rights – Directive Principles Of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies For Citizens.</td></tr>
<tr><td>UNIT-III</td><td colspan="2">GOVERNMENT STRUCTURES</td><td colspan="5">09 HOURS</td></tr>
<tr><td colspan="8">Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister.</td></tr>
<tr><td>UNIT-IV</td><td colspan="2">STRUCTURES AND COURTS</td><td colspan="5">09 HOURS</td></tr>
<tr><td colspan="8">Cabinet – Parliament – Supreme Court of India – Judicial Review-High Courts and other Subordinate Courts.</td></tr>
<tr><td>UNIT-V</td><td colspan="2">GOVERNMENT SYSTEMS</td><td colspan="5">09 HOURS</td></tr>
<tr><td colspan="8">State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States.</td></tr>
<tr><td colspan="3">TOTAL LECTURE HOURS:</td><td colspan="5">45 HOURS</td></tr>
<tr><td colspan="8">TEXT BOOK(S):</td></tr>
<tr><td>1.</td><td colspan="7">Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.</td></tr>
<tr><td>2.</td><td colspan="7">R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi.</td></tr>
<tr><td colspan="8">REFERENCE BOOKS:</td></tr>
<tr><td>1.</td><td colspan="7">Sharma, Brij Kishore, “Introduction to the Constitution of India”, Prentice Hall of India, New Delhi.</td></tr>
</table>

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT006</td><td rowspan="2">INDUSTRIAL SAFETY</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
</table>

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To Understand the Introduction and basic Terminologies safety.

2.To enable the students to learn about the Important Statutory Regulations and standards.

3.To enable students to Conduct and participate the various Safety activities in the Industry.

4.To have knowledge about Workplace Exposures and Hazards.

5.To assess the various Hazards and consequences through various Risk Assessment Techniques.

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1. Understand the basic concept of safety.

CO2. Obtain knowledge of Statutory Regulations and standards.

CO3. Know about the safety Activities of the Working Place.

CO4. Analyze on the impact of Occupational Exposures and their Remedies

CO5. Obtain knowledge of Risk Assessment Techniques.

UNIT-I	SAFETY TERMINOLOGIES	9 HOURS

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects-Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT-II	STANDARDS AND REGULATIONS	9 HOURS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT-III	SAFETY ACTIVITIES	9 HOURS

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan-Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT-IV	WORKPLACE HEALTH AND SAFETY	9 HOURS

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic gas Release

UNIT-V	HAZARD IDENTIFICATION TECHNIQUES	9 HOURS
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment		
	TOTAL LECTURE HOURS:	45 HOURS

TEXT BOOK(S):

1.	R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2.	L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCE BOOKS:

1.	Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2.	Alan Waring.(1996).Safety management system: Chapman &Hall,England
3.	Society of Safety Engineers, USA

MANDATORY COURSE II (NON CREDIT COURSE)

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT007</td><td rowspan="2">ETHICS AND VALUES</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES: After studying this course, you should be able to:</td></tr>
<tr><td colspan="7">1.To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2.To understand the negative health impacts of certain unhealthy behaviors
3.To appreciate the need and importance of physical, emotional health and social health</td></tr>
<tr><td colspan="7">COURSE OUTCOMES: After completion of this course, the students should be able to</td></tr>
<tr><td colspan="7">CO1. Follow sound morals and ethical values scrupulously to prove as good citizens
CO2. Understand various social problems and learn to act ethically
CO3. Understand the concept of addiction and how it will affect the physical and mental health
CO4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
CO5. Identify the main typologies, characteristics, activities, actors and forms of cybercrime</td></tr>
<tr><td>UNIT-I</td><td colspan="4">BEING GOOD AND RESPONSIBLE</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society’s interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society</td></tr>
<tr><td>UNIT-II</td><td colspan="4">ADDICTION AND HEALTH</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases</td></tr>
<tr><td>UNIT-III</td><td colspan="4">DRUG ABUSE AND TECHNOLOGIES</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention
Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites</td></tr>
<tr><td>UNIT-IV</td><td colspan="4">SOCIAL ISSUES 2</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices</td></tr>
<tr><td>UNIT-V</td><td colspan="4">PERSONAL AND PROFESSIONAL ETHICS</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Dishonesty - Stealing - Malpractices in Examinations – Plagiarism</td></tr>
<tr><td colspan="5" align="right">TOTAL LECTURE HOURS:</td><td colspan="2">45 HOURS</td></tr>
</table>

TEXT BOOK(S):	
1.	Dhaliwal, K.K (2016), “Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts, Writers Choice, New Delhi, India.
2.	Vittal, N (2012), “Ending Corruption? - How to Clean up India?”, Penguin Publishers, UK.
REFERENCE BOOKS:	
1.	Pandey, P. K (2012), “Sexual Harassment and Law in India”, Lambert Publishers, Germany.
2.	Pagliaro, L.A. and Pagliaro, A.M (2012), “Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological , Developmental and Clinical Considerations”, Wiley Publishers, U.S.A.

Course Code	Course Title	L	T	P	J	C
22MCT008	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To understand the concepts and perspectives in India.

2.To understand the historiography of science in India.

3.To understand the science and technology in ancient, Medieval and colonial India

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1. Understand various concepts and perspective history of science in India.

CO2. Understand historiography of science and technology in India

CO3. Understand the science and technology in ancient India.

CO4. Understand the science and technology in medieval India.

CO5. Understand the science and technology in colonial India.

UNIT-I	CONCEPTS AND PERSPECTIVES	9 HOURS

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT-II	HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA	9 HOURS

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT-III	SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	9 HOURS

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT-IV	SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA	9 HOURS

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT-V	SCIENCE AND TECHNOLOGY IN COLONIAL INDIA	9 HOURS

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

TOTAL LECTURE HOURS:	**45 HOURS**

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT009</td><td rowspan="2">POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES: After studying this course, you should be able to:</td></tr>
<tr><td colspan="7">This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES: After completion of this course, the students should be able to</td></tr>
<tr><td colspan="7">The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.</td></tr>
<tr><td>UNIT-I</td><td colspan="4">INTRODUCTION</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems.</td></tr>
<tr><td>UNIT-II</td><td colspan="4">CAPITALISM</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. Fascism and totalitarianism. World war I and II and cold war.</td></tr>
<tr><td>UNIT-III</td><td colspan="4">COMMUNISM</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.</td></tr>
<tr><td>UNIT-IV</td><td colspan="4">WELFARE STATE</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature.</td></tr>
<tr><td>UNIT-V</td><td colspan="4">CICILIZATION</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="7">Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions.</td></tr>
<tr><td colspan="5" align="right">TOTAL LECTURE HOURS:</td><td colspan="2">45 HOURS</td></tr>
</table>

