B. Tech. (Artificial Intelligence and Machine Learning)

2022 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA

Ph : 04295-226000/221289 Fax : 04295-226666 E-mail : stayahead@bitsathy.ac.in Web : www.bitsathy.ac.in

Stay Ahead

CONTENTS

VISION OF THE DEPARTMENT

To achieve excellence in the field of Artificial Intelligence and Machine Learning by focusing on knowledge-centric education systems, integrative partnerships, innovation and cutting-edge research to meet latest industry standards and service the greater cause of society.

MISSION OF THE DEPARTMENT

- To develop professionals skilled in the field of Artificial Intelligence and Machine Learning.
- To impart quality and value based education and contribute towards the innovation of computing, expert systems, AI, ML to solve complex problems in research and society.

PROGRAMME EDUCATIONAL OBJECTIVIES (PEOs)

I. To perform well in their professional career by acquiring enough knowledge in the domain of Artificial Intelligence and Machine Learning.

II. To improve communication skills, follow professional ethics and involve in team work in their profession.

III. To update with evolving technology and use it for career advancement.

PROGRAMME OUTCOMES (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. 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)

1. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
2. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

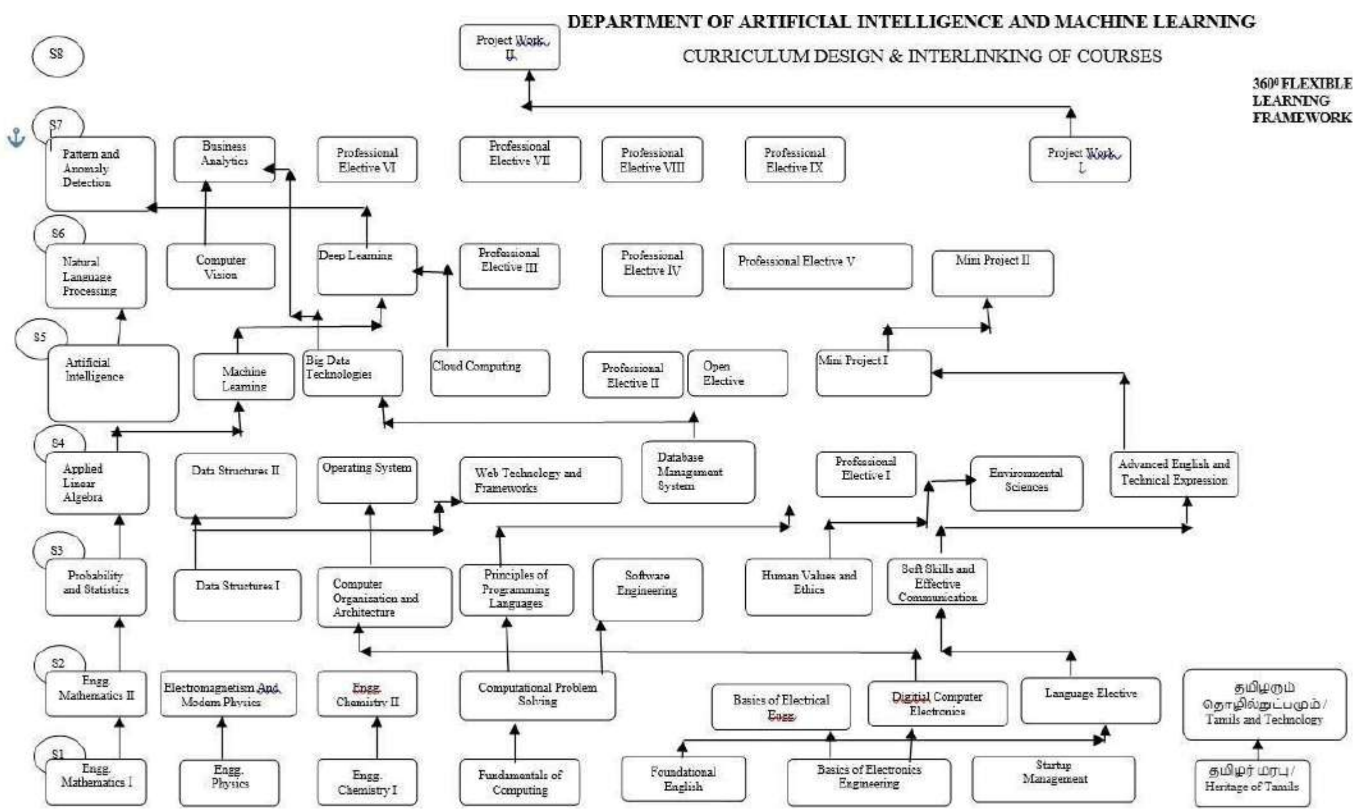
MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
I	X						X					X	X		
II						X	X	X	X	X					X
III		X	X	X	X								X	X	

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CURRICULUM DESIGN & INTERLINKING OF COURSES

CONNECTIVITY CHART



GENERAL ELECTIVES (I TO IX) ARE THE COURSES OFFERED BY THE DEPARTMENT

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING - R 2022
Minimum Credits to be Earned: 163

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
22MA101	Engineering Mathematics I	3	1	0	4	4	40	60	100	BS
22PH102	Engineering Physics	2	0	2	3	4	50	50	100	BS
22CH103	Engineering Chemistry I	2	0	2	3	4	50	50	100	BS
22GE001	Fundamentals of Computing	3	0	0	3	3	40	60	100	ES
22HS001	Foundational English	1	0	2	2	3	100	0	100	HSS
22GE004	Basics of Electronics Engineering	2	0	2	3	4	50	50	100	ES
22HS002	Startup Management	1	0	2	2	3	100	0	100	EEC
22AM108	Comprehensive Work	0	0	2	1	2	100	0	100	EEC
Total		14	1	12	21	27	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
22MA201	Engineering Mathematics II	3	1	0	4	4	40	60	100	BS
22PH202	Electromagnetism and Modern Physics	2	0	2	3	4	50	50	100	BS
22CH203	Engineering Chemistry II	2	0	2	3	4	50	50	100	BS
22GE002	Computational Problem Solving	3	0	0	3	3	40	60	100	ES
22GE003	Basics of Electrical Engineering	2	0	2	3	4	50	50	100	ES
22AM206	Digital Computer Electronics	3	0	2	4	5	50	50	100	ES
	Language Elective	1	0	2	2	3	100	0	100	HSS
22HS003*	தமிழர் மரபு / Heritage of Tamils	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**10**	**23**	**28**	-	-	-	-

* **-** Lateral Entry students have to study this courses during fourth semester

III SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
22AM301	Probability and Statistics	3	1	0	4	4	40	60	100	BS
22AM302	Data Structures I	3	0	2	4	5	50	50	100	ES
22AM303	Computer Organization and Architecture	3	0	0	3	3	40	60	100	PC
22AM304	Principles of Programming Languages	3	0	2	4	5	50	50	100	PC
22AM305	Software Engineering	3	0	0	3	3	40	60	100	PC
22HS004	Human Values and Ethics	2	0	0	2	2	100	0	100	HSS
22HS005	Soft Skills and Effective Communication	0	0	2	1	2	100	0	100	EEC
22HS006	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**8**	**22**	**25**	**-**	**-**	**-**	**-**

IV SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
22AM401	Applied Linear Algebra	3	1	0	4	4	40	60	100	ES
22AM402	Data Structures II	3	0	2	4	5	50	50	100	PC
22AM403	Operating Systems	3	1	0	4	4	40	60	100	PC
22AM404	Web Technology and Frameworks	2	0	2	3	4	50	50	100	PC
22AM405	Database Management System	3	0	2	4	5	50	50	100	PC
	Professional Elective I	-	-	-	-	-	-	-	-	PE
22HS007	Environmental Science	2	0	0	-	2	100	0	100	HSS
22HS008	Advanced English and Technical Expression	0	0	2	1	2	100	0	100	ECC
Total		**19**	**2**	**8**	**23**	**29**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22AM501	Artificial Intelligence	3	0	2	4	5	50	50	100	PC
22AM502	Machine Learning	3	0	2	4	5	50	50	100	PC
22AM503	Big Data Technologies	3	0	0	3	3	40	60	100	PC
22AM504	Cloud Computing	3	0	2	4	5	50	50	100	PC
	Professional Elective II	-	-	-	-	-	-	-	-	PE
	Open Elective	3	0	0	3	3	40	60	100	PE
22AM507	Mini Project I	0	0	2	1	2	100	0	100	EEC
Total		**18**	**0**	**8**	**22**	**26**	-	-	-	-

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22AM601	Natural Language Processing	3	0	0	3	3	40	60	100	PC
22AM602	Computer Vision	3	0	2	4	5	50	50	100	PC
22AM603	Deep Learning	3	0	2	4	5	50	50	100	PC
	Professional Elective III	-	-	-	-	-	-	-	-	PE
	Professional Elective IV	-	-	-	-	-	-	-	-	PE
	Professional Elective V	-	-	-	-	-	-	-	-	PE
22AM607	Mini Project II	0	0	2	1	2	100	0	100	EEC
Total		**18**	**0**	**6**	**21**	**24**	-	-	-	-

VII SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22AM701	Pattern and Anomaly Detection	3	1	0	4	4	40	60	100	PC
22AM702	Business Analytics	3	0	0	3	3	40	60	100	PC
	Professional Elective VI	-	-	-	-	-	-	-	-	PE
	Professional Elective VII	-	-	-	-	-	-	-	-	PE
	Professional Elective VIII	-	-	-	-	-	-	-	-	PE
	Professional Elective IX	-	-	-	-	-	-	-	-	PE
22AM707	Project Work I	0	0	4	2	4	40	60	100	EEC
Total		**18**	**1**	**4**	**21**	**23**	-	-	-	-

VIII SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22AM801	Project Work II	0	0	20	10	20	40	60	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	-

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22HS201	Communicative English II	1	0	2	2	3	100	0	100	HSS
22HSH01	Hindi	1	0	2	2	3	100	0	100	HSS
22HSG01	German	1	0	2	2	3	100	0	100	HSS
22HSJ01	Japanese	1	0	2	2	3	100	0	100	HSS
22HSF01	French	1	0	2	2	3	100	0	100	HSS

ELECTIVES										
PROFESSIONAL ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
VERTICAL I - FULL STACK DEVELOPMENT										
22AM001	Agile software development	3	0	0	3	3	40	60	100	PE
22AM002	UI and UX design	3	0	0	3	3	40	60	100	PE
22AM003	Web Frameworks	3	0	0	3	3	40	60	100	PE
22AM004	App Development	2	0	2	3	3	50	50	100	PE
22AM005	Software Testing and Automation	3	0	0	3	3	40	60	100	PE
22AM006	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL II – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22AM007	Virtualization in Cloud Computing	3	0	0	3	3	40	60	100	PE
22AM008	Cloud Services and Data Management	3	0	0	3	3	40	60	100	PE
22AM009	Cloud Storage Technologies	3	0	0	3	3	40	60	100	PE
22AM010	Cloud Automation Tools and Applications	3	0	0	3	3	40	60	100	PE
22AM011	Software Defined Networks	2	0	2	3	3	50	50	100	PE
22AM012	Security and Privacy in Cloud	3	0	0	3	3	40	60	100	PE
VERTICAL III- CYBER SECURITY AND DATA SCIENCE										
22AM013	Cyber Security	3	0	0	3	3	40	60	100	PE
22AM014	Modern Cryptography	3	0	0	3	3	40	60	100	PE
22AM015	Cyber Forensics	3	0	0	3	3	40	60	100	PE
22AM016	Ethical Hacking	3	0	0	3	3	40	60	100	PE
22AM017	Cryptocurrency and Blockchain Technologies	2	0	2	3	3	50	50	100	PE
22AM018	Malware Analysis	3	0	0	3	3	40	60	100	PE
VERTICAL IV-AI AND ROBOTICS										
22AM019	Robotic Process Automation	3	0	0	3	3	40	60	100	PE
22AM020	Text and Speech Analysis	2	0	2	3	3	50	50	100	PE
22AM021	Edge Computing	3	0	0	3	3	40	60	100	PE
22AM022	Intelligent Robots and Drone Technology	3	0	0	3	3	40	60	100	PE
22AM023	Intelligent Transportation Systems	3	0	0	3	3	40	60	100	PE
22AM024	Expert Systems	3	0	0	3	3	40	60	100	PE
VERTICAL V-MERN STACK DEVELOPMENT										
22AM001	Agile Software Development	3	0	0	3	3	40	60	100	PE
22AM025	Web Frameworks and Applications	3	0	0	3	3	40	60	100	PE

22AM026	Ecommerce and Web Development	3	0	0	3	3	40	60	100	PE
22AM027	Mobile and Web Application	3	0	0	3	3	40	60	100	PE
22AM028	NoSQL Database	2	0	2	3	3	50	50	100	PE
22AM029	Smart Product Development	3	0	0	3	3	40	60	100	PE
VERTICAL VI - DATA ANALYTICS										
22AM030	Bio Medical Image Analysis	2	0	2	3	3	50	50	100	PE
22AM031	Data Analytics and Data Science	3	0	0	3	3	40	60	100	PE
22AM032	Video Analytics	3	0	0	3	3	40	60	100	PE
22AM033	Cyber Threat Analytics	3	0	0	3	3	40	60	100	PE
22AM034	Business Intelligence	3	0	0	3	3	40	60	100	PE
22AM035	Digital Marketing and Techniques	3	0	0	3	3	40	60	100	PE
VERTICAL VII – DIVERSIFIED COURSES										
22AM036	Internet of Things and its Applications	3	0	0	3	3	40	60	100	PE
22AM037	Bioinformatics	3	0	0	3	3	40	60	100	PE
22AM038	Social and Information Networks	3	0	0	3	3	40	60	100	PE
22AM039	Information Storage Management	3	0	0	3	3	40	60	100	PE
22AM040	Software Project Management	3	0	0	3	3	40	60	100	PE
22AM041	Intellectual Property Rights	3	0	0	3	3	40	60	100	PE
VERTICAL VIII – MACHINE LEARNING OPERATIONS										
22AM042	Introduction to Machine Learning	3	0	0	3	3	40	60	100	PE
22AM043	Pattern Recognition Techniques	3	0	0	3	3	40	60	100	PE
22AM044	Business Intelligence and Analytics	3	0	0	3	3	40	60	100	PE
22AM045	Fundamentals of Cloud Computing	3	0	0	3	3	40	60	100	PE
22AM046	Fundamentals of Python Programming	2	0	2	3	3	50	50	100	PE
22AM047	Data Analytics with Python	3	0	0	3	3	40	60	100	PE

ONE CREDIT COURSES										
22AM0XA	Webpack for Frontend Development	1	0	0	1	-	100	0	100	EEC
22AM0XB	Software Process Automation	1	0	0	1	-	100	0	100	EEC
22AM0XC	Application Development using LLMs	1	0	0	1	-	100	0	100	EEC
22AM0XD	Data Driven Threat Detection using Cylance Protect	1	0	0	1	-	100	0	100	EEC
22AM0XE	Machine Learning Deployment Services in Public Clouds	1	0	0	1	-	100	0	100	EEC
22AM0XF	MLOps	1	0	0	1	-	100	0	100	EEC
22AM0XG	Containerizing Intelligence: Leveraging Docker for Machine Learning Deployment	1	0	0	1	-	100	0	100	EEC
22AM0XH	Managing ML Infrastructure with Terraform	1	0	0	1	-	100	0	100	EEC
22AM0XI	AI Python Application Development	1	0	0	1	-	100	0	100	EEC
22AM0XJ	Introduction to Game Development using Python	1	0	0	1	-	100	0	100	EEC
22AM0XK	Deep Reinforcement learning in AI	1	0	0	1	-	100	0	100	EEC
22AM0XL	Empowering Defense Strategies with AI	1	0	0	1	-	100	0	100	EEC
22AM0XM	Streamlined Software Development using CI/CD	1	0	0	1	-	100	0	100	EEC

OPEN ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22OCE01	Energy Conservation and Management	3	0	0	3	3	40	60	100	OE
22OCS01	Object Oriented Programming	3	0	0	3	3	40	60	100	OE
22OCS02	JAVA Fundamentals	3	0	0	3	3	40	60	100	OE
22OCS03	Knowledge Discovery in Databases	3	0	0	3	3	40	60	100	OE
22OCS04	E-Learning Techniques	3	0	0	3	3	40	60	100	OE
22OCS05	Social Text and Media Analytics	3	0	0	3	3	40	60	100	OE
22OEC01	Basics of Analog and Digital Electronics	3	0	0	3	3	40	60	100	OE
22OEC02	Microcontroller Programming	3	0	0	3	3	40	60	100	OE
22OEC03	Principles of Communication Systems	3	0	0	3	3	40	60	100	OE
22OEC04	Principles of Computer Communication and Networks	3	0	0	3	3	40	60	100	OE

22OEI01	Programmable Logic Controller	3	0	0	3	3	40	60	100	OE
22OEI02	Sensor Technology	3	0	0	3	3	40	60	100	OE
22OEI03	Fundamentals of Virtual Instrumentation	3	0	0	3	3	40	60	100	OE
22OEI04	Optoelectronics and Laser Instrumentation	3	0	0	3	3	40	60	100	OE
22OME01	Digital Manufacturing	3	0	0	3	3	40	60	100	OE
22OME02	Industrial Process Engineering	3	0	0	3	3	40	60	100	OE
22OME03	Maintenance Engineering	3	0	0	3	3	40	60	100	OE
22OME04	Safety Engineering	3	0	0	3	3	40	60	100	OE
22OBT01	Biofuels	3	0	0	3	3	40	60	100	OE
22OFD01	Traditional Foods	3	0	0	3	3	40	60	100	OE
22OFD02	Food Laws and Regulations	3	0	0	3	3	40	60	100	OE
22OFD03	Post Harvest Technology of Fruits and Vegetables	3	0	0	3	3	40	60	100	OE
22OFD04	Cereal, Pulses and Oil Seed Technology	3	0	0	3	3	40	60	100	OE
22OFT01	Fashion Craftsmanship	3	0	0	3	3	40	60	100	OE
22OFT02	Interior Design in Fashion	3	0	0	3	3	40	60	100	OE
22OFT03	Surface Ornamentation	3	0	0	3	3	40	60	100	OE
22OPH01	Nanomaterials Science	3	0	0	3	3	40	60	100	OE
22OPH02	Semiconductor Physics and Devices	3	0	0	3	3	40	60	100	OE
22OPH03	Applied Laser Science	3	0	0	3	3	40	60	100	OE
22OPH04	Bio-Photonics	3	0	0	3	3	40	60	100	OE
22OPH05	Physics of Soft Matter	3	0	0	3	3	40	60	100	OE
22OCH01	Corrosion Science and Engineering	3	0	0	3	3	40	60	100	OE
22OCH02	Polymer Science	3	0	0	3	3	40	60	100	OE
22OCH03	Energy Storing Devices	3	0	0	3	3	40	60	100	OE
22OMA01	Graph Theory and Combinatorics	3	0	0	3	3	40	60	100	OE
22OGE01	Principles of Management	3	0	0	3	3	40	60	100	OE
22OGE02	Entrepreneurship Development I	3	0	0	3	3	40	60	100	OE
22OGE03	Entrepreneurship Development II	3	0	0	3	3	40	60	100	OE
22OGE04	Nation building: Leadership and Social Responsibility	3	0	0	3	3	40	60	100	OE
22OAM01	Computer Vision in Healthcare Application	3	0	0	3	3	40	60	100	OE
22OAM02	Neural Networks	3	0	0	3	3	40	60	100	OE

22MA101 Engineering Mathematics I 3 1 0 4

Course Objectives

- To impart mathematical modeling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

Programme Outcomes (POs)

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

b. 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.

Course Outcomes (COs)

1. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	2	3												
3	2	3												
4	3	3												
5	1	3												

UNIT I **9 Hours**

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

UNIT II **9 Hours**

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orhtogonality - Canonical form and its nature.

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test.

UNIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form y = abx through least square approximation - Calculus of exponential functions - Exponential series - Characteristics

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables - Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

Total:45+15: 60 Hours

Reference(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna, 2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

22PH102 Engineering Physics **2 0 2 3**

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Programme Outcomes (POs)

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

b. 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.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

Course Outcomes (COs)

1. Illustrate the concept and principles of energy to understand mechanical systems
2. Exemplify the types of mechanical oscillations based on vibrational energy
3. Infer the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1						2						
2	2	1						2						
3	2	1						2	2					
4	2	1						2						
5	2	1						2						

UNIT I **6 Hours**

CONSERVATION OF ENERGY

Concept of energy - types of energy - conservation of energy Mechanical energy: - translation - rotation - vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forced oscillations - natural frequency – resonance.

UNIT III **6 Hours**

PROPAGATION OF ENERGY

Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Doppler effect. Sound waves and its types - characteristics - human voicere - reflection - refraction – beats.

UNIT IV **7 Hours**

EXCHANGE OF ENERGY

Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes. Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale - maximization of entropy

UNIT V **6 Hours**

ENERGY IN MATERIALS

Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces - Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia - Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of thickness of a thin wire using interference of light - Air wedge method

4 **4 Hours**

EXPERIMENT 4

Determination of AC frequency using Meldes apparatus

5 **3 Hours**

EXPERIMENT 5

Determination of thermal conductivity of a bad conductor using Lees disc method

6 **4 Hours**

EXPERIMENT 6

Wavelength of ultrasonics in a liquid medium
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using ultrasonic interferometer.

7 **4 Hours**

EXPERIMENT 7

Determination of Youngs modulus of a given material- Non uniform bending method.

Total:30+30: 60 hours

Reference(s)

1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017.

22CH103 Engineering Chemistry I **2 0 2 3**

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyze the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

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

b. 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.

Course Outcomes (COs)

1. Understand nuclear transmutation reactions that lead to the formation of elements in the universe
2. Illustrate atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyze endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyze whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

UNIT I **5 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements.

UNIT II **7 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity.

UNIT III **6 Hours**

CHEMICAL BONDING

Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

UNIT IV **6 Hours**

REACTION THERMODYNAMICS

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

UNIT V **6 Hours**

STATES OF MATTER

Solid - liquid - gas - plasma - quantum dots - arrangement of atoms/ions/molecules in different phases

1 **2 Hours**

EXPERIMENT 1

Lab safety rules and guidelines for students - OSHA Guidelines

2 **3 Hours**

EXPERIMENT 2

Estimation of dissolved oxygen content in water sample(s) by Winkler's method

3 **4 Hours**

EXPERIMENT 3

Determination of Fe(II) in a sample using spectrophotometer

4 **3 Hours**

EXPERIMENT 4

Estimation of chromium content in water sample by volumetric analysis

5 **3 Hours**

EXPERIMENT 5

Estimation of chloride present in the given water sample by argentometric method

6 **3 Hours**

EXPERIMENT 6

Conductometric titration of mixture of acids

4 Hours

7

EXPERIMENT 7

Estimation of magnesium ions in given solution by EDTA method

8 **4 Hours**

EXPERIMENT 8
Preparation of salt of fatty acid by saponification process

9 **4 Hours**

EXPERIMENT 9
Recrystallization of aspirin from water/ethanol

Total:30+30: 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford university press, 2019
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford university press, 2020
3. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016
5. Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

22GE001 Fundamentals of Computing **3 0 0 3**

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

Course Outcomes (COs)

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **8 Hours**

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - flow, functions and controls - communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input - Output - Loops - Simple programs.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For The Perplexed From The Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S. Pressman, "Software Engineering: A Practitioner"s Approach", McGraw Hill International edition, Seventh edition, 2010

22HS001 Foundational English 1 0 2 2

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develop abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

l. 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.

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3		2		
2									2	3		2		
3									2	3		2		
4									2	3		2		
5									2	3		2		

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction - Recreating Interview Scenarios (with a focus on verbal communication) - Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs - Self-Introduction - Recreating interview scenarios - Haptics - Gestures - Proxemics - Facial expressions -Paralinguistics/Vocalics - Body Language - Appearance - Eye Contact - Artefacts. Self-Introduction - Powerful openings and closings at the interview - Effective stock phrases - Modified for spontaneity and Individuality-Question tags, framing questions including WH Questions - Prepositions - Listening to Ted Talks-Listening for specific information

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression - Picture Description and Blog Writing - Vocabulary - One word substitution - Adjectives - Similes, Metaphors, Imagery & Idioms - Link words - Inclusive language Narrative Expression - Travelogue and Minutes of Meeting -Verbal analogy -Sequence & Time order words - Jumbled paragraph, sentences, Sequencing - Text & Paragraph completion - Past tense - Using quotation marks

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails - Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to Newspapers - Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail. Conjunctional clause Punctuation - Formal Idioms - Phrases - Articles - Definite & Indefinite - Types of sentences - Modal verbs Precision in comprehension, Summary writing, Selective summary - Reading: Active reading - short paragraphs, excerpts, articles and editorials - Skimming and Scanning. Reading comprehension & analysis - Tenses, QP/ PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal - Note - taking - Listening: Listening for data, for specific information, for opinion -Active and passive Listening - Transcription - Paraphrasing and summarizing information-Agreeing & disagreeing - Note - taking - Writing: Summary writing, selective summary, paraphrasing, note - making, opinion pieces - Finding synonyms in the context Paraphrasing - Sentence Transformation - simple, compound, complex. Sentence substitution - Sentence completion - Interpreting paragraphs.

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE004 Basics of Electronics Engineering **2 0 2 3**

Course Objectives

- To understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic Devices.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	1										
2	3	3	3	2										
3	3	3	3	2										
4	3	3	3	2										
5	3	3	3	1										

UNIT I **6 Hours**

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energy through PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energy conversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

1 **4 Hours**

EXPERIMENT 1

Design and Implement a simple device to communicate basic information between two different small distance points
using wired and wireless methods.

2 **6 Hours**

EXPERIMENT 2

Design and Implement different wave shaping Circuits using PN Junction Diodes.

3 **4 Hours**

EXPERIMENT 3

Design and Implement Voltage Multiplier Circuit using PN Junction Diodes and Capacitors.

4 **4 Hours**

EXPERIMENT 4

Design and Implement t a three Stage Circuit to convert 220V 50Hz AC mains supply to 12V DC supply.

5 **4 Hours**

EXPERIMENT 5

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

6 **4 Hours**

EXPERIMENT 6

Design and Implement Basic Logic Gates using PN Junction Diodes.

7 **4 Hours**

EXPERIMENT 7

Design and Implement Basic Logic Gates using BJTs.

Total: 30+30:60Hours

Reference(s)

1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

22HS002 Startup Management **1 0 2 2**

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering
- Support in developing marketing strategies and financial outlay
- Enable to scale up the porotypes to commercial market offering

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

k. 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.

Course Outcomes (COs)

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							1	2	1		1			
2							2	2	1	1	2			
3							3	3	1	2	2			
4							1	3	1	2	2			
5							2	3	2	2	2			

3 Hours

UNIT I

BUSINESS MODELS AND IDEATION

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking.

UNIT II **3 Hours**

UNDERSTANDING CUSTOMERS

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods - Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes.

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks.

UNIT V **3 Hours**

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors.

1 **1 Hours**

EXPERIMENT 1

Analysis of various business sectors

2 **2 Hours**

EXPERIMENT 2

Developing a Design Thinking Output Chart

3 **1 Hours**

EXPERIMENT 3

Creating Buyer Personas

4 **3 Hours**

EXPERIMENT 4

Undertake Market Study to understand market needs and assess market potential

5 **2 Hours**

EXPERIMENT 5

Preparation of Business Model Canvas

6 **15 Hours**

EXPERIMENT 6
Developing Prototypes

7 **2 Hours**

EXPERIMENT 7
Organizing Product Design Sprints

8 **2 Hours**

EXPERIMENT 8
Preparation of Business Plans

9 **2 Hours**

EXPERIMENT 9
Preparation of Pitch Decks

Total: 15+ 45:60 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021.

22MA201 Engineering Mathematics II **3 1 0 4**

Course Objectives

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of complex functions

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering
b. Specialization to the solution of complex engineering problems. Identify, formulate, review Research literature, and analyze complex engineering problems reaching substantiated Conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Interpret the concept of differential equations through mathematical modeling and analyze its applications in engineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	2	3												
3	2	3												
4	3	3												
5	1	3												

UNIT I **9 Hours**

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations- Solutions of first order linear ODE: Leibnitzs and method of separation of variables - Cooling/Heating of an object - A falling object - Modeling of electric circuits: RL and RC circuits - Modeling of population dynamics: Exponential growth and decay - Logistic growth model

UNIT II **9 Hours**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations - Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits.

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of a vector function and geometrical interpretation - Velocity and acceleration - Gradient and its properties - Tangent and normal vectors - Directional derivative - Divergence of a vector field - Curl of a vector field - Projectile motion

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions

Total:45+15:60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B. Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

22PH202 Electromagnetism and Modern Physics

2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyze the theory of relativity and energy bands

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the principles and mechanism of electrostatics and current
2. Illustrate the principles and mechanism of magneto statics
3. Classify electromagnetic waves and infer the characteristics of visible light
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Exemplify the electrical properties of semiconductor based on the band theory

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2	1							2					
3	2	1							2					
4	2	1												
5	2	1							2					

UNIT I **6 Hours**

ELECTRICITY

Electric monopoles - Electric field - Electric flux - Electric potential - Electrical energy- Capacitor-Conductors and Insulators - Electric dipole and polarization - Electric current - Voltage sources - Resistance

UNIT II **6 Hours**

MAGNETISM

Sources of magnetism - Monopoles - Magnetic field and force - magnetic field and current distribution - Magnetic dipole - Magnetic potential energy - Inductor - Electric and magnetic field comparison.

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: Basic laws - Electromagnetic energy - radiation. Electromagnetic waves: Origin, nature and spectrum - Visible light. Principle of least time - Geometrical optics-Human eye - Diffraction - Interference - Polarization – LASER.

UNIT IV **6 Hours**

MODERN PHYSICS

Special theory of relativity - Simultaneity and time dilation - Length contraction - Relativistic mass variation. Matter waves - De-Broglie hypothesis - Wave nature of particles

UNIT V **6 Hours**

ENERGY BANDS IN SOLIDS

Band theory of solids - Classification of materials - Semiconductors - Direct and indirect semiconductor - Fermi energy - Intrinsic and extrinsic semiconductor - Carrier concentration - Electrical conductivity

1 **5 Hours**

EXPERIMENT 1

Determination of V-I characteristics of a solar cell

2 **5 Hours**

EXPERIMENT 2

Determination of Hall voltage of a given specimen by Hall Effect method

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of a given laser source - Grating method

4 **4 Hours**

EXPERIMENT 4

Determination of particle size using diode laser

5 **3 Hours**

EXPERIMENT 5

Determination of refractive index of a given solid medium and liquid medium

6 **4 Hours**

EXPERIMENT 6

Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

7 **4 Hours**

EXPERIMENT 7

Determination of band gap energy of a given semiconducting material

Total:30+30:60Hours

Reference(s)

1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017.

22CH203 Engineering Chemistry II **2 0 2 3**

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of a metal
2. Analyze the working of batteries for the energy storage devices
3. Understand the mechanism of corrosion and suggest a method to control the corrosion
4. Illustrate reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1					1							
4	2	1												
5	2	1												

UNIT I **6 Hours**

ELECTROCHEMISTRY

Origin of potential - Electromotive force - Electrical double layer - Transport of charge within the cell - Cell description - Prediction of cell potentials.

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - Reversible and irreversible cell - Charging and discharging reactions in a reversible cell - Current challenges in energy storage technologies.

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - Electromigration - Electron transfer in the presence and absence of moisture - Galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - Variation in properties between isotopes - Radioactive decay (alpha, beta and gamma) - Half-life period - Nuclear reactions - Radiocarbon dating

1 **4 Hours**

EXPERIMENT 1

Determination of strength of hydrochloric acid in a given solution using pH meter

2 **4 Hours**

EXPERIMENT 2

Application of calomel electrode to determine the redox potential of Fe(II) solution

3 **4 Hours**

EXPERIMENT 3

Construct an electrochemical cell exhibiting valid output and compare its potential with the given standard cell

4 **5 Hours**

EXPERIMENT 4

Determination of corrosion percentage of iron/steel by weight loss method

5 **4 Hours**

EXPERIMENT 5

Determination of percentage of corrosion inhibition in iron/mild steel using a natural inhibitor

6 **4 Hours**

EXPERIMENT 6

Electroplate copper on the given target object and estimate the amount of copper deposited at cathode.

7 **5 Hours**

EXPERIMENT 7

Determination of rate constant of acid catalyzed hydrolysis of ester

Total:30+30:60Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012
3. E. McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010
4. S. Vairam, Engineering Chemistry, John Wiley & Sons, 2014
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th edition, (revised) New Age International Publishers, 2011
6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017.

22GE002 Computational Problem Solving 3 0 0 3

Course Objectives

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2										
2	3	3	3	3										
3	2	2	2	3										
4	2	2	2	2										
5	2	2	2	2										

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - Logical sequencing - Drawing flowchart - Preparation of visual process model.

UNIT II **12 Hours**

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE

Flat File and Relational database - Data Read & Write in Local Storage, Server Storage and Cloud storage - Database Query Methods.

UNIT V **8 Hours**

NETWORKING ESSENTIALS

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - Network Security - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE003 Basics of Electrical Engineering 2 0 2 3

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy, transfer in electro mechanical conversion

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyze the electric field due to different charge distributions.
3. Analyze the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2								2	2		
2	2	2	2	3							3	2		
3	2	2	1	3							2	2		
4	3	2	1	2							2	2		
5	2	2									2	2		

UNIT I **5 Hours**

ELECTRIC CHARGE

Properties of charge, additivity of charges, quantization of charge, conservation of charge, Forces between multiple charges, Electric charge in conductors, Drift of Electrons, Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

1 **15 Hours**

EXPERIMENT 1

Analyze and design of electromechanical energy conversion system.

2 **15 Hours**

EXPERIMENT 2

Develop an electrical machine and analyze its performance with supplied input of AC from 0 V to 230 V.

Total:30+30:60Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

22AM206 Digital Computer Electronics 3 0 2 4

Course Objectives

- Understand the operation of Arithmetic Logic unit in Microprocessors
- Interpret Data retrieval from Memory by Microprocessors
- Analyze the role of Control Unit in Microprocessors
- Analyze Instruction execution in Microprocessors

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.

Course Outcomes (COs)

1. Analyze the Design of Arithmetic and Logic Unit in Microprocessors.
2. Analyze the Data Storage and Retrieval from Random Access Memory
3. Analyze the working mechanism of Control Unit in Microprocessors
4. Analyze the execution of Arithmetic and Logical Instructions
5. Analyze the execution of Jump and Memory related Instructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2											
2	2	2	2											
3	2	2	2											
4	2	2												
5	2	2												

UNIT I **9 Hours**

BINARY SYSTEM AND DESIGN OF ALU

Conversion of Decimal, Hexadecimal, Octal and Binary Numbers - Representation of Negative Numbers in Binary - Design of Binary Arithmetic Logic Modules - Magnitude Comparator - Encoder - Decoder - Multiplexer - Demultiplexer - Design of Arithmetic and Logic Unit (ALU).

UNIT II **9 Hours**

SYNCHRONOUS CIRCUIT AND DESIGN OF RAM

Latches and Flip Flops - Clock - Registers - Counters - Shift Registers - Storage and Retrieval of Binary Numbers from Registers - Design of Random Access Memory (RAM) - Encoding and Decoding of Memory address locations.

UNIT III **9 Hours**

DESIGN OF CONTROL UNIT

Design of Control Unit - Mechanism of Instruction Read, Data Read, Instruction Decode, Instruction Execute and Data Write

UNIT IV **9 Hours**

BASIC INSTRUCTION EXECUTION

Arithmetic Instructions - Increments, Decrements and Rotate Instructions - Logic Instructions - Arithmetic and Logic instructions

UNIT V **9 Hours**

ADVANCED INSTRUCTION EXECUTION

Memory Reference instructions - Register Instructions - Jump and Call Instructions - Concept of Flag - Extended Register Instructions - Indirect Instructions - Stack instructions

1 **2 Hours**

EXPERIMENT 1

Design and Simulation of Fundamental Gates using Universal Gates (NAND and NOR)

2 **3 Hours**

EXPERIMENT 2

Design and Simulation of Half Adder, Full Adder, Half Subtractor, Full Subtractor

3 **3 Hours**

EXPERIMENT 3

Design and Simulation of 4-bit Ripple Carry Adder

4 **4 Hours**

EXPERIMENT 4

Design and Simulation of a 4-bit Arithmetic and Logic Unit

5 **4 Hours**

EXPERIMENT 5

Design and Simulation of D Flip Flop and J K Flip Flop

6 **4 Hours**

EXPERIMENT 6

Design and Simulation of 8-bit Register.

7 **4 Hours**

EXPERIMENT 7

Design and Simulation of an 8 bit SISO, SIPO, PISO, PIPO Shift Registers

8 **3 Hours**

EXPERIMENT 8

Simulation of Data Read and Data Write from a RAM.

9 **3 Hours**

EXPERIMENT 9

Simulation of Control Unit Functionality

Total:45+30:75 Hours

Reference(s)

1. Morris Mano, "Digital Logic & Computer Design", Pearson Education India, 2019.
2. Albert Paul Malvino and Jerald A Brown, "Digital Computer Electronics,(3rd Edition)", McGraw Hill Education India, 2001.
3. David Money Harris and Sarah L Harris, "Digital Design and Computer Architecture", Elsevier, 2007
4. John C Schott, "But How do it Know? The Basic Principles of Computers for Everyone", John C Scott Publishers, 2009.
5. Petzold Charles, "Code: The Hidden Language of Computer Hardware and Software (2nd Edition)", Microsoft Press, 2022.
6. Thomas C Bartee, "Digital Computer Fundamentals (6th Edition)",Tata Mcgraw Hill Education, 2011.

22HS003 Heritage of Tamils **1 0 0 1**

Course Objectives

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures
- Examine the role of sports and games in promoting cultural values and community bonding
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture.

Programme Outcomes (POs)

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

j. 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.

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I **3 Hours**

UNIT I LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages - Tamil as aClassical 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 II **3 Hours**

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART- SCULPTURE

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 III **3 Hours**

UNIT III FOLK AND MARTIAL ARTS

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

UNIT IV **3 Hours**

UNIT IV THINAI CONCEPT OF TAMILS

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 V **3 Hours**

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

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: 15 Hours

Reference(s)

1. Dr. K. K. Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

22HS003 - தமிழர்மரபு 1 0 0 1

பாடத்திட்டத்தின் ந)ாக்கம்

- இந்தியமமொழிக்கூடும்பத்Fள் திராவிடமமொழிகள் தனித்Fஇயங்கும் தன் மமமய அதன் சிறப்புகள்வழிஅறிதல்.
- மதொன் தமிழர் கமலயில் சிமயஇயம்பூதல். றுமதொடடு அமடந்தவளரச
- சங்ககாலதமிழரின் கற்றல் திறத்மதஇலக்கியங்கள் வழிஆராய்தல்.

கற்றலின் விளைவு

1. இந்தியமமொழிக்கூடும்பத்Fள் திராவிடமமொழிகள் தனித்Fஇயங்கும் தன் மமமய அதன் சிறப்புகள்வழிஅறிதல்.
2. மதொன் தமிழர் கமலயில் சிமயஇயம்பூதல். றுமதொடடு அமடந்தவளரச
3. சங்ககாலதமிழரின் கற்றல் திறத்மதஇலக்கியங்கள் வழிஆராய்தல்.
4. தமிழ்மமொழியின் சிறப்பூகமளஅதன் பமடப்பிலக்கியங்கள் மூலம் அறிந்Fமகொளளுதல்.
5. கற்காலம் மதொடங்கி, இக்காலம் வமரசிற்பக்கமலஅமடந்தவளரசசிமயகண்டுமகாள்ளல் .
6. தமிழரதம் வாழ்வில் எங்கனம் இயற்மகமயவணங்கின் பமததி கிபபாற்றினரமணபகொட்பொட்டின் வழிமதளிதல்.
7. **இந்தியவிடுதமலபபாரில் தமிழரஆற்றியபங்**

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

கிமனமதரிந்Fமகாள்ளூதல்.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22AM301 Probability and Statistics **3 1 0 4**

Course Objectives

- Understand the basic concepts of probability with characteristics and also two-dimensional random variables
- Learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts of random phenomena in the core areas
2. Calculate the relationship of two-dimensional random variables using Correlation techniques
3. Conclude on a particular scenario based on different types of hypothesis
4. Design an experimental analysis for one-way, two-way classifications and Latin square designs
5. Summarize the measurements and procedure for statistical quality control

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3												
2	2	3												
3	3	2												
4	2	1												
5	2	2												

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLES

Introduction to probability concepts-Types of Events, axioms, theorems-Conditional probability-Multiplication theorem- Characteristics of random variables-Discrete case: Probability Mass function-Cumulative distribution function-Characteristics of random variables-Continuous case:Probability density function-Cumulative distribution function-Central and Raw Moments-Expectation-Variance-Moment generating function of discrete and continuous random variable.

UNIT II **9 Hours**

TWO - DIMENSIONAL RANDOM VARIABLES

Joint Distributions-Marginal and Conditional Distributions- Covariance-Correlation and Linear Regression-Transformation of Random Variables-Central Limit Theorem (For Independent and Identically Distributed Random Variables).

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

Sampling distributions-Estimation of parameters-Statistical hypothesis-Large sample test based on normal distribution for single mean and difference of means-Tests based on t - distribution- Chi-square and F distributions for mean, Variance and proportion-Contingency table (Test for independent)-goodness of fit.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

One way and two way classifications-Completely randomized design-Randomized block design-Latin square design- 2 x 2 factorial design.

UNIT V **9 Hours**

STATISTICAL QUALITY CONTROL

Control charts for measurements (X and R Charts)-Control charts for attributes (P, C and NP Charts)-Tolerance limits- Acceptance sampling

Total: 45+15: Hours

Reference(s)

1. Devore. J.L., Probability and Statistics for Engineering and The Sciences, Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L.,Probability and Statistics For Engineers And Scientists, Pearson Education, Asia , 8th Edition, 2007.
3. Seymour Lipschuts, Introduction to Probability and Statistics, 1st Ediion, McGraw Hill, 2012.
4. Richard A Johnson, Miller and Feunds Probability and Statistics for Engineers, 8thEdiion, Phi Learning Private Ltd, 2014.
5. Spiegel. M.R., Schiller. J. And Srinivasan. R.A., Schaum S Outline of Theory and Problems of Probability And Statistics, Tata McGraw Hill Edition, 2004.

22AM302 Data Structures I — 3 0 2 4

Course Objectives

- Implement array and hash data structure for real world applications.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the performance of various data structures using asymptotic notations.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Implement the array data structure and its types for searching and sorting operations.
2. Outline the algorithm efficiency with different asymptotic notations for optimizing the code.
3. Implement the linear node-based data structure for real world applications.
4. Evaluate the performance of Hash over arrays and list in memory access.
5. Analyze the tree traversal algorithms for various non-linear data structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2						2	2	2	1
2	2	2	2	2	2						2	2	1	
3	2	3	3	2	2						2	2	2	1
4	3	3	3	3	2						3	3	3	
5	3	2	3	3	3						3	3	2	2

UNIT I **10 Hours**

FOUNDATIONAL DATA STRUCTURES

Algorithms and Data Structures - Data Structures hierarchy -Types of Data- Singular Data and Plural Data - Position indexing : Array - Sets - Ordered Arrays - Searching over Arrays and Ordered Arrays.

UNIT II **7 Hours**

ALGORITHM EFFICIENCY

Algorithm efficiency using Asymptotic Notations - Optimizing code with and without Big O Notation - Optimizing for optimistic scenarios - Trade- offs between Time and Space.

UNIT III **10 Hours**

ADT AND NODE BASED DATA STRUCTURES

ADT : Stacks - Queues - Recursion - Recursive Algorithms for Speed - Node Based Data Structures : Linked list - Need of Linked List - Arrays vs Linked List - Types of Linked List and its operations - Skip Lists.

UNIT IV **8 Hours**

FAST LOOKUP WITH HASH

Hash Table - Hash functions - Internal implementation of Hash - Iteration over Hash - Hash operations - Hash of Hash - Array of Hash - Hash of Array.

UNIT V **10 Hours**

TREES

Tree - Binary Tree - Binary Search Tree - Tree traversal - AVL Tree - Red Black Tree - B Tree - B+ Tree - Heap.

1 **2 Hours**

EXPERIMENT 1

Implementing Array operations

2 **6 Hours**

EXPERIMENT 2

Implementing stack and queue data structures:
i. Stack applications (expression evaluation, stack-based algorithms)
ii. Queue applications (implementing a circular queue, queue-based algorithms)

3 **4 Hours**

EXPERIMENT 3

Implementing Singly linked list and its operations like insertion, deletion, searching, and traversal

4 **4 Hours**

EXPERIMENT 4

Implementing hashing techniques (linear probing, quadratic probing, chaining)

5 **2 Hours**

EXPERIMENT 5

Implementing Binary tree traversal algorithms (pre-order, in-order, post-order)

6 **2 Hours**

EXPERIMENT 6

Implementing various searching algorithms:
i. Linear search
ii. Binary search

7 **10 Hours**

EXPERIMENT 7

Implementing and analyzing various sorting algorithms:
i. Bubble sort
ii. Selection sort
iii. Insertion sort
iv. Merge sort
v. Quick sort
vi. Heap sort

Total:45+30:75 Hours

Reference(s)

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures & Algorithms in Python, Wiley, 2013.
2. Larry Wall, Tom Christiansen & Randal L. Schwartz, Progrmaming Perl, O""Reilly, 3rd edition, 2000.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2016.
4. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
5. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011.
6. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009.

22AM303 Computer Organization and Architecture

3 0 0 3

Course Objectives

- Understand the computer architecture concepts related to design of processors, memory management and I/O system.
- Explore the GPU computing architecture and develop an environment for creating high performance GPU-accelerated applications using CUDA programming.
- Gain knowledge on modern processor architecture to design the best processor/computing system.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Analyze the processor architecture and instruction sets of x86/x64 and ARM architecture.
2. Design a data path for a simple processor and compare the various techniques related to simultaneous execution of multiple instructions from a program.
3. Organize the computer memory to speed up the performance and facilitate the transfer of data between the computer's central processing unit and the external devices.
4. Analyze the GPU computing architecture and develop applications to run on NVIDIA GPUs using the CUDA programming environment.
5. Analyze the modern processor architectures and instruction sets and implement a RISC-V processor in a low-cost FPGA board.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2								2		1
2	3	3	2	2								2		2
3	2	2	2									2	2	2
4	2	2	2	2	3							2	1	1
5	2	2	2	2								2		2

UNIT I **9 Hours**

UNDERSTANDING PROCESSOR ARCHITECTURE AND INSTRUCTION SETS

Basic Computer Organization and Design - Instruction Set principles - x86 and x64 architecture & instruction sets - 32 bit and 64 bit ARM architecture & instruction sets.

UNIT II **9 Hours**

PROCESSOR DESIGN

Designing a Data path for a Simple Processor - DLX Pipeline - Super Pipelining - Super scalar processor - Instruction level parallelism (ILP) - Speculative Execution - Side channel attack (Spectre and Meltdown)

UNIT III **9 Hours**

MEMORY UNIT AND I/O ORGANIZATION

Memory Hierarchy - Cache Architectures - Levels in Cache - Improving Cache Performance - Memory Prefetch - Tera MTA - Connecting I/O Devices to the Processor.

UNIT IV **8 Hours**

EXPLORING GPU ARCHITECTURE

GPU Vs CPU architecture - GPU Architecture Basics - NVIDIA"s CUDA Toolkit - CUDA Programming

UNIT V **10 Hours**

MODERN COMPUTER ARCHITECTURE

Domain-Specific Computer Architectures - Sony PlayStation design PS3/PS5, MAC M1 chip, Xbox, Cerebas - Wafer Scale Computing, Accelerators (FPGA, ASIC) - RISC-V Architecture and Instruction Set - Implementing RISC-V in a field-programmable gate array (FPGA).

Total: 45 Hours

Reference(s)

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, McGraw-Hill,Third Reprint, 2015.
2. David A, Patterson and John L, Hennessy, Computer Organization and Design: The hardware/ software interface, MorganKaufmann,4th edition, 2014.
3. Jim Ledin, Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-V architectures and the design of smartphones, PCs, and cloud servers - Second Edition,2022.

22AM304 Principles of Programming Lanuages **3 0 2 4**

Course Objectives

- Understand the history and evolution of programming language.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the subprograms, functions, debugging and error handling mechanisms.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Outline the programming paradigms and the basic structure of programming language.
2. Assess the implementation of different types of data, variable and types system.
3. Analyze suitable conditional statements and control structures for real world applications.
4. Develop programs using subprograms and explore their types for problem solving.
5. Determine the tools for error handling and event handling in Programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	1	3						1	2	1	
2	2	3	3	1	3						2	2	1	
3	1	2	3	1	3						2	2	2	
4	1	2	3	1	3						2	2		2
5	1	2	3	1	3						2	2		2

UNIT I **8 Hours**

UNDERSTANDING PROGRAMMING PARADIGMS

Natural Vs Artificial language - Common Programming Paradigms - Syntax and semantics - Language Evaluation Criteria - Programming Language Grammar.

UNIT II **10 Hours**

VARIABLES AND DATA TYPES

Variable Declarations - Guidelines for Initializing Variables - Power of Variable names - Fundamental Data types - Type Systems - Type Inference and Polymorphism.

UNIT III **10 Hours**

STATEMENTS

Expressions and Assignment statements - Organizing straight-line code - Using conditionals - Controlling loops - Unusual control structures - General control issues.

UNIT IV **9 Hours**

SUBPROGRAMS

Fundamentals of Subprograms - Design issues - Parameter passing methods - Overloaded subprograms -Generic subprograms - Implementing subprograms.

UNIT V **8 Hours**

DEBUGGING AND ERROR HANDLING

Debugging - Debugging Strategies - Debugging Tools - Error Messages - Documentation - Test cases - Debugging with print statements - Debugging with comments and questions - Exception handling and Event handling

EXPERIMENT 1 **6 Hours**

Online shopping cart: Develop an application to implement online shopping cart and generate bill for the purchased products.

EXPERIMENT 3 **3 Hours**

Pocket Bazaar: Develop an application to manage an inventory of products for grocery stores.

EXPERIMENT 4 **3 Hours**

Vacation Destination Decision Maker: Create an application program that helps a user decide on their next vacation destination based on their preferences.

EXPERIMENT 5 **3 Hours**

Temperature monitor: Develop an application for temperature monitoring system and provide an alert message.

EXPERIMENT 6 **3 Hours**

Develop an access control system that simulates the granting access to authorized personnel based on their credentials, such as ID cards and PIN codes.

EXPERIMENT 7 **6 Hours**

Math Quiz Generator: Design a math quiz generator that generates questions of various difficulty levels and arithmetic operations.

EXPERIMENT 8 **6 Hours**

Build a maze solver application that finds a path from the entrance to the exit of a maze.

Total: 45+30:75 Hours

Reference(s)

1. Code Complete, Steve McConnell, Microsoft Press, 2004.
2. Concepts of Programming Languages Robert. W. Sebesta 10/E, Pearson Education.
3. Programming Language Design Concepts, D. A. Watt, Wiley Dreamtech, 2007.
4. Programming Languages, 2nd Edition, A.B. Tucker, R. E. Noonan, TMH.
5. Programming Languages, K. C. Louden, 2nd Edition, Thomson, 2003

22AM305 Software Engineering **3 0 0 3**

Course Objectives

- Understand the systematic approach related to the design, development and maintenance of a software system
- Analyze the limitations of manual testing process and provide a succinct summary of those limitations with the help of automated testing tools.
- Understand the Enterprise Architecture (EA) framework that provides the building blocks for successful digital business transformation.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Apply the software development methodologies to various real life scenarios.
2. Apply modern tools and techniques to develop scalable, maintainable, and reliable software systems.
3. Analyze the coding strategies and techniques to write well-structured, efficient, and error-free code.
4. Apply specific modern testing tools to ensure the quality and reliability of software products.
5. Analyze the elements, structure, and positioning of an Enterprise Architecture framework used for successful digital business transformation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2			2		2		2	2	1	
2	3	3	2	2	3		2		2			2		2
3	2	2	2				2		2			2	1	
4	2	2	2		3		2		2			2		2
5	2	2	2						2				1	

UNIT I **9 Hours**

SOFTWARE DEVELOPMENT PROCESS

Phases in Software Development - Traditional Software Development Models - Agile Methodologies - Agile Scaling Frameworks - Lean Software Development - Software Requirements Specification(SRS) - Project Scheduling and Estimation.

UNIT II **10 Hours**

TOOLS AND TECHNIQUES FOR SOFTWARE DEVELOPMENT

DevOps - Version control with Git - Containerization Using Docker and Kubernetes- Application Performance Monitoring (APM) - Continuous Integration Continuous deployment (CICD) - Clean Room build.

UNIT III **9 Hours**

CODE QUALITY

Software Metaphors - Upstream Prerequisites - Key Construction Decisions - Defensive Programming - Code Tuning Strategies and Techniques.

UNIT IV **9 Hours**

TESTING

Writing good test cases - Test driven development - Test Automation - Testing using Selenium tool - Continuous Testing - Exploratory Testing - Testing in Agile and DevOps Environments.

UNIT V **8 Hours**

ENTERPRISE ARCHITECTURE AND MODELING

Enterprise Architecture (EA) in Digital Transformation - Agility in Digital Business - Measuring EA: Metrics, KPIs and Risks.

Total: 45 Hours

Reference(s)

1. Charles Petzold, Code: The Hidden Language of Computer Hardware and Software, Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, Computational thinking for the modern problem Solver, CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, Little Man Computer Programming: For The Perplexed From The Ground Up, The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.

22HS004 Human Values and Ethics 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3	2	1				
2								3	2	1				
3								3	2	1				
4								3	2	1				
5								3	2	1				

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in 21st Century - Understanding the theory of basic human values and ethics - Openness to change - Self enhancement - Conservation - Self transcendence - Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism- Integrity - Freedom - Justice - Honesty - Truthfulness - Responsibility - Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life - Embracing self-love and wellness - Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence. Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in Nature - Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin. 2011.
2. Gupta, N. L. Human Values for The 21St Century. India: Anmol Publications Pvt. Limited. 2002.
3. Mishra, A. Happiness Is All We Want. India: Bloomsbury Publishing.2017.
4. Universal Human Values. (n.p.): Booksclinic Publishing. 2023.
5. A Textbook on Professional Ethics and Human Values. India: New Age International (P) Limited.2007.

22HS005 Soft Skills and Effective Communication

0 0 2 1

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers
3. Provide constructive feedback and file logical complaints
4. Analyze the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I
SELF-EXPRESSION **10 Hours**

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives - Discourse markers – Interjections - Decision making - Synthesis - Higher order thinking Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT II
CREATIVE EXPRESSION **10 Hours**

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

UNIT III
FORMAL EXPRESSION **10 Hours**

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

Reference(s)

1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012
6. Business English by Ken Taylor, Orient Blackswan, 2011

22HS006 Tamils and Technology 1 0 0 1

Course Objectives

- Analyze graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
- Investigate the building materials and the historical context of Hero stones during the Sangam Age by analyzing the details of stage constructions in Silappathikaram and their cultural significance.
- Examine ancient knowledge of oceans and its impact on Tamil society.

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

Course Outcomes (COs)

1. Understand the significance of the weaving industry during the Sangam Age and its cultural importance.
2. Understand the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Explore the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Explore the art of shipbuilding in ancient Tamil culture and its role in maritime trade and transportation.
5. Trace the development of scientific terminology and vocabulary in Tamil language.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I **3 Hours**

WEAVING AND CERAMIC TECHNOLOGY

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

UNIT II **3 Hours**

DESIGN AND CONSTRUCTION TECHNOLOGY

Designing and Structural construction House and 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

UNIT III **3 Hours**

MANUFACTURING TECHNOLOGY

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.

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

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.

UNIT V **3 Hours**

SCIENTIFIC TAMIL & TAMIL COMPUTING

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: 15 Hours

Reference(s)

1. Dr.K.K.Pillay , Social Life of Tamils , A joint publication of TNTB & ESC and RMRL
2. Dr.S.Singaravelu , Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr.S.V.Subatamanian , Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr.M.Valarmathi , The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' , Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu.
7. Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
8. R.Balakrishnan , Journey of Civilization Indus to Vaigai, RMRL

22AM401 Applied Linear Algebra 3 1 0 4

Course Objectives

- Understand the basic concepts of Matrices, Eigen values, Eigenvectors and their Decomposition techniques to solve the given system
- Analyze the system of vectors by different vector space and Inner product space techniques
- Apply the concepts of linear algebra in the field of Artificial Intelligence and Data Science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.

Course Outcomes (COs)

1. Understand the characteristics of matrices and determinants and apply them in computer engineering.
2. Analyze the characteristics of a linear system with Eigen values and Eigenvectors.
3. Implement various matrix decomposition techniques to solve the given system.
4. Analyze the linear dependence and compute the basis and dimension of vector spaces.
5. Analyze the systems through the techniques of Inner product space.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	1	3												
3	2	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

MATRICES

Types of matrices- Matrix operations -Determinants-Orthogonal Matrices-Block Matrices-Rank of a matrix-Solution of Linear system: Matrix inversion method-Rank method-Consistency of system.

UNIT II **9 Hours**

DIAGONALIZATION

Characteristics equation(including Block matrices)-Cayley- Hamilton theorem-Diagonalization-Algebraic and Geometric Multiplicity-Minimal polynomial(including Block matrices)-Characteristic and minimal polynomial of Block Matrices-Iterative method: Eigen values and Eigen vectors by power method.

UNIT III **9 Hours**

MATRIX DECOMPOSITIONS

Nature of Matrices-Echelon matrices-Row canonical form-Gauss elimination method-Gauss Jordan method-Single value decomposition -LU decomposition.

UNIT IV **9 Hours**

VECTOR SPACES

Vector spaces-subspaces-Linear combinations-Spanning sets-Linear dependence and independence -Basis and Dimensions -Rank and nullity.

UNIT V **9 Hours**

INNER PRODUCT SPACES

Inner product spaces-Vector norms -Cauchy -Schwarz inequality -Orthogonality-Gram -Schmidt orthogonalization -QR decomposition.

Total: 45 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 2017.
3. Lloyd N. Trefethen, David Bau III, Numerical Linear Algebra,Society for Industrial and Applied Mathematics, 1997.
4. James W. Demmel, Applied Numerical Linear Algebra, The Orient Blackswan, 1st Edition,2017.
5. Gilbert Strang, Introduction to linear algebra, Fifth Edition, ANE Books, 2016.

22AM402 Data Structures II 3 0 2 4

Course Objectives

- Understand and use the various major modern data structures like Trie, Rope, Segment tree and Octree.
- Apply the graph data structure and tree traversal algorithms for solving real time problems.
- Analyze the performance of algorithm design techniques with different data structures

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Implement the Trie data structure and its basic search operations
2. Outline the traversal algorithm and its types with graph data structure
3. Implement Minimum Spanning tree algorithms and analyze their performance
4. Design and implement different problems using the backtracking and branch and bound techniques and analyze the time complexities of them
5. Implement modern data structures like Segment tree, Quadtree and Octree for real world applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2						2	2		
2	2	2	2	2	2						2	2		
3	2	3	3	2	2						2	2		
4	3	3	3	3	2						3	3		
5	3	2	3	3	3						3	3		

UNIT I **9 Hours**

TRIE DATA STRUCTURES

Trie Structure - Types - Prefix-Based Search - Space Efficiency - Time Complexity - Compact Tries - Applications - Suffix Array and Suffix Tree - Rope

UNIT II **9 Hours**

GRAPH

Graph representation - Breadth-first traversal - Depth-first traversal - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra"s Algorithm - Travelling Salesman Problem - Analysis of shortest path algorithms.

UNIT III **9 Hours**

GRAPH MST

Minimum Spanning Tree: Prim"s Algorithm - Kruskal"s Algorithm- Disjoint-Set Union (Union-Find) - A* algorithm - Flood filling algorithm - Analysis of MST algorithms.

UNIT IV **9 Hours**

ALGORITHM DESIGN TECHNIQUES

NP Complete problems- Backtracking: N-Queens Problem and Subset-Sum problem - Branch and bound: Knapsack problem - Approximation algorithms for NP hard problems: Traveling salesman - P, NP, NP-Complete and NP-Hard Problems

UNIT V **9 Hours**

MODERN DATA STRUCTURES

Segment Tree - Interval Tree - Fenwick Tree - K-D Tree - Quadtree and Octree - Circular Buffer (Ring Buffer) - Marshaling / Unmarshalling - JSON - benefits - Schema - limitations - Protobuf.

1 **4 Hours**

EXPERIMENT 1

Implement a Trie data structure and perform prefix based search

2 **4 Hours**

EXPERIMENT 2

For a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstras algorithm.

3 **4 Hours**

EXPERIMENT 3

Find Minimum Cost Spanning Tree of a given undirected graph using Kruskals algorithm.

4 **6 Hours**

EXPERIMENT 4

Implement the Flood fill algorithm for replacing the color from the source row to source column in 2D array.

5 **4 Hours**

EXPERIMENT 5

Implement N Queen's problem using Backtracking.

6 **4 Hours**

EXPERIMENT 6

Construct a segment tree for computing sum of the elements in a given range.

7 **4 Hours**

EXPERIMENT 7

Implement a Quad tree for locating a node in the given quad.

Total 45+30 : 75 Hours

Reference(s)

1. Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley publications, 2013.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,2016.
3. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010.
5. Reema Thareja, Data Structures Using C, Second Edition , Oxford University Press, 2011

22AM403 Operating Systems 3 1 0 4

Course Objectives

- Establish a solid foundation in the introductory concepts of operating systems and gain insights into the structures, services, and roles of operating systems in computing environments
- To apply process scheduling algorithms in a multi-programming environment and implement the various deadlock strategies effectively to prevent each other from accessing the computer resources
- To gain knowledge on the operations of memory management and File management.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Analyze the basic structure and architectural components of the operating system and interpret how application programs interact with the operating system through APIs.
2. Apply the various scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
3. Analyze memory allocation and deallocation mechanisms involved in memory management for a specific system.
4. Apply the various file handling strategies to manage files on a secondary storage structure and in a distributed environment.
5. Analyze the virtualization technologies and their types to simulate hardware functionality and create a virtual computer system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2			2		2		2	2	1	
2	3	3	2	2	3		2		2			2	1	
3	2	2	2				2		2			2	1	
4	2	2	2		3		2		2			2	1	
5	2	2	2						2				1	

UNIT I **8 Hours**

INTRODUCTION TO OPERATING SYSTEMS

Basic Operating System Concepts - Operating System Structure and Components - Operating System Services and Interfaces - Role of the Kernel and User Space - System calls and System Programs - Open Source and Closed source operating systems.

UNIT II **12 Hours**

PROCESS MANAGEMENT

Processes and Threads - Process Scheduling and CPU Scheduling Algorithms - Process Synchronization and Concurrency Control - Deadlocks and Handling Strategies - Inter-Process Communication (IPC) - Multi-Core and Multi-Processor Management.

UNIT III **9 Hours**

MEMORY MANAGEMENT

Memory Hierarchy - Address Spaces and Memory Allocation - Paging and Segmentation - Page Replacement Algorithms - NUMA (Non-Uniform Memory Access) - Memory Compression - Memory Tiering.

UNIT IV **8 Hours**

FILE SYSTEM DESIGN AND AND IMPROVEMENTS

File System Structures - Storage Technologies - SSD and Flash Storage Optimization - Copy-on-Write (CoW) File Systems - File System Journaling - Distributed File Systems and Cloud Storage - File System Monitoring and Analytics.

UNIT V **8 Hours**

VIRTUALIZATION AND RECENT DEVELOPMENTS

Virtualization Principles and Types (Hardware, Software, Network, Storage) - Hypervisors and Virtual Machine Monitors - Microkernels and Exokernels - Security and Integrity in Virtualized Environments - Security in Operating Systems - Operating Systems for Quantum Computers - Cross-Platform Compatibility.

Total: 45+15: 60 Hours

Reference(s)

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015
2. Andrew S. Tanenbaum, Modern Operating Systems, Fourth Edition, Prentice Hall of India Pvt. Ltd, 2014
3. William Stallings, Operating System, Seventh Edition Prentice Hall of India, 2012
4. Harvey M. DeitelM, Operating Systems, Pearson Education Pvt. Ltd, 2007.
5. Distributed file system for cloud: A Clear and Concise Reference Kindle Edition by Gerardus Blokdyk
6. https://www.redhat.com/en/topics/virtualization.

22AM404 Web Technology and Frameworks **2 0 2 3**

Course Objectives

- Understand the Web Application Architectures and trace the evolution of the web and introduce concepts like Web 3.0 and Decentralized Web.
- Familiar with the different Web development Frameworks and Full stack development.
- Explore the emerging web technologies and implement best practices for making web applications accessible to all users

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Analyze the architecture of various web applications and develop simple use cases for the real time web applications
2. Implement web applications using client-side scripting language and server-side scripting languages.
3. Integrate the web applications with databases using Web frameworks.
4. Develop a complete, functional web application that incorporates both front-end and back-end components.
5. Implement the emerging web technologies in web application development projects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2						2	2	1	
2	2	2	2	2	2						2	2	1	
3	2	3	3	2	2						2	2	1	
4	2	3	3	3	3						3	3	1	
5	2	2	3	3	3						3	3	1	

UNIT I **5 Hours**

INTRODUCTION TO WEB APPLICATIONS

Evolution of the web - Understanding Web Application Architectures: Server Side Rendered Applications- Single Page Application SPA - Mobile Application Development- comparison of Monolithic and Microservice architectures - Serverless computing - HTTP Protocol and Methods - Web Browsers and Rendering Engines - Use cases of various web applications, including Flipkart, BIT Discourse, BIP, Wiki and Moodle.

UNIT II **7 Hours**

SCRIPTING LANGUAGES

Client-side Scripting vs Server-Side Scripting - Client-side Scripting -Execution Location - Languages: JavaScript Fundamentals-Document Object Model (DOM). Server-Side Scripting: Execution Location - Language(s) - PHP Programming fundamentals.

UNIT III **6 Hours**

WEB DEVELOPMENT FRAMEWORKS

Introduction to Web Development Frameworks - MVC Architecture - Building APIs with a Framework - RESTful APIs and API Design - Building a RESTful API-Database Integration with ORM/ODM -Building a Basic Front-End Application

UNIT IV **6 Hours**

FULL STACK DEVELOPMENT

Full-Stack Development - Combining Front-End and Back-End Technologies - Building a Full-Stack Web Application- 12 factor application model-Deployment and Hosting Options - Continuous Integration and Continuous Deployment (CI/CD) - Performance Optimization and Scalability.

UNIT V **6 Hours**

EMERGING WEB TECHNOLOGIES

Emerging Web Technologies-Progressive Web Apps PWAs -WebAssembly and WebRTC - Web Security Best Practices-Open Web Application Security Project OWASP-Web Accessibility and Inclusive Design-Web Performance Optimization.

1 **3 Hours**

EXPERIMENT 1

Create a simple HTML page and use the browsers developer tools to inspect and manipulate elements.

2 **3 Hours**

EXPERIMENT 2

Write JavaScript to validate the following fields of the Registration page.
a) First Name (Name should contains alphabets and the length should not be less than 6 characters).
b) Password (Password should not be less than 6 characters length).
c) E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)
d) Mobile Number (Phone number should contain 10 digits only).
e) Last Name and Address (should not be Empty).

3 **3 Hours**

EXPERIMENT 3

Develop a multi-page website using HTML and CSS and apply responsive design techniques to make the site mobile-friendly.

4 **3 Hours**

EXPERIMENT 4

Develop a QR code generator using PHP and connect to a database to store and retrieve data.

5 **3 Hours**

EXPERIMENT 5

Developing a Simple Web Application using a server-side framework (e.g., Flask, Django, or Ruby on Rails) and apply security measures to protect against common web vulnerabilities

6 **4 Hours**

EXPERIMENT 6

Create a single-page application (SPA) using the front-end framework e.g., React, Angular, or Vue.js and implement routing and state management.

7 **3 Hours**

EXPERIMENT 7

Develop a RESTful API using a back-end framework (e.g., Node.js or Express), perform the CRUD operations and Test the API using tools like Postman

8 **4 Hours**

EXPERIMENT 8

Create a full-stack web application to implement user authentication and authorization connected to a database to store and retrieve data for the application

9 **4 Hours**

EXPERIMENT 9

Deploy a web application in a hosting platform (e.g., Heroku, AWS, or Azure) and set up a continuous integration and continuous deployment (CI/CD) pipeline to monitor the deployed application for performance and errors.

Total: 30+30: 60 Hours

Reference(s)

1. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education,2009.
2. James Gillies and Robert Cailliau, How the Web Was Born: The Story of the World Wide Web, 2000
3. D Crockford , The Good Parts, O Reilly , 2009
4. Mark Masse , REST API Design Book,O Reilly,2011
5. Matti Luukkainen and Jarkko Moilanen , Fullstack Open: Deep Dive Into Modern Web Development"
6. Michal Zalewski , The Tangled Web: A Guide to Securing Modern Web Applications" 2011

22AM405 Database Management System 3 0 2 4

Course Objectives

- Analyze the data models, conceptualize and Design a database system using E-R diagrams
- Gain knowledge on the design principles of relational and modern database systems like SQL, NoSQL and NewSQL
- Impart knowledge in transaction processing, concurrency control and recovery techniques.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Analyze the data models and the types of data used in databases.
2. Implement SQL queries for creating databases and performing the relational operations.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes.
5. Analyze the performance of NoSQL and NewSQL databases related to design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2						2	2	1	
2	2	2	2	2	2						2	2	1	
3	2	3	3	2	2						2	2	1	
4	3	3	3	3	2						3	3	1	
5	3	2	3	3	3						3	3	1	

UNIT I **8 Hours**

INTRODUCTION TO DATABASES AND DBMS

Understanding Data and Information - Database vs DBMS - Modern Databases - DBMS Architecture and Components - Data Models - Relational Model - Codd's 12 Rules - Object-Relational Mapping ORM.

UNIT II **10 Hours**

STRUCTURED QUERY LANGUAGE (SQL)

SQL Basic Commands - Constraints - Database Objects - SQL Functions - Subqueries- Correlated Subqueries- Nested subqueries - Recursive queries - Common Table Expressions CTEs- Triggers and Stored procedures

UNIT III **9 Hours**

DATABASE DESIGN AND NORMALIZATION

Database Design fundamentals - Entity-Relationship Diagrams (ERD) - ERD to tables - Functional Dependencies and Normal Forms: 1NF, 2 NF, 3 NF, BCNF, 4 NF, 5NF and 6 NF - Domain-Key Normal Form DKNF - Nested Normal Form NNF - Denormalization and Trade-offs - Emerging trends in Database Design - Dealing with real-world complexities in Database Design- CASE Tools for Database Design.

UNIT IV **9 Hours**

QUERY OPTIMIZATION AND TRANSACTION MANAGEMENT

Query Optimization and Execution Plans-Optimization Visualization Tool-DB Sharding-Vitess-Vitess vs MySQL-Table partitioning-Transaction Management and ACID Properties-Concurrency Control-Lock based protocols-Deadlock handling-Multi version concurrency control MVCC-Transaction isolation.

UNIT V **9 Hours**

NOSQL AND NEWSQL DATABASES

NoSQL Vs NewSQL- NoSQLDatabases-MongoDB and Cassandra - NewSQL databases-Redis and NuoDB - Selection of NoSQL or NewSQL over RDBMS - CAP Theorem and BASE Properties - HeidiSQL - In-Memory Databases and Caching - Database Security and Encryption - Database Performance Tuning

1 **4 Hours**

EXPERIMENT 1

Create a simple relational database with tables and write SQL queries for basic CRUD operations (Create, Read, Update, Delete).