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>C</th></tr>
<tr><td rowspan="2">22MCT010</td><td rowspan="2">STATE, NATION BUILDING AND POLITICS IN INDIA</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Syllabus version</td><td colspan="2">v. 1.0</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES: After studying this course, you should be able to:</td></tr>
<tr><td colspan="7">The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System.</td></tr>
<tr><td colspan="7">COURSE OUTCOMES: After completion of this course, the students should be able to</td></tr>
<tr><td colspan="7">It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.</td></tr>
<tr><td>UNIT-I</td><td colspan="3">INTRODUCTION</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">Understanding the need and role of State and politics. Introduction to the state, nation building and politics in India.</td></tr>
<tr><td>UNIT-II</td><td colspan="3">ORGANS OF STATE</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">Development of Nation-State, sovereignty, sovereignty in a globalized world.
Organs of State – Executive, Legislature, Judiciary.</td></tr>
<tr><td>UNIT-III</td><td colspan="3">NATION BUILDING IN INDIA</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.</td></tr>
<tr><td>UNIT-IV</td><td colspan="3">FEDERAL SYSTEM</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">Constitution making and the Constitution of India. Goals, objective and philosophy. Why a federal system? National integration and nation-building.</td></tr>
<tr><td>UNIT-V</td><td colspan="3">POLITICS IN INDIA</td><td colspan="3">9 HOURS</td></tr>
<tr><td colspan="7">Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?</td></tr>
<tr><td colspan="4" align="right">TOTAL LECTURE HOURS:</td><td colspan="3">45 HOURS</td></tr>
</table>

Course Code	Course Title	L	T	P	J	C
22MCT011	DISASTER MANAGEMENT	3	0	0	0	0
		Syllabus version		v. 1.0		

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To provide students an exposure to disasters, their significance and types.

2.To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction

3.To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)

4.To enhance awareness of institutional processes in the country and

5.To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1. Differentiate the types of disasters, causes and their impact on environment and society

CO2. Assess vulnerability and various methods of risk reduction measures as well as mitigation.

CO3. Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

CO4. Know about the disaster risk management in India.

CO5. understand the applications and case studies and of works of disaster management.

UNIT-I	INTRODUCTION TO DISASTERS	9 HOURS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT-II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9 HOURS

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT-III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9 HOURS

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-IV	DISASTER RISK MANAGEMENT IN INDIA	9 HOURS
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes 106 and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment		
UNIT-V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9 HOURS**
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1.	Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-9380386423
2.	Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCE BOOKS:

1.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2.	Government of India, National Disaster Management Policy,2009.

IBM SKILLS ACADEMY

PYTHON TRAINING MODULE

(CLASSROOM)

PYTHON TRAINING MODULE

The Python Training module will make the reader accustomed to python language. This material will help the reader in understanding the basics of the python language, Python libraries and the use of python for the analytics.

DELIVERY METHOD

25 % Self-paced Learning

75 % Instructor led training

VERSION

2019

LEARNING OBJECTIVES

- Explain what Python is
- Advantages and disadvantages of Python
- Getting started with Python and its different versions
- Explain variables, strings and functions
- Use of mathematical operators and functions
- Explain different statements like if, for etc.
- Explain the python libraries
- Explain Details of the Pandas library
    - Series and Data Frames
    - Grouping and aggregating
    - Merging and joining
- Define error handling in Python
- Define RE objects
- Define pattern matching and Parsing of data
- Define regression with Use case study
- Define exploratory data analysis
- Define correlation matrix
- Define visualization using matplotlib
- Define churn analysis with Use case
- Define advance Machine learning Algorithms
- Define Support vector machine
- Define Random forest

PREREQUISITES SKILLS

- Computer Science fundamentals
- Basic knowledge of applied math, algorithms, and data modelling
- Basic knowledge of statistics

DURATION

40 Hours

SKILL LEVEL

Basic – Intermediate

HARDWARE REQUIREMENTS

Processor	2 GHz or Higher
GB RAM	8 GB
GB Disk Free	80 GB
Network Requirements	Yes

Notes

The following unit and exercise durations are estimates and might not reflect every class experience. The estimates do not include the duration of optional exercises or sections. Students in this course use an IBM Cloud Lite account to perform the exercises. This account will never expire; therefore, students can continue working on the optional exercises after the class

COURSE AGENDA

UNIT I. Introduction to PYTHON

Duration: 6 Hrs.

Overview	This unit explains what is Python, its advantages and disadvantages, how to run python scripts, how to use variables, string operator and functions.
Learning Objectives	After completing this unit, you should be able to: • Explain what Python is • How to install and get start with python • How to use basic variables and stings in python • Work with Mathematical operators in python

UNIT II. Deep dive into PYTHON

Duration: 8 Hrs.

Overview	This unit consist more in depth working of Python like inputting the data, working with Boolean and other statements.
Learning Objectives	After completing this unit, you should be able to: • How to input data in Python • Use Boolean with python • Use If and elif statement in python • Use while loop in python • Work with lists • Use For statement

UNIT III. Python Libraries

Duration: 8 Hrs.

Overview	This unit explains the use of pandas library for data analysis
Learning Objectives	After completing this unit, you should be able to: • Install Pandas • Work with series and data frames • Work on grouping, aggregating and applying different functions on data • Merge and Join the data

UNIT IV. Error Handling

Duration: 4 hrs.

Overview	This unit explains how to deal with different type of errors that one can encounter while working with Python.
Learning Objectives	After completing this unit, you should be able to: • Deal with Syntax errors • Deal with the exceptions

UNIT V. Other Topics

Duration: 4 hrs.

Overview	This unit explains how to deal with miscellaneous things in python
Learning Objectives	After completing this unit, you should be able to: • Work with regular expression • Work with Pattern matching • Parse data

UNIT VI. Regression (Use case study)

Duration: 3 hrs.

Overview	This unit explains regression analysis with the help of a use case.
Learning Objectives	After completing this unit, you should be able to: • Define regression analysis • Work with regression analysis

UNIT VII. Other Regression related topics

Duration: 4 hrs.

Overview	This unit explains different topics which are important from the point of view of data analytics.
Learning Objectives	After completing this unit, you should be able to: • Define exploratory analysis • Define correlation matrix • Perform visualization using matplotlib • Implement linear regression

UNIT VIII. Advance

Duration: 3 hrs.

Overview	This unit explains some advance data analytics techniques.
Learning Objectives	After completing this unit, you should be able to: • Apply advanced Machine learning algorithms • Work on Support vector machines • Define Random forest

DATA VISUALIZATION TRAINING MODULE

(CLASSROOM)

DATA VISUALIZATION TRAINING MODULE

The Data Visualization Training module will give the reader a thorough introduction to Data Science, Statistics, R, IBM Watson Studio and python using real life examples. This course does not require a prior quantitative or mathematics background. The course introduces the basic concepts such as the mean, median etc. Then it eventually covers all aspects of an analytics (or) data science career from analyzing and preparing raw data to visualizing your findings. It covers both the theoretical aspects of statistical concepts and the practical implementation using R, IBM Watson Studio and python

DELIVERY METHOD

100 % Instructor led training

VERSION

2019

LEARNING OBJECTIVES

- Introduction to Statistics
    - Introduction to Statistics
    - Difference between inferential statistics and descriptive statistics
- Inferential Statistics
    - Drawing Inferences from Data
    - Random Variables
    - Normal Probability Distribution
    - Sampling
    - Sample Statistics and Sampling Distributions
- R overview and Installation
    - Overview and About R
    - R and R studio Installation
- Descriptive Data analysis using R
    - Description of basic functions used to describe data in R
- Data manipulation with R
    - Introduction to dplyr (filter, select, arrange, mutate, summarize)
    - Introduction to data.table
    - Introduction to reshape2 package
    - Introduction to tidyr package
    - Introduction to Lubridate package
- Data visualization with R
    - Working with Base R Graphics (Scatter Plot, Bar Plot, and Histogram)
    - Working with ggplot2
- Data visualization in Watson Studio
    - Adding data to data refinery
    - Visualization of Data on Watson Studio
- Introduction to Python
    - Python and Anaconda Installation
    - Introduction to Jupyter Notebook
    - Python scripting basics