2 **3 Hours**

EXPERIMENT 2

Create multiple tables and perform Database Querying - Simple queries, Nested queries, Sub queries, Joins and views

3 **3 Hours**

EXPERIMENT 3

Create a database with multiple tables. Add constraints (e.g., primary key, foreign key, check constraints) to database tables. Create indexes for performance optimization. Implement triggers to automate actions based on data changes.

4 **3 Hours**

EXPERIMENT 4

Design an ERD for a simple database schema. Normalize the schema to eliminate redundancy and improve data integrity.

5 **3 Hours**

EXPERIMENT 5

Implement the normalized schema in the RDBMS and populate it with sample data.

6 **3 Hours**

EXPERIMENT 6

Install and set up a NoSQL database (e.g., MongoDB). Write queries to insert, update, and query data in MongoDB.

7 **4 Hours**

EXPERIMENT 7

Set up a distributed database cluster using open-source tools (e.g: Apache Cassandra). Store and retrieve data in a distributed environment.

8 **4 Hours**

EXPERIMENT 8

Implement in-memory caching using technologies (Redis) and measure the performance improvements achieved through caching.

9 **3 Hours**

EXPERIMENT 9

Implement access control and user authentication in an RDBMS. Encrypt sensitive data at rest and in transit

Total:45+30: 75 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw -Hill, Sixth Edition, 2018
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems,Pearson Education, Seventh Edition, 2016
3. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, Ninth edition, 2011
4. Guy Harrison , Next Generation Databases: NoSQLand Big Data, Apress.

22HS007 Environmental Science **2 0 0 0**

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Show the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Demonstrate the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Assess the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Compare the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer - pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources - renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - Water pollution - Sewage water treatment by activated sludge and trickling filter process - Noise pollution - Thermal pollution. Disaster management - causes - effects - control measures of floods – Earthquake.

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development - Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles - landfills, incineration, composting. Water conservation - rain water harvesting - watershed management. Climate change - Global warming - acid rain - Ozone layer depletion. E-waste

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering, 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P. H. Hassenzahl, D.M. & Berg, L.R. 2012. Environment, 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I. L, Gerba, C. P. & Brusseau, M. L. 2011, Environmental and Pollution Science, Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014

22HS008 Advanced English and Technical Expression

0 0 2 1

Course Objectives

- To enable students to achieve proficiency in academic writing
- effectively use the language to persuade others
- appreciate the nuances of the language and engage an audience
- use advanced tools of language to improve communicative competence
- prepare for professional demands at the workplace
- give concrete expression to the plans and goals

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

Course Outcomes (COs)

1. Understand the clarity in articulating the objectives and aims and improved proficiency in using the English language
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyze a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I
CREATIVE EXPRESSION **15 Hours**

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: ‘Why should we hire you?' Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, wordplay

UNIT II
FORMAL EXPRESSION **15 Hours**

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning - SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace & L.Ann Masters, Cengage Learning, New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd. 1990, Delhi
6. English Grammar, Composition and Usage by N. K. Agrawal & F. T. Wood, Macmillan India Ltd., New Delhi

22AM501 Artificial Intelligence 3 0 2 4

Course Objectives

- Understand the fundamental concepts of artificial intelligence
- Impart the different paradigms in knowledge representation and reasoning
- Determine the problems to solve using artificial intelligence and machine learning

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

Course Outcomes (COs)

1. Understand the awareness of intelligent agents and problem solving using uninformed, informed and local search methods
2. Identify the knowledge representation and reasoning techniques in logic programming
3. Implement the use of planning and simple decision making
4. Apply and integrate various artificial intelligence techniques in intelligent system development
5. Summarize the basic features of JADE and develop simple programs using it

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			1	1							1	2
2	2	2	2		1	1							1	2
3	2		2		2	1							1	
4	2	2	2	2	1	1							1	
5	1	2	2	2	1	1							1	

UNIT I **9 Hours**

INTRODUCTION

Intelligent Agents - Agents and environments - Good behavior - The nature of environments - Structure of agents - Problem Solving - Problem solving agents- Uniformed search strategies - Avoiding repeated States-Searching with partial information.

UNIT II **9 Hours**

SEARCHING TECHNIQUES

Informed search and exploration - Informed search strategies - heuristic function - Local search algorithms and optimization problems- Local search in continuous spaces - Online search agents and unknown environments - Constraint satisfaction problems (CSP)-Backtracking search and Local search for CSP.

UNIT III **9 Hours**

KNOWLEDGE REPRESENTATION

First order logic - Representation revisited - Syntax and semantics for first order logic - Using first order logic - Knowledge engineering in first order logic - Inference in First order logic - Prepositional versus first order logic - Unification and lifting - Forward chaining - Backward Chaining-Ontological Engineering.

UNIT IV **9 Hours**

PLANNING

Planning problem- Planning with state space search - Partial order planning - Planning graphs - Planning with proportional logic - Time, Schedules, and Resources - Hierarchical Task Planning - Conditional Planning - Execution monitoring and re planning-Continuous planning

UNIT V **9 Hours**

LEARNING

Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning - Logical formulation of learning - Explanation based learning -Learning using relevant Information-Statistical Learning Methods - AI Governance

1 **4 Hours**

EXPERIMENT 1

Implement the Logic Programming for solving N-Queen problem

2 **4 Hours**

EXPERIMENT 2

Implement the Logic Programming for solving Zebra puzzle

3 **4 Hours**

EXPERIMENT 3

A magic square is an arrangement of distinct numbers, generally integers, in a square grid, where the numbers in each row, and in each column, and the numbers in the diagonal, all add up to the same number called the magic constant. Implement Heuristic Search to generate Magic square

4 **6 Hours**

EXPERIMENT 4

Build a Bot to Play Tic Tac Toe gaming problem

5 **6 Hours**

EXPERIMENT 5

Implement Bayes Inference Rule to a problem of drug screening (mandatory testing for federal or many other jobswhich promise a drug-free work environment). Suppose that a test for using a particular drug is 97%sensitive and 95% specific. That is, the test will produce 97% true positive results for drug users and 95%

truenegative results for non-drug users. These are the pieces of data that any screening test will have from their historyof tests. Bayes' rule allows us to use this kind of data-driven knowledge to calculate the final probability.

6 **6 Hours**

EXPERIMENT 6

Harry installed a new burglar alarm at his home to detect burglary. The alarm reliably responds at detecting a burglary but also responds for minor earthquakes. Harry has two neighbors David and Sophia, who have taken a responsibility to inform Harry at work when they hear the alarm. David always calls Harry when he hears the alarm, but sometimes he got confused with the phone ringing and calls at that time too. On the other hand, Sophia likes to listen to high music, so sometimes she misses to hear the alarm. Here we would like to compute the probability of Burglary Alarm. Calculate the probability that alarm has sounded, but there is neither a burglary, nor an earthquake occurred, and David and Sophia both called the Harry using Bayes Belief Networks

Total:45+30:75 Hours

Reference(s)

1. Stuart Russell and Peter Norvig, Artificial Intelligence - A Modern Approach, Prentice Hall India, 2012
2. Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw-Hill, 1997.
3. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill, 2010.
4. M. Tim Jones, Artificial Intelligence: A Systems Approach, Jones and Bartlett Publisher, 2010.
5. Fabio Bellifemine, Giovanni Caire, Dominic Greenwood, Developing Multi agent Systems with JADE, John Wiley and Sons Ltd, 2007.

22AM502 Machine Learning **3 0 2 4**

Course Objectives

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques
- To understand graphical models of machine learning algorithms

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Provide solution for regression approaches in real-world applications
2. Apply data preprocessing techniques for modelling
3. Choose an appropriate classification technique to analyze the data
4. Choose an appropriate clustering technique to solve real world problems
5. Apply Graph models to reduce the dimension of the dataset used in machine learning algorithms.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			1	1						1	1	2
2	2	2	2		1	1						1	1	2
3	2		2	2	1	1						1	1	1
4	2	2	2	2	1	1						1	1	
5	1	2	2	2	1	1						1		

UNIT I **9 Hours**

INTRODUCTION

Learning - Types of Machine Learning - Supervised -Unsupervised Learning - Relationship between attributes using Covariance and Correlation-Relationship between multiple variables- Regression -Linear-Multivariate in prediction.

UNIT II **9 Hours**

DATA PREPROCESSING

Data Objects and attribute types - Basic statistical description of data - Data visualization - Measuring data similarity and dissimilarity - Data cleaning - Integration - Data reduction - Data transformation and data discretization.

UNIT III **9 Hours**

CLASSIFICATION

Naive Bayes Classifier -Model Assumptions, Probability Estimation-Required data processing M-estimates, Feature selection- -K-Nearest Neighbor algorithm- Aspects to consider while designing K-Nearest Neighbor-Support Vector Machines-Linear learning machines and Kernel space, Making Kernels and working in feature space-Decision Trees- ID4, C4.5, CART.

UNIT IV **9 Hours**

CLUSTERING

Distance Measures-Different clustering methods -Distance-Density-Hierarchical-Iterative distance-based clustering-Dealing with continuous, categorical values in K-Means-Constructing a hierarchical cluster-K-Medoids, k-Mode and density-based clustering-Measures of quality of clustering.

UNIT V **9 Hours**

GRAPHICAL MODELS

Markov Chain Monte Carlo Methods - Sampling - Proposal Distribution - Markov Chain Monte Carlo - Graphical Models - Bayesian Networks - Markov Random Fields - Hidden Markov Models - Tracking Methods

1 **5 Hours**

EXPERIMENT 1

Implement and demonstrate the Liner Regression algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a.CSV file.

2 **5 Hours**

EXPERIMENT 2

For a given set of training data examples stored in a .CSV file, implement and demonstrate the Multivariate Regression algorithm to output a description of the set of all hypotheses consistent with the training examples

3 **5 Hours**

EXPERIMENT 3

Write a program to demonstrate the working of the Naive Bayes Classification algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4 **5 Hours**

EXPERIMENT 4

Write a program to demonstrate the working of the K Nearest Neighbor algorithm. Use an appropriate data set to apply classification technique.

5 **5 Hours**

EXPERIMENT 5

Write a program to demonstrate the working of the Support Vector Machines algorithm. Use an appropriate data set to apply classification technique.

6 **5 Hours**

EXPERIMENT 6

Write a program to demonstrate the working of the K-Means algorithm. Use an appropriate data set to apply clustering technique.

Total: 45+30:75 Hours

Reference(s)

1. Peter Flach - Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
2. Jason Bell-Machine learning - Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014
3. Ethem Alpaydin - Introduction to Machine Learning 3e Adaptive Computation and Machine Learning Series, Third Edition, MIT Press, 2014
4. Jiawei Han, Micheline Kamber and Jian Pai , Data Mining: Concepts and Techniques, Morgan Kauffman, 2013.

22AM503 Big Data Technologies 3 0 0 3

Course Objectives

- Understand the basic ideas of Big Data
- Analyze the HDFS mechanism for handling Big Data
- Analyze Hadoop related tools for data integration

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.

Course Outcomes (COs)

1. Demonstrate the concepts and applications of big data
2. Create and Manage data using NoSQL databases.
3. Develop the basic idea of the Hadoop and HDFS
4. Implement programs using Map reduce concepts
5. Design machine learning techniques to resolve the issue by Hadoop related tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1		2	2	1						1	1	
2	2	2		2	3	1						1	1	
3	2	2		2	2	1						1	1	
4	2	2	2	2	3	1						1	1	
5	2	2	3	2	2	1						1	1	

UNIT I **10 Hours**

UNDERSTANDING BIG DATA

Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System, Grid Computing, Volunteer Computing- unstructured data - industry examples of big data.

UNIT II **7 Hours**

BASICS OF HADOOP

Data format - analyzing data with Hadoop-scaling out-Hadoop streaming- Hadoop pipes- design of Hadoop distributed file system (HDFS)- HDFS concepts--compression-serialization

UNIT III **8 Hours**

MAP REDUCE APPLICATIONS

MapReduce workflows - unit tests with MR Unit -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 IV **10 Hours**

NOSQL DATA MANAGEMENT

Introduction to NoSQL- aggregate data models- aggregates -key-value and document data models -relationships-graph databases-schema less databases-materialized views-distribution models -sharding -version - Map reduce-partitioning and combining -composing map-reduce calculations.

UNIT V **10 Hours**

HADOOP RELATED TOOLS

Hbase- data model and implementations- Hbase clients - Hbase examples -praxis. Cassandra-cassandra data model- cassandra examples- cassandra clients -Hadoop integration. Hive - data types and file formats -HiveQL data definition- HiveQL data manipulation -HiveQL queries.

FOR FURTHER READING

Cloud and big data - mobile business intelligence - Crowd sourcing analytics - inter and Trans firewall analytics

Total: 45 Hours

Reference(s)

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O"Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O"Reilley, 2012.
3. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013
4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O"Reilley, 2012.
5. Alan Gates, "Programming Pig", O"Reilley, 2011.

22AM504 Cloud Computing **3 0 2 4**

Course Objectives

- To provide the ideal solution to manage enterprise resources effectively and efficiently by cloud computing.
- Identify the security and privacy issues in cloud computing.
- To develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Outline the concept of virtualization in Cloud Computing.
2. Deploy applications over different Cloud computing infrastructures. 3. Implement Cloud Dockers to automate the deployment of applications. 4. Identify the security and privacy issues in cloud computing. 5. Implement the cloud applications to solve real time problems.
3. Implement Cloud Dockers to automate the deployment of applications.
4. Identify the security and privacy issues in cloud computing.
5. Implement the cloud applications to solve real time problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		1		1						1	2	
2	2	2		1		1						1	2	
3	3	3	3	1	3	1						1	2	
4	3	3	2	1	2	1						1	2	
5	3	3	3	1	3	1						1	2	

UNIT I **9 Hours**

INTRODUCTION

Introduction to Cloud Computing -Characteristics and Benefits of Cloud Computing- Hardware and software - Evolution of cloud computing - Server virtualization: parallel and vector processing.

UNIT II **9 Hours**

CLOUD SERVICE MODELS

Software as a Service (SaaS) - Infrastructure as a Service (IaaS)- Platform as a Service (PaaS) - Cloud Data Center - Service Oriented Architecture (SoA) - Basic approach to a Data center Based SoA.

UNIT III **9 Hours**

CLOUD DOCKER

Introduction - Docker Architecture - Docker Engine - Docker Containers - Docker Objects - Docker Run - Pipeline - Automation Scripts.

UNIT IV **9 Hours**

CLOUD SECURITY

Securing cloud boundary - Service boundary - Security mapping - Brokered cloud storage access - Storage location and tenancy - Encryption - Establishing the Identity and Presence.

UNIT V **9 Hours**

CLOUD APPLICATIONS

Applications in the cloud - Functionality mapping - Applications attributes - Cloud APIs-Cloud storage definition - Managed and Unmanaged cloud storage - Exploring cloud backup solutions - Cloud storage interoperability.

1 **4 Hours**

EXPERIMENT 1

Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows

2 **4 Hours**

EXPERIMENT 2

Install a C compiler in the virtual machine created using virtual box and execute Simple Programs

3 **4 Hours**

EXPERIMENT 3

Implement the procedure to transfer the files from one virtual machine to another virtual machine for reliable data access with the help of any open stack virtual machine

4 **4 Hours**

EXPERIMENT 4

Install the single node private cloud environment to resource allocation

5 **4 Hours**

EXPERIMENT 5

Implement the procedure to create and deploy a simple web application in public cloud environment

6 **4 Hours**

EXPERIMENT 6

Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim

7 **3 Hours**

EXPERIMENT 7

Create and Deploy applications on Microsoft Windows Azure

8 **3 Hours**

EXPERIMENT 8

Install Hadoop single node cluster and run simple applications like word count.

Total:45+30:75 Hours

Reference(s)

1. Rittinghouse, John W., and James F. Ransome, - Cloud Computing: Implementation, Management and Security, CRC Press, 2017
2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India,2014.
3. Adrian Mouat- Using Docker: Developing and Deploying software with containers ,O Reilly Media,2016.
4. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O"Reilly, 2009., CRC Press, 2017
5. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, - Mastering Cloud Computing, Tata Mcgraw Hill, 2013
6. IBM Cloud Computing http://www.ibm.com/cloud-computing/us/en/

22AM507 Mini Project I **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analyzing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. Modern tool usage: Create, select, and apply appropriatete chniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

j. 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.

k. 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.

m. Apply suitable algorithmic thinking and data management practices to design develop, and evaluate effective solutions for real-life and research problems.

n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost effectiveness.
5. Prepare the report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2			2	2	2			1	1
2	1	2	1	1	2			2	2	2			1	1
3	1	2	1	1	2			2	2	2	2		1	1
4	1	2	1	1	2			2	2	2	2		1	1
5	1	2			2			2	2	2			1	1

22AM601 Natural Language Processing 3 0 0 3

Course Objectives

- Apply basic mathematical models and methods in NLP applications to formulate computational solutions.
- Analyze the syntax and semantics of natural languages.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the fundamental mathematical models and algorithms in the field of NLP.
2. Illustrate the logistic regression for classification and sentiment analysis.
3. Implement semantic parsing for measuring word semantics and evaluation.
4. Apply the principles of language resource annotation to annotate the data.
5. Implement the NLP to solve the real world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	1									2	
2	3	2	2	2	2							1	2	
3	3	2	2	2	2							1	3	
4	3	2	2	2	2								3	
5	3	2	2	1	2							1	3	

UNIT I **9 Hours**

INTRODUCTION

Introduction - Regular Expressions,Words - Text Normalization, Minimum Edit Distance,N-gram Language Models - Evaluating Language Models,Sampling sentences from a language model,Smoothing.

UNIT II **9 Hours**

SENTIMENT CLASSIFICATION AND LOGISTIC REGRESSION

Naive Bayes Classifiers - Optimizing for Sentiment Analysis - Evaluation: Precision, Recall, F- measure - Logistic Regression: Classification with Logistic Regression - Multinomial logistic regression - Learning in Logistic Regression - The cross-entropy loss: Gradient Descent - Regularization.

UNIT III **9 Hours**

SEMANTIC PARSING

Lexical Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity - TF-IDF: Weighing terms in the vector - Pointwise Mutual Information - Word2vec - Visualizing Embeddings - Bias and Embeddings - Evaluating Vector Models

UNIT IV **9 Hours**

ANNOTATING LINGUISTIC STRUCTURE

Context-Free Grammars and Constituency Parsing Context-Free Grammars-Treebanks-Grammar Equivalence and Normal Form-Ambiguity -Span-Based Neural Constituency Parsing -Evaluating Parsers-Dependency Parsing Dependency Relations-Transition-Based Dependency Parsing -Graph-Based Dependency Parsing -Evaluation.

UNIT V **9 Hours**

NLP APPLICATIONS

Machine Translation Language Divergences and Typology-Machine Translation using Encoder-Decoder-Translating in low-resource situations-MT Evaluation-Question Answering and Information Retrieval Information Retrieval-IR-based Factoid Question Answering-Entity Linking-Knowledge-based Question Answering-Using Language Models to do QA.

Total: 45 Hours

Reference(s)

1. Daniel Jurafsky, James H. Martin-Speech and Language Processing An Introduction to natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2023.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 2018
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, OReilly Media 1 edition, 2009
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

22AM602 Computer Vision 3 0 2 4

Course Objectives

- Understand the algorithms and techniques used in image formation.
- Implement the motion computation and 3D vision to generate 3-dimensional images of an object.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the image processing techniques for computer vision.
2. Implement the boundary tracking techniques to detect semantic boundaries.
3. Compute Hough Transform for line, circle and ellipse detections.
4. Demonstrate 3D vision and motion related techniques.
5. Apply the computer vision to solve the real-world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1			1						1	2	1
2	2	3	2		3	1						1	3	1
3	2	2	2		2	1						1	3	1
4	2	3	3		3	1						1	3	1
5	2	3	3	2	3	1						1	3	

UNIT I **9 Hours**

FOUNDATIONS OF IMAGE PROCESSING

Images and Image Operations-Classical Filtering Operations-Thresholding Techniques-Edge Detection Techniques-Corner and Interest Point Detection-Mathematical morphology-Texture.

UNIT II **9 Hours**

SHAPES AND REGIONS

Binary Shape Analysis-Connectedness-Object Labeling and Counting-Size Filtering-Distance Functions-Skeletons and Thinning-Deformable Shape Analysis-Boundary Pattern Analysis- Boundary Tracking Procedures-Centroidal Profiles-Tackling the Problems of Occlusion-Boundary Length Measures.

UNIT III **9 Hours**

HOUGH TRANSFORM

Design Concepts - Modular design - Design heuristic - Design model and document - Architectural design - Software architecture - Data design - Transform and transaction mapping - User interface design - Component level Design: Designing Class based components, traditional Components-Introduction to Design Pattern

UNIT IV **9 Hours**

MOTION ESTIMATION

Methods for 3D vision-projection schemes for 3D vision-Three-Dimensional Object Recognition Schemes-Image Transformations and Camera Calibration-Image Rectification-Introduction to motion-triangulation-bundle adjustment-translational alignment -parametric motion-spline-based motion-optical flow-layered motion.

UNIT V **9 Hours**

3D RECONSTRUCTION AND APPLICATIONS

Shape from X-Active Range Finding-Surface Representations-Point-Based Representation-Model-Based Representation-Recovering Texture Maps and Albedos-Emotion Recognition-Gesture Recognition-Face Detection-Biometrics Augmented Reality-Stitching and document processing.

1 **3 Hours**

EXPERIMENT 1

Detect the shape and label the name of the shape in images.

2 **3 Hours**

EXPERIMENT 2

Remove the noise in image using noise removal algorithms.

3 **3 Hours**

EXPERIMENT 3

Detect the edges of an object using Edge detection algorithm.

4 **3 Hours**

EXPERIMENT 4

Build the own lane detection system for indicating the traffic flow, where a vehicle should drive using Perspective projection.

5 **3 Hours**

EXPERIMENT 5

Detect the corners of an object using corner detection algorithm.

6 **3 Hours**

EXPERIMENT 6

Detect the particular color from the image.

7 **3 Hours**

EXPERIMENT 7

Recognize the hand gestures in video streams.

8 **6 Hours**

EXPERIMENT 8

Detect if this is a Face or not and further recognize whose face is it.

9 **3 Hours**

EXPERIMENT 9

Classify the vehicles on the road and count the number of vehicles that travel through a road.

Total:45+30:75 Hours

Reference(s)

1. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
2. R. Szeliski, Computer Vision: Algorithms and Applications, Springer 2011.
3. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
4. David A. Forsyth, Jean Ponce, Computer Vision a Modern Approach, Pearson, 2012.

22AM603 Deep Learning 3 0 2 4

Course Objectives

- To understand the basic ideas and principles of neural networks.
- To enable the students to know deep learning techniques to support real-time application

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Illustrate the fundamental principles of Neural Networks and Deep Learning.
2. Build the CNN model to improve the performance in the classification problems
3. Design the Recurrent Neural Network to model the sequence data.
4. Implement deep generative models to solve problems with high dimensional data.
5. Implement deep learning applications for solving real-time problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2									1	2	1
2	2	3	3	3	3							1	2	1
3	2	3	3	3	3							1	3	
4	2	3	3	3	3							1	3	
5	2	3	3	3	3							1	3	

UNIT I **9 Hours**

FOUNDATIONS OF NEURAL NETWORKS AND DEEP LEARNING

Neural Networks Perceptron - Multilayer Feed Forward Networks -Training in Neural Networks Back propagation Learning-Common Architectural Principles of Deep Networks Layers-Activation Functions-Loss Functions .

UNIT II **9 Hours**

CONVOLUTIONAL NEURAL NETWORKS

Introduction to CNN-Layers-Filters-Weight and Bias-Epoch and Batch Size-Data Augmentation-Parameter sharing-Regularization -Popular CNN Architectures-ResNet,AlexNet.

UNIT III **9 Hours**

RECURRENT NEURAL NETWORKS

Recurrent Neural Networks-Bidirectional RNNs-Encoder-decoder sequence to sequence architectures-Backpropagation through time BPTT for training RNN-Long Short Term MemoryLSTM.

UNIT IV **9 Hours**

AUTOENCODERS

Introduction to Autoencoders-Architecture of Autoencoders-Undercomplete Autoencoders-Regularized Autoencoders-Denoising-Contractive-Predictive Sparse Decomposition-Drawing Samples from Autoencoders-Applications of Autoencoders.

UNIT V **9 Hours**

DEEP GENERATIVE MODELS

Deep Belief networks, Boltzmann Machines-Deep Boltzmann Machine, Generative Adversarial Networks-Case Study Object Detection using CNN-Automatic Image Captioning.

1 **4 Hours**

EXPERIMENT 1

Solve XOR problem using Multilayer perceptron.

2 **4 Hours**

EXPERIMENT 2

Implement character and Digit Recognition using ANN

3 **4 Hours**

EXPERIMENT 3

Develop a code to design object detection and classification for traffic analysis using CNN.

4 **4 Hours**

EXPERIMENT 4

Implement image generation using GAN

5 **4 Hours**

EXPERIMENT 5

Implement LSTM for Anomaly Detection in Time Series.

6 **5 Hours**

EXPERIMENT 6

Implement the dimensionality reduction and Image denoising using autoencoders.

7 **5 Hours**

EXPERIMENT 7

Implement Sentiment Analysis using LSTM.

Total:45+30:75 Hours

Reference(s)

1. Josh Patterson and Adam Gibson, Deep learning: A practitioner"s approach, OReilly Media, First Edition, 2017
2. Ian Good Fellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2017.
3. Simon Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson Prentice Hall.
4. Navin Kumar Manaswi, Deep Learning with Applications Using Python, Apress, 2018.
5. Chao Pan, Deep Learning Fundamentals: An Introduction for Beginners, AI Sciences LLC, 2018.

22AM607 Mini Project II **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analyzing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. 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.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

j. 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.

k. 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.

m. Apply suitable algorithmic thinking and data management practices to design develop, and evaluate effective solutions for real-life and research problems.

n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies

3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2			2	2	2			1	1
2	1	2	1	1	2			2	2	2			1	1
3	1	2	1	1	2			2	2	2	2		1	1
4	1	2	1	1	2			2	2	2	2		1	1
5	1	2			2			2	2	2			1	1

22AM701 Pattern and Anomaly Detection 3 1 0 4

Course Objectives

- To know the fundamental algorithms for pattern recognition
- To instigate the various classification techniques
- To originate the various structural pattern recognition and feature extraction techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Apply various algorithms for pattern classifier and recognition
2. Implement the concepts of Unsupervised classification in pattern recognition
3. Analyze the structural pattern recognition and feature extraction techniques
4. Apply the feature selection and extraction in pattern recognition
5. Create the recent advances of neural network in pattern recognition

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2										1	2	1
2	2	3	3	3	3							1	2	1
3	2	3	3	3	3							1	2	1
4	2	3	3	3	3							1	2	
5	2	3	3	3	3							1	2	

UNIT I **9 Hours**

PATTERN CLASSIFIER

Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayesian parameter estimation - Perception algorithm - LMSE algorithm - Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.

UNIT II **9 Hours**

UNSUPERVISED CLASSIFICATION

Discrete and Binary classification -Techniques to directly obtain linear classifiers - Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm -Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III **9 Hours**

STRUCTURAL PATTERN RECOGNITION

Elements of formal grammars - String generation as pattern description - Recognition of syntactic description - Parsing - Stochastic grammars and applications - Graph based structural representation

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation - Binary feature selection.

UNIT V **9 Hours**

RECENT ADVANCES

Neural network structures for pattern recognition - Neural network based pattern associators -Unsupervised learning in neural pattern recognition - Self organizing networks - Fuzzy logic - Fuzzy pattern classifiers -Pattern classification using Genetic Algorithms.

FOR FURTHER READING

Multilayer, Feed forward Network Structure -Delta Rule -Generalized data rule.

Total 45+15: 60 Hours

Reference(s)

1. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
2. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
3. Duda R.O. and Hart.P.E., Pattern Classification and Scene Analysis, Wiley, New York, 1973
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.

22AM702 Business Analytics **3 0 0 3**

Course Objectives

- Understand the role of business analytics within an organization
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making
- To become familiar with processes needed to develop, report, and analyze business data
- Use decision-making tools/Operations research techniques and Manage business process using analytical and management tools

Programme Outcomes (POs)

b. 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.
d. 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.
e. 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.
f. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Implement the knowledge of data analytics
2. Apply the ability of think critically in making decisions based on data and deep analytics.
3. Analyze the ability to use technical skills in predicative and prescriptive modeling to support business decision-making
4. Determine the ability to translate data into clear, actionable insights
5. Analyze the decision problems in business analytics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1	1		3	2					1	1	
2	2	2	1	1		2			1			1	1	
3	2	2	1	1	2	3			1			1	1	
4	2	2		1	2	2			1			1	1	
5	2	2		1								1	1	

UNIT I **9 Hours**

BUSINESS ANALYTICS AND STATISTICAL TOOLS

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics-Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview

UNIT II **9 Hours**

TRENDINESS AND REGRESSION ANALYSIS

Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III **9 Hours**

ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS

Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV **9 Hours**

FORECATING TECHNIQUES

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

UNIT V **9 Hours**

DECISION ANALYSIS

Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making

FOR FURTHER READING

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism

Total: 45 Hours

Reference(s)

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics by James Evans, persons Education.

22AM707 Project Work I **0 0 4 2**

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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. g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems. n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		2	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3
3	2	2	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2	3		3	3	3		2	3	3

22AM801 Project Work II **0 0 20 10**

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures
- To identify and learn new tools, algorithms and techniques
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems. n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions
2. Express the technical ideas, strategies and methodologies.

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		2	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3
3	2	2	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2	3		3	3	3		2	3	3

LANGUAGE ELECTIVES

22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills
- Increase ability to comprehend complex content
- Enhance confidence in expressing with clarity and elegance
- Enthusiastic and reflective use of the language through sufficient and focused practice
- Articulate fluently and confidently in challenging situations

Course Outcomes (COs)

1. Engage with the English language in functional contexts
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3		3		
2									3	3		3		
3									3	3		3		
4									3	3		3		
5									3	3		3		

UNIT I **15 Hours**
SELF-EXPRESSION
Personal Goals and Values - Being a Team Player-Expressing strengths and Weaknesses-Abstract nouns -Adjectives-Active Listening Skills-Note Making-Pronunciation and Accent Personal goals and values - Reading for Gist and Details-Professional Ethics-Reported Speech- Conjunctions Reading skills - phonemics, word/phrase recognition, sight words Personal Goals and Values-Conditional clauses-Hypothetical questions and Answers-Sentence Structure-Simple Present Tense-Perfect tense

UNIT II **15 Hours**
CREATIVE EXPRESSION
Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept Explanation-Reported Speech-Voice Sentence Equivalence-Proofreading

UNIT III **15 Hours**

FORMAL EXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and Found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and Articles-Spelling-Reading: Analyzing and interpreting notices and Circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords Information words vs Supporting words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, Short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking FoundationBooks, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book forIntermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010.
4. Reynolds, John. Cambridge First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervisionand Curriculum Development, 2008.

22HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -day situations
- To help students understand a simple technical text in Hindi

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

VOWELS AND CONSONANTS

Hindi Alphabet: Introduction (Self introduction) - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises

UNIT III **9 Hours**

PRONOUNS AND TENSES

Pronouns and Tenses - Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Classified Vocabulary: Parts of body -Relatives Spices Eatables -Fruit & Vegetables -Clothes - Directions -Seasons Professions.

UNIT V **9 Hours**

CONVERSATIONS

Speaking - Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.
2. Hindi Prachar Vahini - 1
3. Videos, Stories, Rhymes and Songs.

22HSG01 GERMAN 1 0 2 2

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. Use basic phonemes and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
5. Understand basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**
INTRODUCTION
Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

UNIT II **9 Hours**
LANGUAGE AND ITS COMMON USE
Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention to pronunciation

UNIT III **9 Hours**
TECHNICAL DEUTSCHE
Regular &Irregular verbs -Personal pronouns-family-Introduction to types of sentences

UNIT IV **9 Hours**
INTERROGATION
Question words -Types of Questions -Nominative case-Verb Conjugation -country -nationalities

UNIT V **9 Hours**
IMPLEMENTATION
Verbs to be & to have -conjugation -Hobbies -Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

22HSJ01 JAPANESE 1 0 2 2

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquette

Course Outcomes (COs)

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels - Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. Speaking: Self Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time

UNIT II **9 Hours**

TIME EXPRESSION / VERBS - PAST

Introduction to time -Introduction of verbs -Listening to specific information

UNIT III **9 Hours**

ADJECTIVES

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation

Listening to Japanese Alphabet Pronunciation -Simple Conversation

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu -Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to different Counters, simple conversations with verbs and adjectives

Total: 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

22HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Course Outcomes (COs)

1. Help students acquire familiarity in the French alphabet & basic vocabulary
2. Listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites -Grammaire Verbes Conjugaison Present (Avoir / Etre / ER, IR, RE Regulier et Irregulier) Adjectifs les propositions de lieu Communication Chercher un logement, decrire son voisin, s informer sur un logement - Lexique L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

Grammaire Articles contractes, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche Communication Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie - Lexique le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

Grammaire Verbes Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait Communication Propose a quelqu un de faire quelque chose, raconter une sortie au passe, parler d un film Lexique Les sorties, la famille, l art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, l argent

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

PROFESSIONAL ELECTIVES

22AM001 AGILE SOFTWARE DEVELOPMENT

3 0 0 3

Course Objectives

- To provide students with a theoretical as well as practical understanding of agile software development practices.
- To understand the Agile Scrum framework and development practices.
- To apply software design principles and refactoring techniques to achieve agility.
- To understand Agile requirements and perform testing activities within an agile project.
- To understand the benefits and pitfalls of working in an Agile team in terms of quality assurance.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand genesis of Agile and driving forces for choosing Agile techniques.
2. Apply the Agile Scrum framework and development practices.
3. Apply iterative software development processes by planning and executing them.
4. Analyze the impact of the success of social aspects behind the software testing.
5. Analyze techniques and tools for improving team collaboration and management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2									2	2	
2	2	2	2										2	
3	1		2		2							2	2	
4	1		2		2							2	2	
5	1		2		2							2	2	

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile management - agile software development-traditional model vs agile model - classification of - agile methods - agile manifesto and principles-agile project management agile team interactions - ethics in agile teams agility in design, testing - agile documentations - agile drivers capabilities and values.

UNIT II **9 Hours**

AGILE PROCESSES

Extreme Programming: Method overview - lifecycle - work products, roles and practices - Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, Kanban model.

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile information systems - agile decision making - Earl schools of KM - institutional knowledge evolution cycle - development, acquisition, refinement, distribution, deployment, leveraging - KM in software engineering - managing software knowledge - challenges of migrating to agile methodologies - agile knowledge sharing - role of story - cards - Story- card Maturity Model (SMM).

UNIT IV **9 Hours**

AGILITY AND REQUIREMENTS ENGINEERING

Impact of agile processes in RE - current agile practices - variance - overview of RE using agile - managing unstable requirements - requirements elicitation - agile requirements abstraction model - requirements management in agile environment, agile requirements prioritization - agile requirements modelling and generation - concurrency in agile requirements generation

UNIT V **9 Hours**

AGILITY AND QUALITY ASSURANCE

Agile Interaction Design - Agile product development - Agile Metrics - Feature Driven Development (FDD) - Financial and Production Metrics in FDD - Agile approach to Quality Assurance - Test Driven Development Pair programming: Issues and Challenges - Agile approach to Global Software Development.

Total: 45 Hours

Reference(s)

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), Agile Software Development, Current Research and Future Directions, Springer Verlag Berlin Heidelberg, 2010.
2. David J. Anderson; Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
3. Hazza& Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, Agile and Iterative Development: A managers Guide, Addison Wesley, 2004
5. Kevin C. Desouza, Agile information systems: conceptualization, construction, and management, Butterworth-Heinemann, 2007.