- Numpy and Pandas
  - Numpy overview - Creating and Accessing Numpy Arrays
  - Introduction to pandas
  - Pandas read and write csv
  - Descriptive statistics using pandas
  - Pandas working with text data and datetime columns
  - Pandas Indexing and selecting data
  - Pandas - groupby
  - Merge / Join datasets
- Introduction to Data Visualization Tools in Python
  - Introduction to Matplotlib
  - Read a CSV and Generate a line plot with matplotlib
- Basic plots using matplotib
  - Area Plots
  - Bar Charts
  - Histograms
- Specialized Visualization Tools using Matplotlib
  - Pie Charts
  - Box Plots
  - Scatter Plots
  - Bubble Plots
- Advanced Visualization Tools using Matplotlib
  - Waffle Charts
  - Word Clouds
- Introduction to Seaborn
  - Seaborn functionalities and usage with Hands-on
- Spatial Visualizations and Analysis in Python with Folium
  - Introduction to Folium
  - Case Study (Analyze New York City Taxi Trip Ride Data Set to Identify best locations for taxi stops)

PREREQUISITES SKILLS

Basic knowledge of Python

DURATION

32 Hours

SKILL LEVEL

Advanced

Notes

The following unit and exercise durations are estimates and might not reflect every class experience. The estimates do not include the duration of optional exercises or sections. Students in this course use an IBM Cloud account to perform the exercises.

COURSE AGENDA

UNIT I. Introduction to Statistics

Duration: 1 Hr.

Overview	This chapter introduces you to Statistics.
Learning Objectives	After completing this unit, you should be able to: • Understand the different methods of data collections • Difference between descriptive and inferential statistics • Understanding on Descriptive Statistics: Mean, Median, Mode

UNIT II. Inferential Statistics

Duration: 3.5 Hrs.

Overview	In this chapter, you will be introduced to Inferential Statistics.
Learning Objectives	After completing this unit, you should be able to: • Understand the importance of making inference from Data • Understand Inferential Statistics: Random Variables, Probability Distributions, Normal Distribution, Sampling and Sampling Distribution

UNIT III. R overview and Installation

Duration: 45 Minutes.

Overview	In this unit, we will discuss overview on R and then install R and R studio
Learning Objectives	After completing this unit, you should be able to: • Understand R basics • Install R and R studio

UNIT IV. Descriptive Data analysis using R

Duration: 1 hr.

Overview	In this unit, you learn the basic functions, mathematical functions, graphical functions, statistical functions, summary function used to describe data in R. We will use R to calculate summary statistics, including mean, standard deviation, range, and percentile
Learning Objectives	After completing this unit, you should be able to: • Understand the different used to describe data including basic functions, mathematical, graphical and statistical functions. • We will use R to calculate summary statistics, including mean, standard deviation, range, and percentile

UNIT V. Data manipulation with R

Duration: 2.5 hrs.

Overview	In this chapter, you learn data manipulation with R to improve data accuracy and precision. We will see the usage of inbuilt R function, CRAN packages, and use ML algorithms
Learning Objectives	After completing this unit, you should be able to: • Different Ways to Manipulate / Treat Data: • List of available Packages and its usages with hands on

UNIT VI. Data visualization with R

Duration: 1 Hr.

Overview	This chapter introduces you to data visualization with R. We will learn the basic visualization like Histogram and then advanced visualization like Heat Map and its usage in detail
Learning Objectives	After completing this unit, you should be able to: • Visualize data with R • Good understanding of various basic visualization like Histogram, Bar / Line Chart, Box plot, Scatter plot

UNIT VII. Data visualization in Watson Studio

Duration: 6 Hrs.

Overview	In this chapter, you will be introduced to IBM Watson Studio for data visualization. Visualizing information in graphical ways can give you insights into your data. By enabling you to look at and explore data from different perspectives, visualizations can help you identify patterns, connections, and relationships within that data as well as understand large amounts of information very quickly.
Learning Objectives	After completing this unit, you should be able to: • Visualize data using IBM Watson Studio • Manage Data Refinery flows

UNIT VIII. Introduction to Python

Duration: 4.25 hrs.

Overview	In this unit, we will install Python and Anaconda. We will learn usage of Jupyter notebook and then do scripting using Python
Learning Objectives	After completing this unit, you should be able to: • Install Python and Anaconda. • Understanding on Jupyter notebook and Python

UNIT IX. Numpy and Pandas

Duration: 3 hrs.

Overview	In this unit, you learn the Pandas and Numpy for fast numeric array computations. We will learn the common functionalities of NumPy and Pandas with existing toolboxes in R. the added flexibility have resulted in wide acceptance of python in the scientific community lately.
Learning Objectives	After completing this unit, you should be able to: • use Numpy functions for scientific studies • use Pandas for data manipulation and analysis

UNIT X. Introduction to Data Visualization Tools in Python

Duration: 30 minutes.

Overview	In this chapter, you learn the basics of Matplotlib which is a 2d plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments. Matplotlib can be used in Python scripts, Python and IPython shell, Jupyter Notebook, web application servers and GUI toolkits.
Learning Objectives	After completing this unit, you should be able to: • Data visualization and some of the best practices to keep in mind when creating plots and visuals. • The history and the architecture of Matplotlib. • Basic plotting with Matplotlib. • The dataset on immigration to Canada, which will be used extensively throughout the course. • Generating line plots using Matplotlib.

UNIT XI. Basic plots using matplotib

Duration: 45 Minutes.

Overview	This chapter introduces you to basic plots using Matplotlib.
Learning Objectives	After completing this unit, you should be able to: • Plot 2d graph and plots using Matplotlib • Area plots, and how to create them with Matplotlib. • Histograms, and how to create them with Matplotlib. • Bar charts, and how to create them with Matplotlib.

UNIT XII. Specialized Visualization Tools using Matplotlib

Duration: 1.0 Hr.

Overview	In this chapter, you will be introduced to Specialized Visualization Tools using Matplotlib
Learning Objectives	After completing this unit, you should be able to: • Pie charts, and how to create them with Matplotlib. • Box plots, and how to create them with Matplotlib. • Scatter plots and bubble plots, and how to create them with Matplotlib.

UNIT XIII. Advanced Visualization Tools using Matplotlib

Duration: 30 Minutes.

Overview	In this unit, we will discuss overview on R and then install R and R studio
Learning Objectives	After completing this unit, you should be able to: • Understand the R basics • Install of R and R studio

UNIT XIV. Introduction to Seaborn

Duration: 2 hrs.

Overview	In this unit, we will introduce you to seaborn. We will see how to use it to generate attractive plots.
Learning Objectives	After completing this unit, you should be able to: • Seaborn, and how to use it to generate attractive regression plots.

UNIT XV. Spatial Visualizations and Analysis in Python with Folium

Duration: 4.25 hrs.