22AM002 UI AND UX DESIGN 3 0 0 3

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX design process and methodology.
- Learning the Importance and scope of Interaction design, User centered design

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests learning steps for digital products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1												1	1
2	1	2	2		1								2	1
3		3	3		1								2	1
4		2	2										1	2
5		2	2										1	2

UNIT I **9 Hours**

USER-CENTERED DESIGN PROCESS

Scripting Languages HTML, CSS Fundamentals of graphics design, principles of visual design Overview of UI & UX Design Overview of the UX Design Process Difference between User Interface (UI) vs User Experience (UX) Defining problem and vision statement Persona creation Primary and Secondary persona Requirement definition Creative ideation brainstorming and ideation techniques Scenarios and functionality extraction Information Architecture Task flows Wireframe design

UNIT II **9 Hours**

FUNDAMENTALS OF UI, HEURISTICS, AND INTERACTION DESIGN

Design Principles for UX and UI Design UI Elements Patterns Material Design (Google) and Human Interface Design (Apple) guidelines Interaction Principles & Interaction Behaviour Master the Brand Platforms & Style Guides comments and current UI patterns Understand problems and design solutions for ecommerce, social media, message, data, and dashboard design

UNIT III **9 Hours**

ELEMENTARY SKETCHING

Principles of Sketching Core Responsive Design Wireframing vs Wireflows Click through Wireframing Prototyping Wireflow Creation Work with different tools Figma Low High Fidelity Design: Inclusive Design and Designing for Accessibility Building High-Fidelity Mockups Designing Efficiently with Tools Interaction Patterns Designing animations and interactions

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration Use of grids in UI design Design animations and interaction patterns for key UI elements

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation Qualitative & Quantitative evaluation Guerilla testing , A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Think aloud Introduction and advantages Designing evaluation protocol Conducting usability evaluation study Conduct Usability Test explicit Synthesize Test Findings practices in corporate World Product Design : Types of products & solutions - Design Psychology for e commerce sites CMS Design Thinking Life Cycle

Total: 45 Hours

Reference(s)

1. Norman, Donald A. The Design of Everyday Things. Basic Books, 2002. ISBN: 9780465067107.
2. Nielsen, Jakob. Usability Engineering. Morgan Kaufmann, 1993. ISBN: 9780125184069.
3. Mullet, Kevin, and Darrell Sano. Designing Visual Interfaces: Communication Oriented Techniques. Prentice Hall, 1994. ISBN: 9780133033892.
4. Wilbent. O. Galitz ,The Essential Guide To User Interface Design, John Wiley&Sons, 2001.
5. Ben Sheiderman, Design The User Interface, Pearson Education, 1998.
6. Alan Cooper, The Essential Of User Interface Design, Wiley Dream Tech Ltd.,2002.

22AM003 WEB FRAMEWORKS **3 0 0 3**

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Apply modules and components and Animations for creating Forms and developing web pages
2. Create web applications by performing CRUD operations in database using web frameworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Designing single page applications with reusable UI components using React CSS and SaaS
5. Use Node Package Manager and Node packages for Server Side programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2		2								2	
2	1		1		3								3	
3	1		2		2								3	
4	1		1		3								2	
5	1		1		3								2	

UNIT I **9 Hours**

ANGULAR FRONT-END FRAMEWORK

Introduction Setup Architecture: Modules, Components, Services and DI fundamentals Components and Templates Configuration Forms Observables & RxJS Boot Strapping Ng Modules Dependency Injection Http Client Routing and Navigation Animations.

UNIT II **9 Hours**

FRAMEWORKS WITH DATABASES

MongoDB MongoDB Basics Documents Collections Query Language Installation The mongo Shell Schema Initialization MongoDB Node.js Driver Reading from MongoDB Writing to MongoDB CRUD operations projections - Indexing Aggregation Replication Sharding Creating backup Deployment.

UNIT III **9 Hours**

ANGULAR TECHNIQUES

Service workers & PWA - Server side rendering - Angular Libraries - Schematics - CLI Builders - Angular Ivy - Web Workers

UNIT IV **9 Hours**

REACT

React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS

UNIT V **9 Hours**

NODE JS BACK-END FRAMEWORK

Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js EventEmitter - Frameworks for Node.js - Express.js Web App - Serving static Resource - Node.js Data Access

Total: 45 Hours

Reference(s)

1. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, A Press Publisher, 2019.
2. Christoffer Noring, Pablo Deeleman,Learning Angular, Packt Publishing Limited, 2nd Revised edition edition, 2017.
3. Caleb Dayley Brad Dayley,Brendan Dayley ,Node.js, MongoDB and Angular Web Development, 2nd Edition,Pearson, 2018.
4. Shyam Seshadri, Angular: Up and Running- Learning Angular, Step by Step , O""Reilly; First edition, 2018

22AM004 APP DEVELOPMENT 2 0 2 3

Course Objectives

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development
- To inculcate working knowledge of Android Studio development tool

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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.

Course Outcomes (COs)

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IoS with SqLite Database
5. Design the flutter applications on the Android marketplace for distribution.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1		3									
2	1	2	2		3									
3	1		2		3									
4	1	1	2		3									
5	1	2	2		3									

UNIT I **6 Hours**

INTRODUCTION TO ANDROID

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

UNIT II **6 Hours**

ANDROID APPLICATION DESIGN ESSENTIALS

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

UNIT III **9 Hours**

COMMON ANDROID APIS

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

UNIT IV **9 Hours**

IOS USER INTERFACE DESIGN ESSENTIALS

Ios features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite,Integrating calendar and address book with social media application, Using Wifi, iPhone marketplace.

UNIT V **10 Hours**

APP DEVELOPMENT WITH FLUTTER

Flutter Introduction, Create First Flutter Application, Exploring commonly used flutter widgets: Container, Margin, Padding and Box Constraints, Custom Fonts, Column and Expanded Widgets, Image Asset, Raised Button, and Alert Dialog .

1 **2 Hours**

EXPERIMENT 1

Develop a simple application with one EditText so that the user can write some text in it. Create a button called "Convert Text to Speech" that converts the user input text into voice.

2 **2 Hours**

EXPERIMENT 2

Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.

3 **3 Hours**

EXPERIMENT 3

Create a SIGNUp activity with Username and Password. Validation of password should happen based on the following rules:

Password should contain uppercase and lowercase letters.

Password should contain letters and numbers.

Password should contain special characters.

Minimum length of the password (the default value is 8).

On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying "Successful Login" or else display a toast message saying "Login Failed". The user is given only two attempts and after that display a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

4 **4 Hours**

EXPERIMENT 4

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

5 **4 Hours**

EXPERIMENT 5

Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.

6 **3 Hours**

EXPERIMENT 6

Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

6 **2 Hours**

EXPERIMENT 7

Implement UI elements like TextFields, Label, Toolbar, Statusbar, Tabbar.

Total:40+20: 60 Hours

Reference(s)

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
2. Reto Meier, Professional Android 2 Application Development, Wiley India Pvt Ltd.
3. Mark L Murphy, Beginning Android, Wiley India Pvt Ltd 3. R3. Android Application evelopment All in one for Dummies by Barry Burd.
4. Alberto Miola, Flutter Complete Reference: Create beautiful, fast and native apps for any device ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, Beginning iOS 6Development: Exploring the iOS SDK, Apress, 2013.55.

22AM005 SOFTWARE TESTING AND AUTOMATION 3 0 0 3

Course Objectives

- Understand the importance of software testing in the software development process
- Analyze different testing methodologies and techniques to create test plans, test cases, and test scripts
- Apply automation testing tools and frameworks to design and implement automated test suites

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the importance of testing in the software development process
2. Compare the different test case design strategies
3. Analyze the different levels of testing and their importance
4. Apply test management techniques and the role of a test specialist
5. Analyze the software test automation and its requirements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1		1								1	
2	2	3	2		2								1	
3	2	2	2		2								1	
4	2	3	2		3								1	
5	3	2	1		3								2	

UNIT I **9 Hours**

INTRODUCTION

Basic definitions Software Testing Principles The Testers Role in a Software Development Organization Origins of Defects Cost of Defects Defect Classes The Defect Repository and Test Design Defect Examples Developer/Tester Support of Developing a Defect Repository.

9 Hours

UNIT II

INTRODUCTION

Test Scenarios Test Cases Test case Design Strategies Black Box Approach to Test Case Design Using White Box Approach to Test design Test Adequacy Criteria Static testing vs Structural testing Code functional testing Coverage and Control Flow Graphs Covering Code Logic Paths Code complexity testing Additional White box testing approaches Test Coverage

UNIT III **9 Hours**

LEVELS OF TESTING

Types of testing manual and automation Introduction to testing methods White box, Black-box and Greybox Functional testing Nonfunctional testing Introduction to levels of testing Unit Testing, Integration Testing, System Testing, User Acceptance Testing Introduction to types of testing Regression Testing, Smoke Testing, Database Testing, Usability Testing, Load Testing, Stress Testing, Performance Testing, Compatibility Testing, Security Testing, Internationalization Testing, Localization Testing

UNIT IV **9 Hours**

TEST MANAGEMENT

People and organizational issues in testing Organization structures for testing teams testing services Test Planning Test Plan Components Test Plan Attachments Locating Test Items test management test process Reporting Test Results Introducing the test specialist Skills needed by a test specialist Building a Testing Group The Structure of Testing Group The Technical Training Program.

UNIT V **9 Hours**

TEST AUTOMATION

Software test automation Design and Architecture for Automation Automation testing Automation Tools Selenium Web Driver Create Selenese Commands TestNG TestNG Annotations Jmeter Assertions in JMeter Junit.

Total: 45 Hours

Reference(s)

1. Ilene Burnstein, Practical Software Testing, Springer International Edition, 2003.
2. Edward Kit, Software Testing in the Real World Improving the Process, Pearson Education, 1995.
3. Boris Beizer, Software Testing Techniques 2nd Edition, Van Nostrand Reinhold, New York, 1990.
4. Aditya P. Mathur, Foundations of Software Testing Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

22AM006 DEVOPS 3 0 0 3

Course Objectives

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real-world problems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
3. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2	2								3	
2	3	3	3	3	2								2	
3	2	2	2	3	2								2	
4	2	2	2	2	2								2	
5	2	2	2	2	2								3	

UNIT I **7 Hours**

INTRODUCTION TO DEVOPS

Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and GitHub.

UNIT II **10 Hours**

COMPILE AND BUILD USING MAVEN

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 Artifacts- Dependency Management-Installation of Gradle- understanding build using Gradle.

UNIT III **12 Hours**

CONTINUOUS INTEGRATION USING JENKINS

Install & Configure Jenkins- Jenkins Architecture Overview- creating a Jenkins Job- Configuring aJenkins job- Introduction to Plugins- Adding Plugins to Jenkins-commonly used plugins (Git Plugin,Parameter Plugin- HTML Publisher- Copy Artifact, and Extended choice parameters). ConfiguringJenkins to work with Java- Git- and Maven- Creating a Jenkins Build and Jenkins workspace.

UNIT IV **9 Hours**

CONFIGURATION MANAGEMENT USING ANSIBLE

Ansible Introduction- Installation-Ansible master/slave configuration- YAML basics-Ansible Modules- Ansible Inventory files- Ansible playbooks- Ansible Roles- and ad-hoc commands in Ansible

UNIT V **7 Hours**

BUILDING DEVOPS PIPELINES USING AZURE

Create GitHub Account, Create Repository- Create Azure Organization- Create a new pipeline- Build a sample code- Modify azure-pipelines- yaml file

Total: 45 Hours

Reference(s)

1. 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/

22AM007 VIRTUALIZATION IN CLOUD COMPUTING **3 0 0 3**

Course Objectives

- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud based applications
- Create an application by utilizing cloud platforms such as Amazon Web Services and Windows Azure
- Identify major security and privacy problems in cloud computing environment
- Apply the ability to use the architecture of cloud, service and delivery models
- Implement the key enabling technologies that help in the development of cloud.

Programme Outcomes (POs)

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

c. 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.

d. 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.

e. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Analyze the concept of virtualization and its properties.
2. Apply different forms of virtualization.
3. Implement various architectures for implementing virtualization methods.
4. Create virtual machines and installing various operating systems.
5. Evaluate the performance of the virtual machines and deployed applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	3									1	
2			1	3	2									1
3			2	1	3									2
4	1		2	1	3									2
5	1		3		2									2

UNIT I **9 Hours**

UNDERSTANDING VIRTUALIZATION

Describing Virtualization Microsoft Windows Drives Server Growth Explaining Moores Law Understanding the Importance of Virtualization Examining Todays Trends Virtualization and Cloud Computing Understanding Virtualization Software Operation Virtualizing Servers Virtualizing Desktops Virtualizing Applications

UNIT II **9 Hours**

HYPERVISORS

Describing a Hypervisor Exploring the History of Hypervisors Understanding Type 1 Hypervisors Type 2 Hypervisors Role of a Hypervisor Holodecks and Traffic Cops Resource Allocation Comparing Todays Hypervisors VMware ESX Citrix Xen Microsoft Hyper V Other Solutions.

UNIT III **9 Hours**

VIRTUAL MACHINES

Introduction to Virtual Machine - CPUs in a Virtual Machine Memory in a Virtual Machine - Network Resources in a Virtual Machine - Storage in a Virtual Machine - Understanding How a Virtual Machine Works - Working with Virtual Machines Virtual Machine Clones - Templates -Snapshots - OVF - Containers

UNIT IV **9 Hours**

CREATION OF VIRTUAL MACHINES

Understanding Configuration Options - Installing Windows on a Virtual Machine - Installing Linux on a Virtual Machine Installing VirtualBox Guest Additions - Managing CPUs for a Virtual Machine - Configuring VM CPU Options - Managing Storage for a Virtual Machine - Managing Networking for a Virtual Machine - Copying a Virtual Machine - Managing Additional Devices in Virtual Machines

UNIT V **9 Hours**

AVAILABILITY

Increasing Availability - Protecting a Virtual Machine Protecting Multiple Virtual Machines - Protecting Data Centers Examining Virtual Infrastructure Performance Capabilities Deploying Applications in a Virtual Environment-Understanding Virtual Appliances and vApps - Open Stack and Containers.

Total: 45 Hours

Reference(s)

1. Matthew Portney, Virtualization Essentials, John Wiley & Sons, Second Edition, 2016
2. Kailash Jayaswal, Jagannath Kallakurchi, Donald J.Houde,Dr.devan Shah, Cloud Computing Black Book, Dreamtech press, 2015
3. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S,Mastering in Cloud Computing, McGraw Hill Education, (India) Private Limited, 2013
4. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
5. http//www.microsoft.com/learning/default.mspx
6. https://www.oreilly.com/library/view/cloud- security-and/9780596806453/ch04.html.

22AM008 CLOUD SERVICES AND DATA MANAGEMENT 3 0 0 3

Course Objectives

- Analyze the basic concepts of Cloud and capabilities across the various Cloud service models
- Analyze the basic concepts of Cloud and capabilities across the various Cloud service models
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. 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.

n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Apply Cloud Computing reference architecture for developing clouds
2. Analyze the different forms of cloud service models
3. Apply the characteristics and architecture of IaaS using various real world applications.
4. Evaluate PaaS concepts and architectures with real-world examples.
5. Analyze, and synthesize concepts related to the SaaS delivery model.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1	1									
2	3	1	2	3	2									
3	1	1	3	1	3									2
4	1	1	1	2	3									2
5	1	3	3	2	2									1

UNIT I **9 Hours**

CLOUD COMPUTING REFERENCE ARCHITECTURE (CCRA)

Introduction to Cloud Computing Reference Architecture (CCRA), Benefits of CCRA, Architecture Overview, Versions and Application of CCRA for Developing Clouds.

UNIT II **9 Hours**

INTRODUCTION OF DELIVERY MODELS IN CLOUD COMPUTING

Introduction to Cloud Delivery Models, List Various Cloud Delivery Models, Advantages of Delivery Models in Cloud, Trade off in Cost to Install Versus Flexibility, Cloud Service Model Architecture.

UNIT III **9 Hours**

INFRASTRUCTURE AS A SERVICE (IAAS)

Introduction to Infrastructure as a Service Delivery Model, Characteristics of IaaS, Architecture, Examples of IaaS, Applicability of IaaS in the Industry.

UNIT IV **9 Hours**

PLATFORM AS A SERVICE (PAAS)

Introduction to Platform as a Service Delivery Model, Characteristics of PaaS, Patterns, Architecture and Examples of PaaS, Applicability of PaaS in the Industry.

UNIT V **9 Hours**

SOFTWARE AS A SERVICE (SAAS)

Introduction to Software as a Service Delivery Model, Characteristics of SaaS, Architecture, Examples of SaaS, Applicability of SaaS in the Industry.

Total: 45 Hours

Reference(s)

1. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011
2. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
3. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill, 2011
4. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010
5. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, Oreilly, SPD, 2011

22AM009 CLOUD STORAGE TECHNOLOGIES 3 0 0 3

Course Objectives

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Analyze the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
2. Apply the usage of advanced intelligent storage systems and RAID.
3. Evaluate various storage networking architectures - SAN, including storage subsystems and virtualization.
4. Execute the different roles in providing disaster recovery and remote replication technologies.
5. Implement the security needs and security measures to be employed in information storage management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	3	3								2	
2	3	1	2	3	3									1
3	1	1	3	2	2									2
4	3	2	1	2	2									1
5	1	3	2	1	2									2

UNIT I **8 Hours**

STORAGE SYSTEMS

Cloud Storage Fundamentals and Architecture - Cloud Storage Providers and Services - Access methods (RESTful APIs, SDKs) for cloud object storage - Block storage technologies in cloud environments - File Storage in the Cloud: Network File System (NFS) and Server Message Block (SMB) protocols -Hybrid Cloud Storage - Data Migration - Data Lifecycle Management in the Cloud

UNIT II **9 Hours**

INTELLIGENT STORAGE SYSTEMS AND RAID

Storage Tiering and Caching - Automated Data Placement and Load Balancing: Intelligent Algorithms for Data Placement, Load Balancing Strategies for Distributed Storage Systems, Dynamic Resource Allocation - RAID Technologies in Cloud Storage: RAID Levels - Data Striping, Mirroring, and Parity for Fault Tolerance - RAID Configuration and Performance Optimization

UNIT III **10 Hours**

STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION

Storage Networking in Cloud Environments - Understanding storage protocols - Network-attached storage (NAS) vs storage area network (SAN) - Storage virtualization techniques and technologies - Network-Attached Storage (NAS) - Storage Area Network (SAN) - iSCSI and Fiber Channel over IP (FCIP) in Cloud Storage - Network Virtualization and Overlay Networks Storage Virtualization and Abstraction - Network Performance Optimization - Network Security in Cloud Storage

UNIT IV **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Cloud Backup: Strategies and Architecture, Data Deduplication and Compression, Security - Cloud Archive: Strategies and Architecture, Replication for Data Redundancy: Synchronous and asynchronous replication methods - Disaster Recovery in the Cloud - Hybrid Backup and Archiving in Cloud Environments Backup and Archive Management in Cloud Environments

UNIT V **9 Hours**

SECURING STORAGE INFRASTRUCTURE

Storage Security Fundamentals: Key Security Principles, Threats and Vulnerabilities in Storage Infrastructure, Access Control and Authentication: Role-based Access Control (RBAC) and Permissions Management, Multi-factor authentication (MFA) for Storage Systems - Storage-level Encryption and Application-level Encryption - Storage infrastructure Management Functions and Processes.

Total: 45 Hours

Reference(s)

1. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), OReilly, 2009.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
3. Rajkumar Buyya , Christian Vecchiola S. ThamaraiSelvi Mastering Cloud Computing , Tata Mcgraw Hill , 2013.
4. Ritting house , John W , and James F Ransome , Cloud Computing: Implementation, Management and Security, CRC Press , 2017.
5. Toby Velte , Anthony Velte , Robert Elsenpeter, Cloud Computing A Practical Approach , Tata Mcgraw Hill , 2009.

22AM010 CLOUD AUTOMATION TOOLS AND APPLICATIONS

3 0 0 3

Course Objectives

- To learn the options for running automation tools, and load balancers in the cloud-native applications.
- To learn the configuration management in the cloud.
- To know why cloud automation is important.
- To learn what types of cloud automation tools can be used.
- To learn load balancing and auto scaling in the cloud.

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Implement cloud native applications on AWS, Terraform etc.
2. Apply VM provisioning and migration in the cloud.
3. Analyze cloud automation and configuration.
4. Apply balance load and auto scaling in the cloud.
5. Analyze the AWS cloud formation use-case.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	3									2
2		2			3									1
3			3	2	3								2	2
4			2		3									
5			2		3									2

UNIT I **7 Hours**

UNDERSTANDING THE CLOUD AUTOMATION

Introduction to Automation & Configuration Tools. Introduction to Terraform. Understanding Terraform Vs Cloud Formation. Deploying & Destroying AWS environment with Terraform. Introduction to Packer.

UNIT II **9 Hours**

ABSTRACTION AND VIRTUALIZATION

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding hypervisors Porting Applications, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Centre Automation.

UNIT III **9 Hours**

AUTOMATION AND CONFIGURATION MANAGEMENT IN THE CLOUD

Cloud automation at scale Cloud Configuration Management unmanaged and managed configuration management Modification of the capacity of the service horizontal and vertical scaling and automatic versus manual scaling. Migrating the business to Cloud. Automating cloud deployments Balancers.

UNIT IV **9 Hours**

LOAD BALANCING AND AUTO SCALING IN CLOUD

Managed instance groups , Auto scaling and health check Overview of HTTP(S) load balancing. Example : HTTP load balancer , HTTP(S) load balancing , Configuring an HTTP Load Balancer with Auto scaling, SSL proxy load balancing , TCP proxy load balancing, Network load balancing, Internal load balancing , Configuring an Internal Load Balancer , Choosing a load balancer.

UNIT V **11 Hours**

AWS CLOUDFORMATION USE-CASE

Introduction to AWS CloudFormation , AWS CloudFormation Features and Components , Working of AWS CloudFormation setting up AWS CloudFormation , building a Pipeline for Test and Production Stacks , AWS CloudFormation Artifacts Parameter Override Functions with Code Pipeline , Using AWS CLI. AWS CloudFormation , Terraform, VMware vs Center Configuration Manager (VCM) , and Puppet.

Total: 45 Hours

Reference(s)

1. Bernd Ruecker, Practical Process Automation: Orchestration and Integration in Micro services and Cloud Native Architectures,O"Reilly Media, First Edition, 2021.
2. Douglas Comer, The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC, First Edition, 2021.
3. Karen Tovmasyan, Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation, Packt Publishing Limited, First Edition, 2020.
4. Mikael Krief, Mitchell Hashimoto, Terraform Cookbook: Efficiently define, launch, and manage Infrastructure as Code across various cloud platforms, Packet Publishing Limited, 2020.
5. Yogesh Raheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

22AM011 SOFTWARE DEFINED NETWORKS 2 0 2 3

Course Objectives

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Apply the motivation behind SDN
2. Analyze the functions of the data plane and control plane
3. Evaluate and develop network applications using SDN
4. Execute network services using NFV
5. Implement various use cases of SDN and NFV

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	1	3									
2	2	1	2	2	3								1	
3	2	2	2	3	3									
4	2	2	2	3	1									
5	3	3	1	1	3								2	

UNIT I **6 Hours**

SDN: INTRODUCTION

History of Software Defined Networking (SDN) Modern Data Center Traditional Switch Architecture Why SDN Evolution of SDN How SDN Works Centralized and Distributed Control and Date Planes.

UNIT II **6 Hours**

SDN DATA PLANE AND CONTROL PLANE

Data Plane functions and protocols OpenFLow Protocol Packet Processing and Performance Optimization Flow Table Control Plane Functions Southbound Interface , Northbound Interface SDN Controllers Ryu , OpenDaylight , ONOS Distributed Controllers.

UNIT III **6 Hours**

SDN APPLICATIONS

SDN Application Plane Architecture Network Services Abstraction Layer Traffic Engineering Measurement and Monitoring Security Data Center Networking Wide Area Networks (WAN) Service Provider Networks Internet Service Providers ISPs.

UNIT IV **6 Hours**

NETWORK FUNCTION VIRTUALIZATION

Network Virtualization NFV Architecture Virtual LANs OpenFlow VLAN Support NFV Standards and Frameworks NFV Concepts Benefits and Requirements Reference Architecture.

UNIT V **6 Hours**

NFV FUNCTIONALITY

NFV Infrastructure Virtualized Network Functions NFV Management and Orchestration NFV Use Cases Virtual Customer Premises Equipment , Virtual Evolved Packet Core , Virtualized Network Monitoring and Traffic Analysis , Network Slicing Edge Computing and NFV.

1 **6 Hours**

EXPERIMENT 1

I. Setup your own virtual SDN lab
II. Virtual box/Mininet Environment for SDN - http://mininet.org
III. https://www.kathara.org
IV. GNS3

2 **6 Hours**

EXPERIMENT 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 **6 Hours**

EXPERIMENT 3

Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.

4 **6 Hours**

EXPERIMENT 4

Create a simple end-to-end network service with two VNFs using vim-emu. Https://github.com/containernet/vim-emu

5 **6 Hours**

EXPERIMENT 5

Install OSM and onboard and orchestrate network service.

Total: 30+30:60 Hours

Reference(s)

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1st Edition, CRC Press, 2014.
2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Oswald Coker , Siamak Azodolmolky , Software - Defined Networking with OpenFlow, 2nd Edition, OReilly Media , 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks : A Comprehensive Approach , 2nd Edition Morgan Kaufmann Press , 2016.
5. Thomas D Nadeau , Ken Gray , SDN: Software Defined Networks OReilly Media , 2013.
6. William Stallings , Foundations of Modern Networking : SDN , NFV QoE , IoT and Cloud , Pearson Education , 1st Edition , 2015.

22AM012 SECURITY AND PRIVACY IN CLOUD **3 0 0 3**

Course Objectives

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To be able to monitor and audit cloud applications for security

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Understand the cloud security concepts and fundamentals.
2. Explain the security challenges in the cloud.
3. Analyze the cloud policy, identity and Access Management.
4. Delivers various risks, audit and monitoring mechanisms in the cloud.
5. Applying the various architectural and design considerations for security in the cloud.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	1	2									
2	1	3	2	3	1									
3	3	2	2	3	2								1	
4	2	1	2	3	3									
5	1	3	3	1	1									3

UNIT I **8 Hours**

FUNDAMENTALS OF CLOUD SECURITY CONCEPTS

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 II **11 Hours**

SECURITY DESIGN AND ARCHITECTURE FOR CLOUD

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 - Intertenant network segmentation strategies - Data Protection strategies Data Redaction , Tokenization , Obfuscation , PKI and Key

UNIT III **9 Hours**

ACCESS CONTROL AND IDENTITY MANAGEMENT

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

UNIT IV **8 Hours**

CLOUD SECURITY DESIGN PATTERNS

Introduction to Design Patterns, Cloud Bursting , Geo tagging Secure Cloud Interfaces , Cloud Resource Access Control Secure On-Premise Internet Access , Secure External Cloud

UNIT V **9 Hours**

MONITORING, AUDITING AND MANAGEMENT

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: 45 Hours

Reference(s)

1. Dave Shackleford, Virtualization Security, SYBEX a Wiley Brand, 2013
2. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011.
3. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, Oreilly, 2011.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
5. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.

22AM013 CYBER SECURITY 3 0 0 3

Course Objectives

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the basics of cyber security, cybercrime and cyber law.
2. Classify various types of attacks and learn the tools to launch the attacks.
3. Apply various tools to perform information gathering for data security and integrity.
4. Apply intrusion techniques to detect intrusion and to observe network traffic for malicious transactions in the network.
5. Apply intrusion prevention techniques to prevent intrusion and to protect against known and unknown threats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1	2								2	
2	1	3	1	3	3								2	
3	2	1	1	1	2								2	
4	3	3	2	2	1								3	
5	3	2	2	3	3								3	

UNIT I **9 Hours**

INTRODUCTION

Cyber Security History of Internet Impact of Internet CIA Triad Reason for Cyber Crime Need for Cyber Security History of Cyber Crime Cybercriminals A Global Perspective on Cyber Crimes Classification of Cybercrimes

UNIT II **9 Hours**

ATTACKS AND COUNTER MEASURES

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.

UNIT III **9 Hours**

RECONNAISSANCE

Harvester Who is Netcraft Host Extracting Information from DNS Extracting Information from Email 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 Fingerprinting Techniques.

UNIT IV **9 Hours**

INTRUSION DETECTION

Host Based Intrusion Detection Network Based Intrusion Detection Distributed or Hybrid Intrusion Detection Intrusion Detection Exchange Format Honeypots Example System Snort Cyber Laws The Indian IT Act Cyber Crime and Punishment.

UNIT V **9 Hours**

INTRUSION PREVENTION

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: 45 Hours

Reference(s)

1. David Kim, Michael G. Solomon, Fundamentals of Information Systems Security, Jones & Bartlett Learning Publishers, 2013.
2. Patrick Engebretson, The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy, Elsevier, 2011.
3. Kimberly Graves, CEH Official Certified Ethical hacker Review Guide, Wiley Publishers, 2007.
4. William Stallings, Lawrie Brown, Computer Security Principles and Practice, Third Edition, Pearson Education, 2015.
5. Georgia Weidman, Penetration Testing: A Hands-On Introduction to Hacking, No Starch Press, 2014.

22AM014 MODERN CRYPTOGRAPHY 3 0 0 3

Course Objectives

- To learn about the basics of modern cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudo random permutation.
- To construct the basics of cryptanalytic techniques for ensuring data integrity.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the basic principles of cryptography and general cryptanalysis.
2. Determine the concepts of symmetric encryption and authentication.
3. Identify the use of public key encryption, digital signatures, and key establishment.
4. Apply the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
5. Demonstrate the use of Message Authentication Codes to authenticate information transmitted between the users.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	3	1							2	2	
2	1	3	2	1	2							2	2	
3	1	1	2	3	2							3	1	
4	3	1	2	1	3							2	3	
5	2	3	3	3	3							1	2	

UNIT I **9 Hours**

INTRODUCTION

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 II **9 Hours**

FORMAL NOTIONS OF ATTACKS

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 NMCCA2, Inter relations among the attack model

UNIT III **9 Hours**

RANDOM ORACLES

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, Pseudorandom Functions (PRF).

UNIT IV **9 Hours**

BUILDING A PSEUDORANDOM PERMUTATION

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 V **9 Hours**

MESSAGE AUTHENTICATION CODES

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. Shamirs Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

Total: 45 Hours

Reference(s)

1. 1.William Stallings, Cryptography and Network Security: Principles and Practice, PHI 7th Edition, 2017.
2. 2.OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), 2009.
3. 3.Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, 2007.
4. 4.Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition), 2004.

22AM015 CYBER FORENSICS 3 0 0 3

Course Objectives

- To understand the principles and concepts of computer forensics.
- To learn to utilize forensic tools for network-based attacks.
- To identify and apply appropriate methodologies for forensics data.
- To identify and analyze the vulnerabilities in the network.
- To analyze the various hacking techniques and their impacts.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. To understand the basics of computer forensics, legal and ethical considerations, and the importance of maintaining the integrity of digital evidence.
2. Apply different types of computer forensic tools to preserve the integrity of data in the network.
3. Analyze and validate forensics data from the communicating devices to detect intruders.
4. Apply the various firewall techniques to detect the vulnerabilities in the networks.
5. Implement real-world hacking techniques to test system security and to ensure the system safety from hackers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	1	2			2					2	
2	2	2	3	2	3			2					2	
3	2	1	3	2	2			3					2	
4	2	1	2	3	3			3					3	
5	2	2	2	2	3			3					3	

UNIT I **9 Hours**

INTRODUCTION TO COMPUTER FORENSICS

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques Incident and incident response methodology Forensic duplication and investigation. Preparation for IR Creating response tool kit and IR team. Forensics Technology and Systems Understanding Computer Investigation Data Acquisition.

UNIT II **9 Hours**

EVIDENCE COLLECTION AND FORENSICS TOOLS

Processing Crime and Incident Scenes Working with Windows and DOS Systems. Current Computer Forensics Tools Software Hardware Tools.

UNIT III **9 Hours**

ANALYSIS AND VALIDATION

Validating Forensics Data Data Hiding Techniques Performing Remote Acquisition Network Forensics Email Investigations Cell Phone and Mobile Devices Forensics.

UNIT IV **9 Hours**

E-MAIL SECURITY

PGP S/MIME Internet Firewalls for Trusted System: Roles of Firewalls Firewall related terminology- Types of Firewalls Firewall designs SET for E-Commerce Transactions.

UNIT V **9 Hours**

ETHICAL HACKING IN WEB

Social Engineering Denial of Service Session Hijacking Hacking Web servers Hacking Web Applications SQL Injection Hacking Wireless Networks Hacking Mobile Platforms.

Total: 45 Hours

Reference(s)

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, Computer Forensics and Investigations, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.
3. MarjieT.Britz, Computer Forensics and Cyber Crime: An Introduction, 3rd Edition, Prentice Hall, 2013.
4. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, Cengage Learning, 2nd Edition, 2005.
5. Man Young Rhee, Internet Security: Cryptographic Principles, Algorithms and Protocols, Wiley Publications, 2003.

22AM016 ETHICAL HACKING 3 0 0 3

Course Objectives

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Enumerate the numerous assaults carried out during ethical hacking and penetration testing.
2. Apply the hacking techniques and understand the tools to be used for hacking
3. Understand the various vulnerabilities of Windows and Linux OS
4. Apply the techniques to hack web servers and tools for it.
5. Determine the characteristics of the firewall, the intruder detection mechanisms, and the malicious software to protect the system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	2								2	
2	1	2	2	1	2								2	
3	1	2		2	2								2	
4	1	2	2	3	3								2	
5	1	2	1	2	2								2	

UNIT I **9 Hours**

INTRODUCTION

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-Testing Methodologies- Laws of the Land 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 II **9 Hours**

SCANNING AND ENUMERATION

Introduction to Scanning Objectives Scanning Methodology Tools Introduction to Enumeration Enumeration Techniques Enumeration Procedure Tools

UNIT III **9 Hours**

SYSTEM HACKING

Introduction Cracking Passwords Password Cracking Websites Password Guessing Password Cracking Tools Password Cracking Countermeasures Escalating Privileges Executing Applications Keyloggers and Spyware

UNIT IV **9 Hours**

PROGRAMMING FOR SECURITY PROFESSIONALS

Programming Fundamentals C language HTML Perl Windows OS Vulnerabilities Tools for Identifying Vulnerabilities Countermeasures Linux OS Vulnerabilities Tools for Identifying Vulnerabilities Countermeasures

UNIT V **9 Hours**

NETWORK PROTECTION SYSTEMS

Access Control Lists Cisco Adaptive Security Appliance Firewall Configuration and Risk Analysis Tools for Firewalls and Routers Intrusion Detection and Prevention Systems Network Based and Host Based IDSs and IPSs Web Filtering Security Incident Response Teams Honeypots.

Total: 45 Hours

Reference(s)

1. EC-Council, Ethical Hacking and Countermeasures: Attack Phases, Cengage Learning, 2010.
2. Jon Erickson, Hacking, 2nd Edition: The Art of Exploitation, No Starch Press Inc. 2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, Hands-On Ethical Hacking and Network Defense, Cengage Learning, 2013.
4. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made Easy, Second Edition, Elsevier, 2013.
5. RafayBoloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2014.

22AM017 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES **2 0 2 3**

Course Objectives

- To understand the basics of Blockchain Technology.
- To learn Different protocols and consensus algorithms in Blockchain.
- To learn the Blockchain implementation frameworks.
- To experiment the Hyperledger Fabric, Ethereum networks.
- To understand the Blockchain Applications.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Understand emerging abstract models for Blockchain Technology.
2. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
3. Develop conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
4. Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5. Analyze the real life applications of Blockchain Technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	2	1								1	
2	3	3	3	1	2								2	
3	2	2	1	1										
4		2	2		3								2	
5	1	2	3	1	2								1	

UNIT I **7 Hours**

INTRODUCTION TO BLOCKCHAIN

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 II **6 Hours**

BITCOIN AND CRYPTOCURRENCY

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 III **6 Hours**

BITCOIN CONSENSUS

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 IV **5 Hours**

HYPERLEDGER FABRIC

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V **6 Hours**

BLOCKCHAIN APPLICATIONS

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc - Case Study.