Overview	In this chapter, you learn Folium to visualize geospatial data, create maps with markers and Chropleth maps with Folium
Learning Objectives	After completing this unit, you should be able to: • Folium, a data visualization library in Python. • Creating maps of different regions of the world and how to superimpose markers on top of a map. • Creating Choropleth maps with Folium.

IBM

IBM is empowering university graduates and working IT professionals in India/South Asia with knowledge and skills to serve the largest enterprise business software suite in the world. The IBM Career Education Program is a comprehensive software education program designed by IT professionals, for graduates, post graduates and experienced professionals to accelerate their skills and knowledge so that they succeed in this dynamic industry. The Program curriculum brings together the latest software content, real-world industry experience, hands-on lab courses and best practices, all into a single unique education program.

The Program provides:

- A blended learning approach, integrating classroom, hands-on lab exercises and real life case studies to provide both theoretical and practical training to solve real world problems
- The latest software content and knowledge of IT developments in the market to keep you ahead of technology trends
- A top-class faculty comprising of field consultants, technical specialists and education experts
- A comprehensive semester based format to build technical foundation and widen skill specialties quickly
- IBM leadership and professional certification in IBM software technology

Courses are available across all Software Brands and various levels of proficiency. The extensive portfolio of integrated certifications also focuses on the competencies required in early stages of a professional career. Experiential learning through projects/cases, the most important aspect that companies look for in fresher also forms a critical part of the offering.

At the end of the course, certificates of participation or completion are issued by IBM.

Delivery Method

Delivered through authorized IBM Career Education partners across India/South Asia, students can be sure that they are getting the same quality curriculum, software solutions exposure and knowledge, wherever they are located.
Acquire all the skills you need to advance onto a successful career path and stay on top of the latest technology.

- The Trainer Pool is trained & evaluated by IBM Education Services
- The course material is developed & given by IBM Education Services
- Session plan and course conduct is defined by IBM Education Services
- Certification of Completion of Participation (Course)

Engagement Details

- IBM Education Services provides content, technology and enablement
- IBM Career Education Business Partner will conduct the training as per IBM Guidelines
- College needs to provide Lab facilities as described in the concept note
- Delivery of course will be defined & monitored by IBM Career Education

Technologies

IBM CE – Descriptive Analytics using IBM Cognos BI

IBM Cognos BI

Cognos Business Intelligence solutions help understand, monitor and manage business performance which includes business reporting & analysis, profitability measurement, budgeting, forecasting optimization and cost management. The program will define how above activities will be achieved by using the techniques such as Modelling, provisioning, and Visualization for Cross Sectional Data.
The program will also cover Basic features of Cognos BI: Gather Requirements, Prepare Reusable Metadata, Identify report issue, Calculations and Filters and Prompts Create List or Crosstab reports, Conditional Style, Drill through definitions, Basics of Cognos BI Administration and Security in Cognos BI

About Course:

IBM Cognos BI describes the concept and terminologies of Business Intelligence and how it's being used to bring the right information at the right time to the right audience in any industry.

Target Audience:

Students, satisfying the pre requisite

Pre-requisites:

- In-depth understanding of Relational Database Concepts
- Knowledge in working with any Spread Sheet Application (for e.g. MS Excel)
- Concepts in Basic Statistics will help, but not mandatory

Infrastructure specifications

- Hardware requirement – Systems with minimum 4 GB memory, Windows 7 OS & 2.5 GHZ plus Processor
- Classroom set up
- Machines: 50 Computers with above specified hardware
- Operating system: Windows
- White Board: 1
- LCD Projector: 1
- Instructor Machine: 1
- Flip Chart board: 1
- All machines to be fully networked.

Course Contents

Student Development Program Overview

IBM Cognos BI

Overview of IBM Cognos BI
Introduction to the Reporting Application

- Examine Report Studio and its interface
- Explore different report types
- Create a simple, sorted, and formatted report
- Explore how data items are added to queries

Create List Reports

- Format, group, and sort list reports
- Describe options for aggregating data
- Create a multi-fact query
- Create a report with repeated data

Focus Reports using Filters

- Create filters to narrow the focus of reports
- Examine detail and summary filters
- Determine when to apply filters on aggregate data

Create Crosstab Reports

- Format and sort crosstab reports
- Convert a list to a crosstab
- Create crosstabs using unrelated data items
- Create complex crosstabs using drag and drop functionality

Present Data Graphically

- Create charts containing peer and nested items
- Present data using different chart type options
- Add context to charts
- Create and reuse custom chart palettes
- Present key data in a single dashboard report

Focus Reports using Prompts (Optional)

- Identify various prompt types
- Use parameters and prompts to focus data
- Search for prompt items
- Navigate between pages

Extend Reports using Calculations (Optional)

- Create calculations based on data in the data source
- Add run-time information to the reports
- Create expressions using functions
- Highlight exceptional data
- Show and hide data
- Conditionally render objects in reports
- Conditionally format one crosstab measure

Customize Reports with Conditional Formatting (Optional)

- Create multi-lingual reports
- Highlight Exceptional Data
- Create a Conditionally Rendered Column
- Conditionally Format One Crosstab Measure Based on Another

Predictive Analytics using IBM SPSS Modeler

(CLASSROOM)

PREDICTIVE ANALYTICS USING IBM SPSS MODELER TRAINING MODULE

With increasingly competitive businesses and the advancement in capabilities of computers, many businesses are generating huge amounts of data. Such businesses need to find mechanisms to identify useful patterns and actionable relationships from such data. Predictive Analytics is one such mechanism to find useful patterns, which can be used for making business decisions and growth.

This course aims to introduce participants to the concepts of Predictive Analytics (Machine Learning). The course covers one of the most popular methodology used by Data Scientists – CRISP DM. It also covers several basic and advanced techniques for Data Preparation and Modeling. These techniques are demonstrated using IBM SPSS Modeler – a leading data science and machine-learning platform.

DELIVERY METHOD

100 % Instructor led training

LEARNING OBJECTIVES

1. Introduction to Predictive Analytics
2. Introduction to IBM SPSS Modeler
3. Collecting Initial Data
4. Understand the Data
5. Set the Unit of Analysis
6. Integrate Data
7. Identify Relationships
8. Introduction to Modeling
9. Using Functions in SPSS Modeler
10. Field Transformations: Derive, Binning, Reclassify
11. Additional Field Transformations: Filler, Transform
12. Sequence Data
13. Sampling, Balancing, Partitioning Data
14. Linear Regression
15. Logistic Regression
16. Neural Networks

PREREQUISITES SKILLS

- Basic knowledge of Mathematics and Statistics

DURATION

32 Hours

SKILL LEVEL

Basic – Intermediate

SYSTEM REQUIREMENTS

Processor	x64 processor family (64 bit processor)
GB RAM	Minimum 8 GB RAM
GB Disk Free	Minimum 25 GB
OS	Windows or Mac
IDE	IBM SPSS Modeler to be installed on Laptop / Desktop

The following chapter and exercise durations are estimated and might not reflect every class experience. The estimates do not include the duration of additional exercises or sections. Students in this course to have setup the software requirement as stated. The course contains test your knowledge after each chapter.