1 **5 Hours**

EXPERIMENT 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 **5 Hours**

EXPERIMENT 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 **5 Hours**

EXPERIMENT 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 **5 Hours**

EXPERIMENT 4

Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.

5 **5 Hours**

EXPERIMENT 5

Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.

6 **5 Hours**

EXPERIMENT 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:30+30: 60 Hours

Reference(s)

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O Reilly, 2014.
3. Daniel Drescher, Blockchain Basics, First Edition, Apress, 2017.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
5. Melanie Swan, Blockchain: Blueprint for a New Economy, O Reilly, 2015
6. Ritesh Modi, Solidity Programming Essentials: A Beginners Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publishing.

22AM018 MALWARE ANALYSIS 3 0 0 3

Course Objectives

- Understand the fundamentals of malware, types and its effects.
- Identify and analyze various malware types by static and dynamic analysis.
- To deal with detection, analysis, understanding, controlling, and eradication of malware.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the various concepts of malware analysis and their technologies used.
2. Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
3. Understand the methods and techniques used by professional malware analysts.
4. To be able to safely analyze, debug, and disassemble any malicious software by malware analysis.
5. Understand the concept of Android malware analysis their architecture, and App development.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	2	2								2	
2	3	3	2	2	2								2	
3	3	3	3	3	3								3	
4	3	3	3	3	3								3	
5	3	3	3	3	3								3	

UNIT I **9 Hours**

INTRODUCTION AND BASIC ANALYSIS

Introduction to Malware Malware threats Malware types Viruses Worms Rootkits Trojans Bots Spyware Adware Logic Bombs Goals of Malware Analysis AV Scanning Hashing Finding Strings Packing and Obfuscation PE file format Static Linked Libraries and Functions Static Analysis tools Virtual Machines and their usage in Malware analysis Sandboxing Basic dynamic analysis Malware execution Process Monitoring Viewing processes Registry snapshots

UNIT II **9 Hours**

ADVANCED STATIC ANALYSIS

The Stack Conditionals Branching Rep Instructions Disassembly Global and local variables Arithmetic operations Loops Function Call Conventions C Main Method and Offsets. Portable Executable File Format - The PE File Headers and Sections IDA Pro Function analysis Graphing The Structure of a Virtual Machine Analyzing Windows programs Anti static analysis techniques obfuscation packing metamorphism polymorphism.

UNIT III **9 Hours**

ADVANCED DYNAMIC ANALYSIS

Live malware analysis dead malware analysis analyzing traces of malware system calls api calls registries network activities. Anti-dynamic analysis techniques VM detection techniques Evasion techniques Malware Sandbox Monitoring with Process Monitor Packet Sniffing with Wireshark Kernel vs User Mode Debugging OllyDbg Breakpoints Tracing Exception Handling Patching

UNIT IV **9 Hours**

MALWARE FUNCTIONALITY

Downloaders and Launchers Backdoors Credential Stealers Persistence Mechanisms Handles Mutexes Privilege Escalation Covert malware launching Launchers Process Injection Process Replacement Hook Injection Detours APC injection

UNIT V **9 Hours**

ANDROID MALWARE ANALYSIS

Android Malware Analysis Android architecture App development cycle APKTool APKInspector Dex2Jar JD-GUI Static and Dynamic Analysis Case Study Smartphone (Apps) Security

Total: 45 Hours

Reference(s)

1. Jamie Butler and Greg Hoglund, Rootkits: Subverting the Windows Kernel by 2005, Addison-WesleyProfessional.
2. Bruce Dang, Alexandre Gazet, Elias Bachaalany, SÃƒÂ©bastienJosse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation, 2014.
3. Victor Marak, Windows Malware Analysis Essentials Packt Publishing, OReilly, 2015.
4. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, Android Malware and Analysis, CRC Press, Taylor & Francis Group, 2015.
5. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

22AM019 ROBOTICS PROCESS AUTOMATION 3 0 0 3

Course Objectives

- Understand the basic concepts, methodologies and tools in RPA.
- Implement the exception handling and automation techniques using RPA.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the basic concepts and methodologies in RPA.
2. Infer the UiPath building blocks in the RPA.
3. Apply the RPA techniques to automate the application.
4. Implement the exception handling and BOT in RPA.
5. Implement the RPA to solve real time problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2								2	
2	2	2	3		3								2	
3	2	2	3		3								3	
4	2	2	3		3								3	
5	2	2	3		3								3	

UNIT I **9 Hours**

RPA AND PROCESS METHODOLOGIES

Introduction to RPA Definition importance and benefits of RPA Comparison of RPA with BPO BPM and BPA Understanding RPA Skills On Premise Vs the Cloud Lean and Six Sigma Methodologies for Process Improvement Overview of Agile Methodologies and its importance in RPA

UNIT II **9 Hours**

UIPATH ESSENTIALS

Introduction to UiPath Installation and activation UiPath Activities Flowcharts Sequences and Data Manipulation UiPath Variables and Data Types-Debugging techniques in UiPath Overview of UiPath Orchestrator BOT Development and Management UiPath Automation Best Practices

UNIT III **9 Hours**

ADVANCED RPA TECHNIQUES

Data Manipulation Collections and Data Table Usage File Operations CSV/Excel to data table and vice versa Working with UiExplorer and Desktop Automation Web Automation Basic and Desktop Recording-Advanced Screen Scraping Techniques Data Scraping and Extraction from Websites

UNIT IV **9 Hours**

HANDLING EXCEPTIONS AND USER EVENTS

Exception Handling Techniques: Try-Catch,Re-throwing Exceptions,and Custom Exception Handling-Logging,Debugging, and Error Reporting Techniques- Handling User Events: Assistantbots, System Event Triggers, and Image and Element Triggers-Monitoring Techniques in RPA-Launching an Assistant bot on a Keyboard Event

UNIT V **9 Hours**

DEPLOYMENT AND MAINTENANCE OF BOT

Overview of Orchestration Server and its functionalities Orchestrator to Control Bots and Deploy Bots-Uploading Packages, Managing Packages,and Deleting Packages-Publishing and Managing Updates-Continuous Integration and Continuous Deployment (CI/CD) in RPA

Total: 45 Hours

Reference(s)

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Monrovia, CA, USA, APress, 2020.
2. Alok Mani Tripathi, Learning Robotic Process Automation, Packt Publishing, 2018.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant.
4. Srikanth Miranda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.
5. Christian Czarnecki, Peter Fettke, Robotic Process Automation: Management, Technology, Applications, 2021.
6. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, 1st Edition 2015.

22AM020 TEXT AND SPEECH ANALYSIS 2 0 2 3

Course Objectives

- Acquire a deep understanding of natural language processing (NLP) techniques.
- Develop expertise in text analysis through practical implementation of advanced techniques.
- Explore the fundamentals of speech processing.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the foundations of natural language processing and speech analysis
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Apply deep learning models for building speech recognition and text-to-speech systems
5. Infer co-reference and coherence for text processing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1	3								2	
2	3	1	2	1	3								3	
3	2	2	1	3	1								3	
4	2	1	1	1	2								3	
5	1	3	2	2	1								3	

UNIT I **6 Hours**
NATURAL LANGUAGE BASICS

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

UNIT II **6 Hours**
TEXT CLASSIFICATION
Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Deep Learning models for text classification– Recurrent Neural Networks (RNN) – Transformers –Text summarization and Topic Models

UNIT III **6 Hours**
QUESTION ANSWERING AND DIALOGUE SYSTEMS
Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chat bots – Design of dialogue systems -– evaluating dialogue systems

UNIT IV **6 Hours**
TEXT-TO-SPEECH SYNTHESIS
Text normalization - Letter-to-sound conversion -Prosody – Evaluation -Signal processing - Concatenative and parametric approaches - WaveNet and other deep learning-based TTS systems

UNIT V **6 Hours**
AUTOMATIC SPEECH RECOGNITION
Named Entity Recognition (NER)-Coreference resolution-Text coherence and cohesion-Advanced sentiment analysis-Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

EXPERIMENT 1 **3 Hours**
Create Regular expressions in Python for detecting word patterns and tokenizing text

EXPERIMENT 2 **3 Hours**
Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams

EXPERIMENT 3 **3 Hours**
Accessing Text Corpora using NLTK in Python

EXPERIMENT 4 **3 Hours**
Write a function that finds the 50 most frequently occurring words of a text that are not stop words

EXPERIMENT 5 **3 Hours**
Implement the Word2Vec model

EXPERIMENT 6 **3 Hours**
Use a transformer for implementing classification

EXPERIMENT 7 **5 Hours**
Design a Chabot with a simple dialog system

EXPERIMENT 8 **3 Hours**
Convert text to speech and find accuracy

EXPERIMENT 9 **4 Hours**

Design a speech recognition system and find the error rate

Total:30+30: 60 Hours

Reference(s)

1. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit"by StevenBird, Ewan Klein, and Edward Loper.
2. Speech and Language Processing:An Introduction to Natural Language Processing,Computational Linguistics, and Speech Recognition"by Daniel Juraf sky and JamesH. Martin.
3. TextMining: Classification, Clustering, and Applications"byAshokN.Srivastava and Mehran Sahami.
4. Deep Learning or Natural Language Processing: Creating Neural Networks with Python"by Palash Goyal, Sumit Pandey, and Karan Jain.
5. Speech and Language Processing for Human-Machine Communications"byJoseph Mariani, Gérard Chollet ,and Jacques Lévy.
6. Text Analytics with P ython:A Practical Real-World Approach to Gaining Actionable Insights from Your Data" by Dipanjan Sarkar.
7. Natural Language Processingin Action: Understanding, Analyzing, and Generating Text with Python" by Hobson Lane,Cole Howard, andHannes Hapke.
8. Speech and Language Processing:A Gentle Introduction" byGokhan Turand Renato DeMori.
9. Ethics of Artificial Intelligence and Robotics:A Human-Centered Approach"byVincentC.Müller.
10. Text to Speech Synthes is"by Paul Taylor.

22AM021 EDGE COMPUTING 3 0 0 3

Course Objectives

- To outline an overview of Edge Computing.
- To implement data analytics techniques over edge.
- To apply various security schemes for manipulation and storage service.
- To perform optimization problem using modeling framework.
- To use RaspberryPi for implement edge computing for industry and commercial purpose.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the fundamentals of Edge Computing
2. Implement the data analytics techniques over edge.
3. Apply security schemes for manipulation and storage service.
4. Perform optimization problem using modeling framework.
5. Use RaspberryPi for implement edge computing for industry and commercial purpose.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		3	3								2	
2	2	2		3	3								2	
3	2	3		2	3								3	
4	2	2		2	3								3	
5	2	2		2	1								3	

UNIT I **9 Hours**

INTRODUCTION

Introduction to Edge Computing Scenarios and Use cases-Edge computing purpose and definition, Edge computing use cases Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models-Edge, Fog and M2M.

UNIT II **9 Hours**

EDGE ANALYTICS

Data types Data Analytics Goals, Real Time Applications Phases of Data Analytics Types of Data Analytics Edge Data Analytics Potential Architecture of Edge Analytics Case study Machine learning for Edge Devices.

UNIT III **9 Hours**

EDGE DATA SECURITY

Security Data Confidentiality Identity Attribute based encryption Honey search Encryption Homomorphic Encryption Authentication Single Cross & Handover Privacy Preserving Schemes Secure search and Storage service in Edge.

UNIT IV **9 Hours**

OPTIMIZATION PROBLEMS

Case for optimization Formal modeling framework for Fog Edge computing Metrics Performance measures for Edge optimization Optimization opportunities for service life cycle.

UNIT V **9 Hours**

APPLICATIONS

Edge computing with RaspberryPi Industrial and Commercial IoT and Edge Edge computing and solutions.

Total: 45 Hours

Reference(s)

1. Edge Computing Fundamentals, Advances and Applications By K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy Ã,Â· 2021, ISBN:9781000483598, 1000483592.
2. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
3. Fog/Edge Computing For Security, Privacy, and Applications by Jie Wu, Wei Chang, and Springer International Publishing, 2021, ISBN: 9783030573287, 3030573281.
4. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806.
5. David Jensen, Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE

22AM022 INTELLIGENT ROBOTS AND DRONE TECHNOLOGY

3 0 0 3

Course Objectives

- To understand the Robot types and its sensors, actuators end effectors.
- To understand the basics of Unmanned Arial Vehicles (Drones) and its various applications.
- To impart the knowledge of how to fly a drone by considering the rules and regulations to the specific country.
- To understand the safety measures to be taken during flight.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Select the robot and its grippers based on application.
2. Select sensors and actuators for any robotic system.
3. Implement the various types of frame design for the UAV/Drones
4. Understand the basic working principal behind the electronic components used and its specification to build a drone from scratch.
5. To identify and understand various functional modules of the controller using a preprogrammed controller used in the UAV/Drones.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	3	3									
2	2	2	2	3	3								2	
3	2	3	2	2	3								2	
4	2	2	2	2	3								2	
5	2	2	3	2	1								3	

UNIT I **9 Hours**

ROBOTS INTRODUCTION

Introduction History growth Applications Laws of Robotics Classifications Work envelope Selection and Design Considerations robot teaching specification.

UNIT II **9 Hours**

ACTUATORS AND SENSORS

Actuators and types DC motors, BLDC servo motors. Introduction to sensors characteristics sensortypes Touch Potentiometer Encoder Force Range and proximity. Economic Analysis of Robots.

UNIT III **9 Hours**

DRONES FUNDAMENTALS

Introduction to UAVs/Drones Drones Working Principle and Design Types of Drones Motors Battery connectors Assembling the Drones Frame aerodynamics needed for flying Drone.

UNIT IV **9 Hours**

DRONE AND CONTROLLERS

How to Build a Drone Preparing APM planner Building Fellow me drone Arduino based drones GPS tracker using ESP8266.

UNIT V **9 Hours**

MAINTENANCE&APPLICATIONS

Building PrototypeDrones-GildingDrones-Racing Drones-Maintaining and troubleshooting ArtificialIntelligence techniques in Drones- Case study INSVikrantFlyingProjects.

Total: 45 Hours

Reference(s)

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G Robotics Control, Sensing, Vision, and Intelligence, McGraw Hill, 2015.
2. Pratihar.D.K, Fundamentals of Robotics, Narosa Publishing House, India, 2019.
3. Syed Omar Faruk Towaha, Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266, Packt Publishing, 2018.
4. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha 2016.
5. Handbook of Unmanned Aerial Vehicles Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014

22AM023 INTELLIGENT TRANSPORTATION SYSTEMS 3 0 0 3

Course Objectives

- To learn the fundamentals of ITS.
- To study the ITS functional areas.
- To have an overview of ITS implementation in developing countries.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Demonstrate the functionality of the transport system and security issues.
2. Classify the building blocks of intelligent transport system.
3. Construct the various data collection methodologies for ITS.
4. Summarize various communication protocols that can be used in transportation system.
5. Interpret the significance of ITS under Indian conditions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		2								2	
2	2	2	2		3								2	
3	2	3	2		2								1	
4	1		1										2	
5	2	2	2	1	3								2	

UNIT I **9 Hours**

INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM

Introduction to Intelligent Transportation Systems (ITS) Functions of ITS Components Challenges and Opportunities in ITS Architecture ITS Architecture Framework Logical Architecture Physical Architecture Organizational Architecture.

UNIT II **9 Hours**

TECHNOLOGY BUILDING BLOCKS OF ITS

Data Acquisition Data Analysis wireless adhoc networks Tele communication technologies Cellular wires Wireless application protocols Data and Information processing technologies Data warehousing Online Analytical Processing Voice Processing and Internet.

UNIT III **9 Hours**

DATA COLLECTION METHODS FOR ITS

Detection and Sensing technologies Road way sensors Environmental Sensors probe based sensors Blue tooth RFID Passive Active and BAP RFID systems Real time traffic monitoring using GPS probe Emergency management Incident management.

UNIT IV **9 Hours**

TRANSPORT MANAGEMENT SYSTEM

Vehicle to infrastructure communication Mobility management Integrated Traffic Management Junction Management Strategies ATMS - Route Guidance Predictive Guidance Dynamic Traffic Assignment (DTA).

UNIT V **9 Hours**

TRAVELLER AND INFORMATION SYSTEM

Basic TIS Concepts Pre Trip and Enroute Methods Smart Route System Dissemination to Travelers Evaluation of Information Value of Information Business Opportunities. Case Study Kavach system Automatic train track switching system.

Total: 45 Hours

Reference(s)

1. Sarkar, Pradip Kumar, Amit Kumar Jain, Intelligent Transport Systems, PHI Learning, 2018.
2. Rodolfo I. Meneguette, Robson E. De Grande, Intelligent Transport System in Smart Cities: Aspects and Challenges of vehicular networks and cloud, Springer, 2018.
3. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Fifth Edition, 2019.
4. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.
5. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.

22AM024 EXPERT SYSTEMS 3 0 0 3

Course Objectives

- Understand the concepts of intelligent agents, searching, knowledge and reasoning, planning and learning in expert systems.
- Illustrate the knowledge representation and acquisition in expert systems.
- Analyze the features, tools, limitations and applications of expert systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the features, tools, limitations and applications of expert systems.
2. Infer the procedure to build an expert system.
3. Analyze the requirement of knowledge acquisition in expert systems.
4. Represent the knowledge representation using rules, semantic nets, and frame in expert systems.
5. Interpret the concept of fuzzy expert systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1											1	
2	3	2	3	1	2								2	
3	2	2	2	2	3								2	
4	2	2	2	2	2								3	
5	2	3	2	2	2								3	

UNIT I **9 Hours**

INTRODUCTION TO EXPERT SYSTEMS

Definition Features of an expert system Architecture and Components of Expert System Roles in Expert Systems Stages in the Expert System development life cycle Sources of Error in Expert System Development Limitations and Applications of Expert Systems.

UNIT II **9 Hours**

BUILDING AN EXPERT SYSTEMS

Expert system tools Selecting a tool Evaluating the System Building tool Knowledge acquisition process Resources Inherent Limitations Common pitfalls in planning development Pitfalls in dealing with Domain Expert.

UNIT III **9 Hours**

KNOWLEDGE ACQUISITION IN EXPERT SYSTEMS

Knowledge Basics Knowledge Engineering Views of Knowledge Engineering Knowledge Acquisition Techniques Natural Techniques Contrived Techniques Modelling Techniques.

UNIT IV **9 Hours**

KNOWLEDGE REPRESENTATION IN EXPERT SYSTEMS

Definition- Characteristics Properties of the symbolic representation of knowledge Categories of Knowledge Representation Schemes Types of Knowledge Representational Schemes Formal Logic Semantic Net Frames Scripts Conceptual Dependency.

UNIT V **9 Hours**

FUZZY EXPERT SYSTEMS

Fuzzy Systems Fuzzy Rule Fuzzy Reasoning. Fuzzy Expert Systems Need for Fuzzy Expert Systems Operations Fuzzy Inference Systems The Fuzzy Inference Process in a Fuzzy Expert System Types of Fuzzy Expert Systems Fuzzy Controller

Total: 45 Hours

Reference(s)

1. Gupta, G. Nagpal, Artificial Intelligence and Expert Systems, Mercury Learning & Information, 2020.
2. Donald. A. Waterman, A Guide to Expert Systems, 3rd Edition, Pearson Education, 2009.
3. Giarratano and G. Riley, Expert Systems Principles and Programming, 4th Edition, PWS Publishing Company, 2004.
4. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999.
5. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education India, 2015.

22AM001 AGILE SOFTWARE DEVELOPMENT **3 0 0 3**

Course Objectives

- To provide students with a theoretical as well as practical understanding of agile software development practices.
- To understand the Agile Scrum framework and development practices.
- To apply software design principles and refactoring techniques to achieve agility.
- To understand Agile requirements and perform testing activities within an agile project.
- To understand the benefits and pitfalls of working in an Agile team in terms of quality assurance.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand genesis of Agile and driving forces for choosing Agile techniques.
2. Apply the Agile Scrum framework and development practices.
3. Apply iterative software development processes by planning and executing them.
4. Analyze the impact of the success of social aspects behind the software testing.
5. Analyze techniques and tools for improving team collaboration and management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2									2	2	
2	2	2	2										2	
3	1		2		2							2	2	
4	1		2		2							2	2	
5	1		2		2							2	2	

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile management, agile software development, traditional model vs agile model, classification of agile methods, agile manifesto and principles agile project management agile team interactions, ethics in agile teams, agility in design, testing, agile documentations, agile drivers, capabilities and values.

UNIT II **9 Hours**

AGILE PROCESSES

Extreme Programming, Method overview, lifecycle, work products, roles and practices, Lean production, SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, Kanban model.

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile information systems, agile decision making, Earl schools of KM, institutional knowledge evolution cycle,development, acquisition, refinement, distribution, deployment, leveraging, KM in software engineering, managing software knowledge, challenges of migrating to agile methodologies, agile knowledge sharing, role of story cards, Story, card Maturity Model (SMM).

UNIT IV **9 Hours**

AGILITY AND REQUIREMENTS ENGINEERING

Impact of agile processes in RE, current agile practices, variance, overview of RE using agile, managing unstable requirements, requirements elicitation, agile requirements abstraction model, requirements management in agile environment, agile requirements prioritization, agile requirements modelling and generation, concurrency in agile requirements generation

UNIT V **9 Hours**

AGILITY AND QUALITY ASSURANCE

Agile Interaction Design, Agile product development, Agile Metrics, Feature Driven Development (FDD), Financial and Production Metrics in FDD, Agile approach to Quality Assurance, Test Driven Development Pair programming, Issues and Challenges, Agile approach to Global Software Development.

Total: 45 Hours

Reference(s)

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), Agile Software Development, Current Research and Future Directions, Springer Verlag Berlin Heidelberg, 2010
2. Hazza & Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
3. Craig Larman, Agile and Iterative Development: A managers Guide, Addison Wesley, 2004
4. Kevin C. Desouza, Agile information systems: conceptualization, construction, and management, Butterworth-Heinemann, 2007.
5. David J. Anderson; Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003

22AM025 WEB FRAMEWORKS AND APPLICATIONS 3 0 0 3

Course Objectives

- To introduce the fundamentals of Internet, and the principles of web design.
- To construct basic websites using HTML and Cascading Style Sheets.
- To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
- To develop modern interactive web applications using Word Press, Django

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. 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

Course Outcomes (COs)

1. Describe the concepts of World Wide Web, and the requirements of effective web design
2. Develop web pages using the HTML and CSS features with different layouts as per need of applications.
3. Use the JavaScript to develop the dynamic web pages
4. Create and manage Blogs, Websites using Word Press.
5. Django is a high-level open-source Python web development framework for building websites. It's used in many large applications like YouTube and Spotify.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	1								2	1
2	3	2	1	1	1								2	2
3	2	1	1	1	1								2	2
4	3	2	1	1	1								2	1
5	2	2	1	1	1								2	2

UNIT I **9 Hours**

INTRODUCTION TO WEB DESIGN

Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, features of latest version of Web. Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

UNIT II **10 Hours**

HTML & STYLESHEETS

Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of latest version of HTML.Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of latest version of CSS.

UNIT III **9 Hours**

JAVASCRIPT

Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript and objects, JavaScript own objects, the DOM and web browserenvironments, Manipulation using DOM, forms and validations, DHTML: Combining HTML, CSS and JavaScript, Events and buttons.

UNIT IV **9 Hours**

INTRODUCTION TO WORDPRESS

How WordPress Works- Introduction to Blogging- Creating Blogs- Using Images-Wrapping Text Around Images-Comments-Post Formats- Linking to Posts- Pages and Categories- Using Smiles, - Links Manager-WordPress Feeds- Customizing Feeds- Use Gravatars in WordPress- Writing Code in Your Posts, -Using Password Protection, -Developing a Color Scheme- Designing Headers- CSS Horizontal Menus-Dynamic Menu Highlighting, Navigation Links-Next and Previous Links-Styling for Print

UNIT V **8 Hours**

INTRODUCTION TO DJANGO

Introduction to Back-End Web Development using Django-HTTP protocol MVC Model-Virtual Environment-Django Structure-Generic Views-HTML templates-URL dispatcher.

Total: 45 Hours

Reference(s)

1. Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2009.
2. Joel Sklar, Principles of Web Design, Cengage Learning, 6th Edition, 2015.
3. Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, andAbbey Deitel, 5th Edition, Pearson Education, 2011.
4. http://www.wpbeginner.com/beginners-guide/how-to-learn-wordpress-for-free-in-aweek-or-less/

22AM026 ECOMMERCE AND WEB DEVELOPMENT 3 0 0 3

Course Objectives

- Understand the fundamentals of web development
- Gain knowledge about the technologies used in ecommerce app development.
- Explore security considerations in ecommerce.
- Understand user experience (UX) principles in web development.
- Develop skills in data analysis and analytics for ecommerce.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.

Course Outcomes (COs)

1. Demonstrate the terms and trade cycle of E Commerce.
2. Design dynamic and interactive web pages by embedding Java Script in XHTML.
3. Develop an interactive Ecommerce Web App.
4. Apply UX principles to enhance the user experience.
5. Analyze ecommerce performance and user behavior through analytical tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2											
2	2	1	2	1										
3	2	1	2	1										
4	2		2											
5	2		2											

UNIT I **9 Hours**

INTRODUCTION TO ECOMMERCE

Introduction Scope of ecommerce Traditional Commerce Vs ECommerce Evolution of ecommerce Ecommerce business models Benefits and challenges of ecommerce Ecommerce trends and emerging technologies Electronic Commerce and the Trade Cycle Electronic Data Interchange (EDI) Legal and ethical aspects of ecommerce.

UNIT II **9 Hours**

WEB DEVELOPMENT FUNDAMENTALS

Introduction to XHTML and Editing XHTML Headings Linking Images- Special characters and Horizon rules - Lists Tables Forms Internal Linking Meta Elements Cascading Style Sheets. Introduction to Java script Control statements I, II Functions: Definition Recursion Arrays: Declaring and allocating arrays Multidimensional arrays Window object Events.

UNIT III **9 Hours**

WEB APPLICATIONTECHNOLOGIES

Web server (IIS and Apache): Multitier Architecture Client Server side scripting Server Side Scripting Fundamentals Implementation of Array Function Session Tracking String and Form Processing Database: Relational database SQL SQL Queries Database design and normalization connecting todatabase Database security and backup strategies. web development frameworks MVC (Model View Controller) architecture Building dynamic web applications. case study.

UNIT IV **9 Hours**

WEB USER EXPERIENCE (UX) TECHNOLOGIES

Principles of web design Typography color theory and visual design User experience and Usability Responsive and mobile friendly Design-Ecommerce Platforms and Technologies Introduction to ecommerce platforms (Woo Commerce, Shopify) Payment gateways Content Management Systems (CMS) Security and privacy in ecommerce.

UNIT V **9 Hours**

ECOMMERCE WEB APP DEVELOPMENT

Introduction Product catalog management Shopping cart implementation Order processing and fulfillment Ecommerce Analytics and SEO (Search Engine Optimization): Tracking and analyzing user behavior Conversion rate optimization SEO techniques for ecommerce websites Data visualization and reporting tools case study

Total: 45 Hours

Reference(s)

1. "Learning Web Design: A Beginners Guide to HTML, CSS, JavaScript, and Web Graphics by Jennifer Niederst Robbins
2. Web Development and Design Foundations with HTML5 by Terry Felke-Morris
3. "Ecommerce Evolved: The Essential Playbook to Build, Grow & Scale a Successful Ecommerce Business" by Tanner Larsson
4. "Database Systems: Design, Implementation, & Management" by Carlos Coronel, Steven Morris, and Peter Rob
5. "The Design of Everyday Things" by Don Norman (for UX design principles)

22AM027 MOBILE AND WEB APPLICATION **3 0 0 3**

Course Objectives

- Understand the concept of Mobile system
- Understand the mobile application development
- Understand the mobile OS
- Understand the concepts Android and IOS

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Build interface for mobile applications and web applications
2. Design mobile application for Android platform using primitive UI features, SQLite and GPS
3. Design a mobile application for Android platform using advanced features like animations and graphics.
4. Develop mobile application for IOS platform

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **9 Hours**

INTRODUCTION

Introduction to mobile applications cost of development Market and business drivers for mobile applications Publishing and delivery of mobile applications Requirements gathering and validation for mobile applications. Third party Frameworks. Mobile Content Mobile Applications.

UNIT II **9 Hours**

BASIC DESIGN

Introduction to Web Services Web service language Format Creating a Web service using Microsoft stack Using the Linux Apache MySQL PHP (LAMP) Stack Debugging Web Services. Mobile User Interface Design. Mobile Web Apps Using HTML5.

UNIT III **9 Hours**

ANDROID

Introduction to Android IOS Android Studio UI Elements Activity Intent Menus Containers Layouts - Fragments Permissions. Data storage types of Data Storage Shared Preferences Internal Storage External Storage cache . Storage SQLite Firebase storage.

UNIT IV **9 Hours**

NOTIFICATIONS AND SENSORS

Notifications Toast Alerts Dialog Builder Sensor Registers Reading value Event Listeners Handlers. GOOGLE SIGNIN: Developer Console API Key Dependencies Session Management Revoke Access. GOOGLE MAPS: Maps API key Google Map UI Map types Getting Location Places Search View

UNIT V **9 Hours**

TECHNOLOGY III - IOS

Introduction to Objective C iOS features UI implementation Touch frameworks Data persistence using Core Data and SQLite Location aware applications using Core Location and Map Kit Integrating calendar and address book with social media application Using Wi Fi CASE STUDY iPhone marketplace and mobile application development.

Total: 45 Hours

Reference(s)

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, Wiley Publications, 2012
2. Charlie Collins, Michael Galpin and Matthias Kappler, Android in Practice, Manning Publications Co., 2012
3. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, Beginning iOS 6 Development:
4. Dawn Griffiths and David Griffiths ,Head First Android Development, Second Edition , OReilly 2018
5. Bill Phillips, Chris Stewart and Kristin Marsicano, Android Programming, Third Edition, Big Nerd Ranch Guides, February 9, 2017.

22AM028 NOSQL DATABASE **2 0 2 3**

Course Objectives

- Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
- Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
- Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.

Course Outcomes (COs)

1. Explain and compare different types of NoSQL Databases.
2. Compare and contrast RDBMS with different NoSQL databases.
3. Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases.
4. Explain performance tune of Key-Value Pair NoSQL databases.
5. Apply Nosql development tools on different types of NoSQL Databases.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	1									
2	3	2	1	1	1									
3	2	1	1	1	1									
4	3	2	1	1	1									
5	2	2	1	1	1									

UNIT I **6 Hours**

INTRODUCTIONTO NOSQL CONCEPTS

Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Applicationand Integration Databases, Attack of the Clusters, The Emergence of NoSQL.

UNIT II **6 Hours**

KEY VALUE DATABASE

Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, KeyValue and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. Replication and sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

UNIT III **6 Hours**

DOCUMENT ORIENTED DATABASE

NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency,Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.

UNIT IV **6 Hours**

COLUMNAR DATA MODEL

Column- oriented NoSQL databases using Apache HBASE, Colum oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.

UNIT V **6 Hours**

DATA MODELING WITH GRAPH

NoSQL Key/Value databases using Riak, Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets. Graph NoSQL databases using Neo4,NoSQL database development tools and programming languages, Graph Databases, Graph Database. Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases.

1 **5 Hours**

EXPERIMENT 1

Implementation of Document Document-Oriented Database (MongoDB) to perform CRUD operations,Indexing,Sharding query optimization and data modeling

2 **5 Hours**

EXPERIMENT 2

Implementation of Column-Family Store (Apache Cassandra) to perform data modeling and querying.

3 **5 Hours**

EXPERIMENT 3

Create a database that stores road cars. Cars have a manufacturer ,a type. Each car has a maximum performance and a maximum torque value. Do the following: Test Cassandra's replication schema and consistency models

4 **5 Hours**

EXPERIMENT 4

Implementation of Column-Family Store (Apache Cassandra) to set up replication across multiple nodes and observe read write operation.

5 **5 Hours**

EXPERIMENT 5

Implementation of Graph Database (Neo4j) to demonstrate graph algorithms.

6 **5 Hours**

EXPERIMENT 6

Download a zip code dataset at httpmedia.mongodb.orgzips.json Use mongo import to import the zip code dataset into MongoDB. After importing the data, answer the following questions by using aggregation pipelines: 1Find all the states that have a city called BOSTON. Find all the states and cities whose names include the string BOST. Each city has several zip codes. Find the city in each state with the most number of zip codes and rank those cities along with the states using the city populations. MongoDB can query on spatial information.

Total: 30+30:60 Hours

Reference(s)

1. Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN- 13: 978-9332557338).
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022).
3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O"Reilly Publications, 2013. (ISBN-13: 978-9351102694).

22AM029 SMART PRODUCT DEVELOPMENT 3 0 0 3

Course Objectives

- Understand the fundamentals of Product development and its processes.
- Understand how smart system processes and its functional elements.
- Learn the mapping for smart systems in Industry 4.0
- Understand the processes in product design & development
- Understand how Smart Product Development helps multidisciplinary Engineering

Programme Outcomes (POs)

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

b. 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.

c. 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.

Course Outcomes (COs)

1. Identify the key elements in smart product technologies in Industry
2. Compare the existing smart systems and products in the industry
3. Design a Smart Expert System
4. Develop a Smart Expert System
5. Develop the processes in product design & development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1											
2	3	3	3											
3	2	2	2											
4	2	2	2											
5	2	2	2											

UNIT I **9 Hours**

PRODUCT DEVELOPMENT PROCESSES AND SMART PROCESS ELEMENTS

Product Development Life Cycle, Process Models Prototyping Agile Models New Product Development Processes Knowledge based/driven development Principal Issues and Challenges. User and Customer Research User observation Customer interviews Competitor landscape, Cost Analysis Product teardown Analysis input mapping, Concept generation Analysis wrap up idea generation-idea evaluation-concept formulation, Prototype Testing.

UNIT II **9 Hours**

SMART TECHNOLOGIES 4.0 AND KNOWLEDGE BASED SYSTEM DEVELOPMENT

Cloud Services, Big data & Analytics, Engineering Simulation, 3D printing, Additive Manufacturing. Knowledge Discovery, Knowledge Representation, Knowledge Catalogue, Knowledge Graphs, Knowledge Visualization.

UNIT III **9 Hours**

DEEP QA PROCESSES

Deep QA Architecture, Exploring Deep QA Question Analysis Primary Search Hypothesis Generation Merging and Ranking, Micro services and Robust Tooling in Deep QA.

UNIT IV **9 Hours**

WATSON

Watson Community Services and Watson Discovery Services, Watson Deep Learning, Chatbot, Natural Language Classifier, Concept Expansion, Concept Insights, Language Identifications and Translations, Visualization and Rendering.

UNIT V **9 Hours**

DESIGN OF AN EXPERT SYSTEM

Expert System Architectures, An analysis of some classic expert systems WATSON, Deep expert systems, Co operating expert systems and the blackboard model. Contemporary Issues.

Total: 45 Hours

Reference(s)

1. "Smart Product Design", Send points Publications, 2017
2. Grega Jakus, Veljko Milutinovic, Sanida Omerovic, Saso Tomazic, Concepts, Ontologies and Knowledge Representation, Springer, 2013
3. Ronald J. Brachman and Hector J.Levesque, Knowledge representation and reasoning, 2nd edition, Elsevier publications, 2004.
4. Simon Kendal, Malcolm Creen, An Introduction to Knowledge Engineering, Springer, ISBN-13: 978-1846284755, 2007.

22AM030 BIO MEDICAL IMAGE ANALYSIS 2 0 2 3

Course Objectives

- Understand Nature of Biomedical Images, Image Enhancement and Filtering for removal of artifacts
- Understand the image segmentation and analysis of Image shape and Texture
- Understand the pattern classification and diagnostic decision.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Capable of survey image processing techniques.
2. Apply the theoretical background of Image processing to solve biomedical imaging problems
3. Represent and recognize objects through patterns in application.
4. Analyze various techniques involved in biomedical systems.
5. Modeling biomedical systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **9 Hours**

THE NATURE OF BIOMEDICAL IMAGES

The Nature of Biomedical Images: Objectives of Biomedical Image Analysis, Computer aided Diagnosis. Image Quality and Information Content: Acquisition and Analysis, The Fourier Transform and Spectral Content.

UNIT II **9 Hours**

REMOVALOF ARTIFACTS

Removal of Artifacts: Random noise, Signal dependent noise, Space domain Local statistics based Filters, Frequency domain Filters. Image Enhancement: Greyscale Transforms, Histogram Transformation, Convolution Mask Operators, Homomorphism Filtering for Enhancement. Detection of Regions of Interest

UNIT III **9 Hours**

ANALYSIS OF SHAPE

Analysis of Shape: Representation of Shapes and Contours, Shape Factors, Fourier Descriptors Analysis of Texture: Texture in Biomedical Images, Statistical Analysis of Texture, Fourier domain Analysis of Texture.

UNIT IV **9 Hours**

ANALYSIS OF ORIENTED PATTERNS

Analysis of Oriented Patterns: Oriented Patterns in Images, Measures of Directional Distribution, Directional Filtering, Gabor Filters, Directional Analysis via Multiscale Edge Detection

UNIT V **9 Hours**

PATTERNS ANALYSIS DECISION

Pattern Classification and Diagnostic Decision: Pattern Classification, Probabilistic Models and Statistical Decision, Logistic Regression, Neural Networks, Measures of Diagnostic Accuracy, Reliability of Features, Classifiers and Decisions.

1 **6 Hours**

EXPERIMENT 1

Experiment Description: Develop and implement algorithms for automated cell counting and nucleus detection in microscopy images. Utilize CellProfiler, a modular high-throughput image analysis software, to enhance the structure, function, and compatibility of the analysis.

2 **6 Hours**

EXPERIMENT 2

Experiment Description: Create and validate a deep learning algorithm for automated detection of diabetic retinopathy in retinal fundus photographs. Employ advanced computational methods to aid in the early and accurate identification of diabetic retinopathy for effective medical intervention.

3 **6 Hours**

EXPERIMENT 3

Experiment Description: Focus on developing robust segmentation techniques to identify and characterize tumor regions in breast MRI images. Implement quantitative imaging biomarkers, such as the Yen method, to improve the accuracy and efficiency of breast cancer diagnosis and assessment.

4 **6 Hours**

EXPERIMENT 4

Experiment Description: Utilize diffusion tensor imaging (DTI) to analyze white matter tracts in the brain. Implement three-dimensional tracking methods to visualize and track axonal projections, providing critical insights into brain connectivity and neurological conditions.

5 **6 Hours**

EXPERIMENT 5

Experiment Description: Develop a system to quantitatively analyze cardiac function parameters, including rejection fraction and wall motion abnormalities, using echocardiography images. Adhere to the recommendations provided by the American Society of Echocardiography and the European Association ofCardiovascular Imaging for accurate cardiac disease assessment.

Total:45+30: 75 Hours

Reference(s)

1. Rangaraj M Rangayyan, R. M. Biomedical Image Analysis, CRC Press, 2005.
2. Gonzalez, Rafael C. and Woods, Richard E. Digital Image Processing, Addison Wesley, 3rdEdition, reprint 2008.
3. Jain, Anil K. Fundamentals of digital image processing, PHI, 2002.
4. Chanda and Majumder,D. Dutta. Digital image processing and Analysis, PHI, 2002.
5. M. A.Joshi, Digital Image Processing: An algorithmic approach, 2nd Edition. PHI 2009
6. John C.Russ, The Image Processing Handbook, CRC Press,2007.

22AM031 DATA ANALYTICS AND DATA SCIENCE 3 0 0 3

Course Objectives

- Build computational abilities, inferential thinking, and practical skills for tackling core data scientific challenges
- Explores foundational concepts in data management, processing, statistical computing, and dynamic visualization using modern programming tools.
- Introduce modern data analytic techniques and develop skills for importing and exporting,cleaning and fusing, modeling and visualizing, analyzing and synthesizing complex datasets.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Identify exploratory and statistical analysis methods to prepare the big data Build interface for mobile applications and web applications.
2. Choose basic tools to carry out exploratory data analysis and produce effective visualization of given data Design mobile application for Android platform using primitive UI features, SQLiteand GPS.
3. Perform parallel data processing and duplication with Hadoop and Map-Reduce. Design a mobile application for Android platform using advanced features like animations and graphics.
4. Understand the basic working principal behind the electronic components used and its specification to build a drone from scratch.
5. To identify and understand various functional modules of the controller using a preprogrammed controller used in the UAV/Drones.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **9 Hours**

DATA SCIENCE BASICS

Mathematics foundations for data science, Statistical inference Statistical modelling, Probability distributions, Fitting a model, Exploratory Data Analysis(EDA) and data visualization Basic tools (Plots, Graphs and Summary statistics) of EDA, Data science process, Data visualization Basic principles, ideas and tools for visualization, Analytic processes and tools Analysis Vs Reporting

UNIT II **9 Hours**

BIG DATA DATABASES

Big data platform Challenges of conventional systems Intelligent data analysis Transition to big data databases Map reduce Hadoop, HBase, Hive, MapR Sharding NOSQL databases Hadoop distributed file systems Anatomy of file write and read PIG,HIVE,SPARK.

UNIT III **9 Hours**

MINING DATA STREAMS

Stream data model and architecture Stream computing, sampling data in a stream Filtering streams Counting distinct elements in a stream Estimating moments Counting oneness in window Decaying window Real time analytics platform (RTAP) applications.

UNIT IV **9 Hours**

DESCRIPTIVE ANALYTICS

Mining frequent item sets Apriori algorithm Handling large data sets in main memory Limited pass algorithm Segmentation techniques Hierarchical KMeans Clustering high dimensional data CLIQUE and PROCLUS Clustering in non-Euclidean space Clustering for streams and parallelism, online algorithms.

UNIT V **9 Hours**

CASE STUDIES - PRESCRIPTIVE ANALYTICS

Optimization and Simulation with Multiple Objectives, Text Analytics Text Analytics methods metrics-Applications, Predictive Analytics Models Evaluation Applications.

Total: 45 Hours

Reference(s)

1. Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world. Cambridge University Press, 2010
2. Cathy O"Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O"Reilly.2014.
3. Jure Leskovek, AnandRajaraman and Je_rey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014.
4. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know aboutData Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
5. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data,EMC Education Services, Wiley, 2015
6. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

22AM032 VIDEO ANALYTICS 3 0 0 3

Course Objectives

- Understand the need for video Analytics
- Understand the basic configuration of video analytics
- Understand the functional blocks of a video analytic system.
- Get exposed to the various applications of video analytics.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Design video analytic algorithms for security applications.
2. Design video analytic algorithms for business intelligence
3. Design custom made video analytics systems for the given target application.
4. Understand the algorithms available for performing analysis on video data and address the challenges
5. Understand the functional blocks of a video analytic system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **9 Hours**

VIDEO ANALYTIC COMPONENTS

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction - classifier - Pre-processing- edge detection-smoothing- Feature space-PCA-FLD-SIFT features.

UNIT II **9 Hours**

FOREGROUND EXTRACTION

Background estimation Averaging Gaussian Mixture Model Optical Flow based Image Segmentation Region growing Region splitting Morphological operations erosion-Dilation Tracking in a multiple camera environment.

UNIT III **9 Hours**

CLASSIFIERS

Neural networks (back propagation) Deep learning networks Fuzzy Classifier Bayesian classifier HMM based classifier.

UNIT IV **9 Hours**

LEAD MANAGEMENT

Web to lead forms Web to case forms Lead generation techniques Leads are everywhere social media and lead gen Inbuilt tools for Digital Marketing Ip Tracker CPC reduction (in case of paid ads) Group posting on Social Media platforms.

UNIT V **9 Hours**

VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE

Customer behavior analysis people counting- Traffic rule violation detection traffic congestion identification for route planning driver assistance lane change warning.

Total: 45 Hours

Reference(s)

1. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video- Based Surveillance Systems: Computer Vision and Distributed Processing, Kluwer academic publisher, 2001.
2. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video
3. Zhihao Chen (Author), Ye Yang (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, Create Space Independent Publishing Platform,2014
4. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012.

22AM033 CYBER THREAT ANALYTICS 3 0 0 3

Course Objectives

- Understand how to leverage intelligence to understand adversary behavior and make use of indicators of compromise to detect and stop malware.
- Understand the security problems and defend the cyberspace.
- Understand and protect against attacks, threats and intrusion.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Develop incident response skills to combat network and system.
2. Classify various types of attacks and learn the tools to launch the attacks
3. Evaluate the security of network and system
4. Review and analyze threat intelligence logs and reports.
5. Discover and Respond to the threats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1									2	2
2	1	3	1	3	2								2	2
3	2	1	1	1									2	2
4	3	3	2	2	2								2	2
5	3	2	1	1	1								2	2

UNIT I **9 Hours**

CYBER ATTACKS, INTRUSIONS, THREATS

Introduction to cyber-attacks, attack model, Adversary Types, Vulnerability Types, Threat Types, Attacks vs. Intrusion, DDoS, Types, Malware, malware Types, Introduction to Dark net, Cyber crimes.

UNIT II **9 Hours**

CYBER THREATS AND INTRUSION KILL CHAIN

Introduction to Advanced Persistent Threats, Intrusion Kill Chain, Zero days, Attack surface, Attack vectors, Evasion techniques Host and Network level evasions, Covert Communication: Infiltration and Exfiltration, Advanced Evasion techniques

UNIT III **9 Hours**

THREAT INTELLIGENCE

Cyber Threat Intelligence (CTI), Overview of Threat Intelligence Lifecycle and Frameworks, CTI types, generic threat actor, Indicators of Compromise (IoCs).

UNIT IV **9 Hours**

THREAT INTELLIGENCE MODEL

Campaign analysis, Diamond model, Threat intel methodologies, Intrusion reconstruction, OSINT, Challenges with detection intrusions.

UNIT V **9 Hours**

SECURITY OPERATION CENTRE (SOC)

Introduction to SIEM, Threat Intelligence Data Collection, Threat Intelligence Collection Management, Threat Intelligence Data Feeds and Sources, Data Processing and analysis, building your own SOC, Visualizing the threat intelligence data. Threat Intelligence Reports: Baseline and Diff, Blacklists and Whitelists, Tracking, Integration.

Total: 45 Hours

Reference(s)

1. Wilson Bautista, Practical Cyber Intelligence: How Action-based Intelligence Can be an Effective Response to Incidents, 2018, Packt publisher.
2. Arun E Thomas, Security Operations Center - SIEM Use Cases and Cyber Threat Intelligence, 2018.
3. Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux and Mac Memory, Wiley Publisher.
4. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, Elsevier.
5. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, Syngress publisher.

22AM034 BUSINESS INTELLIGENCE 3 0 0 3

Course Objectives

- To give an insight into Business Intelligence and its concepts.
- To enable the students in understanding project planning and application development.
- To introduce the students to modern information technology.
- To comprehend the process of acquiring Business Intelligence.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Understand the use of Business Intelligence for Decision Support.
2. Execute a Business Intelligence Project by proper planning and analysis.
3. Carry out Meta Data Repository Analysis.
4. Design, implement and evaluate the meta data application.
5. Understand the modern information technology and its business opportunities.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	1	1								3	2
2	3	3	3	2	3								3	1
3	2	2	3	3	2								3	1
4	2	1	2	2	2								1	3
5	2	3	3	3	2								3	1

UNIT I **9 Hours**

INTRODUCTION

Definition, BI process- Private and Public intelligence, BI Decision Support Initiatives, Business Drivers, Cost-Benefit analysis, Risk Assessment, Enterprise Infrastructure Evaluation-Technical and Non-technical -Risk Assessment Tools.

UNIT II **9 Hours**

PROJECTPLANNINGAND DATAANALYSIS

BI Project planning, Requirements definition and gathering, deliverables, Business focused data analysis, Top-down Logical data modeling, Bottom-up source data analysis, data cleansing, Prototyping. Metrics of Deliverables.

UNIT III **9 Hours**

METADATAREPOSITORYANALYSIS AND DESIGN

Meta Data models, Analysis, Database design, Extract/ Transform / Load (ETL) design, Metadata design, ETL Development-Descriptive Metadata.

UNIT IV **9 Hours**

APPLICATION DEVELOPMENT

OLAP Tools-Multidimensional analysis factors, architecture Data mining, Risks, Metadata repository Development Implementation- Release Evaluation- Data Clustering

UNIT V **9 Hours**

MODERN INFORMATION TECHNOLOGY AND ITS BUSINESS OPPORTUNITIES

Business intelligence software, BI on web, Ethical and legal limits, Industrial espionage, BI software, Modern techniques of crypto analysis, Managing and organizing for an effective BI Team. Symmetric-key cryptography.

Total: 45 Hours

Reference(s)

1. Larissa T. Moss and Shaku Atre, Business Intelligence Roadmap: The complete project Lifecycle for Decision Support Applications, Addison Wesley, 2011.
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2010
3. Elizabeth Vitt and Michael Luckevich StaciaMisner, Business Intelligence, Microsoft, 2010.
4. Z. Michalewicz, M. Schmidt. M. Michalewicz and C. Chiriac, Adaptive Business Intelligence, Springer Verlag, 2009.
5. GalitShmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence Concepts, Techniques and Applications Wiley India, 2011.

22AM035 DIGITIAL MARKETING AND TECHNIQUES 3 0 0 3

Course Objectives

- Understand the overview of Digital Marketing.
- Examine the role and importance of digital marketing in the business environment.
- Determine the focuses on digital marketing and its measure

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Identify some of the latest digital marketing trends and skills sets needed for today's Marketer.
2. Compare the strengths and limitations of search engine optimization.
3. Apply the suitable techniques for E-Mail Marketing.
4. 1Discover the hottest techniques to help to successfully plan, predict, and manage your digital Marketing campaigns.
5. Evaluate the importance of your digital marketing assets, which ones actually matter the most to your business.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		1								1	1
2	2	2	3		3								2	3
3	1	3	3		3								2	2
4	2	2	2		3								1	2
5	2	2	1		3								2	3

UNIT I **9 Hours**

INTRODUCTION TO ONLINE MARKET

Online Market space Digital Marketing Strategy Components Opportunities for building Brand Website Planning and Creation Content Marketing.

UNIT II **9 Hours**

SEARCH ENGINE OPTIMISATION

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 III **9 Hours**

E- MAIL MARKETING

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.

UNIT IV **9 Hours**

SOCIAL MEDIA MARKETING

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 V **9 Hours**

DIGITAL TRANSFORMATION

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: 45 Hours

Reference(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. Michael Millerth, B2B Digital Marketing: Using the Web to Market Directly to Businesses,first edition, Que Biz-Tech series2012.
5. Dave Chaffey, Fiona Ellis Chadwick, Digital Marketing: Strategy, Implementation & Practice, Paperback - Import, 2012.

22AM036 INTERNET OF THINGS AND ITS APPLICATION

3 0 0 3

Course Objectives

- Understand how connected devices work together to update other applications
- Acquire knowledge to interface sensors and actuators with microcontroller-based Arduino/Raspberry Pi platform.
- Understand the Communication between microcontroller and PC using IOT protocol
- Understand IoTsecurity and challenges
- Understand IoT applications with case studies.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Interpret the impact and challenges posed by IoT networks leading to new architectural models.
2. Design portable IoT using Arduino/Raspberry Pi /open platform.
3. Appraise the role of IoT protocols for efficient network communication.
4. Elaborate the need for IOT security and challenges.
5. Analyze applications of IoT in real time scenario

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	1	1								2	2
2	3	3	2	3	3								1	3
3	2	3	3	2	2								1	2
4	1	1	2	2	2								3	2
5	3	2	3	2	2								1	2

UNIT I **6 Hours**

INTRODUCTION TO IOT

IoT Definition, IoT characteristics, M2M and IoT, End to End IoT Architecture, Physical design of IoT, Logical Design of IoT, Overview of IoT protocols, IoT levels and deployment templates, Challenges for IoT, Interdependencies of IoT and cloud computing, Web of things.

UNIT II **12 Hours**

EMBEDDED IOT DEVICES

Sensors and actuators for IoT applications, IoT components and implementation, Programming of Node MCU and Raspberry PI, Implementation of IoT with Edge devices, reading sensor data and transmit to cloud, controlling devices through cloud using mobile application and web application, Types and configurations of gateways, Specifications of IoT gateways

UNIT III **10 Hours**

IOT PROTOCOLS

Link layer protocols, Network/internet layer protocols, Transport layer protocols, Application layer protocols:Hypertext transfer protocol (HTTP), Systematic HTTP access methodology, Web Socket, Constrained application protocol CoAP), Message Queue Telemetry Transport Protocol (MQTT), XMPP, DDS, AMQP .

UNIT IV **7 Hours**

IOT SECURITY AND CHALLENGES

IOT Security, Dangers, Assigning values to Information, Security Components, Key Management, Update Management, Challenges in IoT security.

UNIT V **10 Hours**

IOT APPLICATIONS AND CASE STUDY

Broad categories of IoT applications: Consumer IoT, Commercial IoT, Industrial IoT, Infrastructure IoT, Military Things (IoMT).IoT Case studies: Home automation with IoT, River water pollution monitoring, Smart city street light control and monitoring, Health care monitoring, Voice Apps on IoT device

Total: 45 Hours

Reference(s)

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743),2017.
2. Srinivasa K G, Internet of Things,CENGAGE Leaning India, 2017
3. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Handson-Approach), 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
4. Raj Kamal, Internet of Things: Architecture and Design Principles, 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224).
5. A. McEwen, H. Cassimally, Designing the Internet of Things, Wiley, 2013.

22AM037 BIOINFORMATICS 3 0 0 3

Course Objectives

- Understand the fundamental concepts of structural biology (chemical building blocks, structure, superstructure, folding, etc.)
- Acquire knowledge the sequence and structure alignment, protein structure prediction, protein folding, and protein- protein interaction
- Understand and use bioinformatics databases and understand protein design
- Understand the current approaches in bioinformatics application.
- Understand the methodology of protein structure prediction and assessment.

Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Apply computational based solutions for biological perspectives.
2. Practice life-long learning of applied biological science
3. Develop the ability to design, predict, analyze and compare the protein structures as well as predict the function of target proteins.
4. Ability to reach the frontier of bioinformatics and use bioinformatics tools to solve the research problems.
5. Develop bioinformatics tools with programming skills.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	2								3	2
2	3	3	3	1	2								3	1
3	2	2	2	1	2								3	1
4	2	2	2	1	1								1	3
5	2	2	2	1	1								3	1

UNIT I **7 Hours**

BASICS OF BIOINFORMATICS

Introduction: What is bioinformatics, Principles of protein structure, Tertiary structure, Quaternary structure,Similarity of ternary and quaternary structure; Bioinformatics databases: Introduction, Nucleotide sequence databases, Protein sequence databases, Sequence motif databases, Protein structure database.

UNIT II **10 Hours**

SEQUENCE ALIGNMENT

Similarity and Homology, Types of divergence, Conserved regions, Methodological principles, Substitution scores, Insertion/deletion scores, Statistical significance, Database search, Multiple alignment, Structure alignment, matching algorithms, Searching 3D Databases.

UNIT III **8 Hours**

PROTEIN STRUCTURE AND MODELING

Protein secondary structure: Introduction, Hydrogen bond, defining a secondary structure element, Methods for predicting secondary structure; Experimental methods for protein structure determination: X-ray crystallography, Nuclear magnetic resonance (NMR); Protein folding and dynamic simulation.

UNIT IV **10 Hours**

CURRENT TECHNIQUES AND DRUG DISCOVERY

Bayesian Networks, Nearest neighbourhood approach, Neural Networks, Genetic algorithms, Ensemble learning. Computer Aided Drug Designing (CADD): SBDD, LBDD, Drug discovery, Drug Target Identification, Drug Target Validation.

UNIT V **10 Hours**

STRUCTURAL DOMAINS IN PROTEIN AND APPLIED BIOINFORMATICS TOOLS

Basics, First and second-generation algorithms for domain assignments, domain assignment based on graph theoretical methods, prediction of binding sites and characterization. Designing protein interfaces: Designing for affinity,designing for specificity. Entrez, ExPASy, BLAST: Online and Local BLAST, Motif Search: SMART Search, MEME Search, HMM Search, Scoring Matrix, Dotlet.

Total: 45 Hours

Reference(s)

1. Bioinformatics and Functional Genomics (2nd edition) by Jonathan Pevsner, Wiley-Liss,2015.
2. Basics of Bioinformatics: Lecture notes of the Graduate Summer School, Rui Jiang, Zhang, Springer,2013.
3. Bioinformatics Databases: Design, Implementation, and Usage by SorinDraghici,2013
4. Keedwell, Edward, and Ajit Narayanan. Intelligent bioinformatics: The application of artificial intelligence techniques to bioinformatics problems. John Wiley & Sons, 2005.
5. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.
6. Structural Bioinformatics (2nd Edition), Jenny Gu, Philip E. Bourne, 2009.

22AM038 SOCIAL AND INFORMATION NETWORKS 3 0 0 3

Course Objectives

- Understand the components of social networks.
- Facsimiles and visualize social networks.
- Understand the role of semantic web in social networks.
- Habituate with the security concepts of social networks.
- Discern the various applications of social networks.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.

Course Outcomes (COs)

1. Illustrate the basic components of social networks.
2. Analyze the different measurements and metrics of social networks.
3. Apply different techniques to detect and evaluate communities in social networks.
4. Apply various types of social network models.
5. Apply semantic web format to represent social networks.
6. Develop social network applications using visualization tools.
7. Usage of the security features in social and information networks for various practical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	1									
2	3	3	3	1	1									
3	2	2	2	1	1									
4	2	2	2	1	1									
5	2	2	2	1	1									

UNIT I **9 Hours**

INTRODUCTION

Introduction to social network analysis Fundamental concepts in network analysis social network data notations for social network data Graphs and Matrices. Measures and Metrics: Strategic network formation - network centrality measures: degree, betweenness, closeness, eigenvector - network centralization density reciprocity transitivity ego network measures for ego network - dyadic network triadic network - cliques - groups- clustering search.

UNIT II **9 Hours**

COMMUNITYNETWORKS

Community structure modularity, overlapping communities detecting communities in social networks Discovering communities: methodology, applications community measurement evaluating communities applications.

UNIT III **9 Hours**

MODELS

Small world network Watts Strogatz networks Statistical Models for Social Networks Network evolution models: dynamical models, growing models Nodal attribute model: exponential random graph models Preferential attachment Power Law random network model: Erdos Renyi and Barabasi AlbertEpidemics Hybrid models of Network Formation.

UNIT IV **9 Hours**

SEMANTIC WEB

Modelling and aggregating social network data developing social semantic application evaluation of web-based social network extraction Data Mining Text Mining in social network tools-case study.

UNIT V **9 Hours**

VISUALIZATION AND SECURITY APPLICATIONS

Visualization of social networks novel visualizations and interactions for social networks applications of social network analysis tools sna: R Tools for Social Network Analysis Social Networks Visualiser (SocNetV) Pajek.

Total: 45 Hours

Reference(s)

1. Stanley Wasserman, Katherine Faust, Social network analysis: Methods and applications, Cambridge university press, 2009.
2. John Scott, Social network analysis, 3rd edition, SAGE, 2013.
3. Borko Furht, Handbook of Social Network Technologies and applications, Springer, 2010.
4. Jalal Kawash, Online Social Media Analysis and Visualization, 2015.
5. Charu Aggarwal, Social Network data analysis, Springer, 2011.
6. Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world. Cambridge University Press, 2010.

22AM039 INFORMATION STORAGE MANAGEMENT **3 0 0 3**

Course Objectives

- Understand the challenges in information storage and management
- Understand the core elements in a data center.
- Understand RAID and its various levels for data backup

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Explain physical and logical components of a storage infrastructure including storage subsystems, RAID and intelligent storage systems.
2. Describe storage networking technologies such as FC-SAN, IP-SAN, FCoE, NAS and object-based and unified storage.
3. Illustrate and articulate business continuity solutions, backup and replications, along with archives for managing fixed content.
4. Explain key characteristics, services, deployment models, and infrastructure components for Cloud computing.
5. Implement the concept of security storage infrastructure management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **9 Hours**

STORAGE SYSTEM

Introduction to information storage, Virtualization and cloud computing, Key data centre elements, Compute, application, and storage virtualization, Disk dive & flash drive components and performance, RAID, Intelligent storage system and storage provisioning (including virtual provisioning)

UNIT II **9 Hours**

STORAGENETWORKING TECHNOLOGIES AND VIRTUALIZATION

Fibre Channel SAN components, FC protocol and operations, Block level storage virtualization, iSCL and FCIP as an IP-SAN solution, converged networking option FcoE, Network Attached Storage (NAS) components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.

UNIT III **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Business continuity terminologies, planning and solutions, Clustering and multi pathing to avoid single points of failure, Backup and recovery methods, targets and topologies, data deduplication and backup in virtualized environment, fixed content and data archive.

UNIT IV **9 Hours**

CLOUD COMPUTING CHARACTERISTICS AND BENEFITS

Cloud Enabling Technologies - Characteristics of Cloud Computing- Benefits of Cloud Computing-Cloud Service Models Cloud deployment models- Cloud Computing Infrastructure-Cloud Challenges, Cloud migration considerations.

UNIT V **9 Hours**

SECURING AND MANAGING STORAGE INFRASTRUCTURE

Security threats, and countermeasures in various domains, Security solutions for FC-SAN, IP-SAN and NAS environments, Security in virtualized and cloud environments, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle Management (ILM) and storage tiering.

Total: 45 Hours

Reference(s)

1. EMC Infrastructure Management Tools-Parallel SCSI-SAN Design Exercises-Network Technologies for Remote Replication-Information Availability.
2. Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments, 2nd Edition, EMC Educations Services, Wiley, May 2012.
3. Information Storage and Management: Storing, Managing, and Protecting Digital Information, EMC Education Services, Wiley, January 2010.
4. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,"Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE, 2nd Edition, Wiley, July 2009.

22AM040 SOFTWARE PROJECT MANAGEMENT 3 0 0 3

Course Objectives

- Understand the Software Project Planning and Evaluation techniques.
- Understand the project management at each stage of the software development life cycle (SDLC).
- Learn about the activity planning and risk management principles.
- Understand the various phases involved in project management and people management.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Able to plan and manage projects at each stage of the software development life cycle (SDLC).
2. Able to manage software projects and control software deliverables.
3. Develop skills to manage the various phases involved in project management and people management.
4. Deliver successful software projects that support organization s strategic goals.
5. Understand staffing maintenance in software projects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3		3									2	1
2	1	2	3	2									2	2
3		2	3	3									2	2
4		2	2	2									2	1
5		2	2	2									2	2

UNIT I **9 Hours**

PROJECT EVALUATION AND PROJECTPLANNING

Importance of Software Project Management Activities Methodologies Categorization of Software Projects Setting objectives Management Principles Management Control Project portfolio Management Cost- benefit evaluation technology Risk evaluation Strategic program Management Stepwise Project Planning.

UNIT II **9 Hours**

PROJECT LIFE CYCLEAND EFFORT ESTIMATION

Software process and Process Models Choice of Process models Rapid Application development Agile methods Dynamic System Development Method Extreme Programming Managing interactive processes Basics of Software estimation Effort and Cost estimation techniques COSMIC Full function points COCOMO II a Parametric Productivity Model.

UNIT III **9 Hours**

ACTIVITY PLANNING AND RISK MANAGEMENT

Objectives of Activity planning Project schedules Activities Sequencing and scheduling Network Planning models Formulating Network Model Forward Pass & Backward Pass techniques Critical path (CRM) method Risk identification Assessment Risk Planning Risk Management PERT technique Monte Carlo simulation Resource Allocation Creation of critical paths Cost schedules.

UNIT IV **9 Hours**

PROJECT MANAGEMENT AND CONTROL

Framework for Management and control Collection of data Visualizing progress Cost monitoring Earned Value Analysis Prioritizing Monitoring Project tracking Change control Software Configuration Management Managing contracts Contract Management.

UNIT V **9 Hours**

STAFFINGIN SOFTWARE PROJECTS

Managing people Organizational behavior Best methods of staff selection Motivation The Oldham Hackman job characteristic model Stress Health and Safety Ethical and Professional concerns Working in teams Decision making Organizational structures Dispersed and Virtual teams Communications genres Communication plans Leadership.

Total: 45 Hours

Reference(s)

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management Fifth Edition, TataMcGrawHill,New Delhi, 2012.
2. Robert K. Wysocki Effective Software Project Management Wiley Publication, 2011.
3. Walker Royce: Software Project Management Addison Wesley, 1998.
4. Gopalaswamy Ramesh, Managing Global Software Projects McGraw Hill Education(India),FourteenthReprint 20

22AMO41 INTELLECTUAL PROPERTY RIGHTS 3 0 0 3

Course Objectives

- Understand the fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- Understand the patents registration procedure in India and abroad.
- Understand the concept of copyrights and its related rights.
- Understand the concept of trademarks and its registration.

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, reviewer search literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

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

Course Outcomes (COs)

1. Describe the fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. Disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. Disseminate knowledge on copyrights and its related rights and registration aspects.
4. Disseminate knowledge on trademarks and registration aspects.
5. Disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1										
2	3	2	2	1										
3	3	2	2	1										
4	3	2	2	1										
5	3	2	2	1										

UNIT I **9 Hours**

OVERVIEW OF INTELLECTUAL PROPERTY

Introduction and the need for intellectual property right (IPR)-Kinds of Intellectual Property Rights-Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design-Genetic Resources and Traditional Knowledge-Trade Secret-IPR in India: Genesis and development-IPR in abroad- Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention,1886,the Universal Copyright Convention, 1952, the WIPO Convention, 1967, the Patent Co- Operation Treaty, 1970, the TRIPS Agreement, 1994.

UNIT II **9 Hours**

PATENTS

Patents-Elements of Patentability-Novelty, Non Obviousness Inventive Steps, Industrial Application-Non- Patentable Subject Matter-Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties-Patent office and Appellate Board.

UNIT III **9 Hours**

COPYRIGHTS

Nature of Copyright-Subject matter of copyright-original literary, dramatic, musical, artistic works- cinematograph films and sound recordings-Registration Procedure, Term of protection, Ownership of copyright Assignment and license of copyright-Infringement, Remedies & Penalties-Related Rights- Distinction between related rights and copyrights.

UNIT IV **9 Hours**

TRADEMARKS

Concept of Trademarks-Different kinds of marks brand names, logos, signatures, symbols, well known marks, certification marks and service marks-Non-Registrable Trademarks-Registration of Trademarks-Rights of holder and assignment and licensing of marks-Infringement, Remedies & Penalties-Trademarks registry and appellate board.

UNIT V **9 Hours**

OTHER FORMS OF IP

Design concept of novel and original-Procedure for registration, effect of registration and term of protection. Geographical Indication (GI) and difference between GI and trademarks-Procedure for registration, effect of registration and term of protection.Layout Design protection and it procedure for registration, effect of registration and term of protection. Indias New National IP Policy-Career Opportunities in IP-IPR in current scenario with case studies.

Total: 45 Hours

Reference(s)

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN:Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning private Limited.
3. Ahuja, V K. (2017). Lawrelating to Intellectual Property Rights. India, IN: Lexis Nexis.
4. World Intellectual Property Organisation. (2004). WIPO Intellectual Property Handbook. Retrieved fromhttps://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.

22AM042 Introduction to Machine Learning

3 0 0 3

Course Objectives

- To understand the basic concepts of Machine Learning.
- To understand and build supervised learning models.
- To understand and build unsupervised learning models.
- To evaluate the algorithms based on corresponding metrics identified

Programme Outcomes (POs)

a) Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b) Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) 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.
d) 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.
e) Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f) 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.
g) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
h) 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.

Course Outcomes (COs)

- Understand the basic concepts of Machine Learning
- Construct supervised learning models
- Construct unsupervised learning algorithms
- Choose and apply appropriate graphical model for a given real world problem
- Identify applications suitable for different types of machine learning with suitable justification.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	1	1	1	-	1	-	-	-	-	1	-	2	2
2	1	3	1	3	2	1	-	-	-	-	-	-	2	2
3	2	1	1	1	-	1	-	-	-	-	1	-	2	2
4	3	3	2	2	2	1	-	-	-	-	-	-	2	2
5	3	2	1	1	1	1	-	1	-	-	1	-	2	2

UNIT I **9 Hours**
INTRODUCTION
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory –Turning Data into Probabilities – The Bias-Variance Trade off- Setting up an Anaconda, Google colab environment –Introduction to statistical view of Machine Learning- Ethical considerations in machine learning
UNIT II **9 Hours**
SUPERVISED LEARNING
Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear

Regression – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Probabilistic Generative Models – Probabilistic Discriminative Models – Laplace Approximation – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbours – Decision Trees – Random Forest model – Support Vector Machines.

UNIT III **9 Hours**

UNSUPERVISED LEARNING

K-Means Clustering – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models(LVM) – Association rule learning.

UNIT IV **9 Hours**

BASICS OF GRAPHICAL MODELS

Naive Bayes Classifiers: Simple Probabilistic Models for Classification - Bayesian Networks and Markov Models - Hidden Markov Models (HMM) and Conditional Independence

UNIT V **9 Hours**

ADVANCED LEARNING

Reinforcement Learning: Basic Concepts and Algorithms - Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines

Total 45 Hours

Reference(s)

1. EthemAlpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2015..
2. Tom Mitchell, “Machine Learning”, McGraw-Hill, 2017.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, CRC Press, 2014.
4. Fabio Nelli, “Python Data Analytics with Pandas, Numpy, and Matplotlib”, Second Edition, Apress, 2018.
5. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

22AM043 Pattern Recognition Techniques **3 0 0 3**

Course Objectives

- To know the fundamental algorithms for pattern recognition
- To instigate the various classification techniques
- To originate the various structural pattern recognition and feature extraction techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Apply various algorithms for pattern classifier and recognition.
2. Implement the concepts of Unsupervised classification in pattern recognition.
3. Analyze the structural pattern recognition and feature extraction techniques.
4. Apply the feature selection and extraction in pattern recognition.
5. Create the recent advances of neural network in pattern recognition.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	1			1						3	3
2	3	3	3	1			1			1	1		3	3
3	3	3	3	2								1	3	3
4	3	3	3	1			1				1	1	3	3
5	3	3	3										3	3

UNIT I **9 Hours**
INTRODUCTION
Definitions, datasets for Pattern-Different Paradigms of Pattern Recognition-Representations of Patterns and Classes- Overview of Data Sets for Pattern Recognition.

UNIT II **9 Hours**
PROXIMITY MEASURES AND FEATURE EXTRACTION
Metric and Non-Metric Proximity Measures - Feature Extraction Techniques - Different Approaches to Feature Selection.

UNIT III **9 Hours**
CLASSIFICATION TECHNIQUES
Nearest Neighbour Classifier and Variants-Efficient Algorithms for Nearest Neighbor Classification -

Decision Trees-Linear Discriminant Function-Support Vector Machines (SVM).

UNIT IV **9 Hours**

CLUSTERING AND LARGE DATASETS

Clustering Techniques - Combination of Classifiers - Dimensionality Reduction for Large Datasets-Scalable Approaches for Clustering Large Datasets.

UNIT V **9 Hours**

APPLICATIONS AND ADVANCED TOPICS

Applications of Pattern Recognition Techniques-Document Recognition-Advanced Topics and Emerging - Trends in Pattern Recognition

Total: 45 Hours

Reference(s)

1. Devi V.S.; Murty, M.N.(2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R. O. Duda, P.E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning.
4. Stefan Jaeger and Rangachar Kasturi, Document Recognition and Retrieval.

22AM044 Business Intelligence and Analytics 3 0 0 3

Course Objectives

- Explain the Business Intelligence, Analytics and Decision Support system
- List the technologies for Decision making, Automated decision systems
- Explain sentiment analysis techniques
- Illustrate Multi-criteria Decision making systems, predictive modelling techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. 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.

m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Able to analyze Business Intelligence, Analytics and Decision Support
2. Explain the technologies for Decision making
3. Apply sentiment analysis techniques
4. Apply predictive modelling techniques
5. Analyze the architecture of Expert Systems, including knowledge bases, inference engines, and user interfaces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	2								2	1
2	3	2	3	2	2								2	1
3	3	2	2	2	2								3	2
4	3	2	2	2	2								3	3
5	3	3	3	2	2								3	3

UNIT I 9 Hours

AN OVERVIEW OF BUSINESS INTELLIGENCE, ANALYTICS, AND DECISION SUPPORT

Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief

Introduction to Big Data Analytics.