COURSE AGENDA

Chapter 1. Introduction to Predictive Analytics

Duration: 2 hours

Overview	This chapter covers introduction to Predictive Analytics and its use cases. The chapter also covers CRISP – DM methodology and the skills required for successfully implementing Predictive Analytics / Machine Learning Use Cases
Learning Objectives	After completing this unit, you should be able to: • Understand the need and applications of Predictive Analytics • Explain CRISP - DM • Explain the basics of Predictive Models and the skills required

Chapter 2. Introduction to IBM SPSS Modeler

Duration: 2 hours

Overview	This chapter covers an introduction to IBM SPSS Modeler. Chapter covers SPSS Modeler interface, and the terminologies such as streams, nodes, palettes, etc.
Learning Objectives	After completing this unit, you should be able to: • Describe SPSS Modeler Interface • Work with streams and nodes • Run and execute a sample stream

Chapter 3. Collecting Initial Data

Duration: 2 hours

Overview	This chapter focusses on two main tasks in the Data Understanding stage: Collecting Initial Data and Describing Data
Learning Objectives	After completing this unit, you should be able to: • Explain the concepts of “data structure”, “unit of analysis”, “field storage”, “field measurement level” • Importing and Exporting Datasets

Chapter 4. Understand the Data

Duration: 2 hours

Overview	This chapter deals with exploring the data and assessing the quality of data.
Learning Objectives	After completing this unit, you should be able to: • Audit the Data • Checking invalid values and taking action for such values

Chapter 5. Set the Unit of Analysis

Duration: 2 hours

Overview	This chapter deals with some of the techniques which can be used to set the Unit of Analysis.
Learning Objectives	After completing this unit, you should be able to: • Set the Unit of Analysis by using appropriate techniques like Distinct, Aggregate, etc.

Chapter 6. Integrate Data

Duration: 2 hours

Overview	This chapter deals with some of the techniques which can be used to integrating datasets which are typically stored in different tables / databases.
Learning Objectives	After completing this unit, you should be able to: • Integrate Data by appending records • Integrate Data by merging fields from multiple datasets

Chapter 7. Identifying Relationships

Duration: 2 hours

Overview	This chapter explores some techniques to identify relationships between the target variable and predictors.
Learning Objectives	After completing this unit, you should be able to: • Examine relationship between two categorical fields • Examine relationship between a categorical field and a continuous field • Examine relationship between two continuous fields

Chapter 8. Introduction to Modeling

Duration: 2 hours

Overview	This chapter focusses on some of the modeling techniques and algorithms in Predictive Analytics.
Learning Objectives	After completing this unit, you should be able to explain the following: • Classification • Regression • Segmentation • Association

Chapter 9. Using Functions in IBM SPSS Modeler

Duration: 3 hours

Overview	This chapter covers the commonly used inbuilt functions in IBM SPSS Modeler.
Learning Objectives	After completing this unit, you should be able to understand and explain: • Date and Time Functions • Conversion Functions • String Functions • Statistical Functions • Missing Value Functions

Chapter 10. Field Transformations: Derive, Binning, Reclassify

Duration: 2 hours

Overview	This chapter presents three nodes to cleanse and enrich data: Derive, Binning, Reclassify.
Learning Objectives	After completing this unit, you should be able to: • Explain the use and implementation of Derive, Binning and Reclassify Nodes

Chapter 11. Additional Field Transformations: Filler, Transform

Duration: 1 hours

Overview	This chapter presents additional nodes for Data Preparation: Filler and Transform
Learning Objectives	After completing this unit, you should be able to: • Explain the use and implementation of Filler and Transform Nodes

Chapter 12. Sequence Data

Duration: 2 hours

Overview	This chapter covers the concept of Sequence Data, and how it can be handled.
Learning Objectives	After completing this unit, you should be able to: • Explain Sequence Data • Explain Sequence Functions • Understand the use of Restructure Node

Chapter 13. Sampling, Balancing and Partitioning Data

Duration: 1 hour

Overview	This chapter describes the concepts of Sampling, Balancing and Partitioning Data.
Learning Objectives	After completing this unit, you should be able to: • Draw Simple and Complex Samples • Partition Datasets • Reduce or Boost your datasets

Chapter 14. Linear Regression

Duration: 2.5 hours

Overview	This chapter presents the concepts of Linear Regression and its applications.
Learning Objectives	After completing this unit, you should be able to: • Explain Linear Regression • Understand Simple Linear Regression, Multiple Linear Regression • Demonstrate Linear Regression applications

Chapter 15. Logistic Regression

Duration: 2.5 hours

Overview	This chapter presents the concepts of Logistic Regression and its applications.
Learning Objectives	After completing this unit, you should be able to: • Explain Logistic Regression • Demonstrate Logistic Regression applications

Chapter 16. Neural Networks

Duration: 2 hours

Overview	This chapter presents the concepts of Neural Networks and its applications.
Learning Objectives	After completing this unit, you should be able to: • Explain Neural Networks • Explain Multilayer Perceptron and Radial Basis Function Neural Networks • Demonstrate Neural Network applications

Devops, Agile Development and Design Thinking

Duration – 32 hours

About the course
DevOps (**Dev**elopment plus IT **Op**erations) is an enterprise software development process which is a combination of software development and IT Operations use agile methodologies. This involves various phases of software development like coding, build automation, testing, deployment, monitoring etc. This also include Continuous Integration (CI) & Continuous Delivery (CD). Devops could be applied to various forms of software development including DevOps in Mobile Applications, DevOps in Web Applications & IoT.

There are technical benefits:

Continuous software delivery
Less complexity to manage
Faster resolution of problems

And there are business benefits:

Faster delivery of features
More stable operating environments
Improved communication and collaboration
More time to innovate (rather than fix/maintain)

Agile Methodology and Design Thinking also aid Devops. Sharing below links and also the Table of Content for the course. DevOps is an present industry need and has huge opportunities in the market.

Course Content

<u>Devops</u>

- Introduction to CI/CD & Devlops Tools
- Devops Use cases & Setup
- Solving problems with Devops
- Introduction to advanced DevOps Concepts
- Introduction to Cloud
- DevOps on IBM Cloud

<u>Agile</u>

- Introduction to Agile
- Test Driven Development (TDD)
- Kanban Methodology
- Software Development using Extreme Programming
- Software Development using Scrum Framework

<u>Design Thinking</u>

- Introduction to Design Thinking

- Importance of Design Thinking
- History of Design Thinking
- IBM Design Thinking Framework
- Design Thinking Methods
- Customer Example

Target Audience
Students of
– Engineering (CS, IT)-

Pre-Requisities

Before taking this course, it is recommended you should have
- Basic knowledge of programming
- Basic knowledge of database concepts and SQL Pre-requisites courses:
-

FUNDAMENTALS OF SCALA AND SPARK TRAINING MODULE

(CLASSROOM)

FUNDAMENTALS OF SCALA AND SPARK TRAINING MODULE

This training module provides the participant to understand the concepts of Scala and Spark. Participants will understand the concepts, datatypes, functions, flow control statements, along with practical lab exercises.