UNIT II **9 Hours**

DECISION MAKING

Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.

UNIT III **9 Hours**

NEURAL NETWORKS AND SENTIMENT ANALYSIS

Basic Concepts of Neural Networks, Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbor Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Sentiment Analysis, Speech Analytics.

UNIT IV **9 Hours**

MODEL-BASED DECISION MAKING

Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making with Pairwise Comparisons.

UNIT V **9 Hours**

AUTOMATED DECISION SYSTEMS AND EXPERT SYSTEMS

Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.

Total: 45 Hours

Reference Books:

1. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017by EdwardMize.
2. Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, “Business Intelligence and Analytics: System for Decision Support”, 10th Edition, Pearson Global Edition, 2013.

22AM045 Fundamentals of Cloud Computing 3 0 0 3

Course Objectives

- To provide students a sound foundation of the Cloud Computing
- To start using and adopting Cloud Computing services and tools in their real life scenarios.
- To enable students exploring some important cloud computing driven commercial systems and applications.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Implement the different linguistic components of given sentences.
2. Design a morphological analyzer for a language using finite state automata concepts
3. Implement a parser by providing suitable grammar and words
4. Analyze the semantic role of the sentence and implement the semantic parsing
5. Apply the machine translation and statistical translation to extract the information from the sentence

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3										3	3
2	3	3	3										3	3
3	3	3	3										3	3
4	3	3	3										3	3
5	3	3	3										3	3

UNIT I 8 Hours

INTRODUCTION

Essential Characteristics-Architectural Influences-Technological Influences –Operational Influences.

UNIT II 9 Hours

CLOUD COMPUTING ARCHITECTURE

Cloud Delivery models- The SPI Framework, Cloud Software as a Service (SaaS) – PaaS
Cloud Platform as a Service, Cloud Infrastructure as a Service(IaaS)- Cloud deployment models,
Public Clouds, Community Clouds ,Hybrid Clouds, Alternative Deployment Models-Expected benefits.

UNIT III **10 Hours**

CLOUD COMPUTING SOFTWARE SECURITY FUNDAMENTALS

Cloud Information Security Objectives- Confidentiality, Integrity-Availability, Cloud Security Services-Relevant Cloud Security Design Principle- Secure Cloud Software Requirements- Secure Development practices- Approaches to Cloud Software Requirement Engineering-Cloud Security Policy Implementation

UNIT IV **10 Hours**

CLOUD COMPUTING RISK ISSUES & CLOUD COMPUTING SECURITY CHALLENGES

The CIA Triad- Privacy and Compliance Risk-Threats to Infrastructure-Data and Access Control-Cloud Access Control Issues- Cloud Service Provider Risks-Cloud Computing Security challenges: Security Policy Implementation-Policy Types-and Computer Security Incident Response Team (CSIRT).

UNIT V **8 Hours**

CLOUD COMPUTING SECURITY ARCHITECTURE

Architectural Considerations-General Issues-Trusted Cloud Computing-Secure Execution Environments and Communications- Micro Architectures-Identity Management and Access Control- Autonomic Security.

Total: 45 Hours

Reference(s)

1. .L-G-0000006558-0002335282.pdf (e-bookshelf.de) Ch01. Cloud Computing.pdf (nus.edu.sg)
2. John W. Itinghouse James F.Ransome, “Cloud Computing Implementation, Management and Security” , CRC Press.
3. Borko Furht. Armando Escalante, “Handbook of Cloud Computing”, Springer Charles Badcock, “Cloud Revolution”

22AM046 Fundamentals of Python Programming 2 0 2 3

Course Objectives

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python

Programme Outcomes:

a.Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d.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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

k. 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.

l.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.

Course Outcomes:

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3								1	2	1	
2	1		2		2						1	2	1	
3	1	1	2									3	1	
4	3	1	2	1	3						1	2	1	
5	2	3	3	3	3		3				1	1	1	

UNIT I 7 Hours

INTRODUCTION, PYTHON BASICS AND FLOW CONTROL

Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program-Flow control: Boolean Values, Comparison Operators,
Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow

Control Statements, Importing Modules, Ending a Program Early with sys. exit().

UNIT II **6 Hours**

FUNCTIONS AND EXCEPTION HANDLING

Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print (), Local and Global Scope, The global Statement, Exception Handling. Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods.

UNIT III **5 Hours**

DICTIONARIES AND STRUCTURING DATA

The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things. Manipulating Strings - Working with Strings, Useful String Methods

UNIT IV **6 Hours**

PATTERN MATCHING WITH REGULAR EXPRESSIONS

Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and No greedy Matching, The find all() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re.IGNORECASE, re .DOTALL, and re .VERBOSE.

UNIT V **6 Hours**

WEB SCRAPING: PROJECT AND SPREADSHEETS

Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML. Working with Excel Spreadsheets: Excel Documents, Installing the openpyxl Module, Reading Excel Documents, Project: Reading Data from a Spreadsheet, Writing Excel Documents, Project: Updating a Spreadsheet, Setting the Font Style of Cells, Font Objects, Formulas, Adjusting Rows and Columns, Charts.

TOTAL: 30 Hours

List of Laboratory Experiments

1 **4 Hours**

EXPERIMENT 1

Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.

2 **4 Hours**

EXPERIMENT 2

Python programming using simple statements and expressions.

3 **3 Hours**

EXPERIMENT 3

Scientific problems using Conditionals and Iterative loops.

4 **7 Hours**

EXPERIMENT 4

Implementing real-time/technical applications using Lists, Tuples

5 **4 Hours**

EXPERIMENT 5

Implementing real-time/technical applications using Sets, Dictionaries.

6 **5 Hours**

EXPERIMENT 6

Implementing programs using Functions.

7 **3 Hours**

EXPERIMENT 7

Implementing programs using Strings.

Total= (30+30) 60 Hours

References

1. Al Wiegert, "Automate the Boring Stuff with Python", William Pollock, 2015,ISBN: 978-1593275990.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
3. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
4. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
5. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, "Data Structures and Algorithms in Python", 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.
6. ReemaThareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978-0199480173

22AM047 Data Analytics with Python 3 0 0 3

Course Objectives

- To familiarize students with the concept and significance of data analytics.
- To introduce the fundamental concepts of probability and their importance in data analytics.
- To teach students the process and principles of hypothesis testing and basics of ANOVA.
- To teach the concepts of Maximum Likelihood Estimation (MLE) and Logistic Regression.
- To educate students the concept of ROC and how to build models using Regression Analysis.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. 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.

m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Gain a strong foundation in Python programming for data analysis.
2. Understand the fundamental concepts of probability and how they apply to data analysis.
3. Learn to conduct two-sample testing and understand the basics of ANOVA.
4. Apply the concepts of Maximum Likelihood Estimation (MLE) and Logistic Regression.
5. Analyze how to conduct clustering analysis and apply Classification and Regression Trees (CART) in data analytics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	2						1	1	2	1
2	3	2	3	2	2						1	1	2	1
3	3	2	2	2	2						1	1	2	2

4	3	2	2	2	2						1	1	1	1
5	3	3	3	2	2								1	1

UNIT I **11 Hours**

INTRODUCTION TO DATA ANALYTICS AND PYTHON BASICS

Getting started with Python: installation, setup, and basic commands, Python fundamentals: variables, data types, operators, and control structures, Central Tendency and Dispersion-Data Analytics –Specify Data Requirements-Prepare or Collect Data-Clean and Process-Analyze-Share- Report-Ethical considerations in data analytics, privacy concerns, and bias mitigation strategies-Data visualization-plots, histograms, bar charts, pie charts, box plots, and scatter plots-process of creating these visualization tools using Matplotlib.

UNIT II **8 Hours**

PROBABILITY AND SAMPLING

Introduction to probability, Probability Distributions, Sampling and Sampling Distributions, Distribution of Sample Means, population, and variance, Confidence interval estimation: Single population.

UNIT III **8 Hours**

HYPOTHESIS TESTING AND ANALYSIS OF VARIANCE (ANNOVA)

Hypothesis Testing, Errors in Hypothesis Testing, Hypothesis Testing: Two sample tests, ANOVA, Post Hoc Analysis (Tukey's Test).

UNIT IV **9 Hours**

REGRESSION ANALYSIS

Randomized block design (RBD), Two Way ANOVA, Linear Regression, Estimation, Prediction of Regression Model Residual Analysis, Multiple Regression Model, Categorical variable regression, Maximum Likelihood Estimation, Logistic Regression, Comparison of Linear Regression Model Vs Logistic Regression Model.\

UNIT V **9 Hours**

ADVANCED DATA ANALYTICS TECHNIQUES

Confusion matrix and ROC, Performance of Logistic Model, Regression Analysis Model Building, c2 Test and introduction to cluster analysis, Clustering analysis, Classification and Regression Trees (CART).

Total: 45 Hours

Reference Books:

1. Bharti Motwani , (2020). Data Analytics using Python , Wiley Publications.
2. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
3. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
4. Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc".
5. Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".
6. Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc"
7. Jay L. Devore (2011). Probability and Statistics for Engineering and the Sciences. "Cengage Learning".
8. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). "Wiley-Interscience Publication".

9. Jiawei Han and Micheline Kamber (2006). Data Mining: Concepts and Techniques. "
10. Leonard Kaufman, Peter J. Rousseeuw (1990). Finding Groups in Data: An Introduction to Cluster Analysis. "John Wiley & Sons, Inc".

ONE CREDIT COURSES

22AM0XA Webpack for Frontend Development 1 0 0 1

Course Objectives

- To Learn how to create dynamic and interactive user interfaces using React.
- To Build reusable UI components that respond to user interactions, enabling the development of modern and engaging web applications
- To Learn how to fetch, display, and manipulate data from various sources, enhancing the functionality and relevance of their projects

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
g. 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.
j. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the basics of reactjs, including components, props and state.
2. Apply reactjs to create interactive and dynamic user interfaces

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1				1			1		1	1	
2		1	2	2		1		1					1	

Course Syllabus

Introduction to React basics Node Package manager Javascript Expressions in JSX ES6 Javascript Maths Inline styling using React React Components React Props React Use state Hooks Context API Mapping React Forms Event handling React Routers Sending HTTP request Redux Building a Food Order Application Stripe Payment Integration

Total: 15 Hours

Reference(s)

1. Alex Banks and Eve Porcello, "Learning React: Modern Patterns for Developing React Apps", 2020.
2. Stoyan Stefanov, "React Up and Running: Building Web Applications", 2015.
3. Kirupa Chinnathambi, "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", 2017.
4. Anthony Accomazzo, Ari Lerner, and David Guttman, "Fullstack React: The Complete Guide to ReactJS and Friends", 2017.

22AM0XB Software Process Automation 1 0 0 1

Course Objectives

- To Understand the benefits of SPA and how it can be used to improve the efficiency and productivity of software development teams.
- To Develop the skills necessary to automate software processes, including scripting, programming, and testing.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. 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.
j. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Apply analytical skills to recognize and automate repetitive tasks, thereby elevating organizational efficiency.
2. Create and implement software bots proficiently to achieve optimized process automation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2				2			1		1	1	
2		1	2	2		1		1					1	

Course Syllabus

Introduction to System Process Automation Basics of Scripting and Programming Workflow Automation with Scripting Introduction to Task Automation Tools Web Scraping and API Automation Using libraries like Beautiful Soup and Requests Automation of Cloud Services Automating cloud resource provisioning Task Scheduling and Orchestration Using cron jobs for task scheduling

Monitoring and Error Handling Automation Handling errors and exceptions in automation scripts Case Study comprehensive automation projects

Total: 15 Hours

Reference(s)

1. Maria Manuela Cruz Cunha and Varuna Godara, Robotic Process Automation Concepts, Methodologies, Tools, and Applications, 2020.
2. Jonathan Whelan, Practical Robotic Process Automation How to Build Bots that Work, 2020.
3. Peter G. NorÃƒÂ©n, Vikas Bhonsle, Avinash Kulkarni, and Robert Wollan, Robotic Process Automation A Guide to the Implementation Journey, 2019.

22AM0XC Application Development using LLMs

1 0 0 1

Course Objectives

- To understand Large Language Models and build applications using LLMs.
- To develop practical skills in working with LLMs through hands-on exercises and projects.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
g. 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.
j. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the evolution and significance of Large Language Models (LLMs).
2. Apply LLMs in Real-World Scenerios
3. Develop LLM-Powered Applications using Lang Chain
4. Apply zero-shot prompting techniques to achieve accurate outputs without specific training.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2				2			1		1	1	
2		1	2	2		1		1					1	
3	1		1										1	
4		2											1	

Course Syllabus

Overview of Large Language Models Evolution and Significance Understanding LLM architectures Applications and use cases of LLMs in real world scenarios Application development Text generation applications, Interactive Chatbot, Language translation applications using LangChains LLM Introduction to Prompt Engineering Components of a Prompt Zero Shot Prompting Case Study Zero Shot, One Shot Prompting in Action.

Total: 15 Hours

Reference(s)

1. Bird, Steven, Ewan Klein, and Edward Loper. Natural language processing with Python analyzing text with the natural language toolkit. O"Reilly Media, Inc., 2019.
2. Keselj, Vlado. Book Review: Speech and Language Processing by Daniel Jurafsky and James H. Martin. Computational Linguistics 35, no. 3 (2019).Applications, 2020
3. Radford, Alec, Jeffrey Wu, Rewon Child, David Luan, Dario Amodei, and Ilya Sutskever. Language models are unsupervised multitask learners. OpenAI blog 1, no. 8 (2019):
4. Zhou, Yongchao, Andrei Ioan Muresanu, Ziwen Han, Keiran Paster, Silviu Pitis, Harris Chan, and Jimmy Ba. Large language models are human-level prompt engineers.arXiv preprint arXiv 2211.01910 (2022).
5. Zero-Shot Text Generation by Li et al, 2021

22AM0XD Data Driven Threat Detection with AI

1 0 0 1

Course Objectives

- Understand the fundamental concepts of data-driven threat detection and prevention
- Develop the ability to set up and fine-tune behavioural analytics for anomaly detection.

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

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

g. 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.

j. 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.

l. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Develop a threat prevention policy using AI-driven insights.
2. Analyze the ethical considerations surrounding AI usage in cybersecurity

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1				2			1	1	1	1	
2		1	2	1		1		1					1	

Course Syllabus

Overview of AI and Machine Learning in Cybersecurity Data Sources for Threat Detection Logs Network Traffic Endpoints AI Models for Threat Detection Behavioral Analytics and Anomaly Detection Threat Intelligence and AI Integration Endpoint Security and AI Network Traffic Analysis with AI AI in Malware Detection Threat Hunting and Incident Response with AI Ethical and Privacy Considerations Future Trends and Emerging Technologies.

Total: 15 Hours

Reference(s)

1. Chris Sanders, Jason Smith, Applied Network Security Monitoring Collection, Detection, and Analysis Technical Editor, Elsevier.
2. Clarence Chio and David Freeman, Machine Learning and Security Protecting Systems with Data and Algorithms OReilly.
3. Michael Sikorski and Andrew Honig, Practical Malware Analysis A Hands On Guide to Dissecting Malicious Software no starch press, San Francisco.
4. Eric D. Knapp and Raj Samani, Applied Cyber Security and the Smart Grid Implementing Security Controls into the Modern Power Infrastructure Elsevier Science.

22AM0XE Machine Learning Deployment Services in Public Cloud Services 1 0 0 1

Course Objectives

- Explain the advantages of deploying machine learning models in cloud environments
- Utilize Amazon Sage Maker to build and deploy machine learning models.
- Apply Azure Machine Learning Studio for building and deploying models.
- Use Google AI Platform to deploy and manage machine learning models.
- Deploy machine learning models using Kubernetes in the cloud.

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. 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.

g. 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.

j. 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.

l. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand Cloud-Based Machine Learning Deployment
2. Utilize AWS Machine Learning Services

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1				2			1	1	1	1	
2		1	2	1		1		1					1	

UNIT I **2 Hours**

INTRODUCTION TO CLOUD-BASED ML DEPLOYMENT SERVICES

Overview of Cloud-Based Machine Learning Services-Introduction to cloud-based ML deployment-Key benefits and Considerations Comparison of Cloud Providers-AWS, Azure, and Google Cloud strengths and focus areas-Choosing the right cloud provider for ML deployment

UNIT II **2 Hours**

AWS MACHINE LEARNING SERVICES

Amazon SageMakerOverview and Features-Creating and deploying models with Sage Maker AWS Lambda for Serverless Deployments Introduction to AWS Lambda-Deploying machine learning models with Lambda

UNIT III **3 Hours**

AZURE MACHINE LEARNING SERVICES

Azure Machine Learning Studio-Overview and capabilities Building and deploying models with Azure ML Studio-Azure Functions for Serverless Deployments-Introduction to Azure Functions-Deploying machine learning models with Azure Functions

UNIT IV **3 Hours**

GOOGLE CLOUD MACHINE LEARNING SERVICES

Google AI Platform-Overview and Features-Deploying models with Google AI Platform-Google Cloud Functions for Serverless Deployments-Introduction to Google Cloud Functions-Deploying machine learning models with Cloud Functions

UNIT V **3 Hours**

ADVANCED DEPLOYMENT STRATEGIES

Kubernetes for Model Deployment-Kubernetes Overview-Deploying models on Kubernetes in the cloud-AutoML Services-Overview of AutoML services in AWS, Azure, and Google Cloud-Using AutoML for model deployment

UNIT VI **2 Hours**

PRACTICAL HANDS-ON PROJECT

Hands-On Project-Deploying a machine learning model on AWS, Azure, or Google Cloud-Comparing and contrasting the deployment process on different platforms

Total: 15 Hours

Reference(s)

1. Hands-On Project-Deploying a machine learning model on AWS, Azure, or Google Cloud - Comparing and contrasting the deployment process on different platforms
2. "Deploying Machine Learning Models: A practical guide to deploying machine learning models in production" by Alice Zheng
3. "Deploying Machine Learning Models Using Kubernetes: A Complete Guide to Deploy, Monitor, and Scale Machine Learning Models in Production with Kubernetes" by David Gonzalez
4. "Hands-On Azure for Developers: Implement rich Azure PaaS features, incorporate machine learning, and implement serverless architectures with Azure" by Suren Machiraju and Onur Dogan .

22AM0XF MLOps 1 0 0 1

Course Objectives

- Understand the Concepts of MLOps
- Version Control in MLOps
- Containerization for ML Applications
- CI/CD Pipelines for ML
- Model Deployment Strategies

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, andengineering sciences.
c. 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.
d. 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 toprovide valid conclusions.
e. 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.
g. 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.
j. 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 anddesign documentation, make effective presentations, and give and receive clear instructions.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, usingAI and modern tools.

Course Outcomes (COs)

1. Define MLOps and explain its significance in the context of machine learning development
2. Demonstrate the use of version control systems for ML projects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1				2			1	1	1	1	
2		1	2	1		1		1					1	

UNIT I **2 Hours**

UNDERSTANDING MLOPS

Introduction to Machine Learning Operations (MLOps) Definition and importance of MLOps Key components and Practices-Challenges in Traditional ML Workflow Version control issues Reproducibility Challenges Deployment complexities

UNIT II **2 Hours**

VERSION CONTROL FOR MACHINE LEARNING

Git for Machine Learning Projects Basics of Git Versioning data and models Collaborative workflows- Git Integration with Jupyter Notebooks Using Jupyter notebooks with Git Tracking changes in code and data

UNIT III **3 Hours**

CONTAINERIZATION FOR ML APPLICATIONS

Introduction to Docker - Basics of Docker containers Dockerizing a simple machine learning Application-Container Orchestration with Kubernetes Overview of Kubernetes Deploying and managing ML applications with Kubernetes

UNIT IV **3 Hours**

CONTINUOUS INTEGRATION (CI) FOR ML

Introduction to Continuous Integration-Building a CI/CD Pipeline-Automated testing for ML models- CI/CD Tools for MLOps -Integration of GitLab CI, Jenkins, or GitHub Actions for ML Workflows- Triggering automated builds and tests

UNIT V **3 Hours**

MODEL DEPLOYMENT AND MONITORING

Model Deployment Strategies-Deployment options cloud services, server less-Deploying a model using Flask or FastAPI-Monitoring and Logging for ML Models- Setting up monitoring tools-Logging and tracking model performance

UNIT VI **2 Hours**

PRACTICAL MLOPS PROJECT

Hands-On Project-Applying MLOps concepts to a real-world Example-Building an end-to-end MLOpspipeline

Total: 15 Hours

Reference(s)

1. "Building Machine Learning Powered Applications: Going from Idea to Product" by Emmanuel Ameisen
2. "Production-Ready Microservices: Building Standardized Systems Across an EngineeringOrganization" by Susan J. Fowler
3. "Site Reliability Engineering: How Google Runs Production Systems" by Niall RichardMurphy, Betsy Beyer, Chris Jones, Jennifer Petoff
4. "MLOps: Continuous delivery and automation pipelines in machine learning" by Mark Treveil

22AM0XG Containerizing Intelligence: Leveraging Docker for Machine Learning Deployment **1 0 0 1**

Course Objectives

● Understand the principles of containerization and its relevance to machine learning deployment.
● Learn how to set up Docker environments for machine learning projects.
● Explore techniques for packaging machine learning models into Docker containers.
● Gain proficiency in deploying containerized machine learning applications in various environments.
● Explore best practices for managing dependencies and versioning in Dockerized machine learning projects.
● Understand security considerations specific to deploying machine learning models in Docker containers.
● Develop skills in optimizing Docker configurations for efficient machine learning inference.
● Explore orchestration tools and frameworks for managing containerized machine learning deployments at scale.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
k. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.

Course Outcomes (COs)

1. Ability to design and implement Docker environments tailored for machine learning projects.
2. Proficiency in packaging machine learning models into Docker containers with all necessary dependencies and Competence in deploying containerized machine learning applications in production and development environments.
3. Understanding of version control and management strategies for Dockerized machine learning projects and Capability to address security concerns associated with deploying machine learning models

in Docker containers.

4. Skills in optimizing Docker configurations to ensure optimal performance of machine learning inference.

5. Familiarity with orchestration tools like Kubernetes for managing containerized machine learning deployments at scale and Ability to troubleshoot common issues encountered in containerized machine learning deployments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1				2			1	1	1	1	
2		1	2	1		1		1					1	
3	1	2	1				2			1	1	1	1	
4	1	2	2				2			1	1	1	1	
5	1	1	2				2			1	1	1	1	

Course Syllabus

Introduction to Docker and Containerization-Overview of containerization and its benefits for machine learning deployment-Introduction to Docker: architecture, components, and key concepts-Dockerizing Machine Learning Applications-Understanding Dockerfiles: syntax and best practices for machine learning projects-Packaging machine learning models into Docker containers-Deploying Machine Learning Models with Docker-Deployment considerations for machine learning models-Serving machine learning models using Docker containers-Optimization and Best Practices-Optimizing Docker configurations for efficient machine learning inference-Version control and management strategies for Dockerized machine learning projects- Advanced Topics and Case Studies-Advanced Docker features for machine learning deployments- Project work: participants work on a hands-on project applying concepts learned throughout the Course-Instructor guidance and support for project Implementation-Course review: recap of key concepts and takeaways from the course.

Total: 15 Hours

Reference(s)

1. "Docker for Data Science: Building Scalable and Extensible Data Infrastructure Around the JupyterNotebook Server" by Joshua Cook
2. "Docker Deep Dive" by Nigel Poulton
3. "Building Machine Learning Powered Applications: Going from Idea to Product" by EmmanuelAmeisen
4. "Hands-On Docker for Microservices with Python: Design, deploy, and operate scalable and reliablemicroservices with Docker containers" by Jaime Buelta

22AM0XH Managing ML Infrastructure with Terraform 1 0 0 1

Course Objectives

- Understand the principles of infrastructure as code (IaC) and its relevance to machine learning (ML) infrastructure management.
- Learn the fundamentals of Terraform and its role in provisioning and managing ML infrastructure.
- Explore best practices for organizing Terraform code and managing infrastructure configurations.
- Gain proficiency in using Terraform to provision and configure cloud resources commonly used in ML workflows.
- Understand how to leverage Terraform modules and templates for reusable and scalable infrastructure provisioning.
- Explore techniques for integrating Terraform with other tools and frameworks in the ML ecosystem.
- Develop skills in managing state files and handling Terraform workflows in collaborative environments.
- Learn techniques for automating deployment, scaling, and monitoring of ML infrastructure using Terraform.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
k. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.

Course Outcomes (COs)

The students will be able to

1. Design and implement infrastructure as code solutions for managing ML infrastructure using Terraform and Proficiency in defining and managing Terraform configurations for provisioning cloud resources such as virtual machines, storage, and networking components.

2. Competence in organizing Terraform codebase using modules, templates, and best practices for maintainability and scalability and Understanding of how to integrate Terraform with other tools and frameworks commonly used in ML workflows, such as Kubernetes, Docker, and machine learning frameworks.
3. Capability to manage state files effectively and handle Terraform workflows in collaborative development environments and Skills in automating deployment, scaling, and monitoring of ML infrastructure using Terraform and related tools.
4. Familiarity with Terraforms ecosystem and community resources for extending and customizing ML infrastructure provisioning workflows.
5. Ability to troubleshoot common issues and optimize Terraform configurations for efficient and reliable ML infrastructure management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1				2			1	1	1	1	
2		1	2	1		1		1					1	
3	1	2	1				2			1	1	1	1	
4	1	2	2				2			1	1	1	1	
5	1	1	2				2			1	1	1	1	

Course Syllabus

Introduction to Terraform and Infrastructure as Code-Overview of infrastructure as code (IaC) principles and benefits for managing ML Infrastructure-Introduction to Terraform: history, architecture, and key concepts-Installing Terraform: instructions for various Platforms-Terraform Configuration Basics-Understanding Terraform configuration files (.tf files): syntax and Structure-Defining resources and managing dependencies in Terraform-Provisioning Cloud Resources with Terraform-Overview of cloud providers supported by Terraform (e.g., AWS, Azure, Google Cloud Platform)-Provisioning compute resources (virtual machines, containers) using Terraform-Advanced Terraform Features-Using Terraform templates and dynamic blocks for flexible configurations-Infrastructure Scaling and Automation-Instructor guidance and support for project implementation-Peer review and feedback session: participants present their projects and receive feedback from peers and instructor-Wrap-up and next steps: resources for further learning and exploration in containerized machine learning deployment-Case Studies and business opportunities in “Managing ML Infrastructure with Terraform”.

Total: 15 Hours

Reference(s)

1. "Terraform: Up & Running: Writing Infrastructure as Code" by Yevgeniy Brikman
2. "Terraform in Action" by Scott Winkler
3. "Infrastructure as Code: Managing Servers in the Cloud" by Kief Morris

22AM0XI AI Python Application Development 1 0 0 1

Course Objectives

- To gain a solid understanding of fundamental concepts in artificial intelligence, including machine learning, deep learning, and understand the process of gathering and pre-processing data, selecting a suitable AI model for deployment
- To learn fundamental concepts of web development, including HTTP protocol, client-server architecture, and understand the role of HTML, CSS, and JavaScript in building web user interfaces, and how Flask integrates with these technologies
- To acquire skills in integrating databases with Flask applications for storage and retrieval.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
k. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.

Course Outcomes (COs)

1.Demonstrate proficiency in developing web applications using the Flask framework and Implement Flask routes, views, templates, and forms to create dynamic and interactive web pages
2. Acquire skills in integrating databases with Flask applications, including database modeling, schema design, and performing CRUD (Create, Read, Update, Delete) operations
3. Learn how to integrate front-end technologies with Flask back-end to create full-stack web applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	1		1		1	1			1	
2		2	2	2		1		1			1	1	1	
3	1	1	2	2		1		1				1	1	

Course Syllabus

Python development - Overview of the language and setup of the development environment - Python's syntax, control structures, functions, and object-oriented programming concepts. Web development using Flask - Encompassing HTML, CSS, and JavaScript for UI development, responsive design, and the creation of RESTful APIs. Database integration - Introducing Database Management Systems (DBMS), SQL, database modeling, schema design, CRUD operations, and Object-Relational Mapping (ORM) query building. AI Application - Machine Learning (ML), Deep Learning (DL), Data analysis and Data visualization - Integrating front-end components and building an end-to-end Python AI Application.

Total: 15 Hours

Reference(s)

1. Grinberg, M. (2018). Flask Web Development: Developing Web Applications with Python. O'Reilly Media
2. Gray, E., & Furr, J. (2021). Flask: Building Python Web Services. O'Reilly Media
3. Ameisen, E. (2018). Building Machine Learning Powered Applications: Going from Idea to Product. O'Reilly Media
4. Russell, M. A. (2018). Building Intelligent Web Applications: Using Deep Learning and Cognitive Services. O'Reilly Media
5. Rosebrock, A. (2019). Deep Learning for Computer Vision with Python. PyImageSearch

22AM0XJ Introduction to Game Development using Python 1 0 0 1

Course Objectives

- To provide foundational understanding of game development principles using the Python programming language.
- To build the core principles and techniques of game development, including game loop, graphics rendering, user input handling, collision detection, and game physics

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
k. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.

Course Outcomes (COs)

1. Demonstrate proficiency in developing games using the Python programming language.
2. Apply Python syntax, data structures, and libraries such as Pygame to create interactive and engaging games

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1				1			1		1	1	
2		1	2	2		1		1					1	

Course Syllabus

Python Basics - Input and output in Python - Functions and Modules - Importing modules - Introduction to Pygame -Installing Pygame - Basic Pygame program structure - Display and Images in Pygame - Creating a window - Loading and displaying images - Basic user input handling - Game Sprites and Animation - Understanding sprites -Creating sprite classes - Basic animation techniques – Collision Detection and Game Logic - Detecting collisions between sprites - Implementing simple game logic - Group project: creating a basic game prototype - Sound and Music in Pygame – Incorporating background music - Enhancing user experience with audio - Advanced Pygame Features - Text rendering - Advanced user input handling - Utilizing Pygame libraries and extensions.

Total: 15 Hours

Reference(s)

1. Sweigart, A. (2019). Automate the Boring Stuff with Python: Practical Programming for Total Beginners. No Starch Press.
2. Rodas de Paz, A., & Howse, J. (2020). Pygame: Build Your Own Python Game Projects. Packt Publishing.
3. Lardner, D. (2020). Game Programming with Python, Lua, and Ruby. CRC Press.
4. Dawson, M. W. (2021). Beginning Game Development with Python and Pygame: From Novice to Professional. Apress.
5. Bukowski, D., & Bukowski, P. (2021). Pygame: Powerful, Open-Source Python Library for Developing Games. O'Reilly Media

22AM0XK Introduction to Game Development using Python 1 0 0 1

Course Objectives

- To Understand the synergy between deep neural networks and RL for solving complex problems.
- To Implement DDPG algorithms and utilize experience replay for stability.
- To Analyze real-world applications of deep reinforcement learning in various domains.

Programme Outcomes (POs)

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

b. 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

c. 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.

d. 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.

f. 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.

g. 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.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j. 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.

k. 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.

l. 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.

m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.

n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

The students will be able to

1. Understand the fundamental concepts of Deep RL, including Q-learning, policy gradients, and actor-critic methods.
2. Apply deep neural networks to design and train effective RL agents for complex environments.
3. Implement advanced DRL algorithms in Python using popular libraries.
4. Demonstrate proficiency in implementing and applying Deep Q-Learning (DQN) algorithms.
5. Apply policy gradient methods, such as the REINFORCE algorithm, and understand the advantages of Actor-Critic architectures in optimizing policies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2	2	1			2	1			1	1
2	3	3	3	3	3				2				1	1
3	3	3	3	3	3	1			3	1				1
4	3	3	3	3	3	1			2				1	
5	3	3	3	3	2				2	1			1	1

Course Syllabus

Deep Reinforcement learning in AI-Introduction to deep reinforcement learning: Basics of deep learning for RL, Applications of Deep RL – Markov Decision Processes: State, Action, Reward and Transition probabilities, Bellman Equation - Q-learning and Deep Q Network (DQN): Experience Replay - Policy gradient methods, Actor-critic methods – Advanced topics in Deep RL: Proximal policy optimization, Trust region policy optimization, Deep deterministic policy gradients-Introduction to python libraries for Deep RL - Creating an environment for a simple RL problem -Training a basic Q-learning agent - Training a DQN agent for a custom environment - Implementing REINFORCE algorithm - Training a DDBG agent for a continuous Action space - Implementing a multi agent Q-Learning.

Total: 15 Hours

Reference(s)

1. Maxim Lapan, Textbook: "Deep Reinforcement Learning Hands-On" (2018).
2. Maxim Lapan , Hands-On Reinforcement Learning with Python (2020).
3. Richard Sutton and Andrew Barto, Reinforcement Learning: An Introduction by (2018).

22AM0XL Empowering Defense Strategies with AI 1 0 0 1

Course Objectives

- Understanding machine learning's foundational ideas and how it applies to cyber security is the course's main goal.
- Gain expertise with machine learning techniques for malware analysis, intrusion detection, and anomaly detection, among other cybersecurity duties.
- Discover cutting-edge ideas in AI-powered cybersecurity, such as adversarial machine learning, threat intelligence, and moral issues.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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
c. 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.
d. 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.
e. 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.
f. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming Knowledge in the respective domains fulfilling with real- time constraints.

Course Outcomes (COs)

The students will be able to

1. Demonstrate a strong understanding of machine learning algorithms and their application to cybersecurity.
2. Gain practical expertise in data pre-processing, feature engineering, and model training for cybersecurity tasks.
3. Assess and counter adversarial assaults, automating security procedures, and handling moral and legal dilemmas in the field are just a few of the cutting-edge innovations in AI-driven cybersecurity.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	3	2	1		1	2			2	2	1
2	3	3	1	2	2			1	2			2	2	2
3	3	3	2	3	2	1			2			2	1	2

Course Syllabus

Introduction to AI and Cybersecurity-Overview of Artificial Intelligence-Definition of AI and its applications in various fields-Introduction to machine learning-deep learning-and natural language processing-Introduction to Cybersecurity-Understanding the importance of cybersecurity-Basic cybersecurity concepts: threats, vulnerabilities, and attacks-Overview of common cybersecurity techniques and technologies-Fundamentals of Machine Learning-Introduction to Machine Learning-Basic concepts: supervised learning- unsupervised learning-reinforcement learning-Understanding algorithms: decision trees-k-nearest neighbors, support vector machines-Machine Learning for Cybersecurity-Applications of machine learning in cybersecurity-Use cases: malware detection-intrusion detection-anomaly detection-Challenges and limitations of using machine learning in cybersecurity-Deep Learning for Cybersecurity-Understanding neural networks: structure, activation functions-layers-Deep learning architectures-convolutional neural networks (CNNs)- recurrent neural networks (RNNs)-Deep Learning in Cybersecurity-Use cases: malware detection-phishing detection, network traffic analysis.

Total: 18 Hours

Reference(s)

1. Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, MIT Press, 20 Oct 2020
2. Deep Learning: Fundamentals, Theory and Applications, Amir Hussain, Kaizhu Huang, Qiu Feng Wang, Rui Zhang, 15 February 2019.
3. Fundamental of Cyber Security: Principles, Theory and Practices, Mayank Bhusan/Rajkumar Singh Rathore/Aatif Jamshed, BPB Publications, 2018.

22AM0XM Streamlined Software Development using CI/CD 1 0 0 1

Course Objectives

- To learn the new tool and technique followed in the industry.
- To use Git-based repositories and other sourcing options.
- To manage resource dependencies and similar resources in code pipeline.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. 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.
l. 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies using AI and modern tools.

Course Outcomes (COs)

The students will be able to
1. Learn Git-based repositories and other sourcing options.
2. Gain knowledge of AWS Code Pipeline use cases and integration options.
3. Learn how to secure your pipeline and components.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1			1	1			1	1	1	
2	3	1	2		3				2				1	
3	3	1			3			1	2		1	1		

Course Syllabus

Introduction to Git - The very basics of Git: Adding & Committing – Comparing changes with Git Diff – GitHub actions - Introduction to CI/CD pipeline – Basics of AWS codePipeline - CI/CD Pipeline with CodeCommit, CodeBuild and CodeDeploy - Build stage with AWS CodeBuild - Creating a CI/CD pipeline with AWS CodePipeline.