DELIVERY METHOD

25 % Self-paced Learning

75 % Instructor led training

VERSION

Scala 2.1.1, Spark 2.1

LEARNING OBJECTIVES

- Introduction to Scala.
- Explain data types, variable types, flow control statements.
- Using Functions in Scala.
- Introduction to Spark.
- Understand the Spark Unified Stack.
- Understand the Spark Runtime Architecture.
- Understanding Resilient Distributed Datasets (RDD).
- Implement Transformations and Actions on RDDs.
- Understand the need for Spark Libraries.
- Understand Spark Configuration, Monitoring and Tuning.

PREREQUISITES SKILLS

- Computer Science fundamentals.
- Knowledge of any programming and object oriented language (eg. C, C++, Java), and Math.

DURATION

32 Hours

SKILL LEVEL

Basic – Intermediate

HARDWARE REQUIREMENTS

Processor	2 GHz or Higher
GB RAM	8 GB
GB Disk Free	80 GB
Network Requirements	Yes

SOFTWARE REQUIREMENTS

Operating System	Windows / Linux
Scala	Version 2.11
Spark	Version 2.1

The following chapter and exercise durations are estimated and might not reflect every class experience. The estimates do not include the duration of additional exercises or sections. Students in this course to have setup the software requirement as stated. The course contains test your knowledge after each chapter.

COURSE AGENDA

Chapter 1. Introduction to Scala

Duration: 8 Hrs.

Overview	This chapter is an introduction to programming in Scala and its concepts.
Learning Objectives	After completing this unit, you should be able to: • Explain the use and advantages of Scala Programming • Explain types of variables in Scala, Functions, Flow Control Statements. • Implement programs to experience hands on.

Chapter 2. Introduction to Spark

Duration: 8 Hrs.

Overview	This chapter is an introduction to Spark concepts.
Learning Objectives	After completing this unit, you should be able to: • Understand the need and use of Spark. • Explain the Spark Unified Stack. • Explain the Spark Runtime Architecture.

Chapter 3. Spark Fundamentals

Duration: 16 Hrs.

Overview	This chapter explains a fundamental concept of Spark – Resilient Distributed Datasets, and how are they used. The chapter also covers Spark Libraries.
Learning Objectives	After completing this unit, you should be able to: • Explain Resilient Distributed Datasets (RDD). • Understand the Transformations and Actions on RDDs. • Understand and Explain the need and use of Spark Libraries. • Implement programs to experience hands on.

Artificial Intelligence Analyst 2019

(Classroom)

Career path description

The Artificial Intelligence Analyst career path prepares students to apply AI concepts to build real-life solutions. This career path introduces students to basic concepts of AI, machine learning algorithms, natural language processing, chatbots, and computer vision. Students apply the concepts they learn to practical examples by using IBM Watson services and tools on IBM Cloud.

ibm.com/training

General information

Delivery method

25% self-placed training

75% Instructor led training

Version

2019

Product

Watson Discovery, Watson Assistant, Watson Visual Recognition, Watson Tone Analyzer, Watson Natural Language Understanding, IBM Watson Studio, IBM Watson Knowledge Studio, IBM Cloud

Audience

Undergraduate senior students from IT related academic programs, for example, computer science, software engineering, information systems etc.

Learning objectives

After completing this course, you should be able to:

- Explain what AI is
- Describe the field of AI and its subfields: Machine learning, natural language processing (NLP), and computer vision
- List applications of AI in the industry and government
- Describe machine learning
- Describe different type of machine learning algorithms
- Apply machine learning algorithms to specific problems
- Explain deep learning
- Explain convolutional neural networks and neural networks
- Describe examples of unsupervised and supervised learning
- Describe IBM Watson
- Explain how Watson technology is applied to solve real world problems
- Explain the capabilities of each Watson service
- Describe Watson Studio, its components, and key applications
- Describe the CRISP-DM process model and explain where machine learning fits in the CRISP-DM process
- Create machine learning models for different machine learning algorithms by using Watson Studio
- Explain domain adaptation
- Describe the purpose of training the various Watson services
- Describe IBM Watson Knowledge Studio capabilities and use
- Explain what NLP is
- List tools and services for NLP
- Identify NLP use cases
- Explain main NLP concepts
- Explain how to evaluate the quality of an NLP algorithm
- Identify the Watson services based on NLP technology
- Use IBM Watson Discovery to build a cognitive query application
- Describe chatbot applications and chatbots design guidelines
- Explain core concepts and artifacts needed to build a chatbot application
- Build chatbot applications with Watson Assistant and Node-RED.
- Explain what computer vision is
- Identify computer vision use cases
- Explain how computer vision analyzes and processes images and describe commonly used computer vision techniques
- Use the Watson Visual Recognition service to classify an image, detect faces, and recognize text in an image
- Create custom models with Watson Visual Recognition
- Train the Watson Visual Recognition service with Watson Studio

- Integrate multiple Watson services to build a comprehensive intelligent solution

Prerequisites Skills

- Computer science fundamentals
- Basic knowledge of applied math, algorithms, and data modeling
- Basic knowledge of probability and statistics
- Basic knowledge of Node.js and cloud computing
- Access to IBM Cloud
- Exposure to the IBM Skills Academy Portal learning environment

Duration

40 hours and 30 minutes

Skill level

Basic – Intermediate

Hardware requirements

Classroom (ILT) setup requirements	
Processor	2 GHz or higher
GB RAM	8 GB
GB free disk space	80 GB
Network requirements	Yes
Other requirements	IBM ID

Notes

The following unit and exercise durations are estimates, and might not reflect every class experience. The estimates does not include the duration of optional exercises or sections.

Students in this course use an IBM Cloud Lite account to perform the exercises. This account will never expire, therefore students can continue working on the optional exercises after the class.

Course Agenda

MODULE I – AI OVERVIEW

Duration: 3 hours and 30 minutes

Course I – AI Overview

Course Overview Duration: 5 minutes

Unit 1. Introduction to artificial intelligence Duration: 3 hours	
Overview	This unit explains what artificial intelligence (AI) is, its history and evolution, AI types, integral components of AI systems, factors that influenced the evolution of AI, and applications of AI in the industry, government, and science.
Learning objectives	After completing this unit, you should be able to: • Explain what AI is. • Describe the types of AI. • List the factors that influenced the advancement of AI in recent years. • List the applications of AI in the industry, science, and government. • List the subfields that are the focus of AI research.

Unit 2. Business analytics Duration: 30 minutes	
Overview	This unit introduces business analytics and describes different approaches and types of business analytics
Learning objectives	After completing this unit, you should be able to: • Explain what business analytics is • Describe different approaches and types of business analytics • Describe analytical solutions • Explain the challenges of analytical solutions

MODULE II – Prerequisites

Duration: 6 hours and 30 minutes

Course I – IBM Watson overview

Unit 1. Introduction to IBM Watson Duration: 1 hour	
Overview	This unit introduces IBM Watson and its history.
Learning objectives	After completing this unit, you should be able to: • Explain what IBM Watson is and how it works • Explain how Watson technology is made available to developers and organizations

Unit 2. IBM Watson applied to industry, business and science Duration: 1 hour and 30 minutes	
Overview	This unit provides several examples that demonstrate how IBM Watson is transforming industry, business and science.
Learning objectives	After completing this unit, you should be able to: • Provide examples of Watson AI technologies applied to several industries

Unit 3. IBM Watson use cases Duration: 30 minutes	
Overview	This unit presents two use cases showing organizations that successfully implemented AI solutions, based on IBM Watson technology.
Learning objectives	After completing this unit, you should be able to: • Describe how IBM Watson technology is being applied to solve real world problems

Unit 4. Evolution from DeepQA to Watson services
Duration: 1 hour

Overview	This unit describes the evolution of Watson technology from the original DeepQA architecture to the present.
Learning objectives	After completing this unit, you should be able to: • Explain what the DeepQA architecture was • Explain why IBM decided to commercialize Watson • Describe the evolution of Watson services from the original DeepQA architecture to the present • Recognize the Watson services available today on the IBM Cloud

Unit 5. Watson services overview
Duration: 2 hours

Overview	This unit provides an overview of the Watson services available in IBM Cloud.
Learning objectives	After completing this unit, you should be able to: • List the Watson services • Explain the capabilities of each Watson service

Exercise 1. Setting up your hands-on environment
Duration: 30 min

Overview	This exercise guides you through the setup of your workstation before you perform the exercises in this course.
Learning objectives	After completing this exercise, you should have: • An IBM Cloud Lite account. • cURL installed on your workstation. • Node.js installed on your workstation. • Git installed on your workstation. • A code/text editor installed on your workstation. • Images required for *Exercise 10.Classifying images with Watson Visual Recognition* downloaded to your workstation.

MODULE III – AI Analyst (Clasroom)

Duration: 30 hours and 5 minutes

Course introduction
Duration: 5 minutes

Unit 1. Introduction to machine learning
Duration: 1 hour and 15 min

Overview	This unit recaps the main topics in Module I, AI overview and provides a deeper view into complex subjects such as: • Machine learning • Machine learning algorithms • Neural networks • Deep learning
Learning objectives	After completing this unit, you should be able to: • Explain what machine learning is. • Describe machine learning types and approaches. • List different machine learning algorithms. • Explain what neural networks and deep learning are, and why they are important in today's AI field. • Explain how to evaluate your machine learning model.

Exercise 1. Applying machine learning algorithms
Duration: 1 hour

Overview	In this exercise, you apply machine learning algorithms to solve real problems.
Learning objectives	After completing this exercise, you should be able to: • Determine the centroids of a data set with the K-means clustering algorithm • Predict the class of an object with the Naïve Bayes classifier • Apply the linear regression algorithm to solve supervised learning problems • Construct a decision tree to predict outcomes

Unit 2. Introduction to IBM Watson
Duration: 1 hour

Overview	This unit provides an overview of key IBM Watson services, their purpose, how they work, and helps you get started with Watson services on IBM Cloud.
Learning objectives	After completing this unit, you should be able to: • Explain what IBM Watson is • List IBM Watson services offerings • List IBM Cloud Watson services • Explain the capabilities of each Watson service • List the Watson services that can be trained • List the Watson services that cannot be trained • Create a Watson service instance on IBM Cloud

Exercise 2. Exploring Watson services
Duration: 1 hour 15 min

Overview	This exercise introduces you to Watson REST APIs. You will use cURL commands to submit requests to and receive responses from several Watson services.
Learning objectives	After completing this exercise, you should be able to: • Create Watson service instances. • Copy credentials from a service instance. • Submit API calls with the appropriate parameters. • Analyze the response returned from the Watson service. • Use Watson API Reference documentation.

Unit 3. Introduction to IBM Watson Studio Duration: 30 minutes	
Overview	This unit provides a high level overview of Watson Studio, its components, key applications and the value added by the IBM offering.
Learning objectives	After completing this unit, you should be able to: • Describe Watson Studio • Identify industry use cases • List Watson Studio offerings • Create Watson Studio projects • Describe Watson Studio and Spark • Describe Watson Studio and Object Storage • Explain Watson Studio high availability considerations • Prepare and analyze data • Use Jupyter notebooks

Exercise 3. Getting started with Watson Studio Duration: 1 hour and 30 min	
Overview	This exercise introduces you to the basic tasks that you have to perform when using Watson Studio.
Learning objectives	After completing this exercise, you should be able to: • Create a Watson Studio project • Manage the project • Assign collaborators • Load a data set into the project's object store • Manage Object Storage • Analyze data by using Watson Studio • Use PixieDust for data visualization

Unit 4. Introduction to IBM Watson Machine Learning Duration: 30 minutes	
Overview	This unit describes the CRoss Industry Standard Process for Data Mining known as CRISP-DM and explains the process of preparing data for a machine learning algorithm. This unit provides an overview of the IBM Watson Machine Learning service available on IBM Cloud.
Learning objectives	After completing this unit, you should be able to: • Describe the CRISP-DM process model. • Explain where machine learning fits in the CRISP-DM process. • Describe data preparation before feeding into machine learning algorithms. • Describe Watson Machine Learning features and capabilities.

Exercise 4. Getting started with Watson Machine Learning Duration: 2 hours	
Overview	This exercise introduces you to the basic tasks that you have to perform while building machine learning models for different algorithms using Watson Machine Learning and Watson Studio.
Learning objectives	After completing this exercise, you should be able to: • Create a machine learning model by using Watson Studio and Watson Machine Learning. • Use data sets to train the model. • Use different estimators to train the machine learning model representing different machine learning algorithms. • Deploy machine learning models. • Evaluate the deployed models. • Call the deployed models from your applications. • Test the model with your data.

Exercise 5. Exploring Deep Learning and Neural Network Modeler with Watson Studio Duration: 1 hour	
Overview	This exercise guides you through designing, building, and training a deep learning model to recognize handwritten digits. The optional exercise guides you through using the MNIST computer vision data set to train a TensorFlow model to recognize handwritten digits.
Learning objectives	After completing this exercise, you should be able to: • Build a neural network to recognize handwritten digits. • Create a neural network design flow by using the neural network modeler. • Train models with experiment builder. • Work with Watson Machine Learning experiments to train deep learning models (TensorFlow).

Unit 5. Introduction to natural language processing (NLP) Duration: 30 minutes	
Overview	This unit introduces NLP. It covers key applications of NLP, basics concepts and terminology, tools and services and NLP challenges.
Learning objectives	After completing this unit, you should be able to: • Explain what NLP is. • Identify NLP use cases. • Explain basic NLP concepts and terminology. • List the tools and services for NLP.

Unit 6. NLP concepts and components Duration: 30 minutes	
Overview	This unit covers NLP components, the NLP pipeline, natural language understanding, natural language generation, information retrieval, and information extraction.
Learning objectives	After completing this unit, you should be able to: • Define the NLP categories. • Describe the NLP pipeline. • Explain the challenges in natural language understanding. • Explain the concepts of information retrieval and extraction. • Describe sentiment analysis.

Unit 7. NLP evaluation metrics Duration: 30 min	
Overview	This unit explains how to evaluate the quality of your NLP algorithm.
Learning objectives	After completing this unit, you should be able to: • Define various metrics to measure the quality of your NLP algorithm. • Understand the difference between these metrics.

Unit 8. NLP and IBM Watson Duration: 30 minutes	
Overview	This unit lists the Watson services and software that are based on NLP and explains the main capabilities of Watson Natural Language Classifier, Watson Natural Language Understanding, Watson Discovery.
Learning objectives	After completing this unit, you should be able to: • List the NLP Watson services • List the Watson services that perform information extraction. • Describe the capabilities of IBM Watson Natural Language Classifier. • Describe the capabilities of the IBM Watson Natural Language Understanding. • Describe the capabilities of IBM Watson Discovery.

Exercise 6. Ingest, Convert, Enrich and Query with Watson Discovery Service Duration: 1 hour 30 min	
Overview	This exercise takes you through the process of preparing a collection of documents and running queries to extract insights from the documents. In the optional exercise you will work with the Discovery API.
Learning objectives	After completing this exercise, you should be able to: • Create a Watson Discovery service instance • Create a collection • Add content to a collection • Create a custom configuration • Build queries • Use the Discovery API

Unit 9. Introduction to IBM Watson Knowledge Studio Duration: 45 minutes	
Overview	This unit introduces Watson Knowledge Studio, its capabilities, and features. This unit explains the end-to-end domain adaptation process.
Learning objectives	After completing this unit, you should be able to: • Describe IBM Watson Knowledge Studio. • List the Watson services that are trained by Knowledge Studio. • List the Knowledge Studio workspace resources. • Explain the process to build Knowledge Studio models that can be deployed and used with other Watson services.

Exercise 7. Creating a machine learning model with Watson Knowledge Studio. Duration: 1 hour and 30 minutes	
Overview	This exercise takes you through the process of building a machine learning model with Knowledge Studio that you can deploy and use with Watson services. In the optional exercise, you will create a rule-based model that you can use to find text patterns in documents.
Learning objectives	After completing this exercise, you should be able to: • Create a workspace for Watson Knowledge Studio. • Configure the workspace resources. • Create document sets. • Pre-annotate documents. • Create tasks for human annotators. • Analyze inter-annotator agreement and adjudicate conflicts in annotated documents. • Create machine learning models.

Unit 10. Introduction to chatbots Duration: 30 minutes	
Overview	This unit provides a high level introduction to chatbots, chatbot applications and guidelines to consider when designing a chatbot.
Learning objectives	After completing this unit, you should be able to: • Explain what a chatbot is • Describe common applications of chatbots • Identify factors that drive the growing popularity of chatbots • Recognize the guidelines to consider when designing a chatbot • List examples of tools and services that you can use to create chatbots

Unit 11. Introduction to IBM Watson Assistant Duration: 1 hour	
Overview	This unit covers the core concepts that you need to understand to build a chatbot with Watson Assistant.
Learning objectives	After completing this unit, you should be able to: • Explain assistants and skills. • Explain intents. • Explain entities. • Explain context variables. • Describe how the nodes in a dialog are triggered. • Describe how the dialog flow is processed. • Describe the features that can be used to enrich the chatbot.

Exercise 8. Getting started with Watson Assistant Duration: 45 minutes	
Overview	This exercise introduces IBM Watson Assistant and walks you through the process of creating a very simple chatbot with Watson Assistant.
Learning objectives	After completing this exercise, you should be able to: • Create a Watson Assistant service instance. • Create a Watson Assistant skill. • Add intents. • Build a dialog.

Exercise 9. Help Desk chatbot Duration: 1 hour 30 minutes	
Overview	In this exercise you will create a chatbot application with Node-RED without coding and integrate it with the Watson Assistant service.
Learning objectives	After completing this exercise, you should be able to: • Create a Watson Assistant skill. • Add intents and entities. • Build a dialog. • Create a Node-RED application that integrates with the Watson Assistant service. • Set up Slack as a front-end chat service for the Help Desk chatbot.

Unit 12. Introduction to computer vision Duration: 30 minutes	
Overview	This unit provides a high level introduction to computer vision.
Learning objectives	After completing this unit, you should be able to: • Define computer vision. • Explain the history of computer vision and its advancement with AI. • Identify computer vision use cases. • List tools and services for computer vision.

Unit 13. Computer vision fundamentals Duration: 30 minutes	
Overview	This unit explains the basic steps of a typical computer vision pipeline, how CV analyzes and processes images, and explores commonly used techniques in CV.
Learning objectives	After completing this unit, you should be able to: • Describe image representation for computers. • Describe the computer vision pipeline. • Describe different preprocessing techniques. • Explain image segmentation. • Explain feature extraction and selection. • Describe when object recognition takes place.

Unit 14. Introduction to IBM Watson Visual Recognition Duration: 45 min	
Overview	This unit introduces the Watson Visual Recognition service, describes its capabilities and how to train the service.
Learning objectives	After completing this unit, you should be able to: • Describe the IBM Watson Visual Recognition service • List the features available with Watson Visual Recognition • Describe the output provided by the Watson Visual Recognition service • Explain the capabilities of the default model • Explain the difference between a default and a custom model • Describe how to train a custom model

Exercise 10. Classifying images with Watson Visual Recognition Duration: 2 hours	
Overview	This exercise guides you through the use of the built-in models (classifiers) in IBM Watson Visual Recognition to classify an images, detect faces, and recognize text. Then, you create a custom model to train the Visual Recognition service to classify images to suit your business needs.
Learning objectives	After completing this exercise, you should be able to: • Create a Watson Visual Recognition service and obtain the API key value. • Classify images • Detect faces in an image • Recognize text in an image • Create and train a custom model

Unit 15. Designing and building an intelligent solution Duration: 45 minutes	
Overview	This unit explains the benefits of integrating multiple Watson services to build a comprehensive intelligent solution. This unit presents two intelligent solutions use cases: Cognitive banking FAQ chatbot and Intelligent procurement system.
Learning objectives	After completing this unit, you should be able to: • Explain the need to integrate multiple IBM Watson services to build an intelligent solution. • Describe the general outline for the integration of IBM Watson Assistant with other services and applications. • Explain the key concepts that enable Watson Assistant integration. • Describe the integration flow between Watson Assistant, Watson Discovery, Watson Natural Language Understanding, and Watson Tone Analyzer to build the cognitive banking chatbot. • Describe the integration flow between Watson Knowledge Studio and Watson Discovery.

Exercise 11. Creating a cognitive banking FAQ chatbot Duration: 1 hour and 30 minutes	
Overview	This exercise introduces you to IBM Watson Node.js SDK to include conversation interactions, anger detection, natural language understanding, and answer discovery in your FAQ chatbot application.
Learning objectives	After completing this exercise, you should be able to: • Create a chatbot using Watson Assistant and Node.js. • Use Watson Discovery with passage retrieval to find answers in FAQ documents. • Use Watson Tone Analyzer to detect emotion in a conversation • Identify entities in the user’s input with Watson Natural Language Understanding

Exercise 12. Integrating Watson Knowledge Studio with Discovery for the procurement domain (optional)
Duration: 1 hour

Overview	In this exercise, you will create a Discovery collection with procurement documents initially enriched by the Discovery Default Configuration. Then, you will create a Knowledge Studio machine learning model trained for the procurement domain and deploy the model to Discovery. Finally, you will evaluate the results.
Learning objectives	After completing this exercise, you should be able to: • Create a machine learning model in Watson Knowledge Studio and deploy it to Watson Discovery. • Create a Watson Discovery custom configuration and leverage a Watson Knowledge Studio model to enrich entities and relations. • Integrate a custom model from Watson Knowledge Studio with the Discovery service to provide custom entity and relations enrichments customized for a specific procurement domain.