Total: 20 Hours

Reference(s)

1. https://aws.amazon.com/codepipeline/
2. https://docs.aws.amazon.com/whitepapers/latest/cicd_for_5g_networks_on_aws/cicd-on-aws.html
3. https://docs.github.com/en/get-started/onboarding/getting-started-with-github-enterprise-cloud

OPEN ELECTIVES

22OCE01 Energy Conservation and Management 3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings and
- To utilize the available resources in optimal ways

Course Outcomes (COs)

1. Classify and characterize the various energy utilization techniques.
2. Identify suitable technique to provide an energy efficient system.
3. Identify the need for thermal systems with latest technologies.
4. Choose suitable techniques doe conserving energy with respect to emerging trends.
5. Assess the impact economics on the conservation of energy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1										1	3
2	1	3									1	3
3	1	3									2	3
4	1	3	2								3	3
5	1	2	2								1	3

UNIT I **9 Hours**

INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III **9 Hours**

THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and Encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV **9 Hours**

ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V **9 Hours**

ECONIMICS

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept .

Total: 45 Hours

Reference(s)

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
3. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
5. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

22OEC01 Basics of Analog and Digital Electronics 3 0 0 3

Course Objectives

- Understand the working of diodes and transistors in electronic circuits.
- Understand the analog operational amplifier and its applications.
- Understand the implementation of combinational and sequential circuits in digital systems.

Course Outcomes (COs)

1. Apply the diodes and transistors in regulators and amplifiers and analyze their characteristics.
2. Illustrate the working of analog IC with different configurations and its applications.
3. Simplification of Boolean expressions using K-map and implementation of combinational circuits.
4. Analyze the Flip flops and memory configurations in digital circuits.
5. Classify and analyze A/D and D/A converters with its parameters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	2	3	1								
2	2	2	3									
3	2	2	3	2								
4	2	2	3	3								
5	2	2	3	3								

UNIT I **9 Hours**

SEMICONDUCTORS DEVICES

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram - Mobility - Electrons and holes - The P-N junction diode - Zener diode - Avalanche effect- Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier. PNP and NPN Bipolar Junction Transistors - H parameters equivalent circuit - Common emitter amplifier - DC behavior: the load slope and the Q point - AC behavior - Emitter follower amplifier - Field effect transistors: JFET and MOSFET.

UNIT II **9 Hours**

OPERATIONAL AMPLIFIERS: DC PERFORMANCE

The operational amplifier - Input resistance, Output resistance, Open loop gain - Bias currents - Offset currents - Offset voltage - Differential mode gain - Common mode gain - Common mode rejection ratio - Negative feedback - Open loop gain and closed loop gain - Inverter amplifier - Non-inverter amplifier - The voltage follower - Trans impedance amplifier (Current to voltage converter) - Differential amplifier. Adders, Subtractors, Comparator, Integrator and Differentiator.

UNIT III **9 Hours**

DIGITAL TECHNIQUES: COMBINATIONAL CIRCUITS

Numbering systems - Binary, octal and hexadecimal numbers - Boole algebra - Conversion and operations - AND gate- OR gate - Inverter - NAND gate - NOR gate - Exclusive OR gate. Morgan's laws. Combinational Circuits: Truth tables, logic expressions, Logic simplification using K- map, half and full adder/subtractor, multiplexers, demultiplexers, Logic families: TTL and CMOS.

UNIT IV **9 Hours**

DIGITAL TECHNIQUES: SEQUENTIAL CIRCUITS

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Flip Flop Conversion. Shift registers, Counters. Memories Structure: address and data bus. ROM, PROM, EPROM and flash RAM. Volatiles Memories: RAM, SRAM, DRAM. Addressing modes.

UNIT V **9 Hours**

DIGITAL TO ANALOG CONVERTERS AND ANALOG TO DIGITAL CONVERTERS

DIGITAL TO ANALOG CONVERTERS: Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network. Pulse Width Modulation. Resolution. Accuracy. Linearity. Zero Offset. Settling Time. Glitches. ANALOG TO DIGITAL CONVERTERS: Sampling. Real time sampling and equivalent time sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion.

Total: 45 Hours

Reference(s)

1. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education,2012.
2. J Millman, C. Halkias & Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw- Hill,2010.
3. Ramakant A. Gayakwad, OP-AMP and Linear IC"s, Prentice Hall of India, 2002.
4. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5. Thomas L. Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
6. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

22OEC02 Microcontroller Programming 3 0 0 3

Course Objectives

- Understand Series of Microcontrollers in terms of architecture, Programming and Interfacing.
- Learn Programming of PIC series of microcontrollers and learn building of hardware circuits using PIC 16F series of Microcontrollers
- Learn the emerging trends in the design of advanced Microcontrollers.

Course Outcomes (COs)

1. Interpret the components and functionalities of 8051 Microcontrollers.
2. Develop microprocessor applications using the Assembly Language Program
3. Illustrate the working nature of PIC microcontroller on various versions
4. Illustrate the interfacing of different peripherals using PIC Microcontroller
5. Analyze the architecture and instruction set of ARM Microcontroller

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	1									
2	1	3	1									
3	1	1	2		1							
4	1	1	2		3							
5	1	1	3		2							

UNIT I **9 Hours**

8-BIT MICROCONTROLLER

Introduction-Intel 8051 Architecture-Counters and Timers-Serial Interface- Interrupts-Interfacing to external memory and 8255- Instruction set- Address modes.

UNIT II **9 Hours**

8051 ALP AND APPLICATIONS

Assembly language program- Timers and Counters programming- DAC- ADC- Sensor-Keyboard and LCD.

UNIT III **9 Hours**

PIC MICROCONTROLLER

PIC Microcontroller features- PIC Architecture, Program Memory, Addressing Modes, Instruction Set, Instruction Format- Byte-oriented Instructions- Bit-oriented Instructions-Literal Instructions- Control Instructions (CALL & GOTO)- Destination Designator. MPLAB overview: Using MPLAB, Toolbars, Select Development Mode and Device type, Project, Text Editor, Assembler, MPLAB operations.

UNIT IV **9 Hours**

PIC HARDWARE

Reset, Clock, Control registers, Register banks, Program Memory Paging, Ports, Interrupts, Timer and Counter, Watchdog Timer, Power up timer, Sleep mode, I2C bus- A/D converter.

UNIT V **9 Hours**

HIGH PERFORMANCE RISC ARCHITECTURE

ARM: The ARM architecture- ARM organization and implementation- The ARM instruction set- The THUMB instruction set- Basic ARM Assembly Language Program- ARM CPU Cores.

FOR FURTHER READING

Introduction- Architecture- Registers- Memory- Instruction set- Addressing Modes- I/O Pins- Timers- Counters- Interrupts.

Total: 45 Hours

Reference(s)

1. Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 3rd Edition, 2004.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems", Person Education, 2nd Edition, 2004.
3. John B. Peatman, "Design with Microcontrollers", Person Education", 1st Edition, 2004.
4. Steave Furber, "ARM system-on-chip architecture" Addison Wesley, 2nd Edition, 2000.
5. A.V. Deshmukh, "Microcontrollers: Theory and Applications", Tata Mc Graw Hill, 12th reprint, 2005.

22OEC03 Principles of Communication Systems 3 0 0 3

Course Objectives

- To study the various analog and digital modulation techniques
- To study the various digital communication techniques
- To enumerate the idea of spread spectrum modulation
- To study the design concepts of satellite and optical communication

Course Outcomes (COs)

1. Illustrate the process involved in Amplitude, Frequency and phase modulation systems.
2. Analyze the performance of different digital modulation /demodulation techniques.
3. Analyze Pulse Code Modulation scheme for the transmission of analog data in digital format.
4. Apply the concepts of spread spectrum modulation techniques to eradicate interference in wireless communication.
5. Analyze the system design of satellite and optical communication.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	2									
2	3	2										
3	3	2										
4	2	2	2									
5	3	2										

UNIT I **9 Hours**

FUNDAMENTALS OF ANALOG COMMUNICATION

Principles of amplitude modulation, AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM Voltage distribution, AM power distribution, Angle modulation. FM andPM waveforms, phase deviation and modulation index, frequency deviation and percent modulation, Frequency analysis of angle modulated waves. Bandwidth requirements for Angle modulated waves

UNIT II **9 Hours**

DIGITAL COMMUNICATION

Introduction, Shannon limit for information capacity, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Minimum Shift Keying (MSK), Phase Shift Keying (PSK), BPSK, QPSK, 8 PSK Quadrature Amplitude Modulation (QAM), Bandwidth Efficiency,Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

UNIT III **9 Hours**

DIGITAL TRANSMISSION

Introduction, Pulse modulation, PCM, PCM sampling, sampling rate, signal to quantization noise rate,companding, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission, Intersymbol interference, eye patterns.

UNIT IV **9 Hours**

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques, wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

UNIT V **9 Hours**

SATELLITE AND OPTICALCOMMUNICATION

Satellite Communication Systems-Keplers Law, LEO and GEO Orbits, footprint, Link model-OpticalCommunication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.

Total: 45 Hours

Reference(s)

1. Wayne Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson Education, 2007.
2. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons., 2001.
3. H. Taub,D L Schilling,G Saha ,Principles of Communication,3/e,2007.
4. B.P. Lathi,Modern Analog And Digital Communication systems, 3/e, Oxford University Press, 2007
5. Dennis Roddy, "Satellite Communications", Third Edition, Mc Graw Hill International Editions, 2001.
6. Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 4th edition., 2011.

21OEC04 Principles of Computer Communication and Networks 3 0 0 3

Course Objectives

- To understand the concept of data communication and networking models.
- To study the various networking Components and Networks.
- To explore the routing, addressing and security and management aspects of computer networks.

Course Outcomes (COs)

1. Classify the types of computer networks and analyze the seven layers of OSI model.
2. Analyze the basic operations of Routing Algorithms and Routing devices
3. Analyze the local and wide area networking technologies.
4. Apply the ISDN and ATM interface connections in broadband networks.
5. Analyze the security and management techniques related with networks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	1	1								
2	1	2	2	3								
3	1	1	2	3								
4	1	1	3									
5	1	2	3	3								

UNIT I **9 Hours**

NETWORK FUNDAMENTALS

Types of Computer Networks: by Area, by Topology; Communication Services: Serial and Parallel, Synchronous and Asynchronous, Simplex and Duplex, Analog and Digital; Speed and Capacity; Multiplexing and Switching; Network Architecture: OSI Seven-Layer Network model.

UNIT II **9 Hours**

INTERNETWORKING AND COMPONENTS

Routing Concepts: Routing Algorithms, RIP, RIP-2, OSPF and other routing Protocols; Switches and Hubs: Store and Forward Switch, Cut-Through Switch, Hybrid Switch, Performance of Switches; Repeaters; Repeater Vs Hubs; Bridges: Standards, Bridges Vs Repeaters; Routers and Gateways.

UNIT III **9 Hours**

LOCAL AND WIDE AREA NETWORKING TECHNOLOGIES

LAN Components and Topologies; Access Techniques; Transmission Protocols and Media; Ethernet and IEEE 802.3 Networks: History, 10-MBPS Ethernet, Switched Ethernet, 100-MBPS Ethernet, Gigabit Ethernet.

UNIT IV **9 Hours**

BROADBAND NETWORKS

ISDN: Evolution, ISDN Channel and Interface Structures; Broadband ISDN: Basics, Principles and General Architecture; Asynchronous Transfer Mode(ATM): Introduction, Concepts, Components, Connection Supported by ATM network and Concept of Virtual Channel and Virtual Path, Traffic control and Congestion Control, Operation and Maintenance aspects.

UNIT V **9 Hours**

NETWORK SECURITY AND MANAGEMENT

Security: Need of Security, Security Threats, Vulnerabilities, Methods, tools and Techniques for Attacks; Network Security: Levels of Security, Cryptosystems; Data Encryption Standard (DES), Public Key Cryptography, Firewalls; Network Management: Functions and Elements, Distribution of Management; Simple Network Management Protocol (SNMP), Remote Network Management Services.

Total: 45 Hours

Reference(s)

1. Michael A. Gallo, William M. Hancock, Computer Communications and Networking Technologies, 1 Ed, Thomson Learning, 2002.
2. Kenneth C. Mansfield, Jr. James L. Antonakos, An Introduction to Computer Networking, 1Ed, Prentice Hall of India, 2002
3. A Shanmugam, S Rajeev, Computer Communication Networks, 1Ed, ISTE Learning Materials Centre, 2001
4. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall
5. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY

22OEI01 Programmable Logic Controllers 3 0 0 3

Course Objectives

- To impart knowledge about automation and architecture of PLC
- To understand the PLC programming using timers, counters and advanced PLC functions
- To familiarize the student with PLC based applications

Course Outcomes (COs)

1. Outline the fundamental Concepts of Automation
2. Conclude the architecture, interfacing and communication techniques of PLC
3. Execute the suitable PLC Programming languages
4. Attribute the various functions and instruction sets of PLC
5. Generate a suitable logical programming for given applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2	2		3							
2	2	1		2	2		3							
3	2	1		2	2		3							
4	2	1		2	2		3							
5	2	1		2	2		3							

UNIT I **10 Hours**

INTRODUCTION TO AUTOMATION

Evolution of automation -Types of automation - Fixed, flexible and programmable automation - Batch process and continuous process - open loop system and closed loop system - Function of sensors - Proximity sensors: Capacitive and Inductive - Infrared and Laser Push-buttons and toggle switches - Actuators: Solenoid valve - servo motor - electromagnetic relays.

UNIT II **9 Hours**

ARCHITECTURE OF PLC

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC.

UNIT III **8 Hours**

PLC PROGRAMMING

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming, Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter.

UNIT IV **10 Hours**

ADVANCED PLC FUNCTONS

Instructions in PLC: Program Control Instructions, Math Instructions, Data Manipulation Instructions: Data compare operations, Data transfer operations - Sequencer and Shift register instructions- Analog Instructions: PID Controller - Scaling Instructions.

UNIT V **8 Hours**

APPLICATIONS OF PLC

Case Studies: Bottle filling system - Pick and place robot - Car Parking - Traffic light control (4 ways with pedestrian signal) -Elevators - Pneumatic stamping system - alarm annunciator system.

Total: 45 Hours

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015.
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India, New Delhi, 2014.
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes, Elsevier, 2015.
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014.
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.

22OEI02 Sensor Technology 3 0 0 3

Course Objectives

- To impart knowledge about various sensors in multidisciplinary engineering domain
- To familiarize students with different applications and its material handling technology
- To understand the concept of sensing circuits and its static and dynamic characteristics

Course Outcomes (COs)

6. Conclude the static and dynamic characteristics of measuring instruments
7. Compare the characteristics and working principles of Resistance, Inductance and Capacitance type sensors
8. Construct the interfacing and signal conditioning circuit for measurement system using different types of sensor
9. Analyze and select the suitable sensor for different industrial applications
10. Combine the modern technologies and smart materials to design various sensors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	2	3	2	1	1									
3	1	2	3	3	1									
4	2	1	1	3	3									
5	1	2	1	2	3									

UNIT I **8 Hours**

SENSORS FUNDAMENTALS AND CHARACTERISTICS

Sensors: Principles of Sensing - Sensor Classification and terminology- Units of Measurements - Measurands- Sensor Characteristics: Static and Dynamic.

UNIT II **8 Hours**

PHYSICAL PRINCIPLES OF SENSING

Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements.

UNIT III **9 Hours**

INTERFACE ELECTRONIC CIRCUITS

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.

UNIT IV **10 Hours**

SENSORS IN DIFFERENT APPLICATION AREA

Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors.

UNIT V **10 Hours**

SENSOR MATERIALS AND TECHNOLOGIES

Materials, Surface Processing- MEMS microsystem components- Microfluidics microsystem components - Nano Technology- Smart Materials.

Total: 45 Hours

Reference(s)

1. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer, 2016.
2. D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, New Delhi, 2009.
3. Guozhen Shen, Zhiyong Fan, “Flexible Electronics: From Materials to Devices”, 1st Edition, World Scientific Publishing Co, Singapore, 2015.
4. Horowitz, P., and W. Hill. The Art of Electronics. 2nd ed. Cambridge University Press, 1989.

22OEI03 Fundamentals of Virtual Instrumentation 3 0 0 3

Course Objectives

- Understand the basic components of Virtual Instrumentation system.
- Learn the developing VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.

Course Outcomes (COs)

11. Outline the concepts of traditional instruments and virtual instruments
12. Conclude the overview of modular programming and the structuring concepts in VI programming
13. Attribute the procedure to install DAQ in various OS and its interfacing methods
14. Implement the VI toolsets for specific applications
15. Generate the applications using Virtual Instrumentation software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1										
2	3	3	2	2	2					2	2	2		
3	2	2	2	1										
4	3	3	3	1	2					1	2	2		
5	3	2	2	1	2				-	1	2	2		

UNIT I **9 Hours**

INTRODUCTION

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II **9 Hours**

PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III **9 Hours**

DATA ACQUISITION

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT IV **9 Hours**

VI TOOLSETS

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipment's like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory.

UNIT V **9 Hours**

APPLICATIONS

Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Total: 45 Hours

Reference(s)

1. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
2. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, New York, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.

22OEI04 Optoelectronics and Laser Instrumentation 3 0 0 3

Course Objectives

- To enhance the student knowledge in fiber optics fundamentals and fabrication
- To be recognized with industrial applications of fibers
- To understand the fundamental concepts about lasers
- To identify and describe various fiber optic imaging and optoelectronic sensor applications

Course Outcomes (COs)

16. Attribute the properties of optical fibers, their light sources and detectors.
17. Implement the fiber-optic sensor for the measurement of various physical quantities.
18. Conclude the fundamentals of laser, types of laser and its working.
19. Outline the applications of laser for industrial applications.
20. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	3	2	1	2										
3	3	2	1											
4	3	2	2	2										
5	3	2	2	2										

UNIT I **9 Hours**

OPTICAL FIBERS AND THEIR PROPERTIES

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors.

UNIT II **9 Hours**

INDUSTRIAL APPLICATION OF OPTICAL FIBERS

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

UNIT III **9 Hours**

LASER FUNDAMENTALS

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

UNIT IV **9 Hours**

INDUSTRIAL APPLICATION OF LASERS

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing.

UNIT V **9 Hours**

HOLOGRAM AND MEDICAL APPLICATIONS

Holography: basic principle, methods - holographic interferometry and application, holography for non-destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

Total: 45 Hours

Reference(s)

1. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
4. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India, 2012.
5. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
6. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

21OME01 Digital Manufacturing 3 0 0 3

Course Objectives

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder based methodology and emerging trends with case studies, applications of AM techniques.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Design, analyze and evaluate the performance of mechanical systems.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Design a 3D model from the 2D data.
2. Develop a CNC program for simple components.
3. Generate stl file and manipulate parameters of AM machine
4. Select appropriate liquid or solid materials based AM process to the respective application
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2								1	2	
2	2	2	2		2								1	2	
3	2	2	2		2								1	2	

4	2	2	2		2								1	3	
5	2	2	2		2								1	2	

UNIT I **9 Hours**

CAD MODELING

Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R. Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T. Pham, S. S. Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.

5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6
6. www.grabcad.com, www.all3dp.com

21OME02 Industrial Process Engineering 3 0 0 3

Course Objectives

- To impart the knowledge on production planning methodologies and layout design
- To learn about production planning and its control methods
- To provide the knowledge of work study, process charts and ergonomic condition
- To impart the knowledge on inventory control and material handling
- To learn about system analysis and different types of maintenance processes

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
k. 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.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Select proper plant layout for the required production system
2. Plan the resources required for the production and to perform the control methods
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling
5. Perform system analysis and use different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1		1									2	
2	3	3	1		2						2			2	
3	1	3	3		2									2	
4	2	3	1		2									2	
5	2	3	1		2									2	

UNIT I **9 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

UNIT II **10 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process Planning-Definition, Procedure, Process selection, Machine capacity, Process sheet. Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

UNIT III **8 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.

UNIT IV **10 Hours**

INVENTORY MANAGEMENT

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models,ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

UNIT V **8 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010
2. Martand T.Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009

21OME03 Maintenance Engineering 3 0 0 3

Course Objectives

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature,and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of,and need for sustainable development.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Explain the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Utilize computers in maintenance and inventory management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2												2	
2	2	2												2	
3					2	2	1							2	

4	1	2	1		2	2	2							2	
5	2	2	2		1	1	1							2	

UNIT I **9 Hours**

PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

UNIT II **9 Hours**

MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

UNIT III **9 Hours**

CONDITION MONITORING

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

UNIT IV **9 Hours**

FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

UNIT V **9 Hours**

COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

FURTHER READING

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

21OME04 Safety Engineering 3 0 0 3

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
l. 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.
m. Design, analyse and evaluate the performance of mechanical systems.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.
o. Address all the fluid flow and heat transfer related problems of mechanical systems.

Course Outcomes (COs)

1. Explain safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1					2	1		1						2	2

2					1			3					2	1	
3	2											3	1		2
4	2	3							2				2		1
5					2					3				3	

UNIT II **8 Hours**

SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II **10 Hours**

SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Electricity Rules.

UNIT III **10 Hours**

SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop, - Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV **9 Hours**

SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

UNIT V **8 Hours**

SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and Training- Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights, -Working on fragile roofs, work permit Systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

FOR FURTHER READING

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India.

Total: 45 Hours

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey,1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988

3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras
4. Environmental Pollution Control Act, 1986
5. BOCW Act,1996, Madras Book agency, Chennai-1
6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

22OBT01 Biofuels **3 0 0 3**

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

Course Outcomes (COs)

1. Apply thee bio resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio-refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2				3								1
2	2						1								3
3	1						3								2
4	2						3								3
5	1						1								

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

9 Hours

UNIT III

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

9 Hours

UNIT V

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total Hours: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology,McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer,2007

22OFD01 Traditional Foods **3 0 0 3**

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2		1												
3	2	1	1											
4								2						
5								2						

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:-Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods -types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

3 0 0 3

22OFD02 Food Laws And Regulations

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2		1				1	2	1						
3		1												
4	1	2												
5	1	2												

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR)

WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

22OFD03 Post Harvest Technology of Fruits And Vegetables 3 0 0 3

Course Objectives

- To understand the importance and different methods of post-harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

Course Outcomes (COs)

1. Implement the different post-harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1			1							
2	1	1												
3	1	2												
4	1		1											
5	2	1	1											

UNIT I **9 Hours**

POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **9 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **9 Hours**

PRESERVATION BY DRYING

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT V **9 Hours**

PRESERVATION BY CANNING

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

Total: 45 Hours

Reference(s)

1. S. Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-Harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

22OFD04 Cereal, Pulses and Oilseed Technology **3 0 0 3**

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2		2								
2	1	2		2		1								
3	2	2		1		2								
4	2	3		2		2								2
5	2	2		2		3								

UNIT I **9 Hours**

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut,rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure
and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting,
dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OIL SEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and
modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends;
applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition,CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

22OFT01 Fashion Craftsmanship 3 0 0 3

Course Objectives

- To impart theoretical and practical knowledge about various handi-craft techniques
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Course Outcomes (COs)

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile based handicrafts. Produce various decorative and appealing products
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories
4. Design and construct head accessories, home furnishings and paintings
5. Design and construct various decorative and appealing products for interiors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	3				2		2	2		2	2	
2	3	2	3				1		2	3		2	2	
3	3	2	3				2		2	3		2	2	
4	3	2	3				2		2	3		2	2	
5	3	2	3				2		2	3		2	2	

UNIT I **9 Hours**

TECHNIQUES OF HANDICRAFT MATERIALS

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

UNIT II **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - INTERIORS

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

UNIT III **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

UNIT IV **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

UNIT V **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

Total: 45 Hours

Reference(s)

1. Handmade in India: A Geographic Encyclopedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007
3. All about Techniques in Illustration, Barron Educational Series, 2001
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000
6. https://www.marthastewart.com/274411/fashion-crafts

22OFT02 Interior Design in Fashion 3 0 0 3

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

Course Outcomes (COs)

1. Interpret the elements of interior design concepts and resolve the personality requirements
2. Develop graphical representations of interior design concepts
3. Resolve the space planning requirements of residential home as per CPWD guidelines
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3		-	1							2	
2	3	2	3		2	3		2					3	
3	3	3	3		2	2		2					2	
4	3	3	3		2	3		2					2	
5	3	2			2			3					3	

UNIT I **9 Hours**

INTRODUCTION

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design -Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

UNIT II **9 Hours**

GRAPHICAL PRESENTATIONS

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with color rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

UNIT III **9 Hours**

SPACE PLANNING

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

UNIT IV **9 Hours**

INTERIOR COMPONENTS

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

UNIT V **9 Hours**

ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

Total: 45 Hours

Reference(s)

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. Https://eclectictrends.com

22OFT03 Surface Ornamentation 3 0 0 3

Course Objectives

- To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- To aware of various types of embroidery and methods of producing it.
- To make the students confident about doing surface embellishment work

Course Outcomes (COs)

1. Analyze the raw material requirements for surface ornamentation and its application
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations
3. Apply the machine and computerized embroidery stitches
4. Analyze the surface embellishment techniques and its application
5. Assess the quality maintenance parameters of all embroidered products and analyze the 6 traditional embroidery techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2					1						
2	2	3	2						2				2	2
3	2	3	2		3								2	2
4	2	2	2						2				2	2
5	2	2	2						2					2

UNIT I **9 Hours**

INTRODUCTION TO SURFACE ORNAMENTATION

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

UNIT II **9 Hours**

HAND EMBROIDERY

General rules for hand embroidery. Types of hand embroidery Stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

UNIT III **9 Hours**

MACHINE EMBROIDERY

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

UNIT IV **9 Hours**

EMBELLISHMENT TECHNIQUES

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and Decorations-Laces, Pompons, Fringes, Tassels, Tucks, show buttons, Crocheting.

UNIT V **9 Hours**

TRADITIONAL EMBROIDERIES OF INDIA AND CARE

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

Total: 45 Hours

Reference(s)

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations,2014
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013
3. Christen Brown, Embroidered & Embellished, C&T Publishing, 2013
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. http://www.needlenthread.com/tag/hand-embroidery-stitches

22OPH01 Nanomaterials Science **3 0 0 3**

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future -classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD-chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits-single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W. Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

22OPH02 Semiconductor Physics And Devices 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity-diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

9 Hours

UNIT IV

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

9 Hours

UNIT V

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

22OPH03 Applied Laser Science 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	1												
4	2	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd: YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light Detection and Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006

22OPH04 Bio-Photonics 3 0 0 3

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra-short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2												
3	3	2							3					
4	3	2							3					
5	3	2												

UNIT I

9 Hours

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

UNIT II
9 Hours
PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9**
Hours
BIO-NANO-PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fiber-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9**
Hours
TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skinoptics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9**
Hours
BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering – Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Introduction to Biophotonics, ParasN.Prasad, WileyInter-science, AJohnWiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G. Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V. Wang, Hsin.-I.Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R. Splinterand B.A.Hooper, Taylor & Francis
4. Bioimaging Current Concepts in Light and Electron Microscopy, DouglasE.Chandler & Robert W. Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy: Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

22OPH05 Physics of Soft Matter 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter
- To understand the fundamental interactions of colloids and gels
- To explain the structure and phase behavior of liquid crystals and supramolecules
- To summarize the soft matter proprties of structures and components of life

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2	2												
5	2	2												

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular Forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS & GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids. Physical and chemical gels-classical theory of gelation-elasticity of gels

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

9 Hours

UNIT IV

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

9 Hours

UNIT V

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

REFERENCES

1. Richard A L Jones, *Soft Condensd Matter*, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

22OCH01 Corrosion Science and Engineering 3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress Corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection (sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E. McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html

22OCH02 Polymer Science 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

22OCH03 Energy Storing Devices 3 0 0 3

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3					1							
3	3	1												
4	2	2					1							
5	3	3					1							

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photo biochemical conversion cell.

Total: 45 Hours

Reference(s)

1. N. Eliza, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

22OMA01 Graph Theory and Combinatorics 3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2													
2	1	3													
3	2	3													
4	2	3													
5	3	3													

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics and Its Applications, McGraw Hill, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

21OGE01 Principles of Management

3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2		3				
2									2		2				
3									2		2				
4									3		2				
5									2		2				

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

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 II **9 Hours**

PLANNING

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 III **9 Hours**

ORGANISING

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 IV **9 Hours**

DIRECTING

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 V **9 Hours**

CONTROLLING

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: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons,
   2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

21OGE02 Entrepreneurship Development I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship
- Understand the generation of ideas of the Entrepreneurship
- Evolve the legal aspects of the business
- Learn to analyze the various business finance
- Learn the basics of the Operations Management

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CONo	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act - Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments - promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance - functions - deciding on the production system - facility decisions: plant location, plant layout (cases), capacity requirement planning - inventory management (cases) - lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business

21OGE03 Entrepreneurship Development II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services
- Handle the human resources and taxation
- Learn to analyze the taxation
- Understand the Government industrial policies and supports
- Preparation of a business plan

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyze the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions - TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html

22OGE04 Nation Building, Leadership And Social Responsibility 3 0 0 3

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality
- To analyze the different types of responsibility role of play for the improvement of society

Course Outcomes (COs)

1. Understand religo-cultural diversity of the country and its impact on the lives of the people and their beliefs
2. Acquire a sense of responsibility, smartness in appearance and improve self confidence
3. Develop the sense of self-less social service for better social & community life
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication
5. Acquire awareness about the various types of weapon systems in the Armed Forces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		1				1					3			
2	2		2				2					2			
3	2		1				1					2			
4	2		3				3					3			
5	2		1				1					2			

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation.

Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy

Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion –

copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counseling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness.

Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga- Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, Zig Zag Balance, High Wall etc.

COMMUNICATION: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture-Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

Total: 45 Hours

Reference(s)

1. Director General NCC Website: https://indiancc.nic.in/ncc-general-elective-subject-course-design/
2. Grooming Tomorrow's Leaders, published by DG, NCC. https://indiancc.nic.in/
3. Youth in Action, published by DG, NCC. https://indiancc.nic.in/
4. The Cadet, Annual Journal of the NCC. https://indiancc.nic.in/
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. https://indiancc.nic.in/

22OAM01 Computer Vision in Healthcare Application 3 0 0 3

Course Objectives

- Understand the algorithms and techniques used in image formation.
- Implement the motion computation and 3D vision to generate 3-dimensional images of an object.
- Develop computer vision tools to assist surgeons during procedures, providing real-time feedback and guidance.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. 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.

c. 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.

d. 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.

e. 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.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the image processing techniques for computer vision.
2. Implement the image pre-processing techniques.
3. Demonstrate 3D vision and motion related techniques.
4. Computer Vision for physical rehabilitation and training
5. Analysis of Medical Image for Predictive Analytics and Therapy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1										2	
2	2	3	2		3								3	
3	2	2	2		2								3	
4	2	3	3		3								3	
5	2	3	3	2	3								3	

UNIT I 10 Hours

COMPUTER VISION FOUNDATIONS

History of Computer Vision – Basics of Image Processing, Machine Learning – Information Retrieval – Neuroscience – Robotics – Speech – Cognitive Sciences –Algorithms, Systems and Theory .Image Processing - Colour - Linear Algebra Primer - Pixels and Filters - Edge

Detection - Features and Fitting - Feature Descriptors - Image Resizing - Segmentation - Semantic Segmentation - Clustering - Object recognition - Dimensionality Reduction - Face Identification - Visual Bag of Words - Object Detection from Deformable Parts - Semantic Hierarchies and Fine Grained Recognition - Motion - Tracking - Deep Learning

UNIT II **10 Hours**
IMAGE FORMATION AND IMAGE PRE-PROCESSING
Geometric primitives and transformations – Photometric image formation – The digital camera – Point operators – Linear Filtering – More neighbourhood operators – Fourier transforms – Pyramids and wavelets – Geometric transformations – Global optimization. Feature detection and matching – Segmentation – Edge detection - 2D and 3D feature based alignment – Pose estimation – Geometric intrinsic calibration – Triangulation – Two-Frame Structure from motion – Factorization – Bundle adjustment – Constrained Structure and Motion – Dense motion estimation.

UNIT III **7 Hours**
3D VISION
Methods for 3D Vision - 3D reconstruction – Image based rendering, Image Recognition – Object Detection – Space, Instance and Category Recognition – Recognition Databases and test sets.

UNIT IV **9 Hours**
COMPUTER VISION FOR ASSISTING HEALTHCARE APPLICATIONS
Computer Vision to see - Computer Vision for Cognition - Computer Vision for physical rehabilitation and training - Computer Vision for CAD systems in surgery - Computer Vision for human-machine interaction - Computer Vision for Ambient Assisted Living - Egocentric (first person) vision.

UNIT V **9 Hours**
HEALTH CARE APPLICATIONS AND CONTEMPORARY ISSUES
Analysis of Medical Image - Computer Vision for Predictive Analytics and Therapy - Fundamental Algorithms for Medical Images - Machine Learning Algorithms for Medical Images – Deep learning approaches for healthcare applications - Contemporary issues.

Total: 45 Hours

Reference(s)

1. Ranjay Krishna, "Computer Vision: Foundations and Applications", Stand ford University, December 2017.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
4. Forsyth D A and Ponce J, "Computer Vision: A Modern Approach", Prentice Hall 2003.
5. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
6. Forsyth D A and Ponce J, "Computer Vision: A Modern Approach", Prentice Hall 2003.

22OAM02 Neural Networks 3 0 0 3

Course Objectives

- To understand the major concepts in deep neural networks.
- To apply Convolutional Neural Network architectures for any real-life applications.
- To analyse the key computations underlying deep learning to build and train deep neural networks for various tasks.

Program Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Apply Convolution Neural Network for any suitable applications.
2. Analyze the various classifiers of Single-layer perceptron.
3. Apply Convolutional Neural Networks and its variants for any suitable applications.
4. Analyze the Single-layer Feedback Networks with its mathematical foundation.
5. Analyze the various categories of associative memory with its case studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		1								2	
2	2	2	3		3								2	
3	1	3	3		3								2	
4	2	2	2		3								2	
5	2	2	1		3								2	

UNIT I **9 Hours**

INTRODUCTION

Fundamental concepts and Model: Models of artificial Neural Networks, Neural processing, Learning and Adaptation, Neural network Learning rules- Hebbianrule, Perceptron rule, Delta rule.

UNIT II **9 Hours**
SINGLE LAYER PERCEPTRON MODEL
Single-layer perceptron classifiers: Classification model, Features and decision regions, Discriminant functions, Linear machine and Minimum distance classification, Non-parametric training concept, Training and Classification using the Discrete perceptron: algorithm and example, Single layer continuous Perceptron networks for linearly separable classifications.

UNIT III **9 Hours**
MULTI LAYER FEED FORWARD NETWORKS
Multilayer feed forward Networks: Linearly separable Pattern classification, Delta learning rule for Multiperceptron model, Generalized Delta learning rule, Feed forward recall and error back propagation training.

UNIT IV **9 Hours**
SINGLE LAYER FEEDBACK NETWORKS
Single-layer Feedback Networks: Basic concepts of dynamic systems, Mathematical foundations of Discrete-time Hopfield Networks, Mathematical foundations of Gradient type Hopfield networks, Associative memories: Basic concepts, Linear Associator.

UNIT V **9 Hours**
ASSOCIATIVE MEMORY
Bidirectional associative memory - associative memory for spatio-temporal patterns - Case study: Implementation of NN in anysimulator. Self-Learning: Bidirectional Associative memory.

Total: 45 Hours

Reference(s)

1. E. A.E and S. J.E, "Introduction to Evolutionary Computing | The on-line accompaniment to the book Introduction to Evolutionary Computing", Evolutionary computation.org, 2015.
2. F. Lobo, "Evolutionary Computation 2018/2019", Fernandolobo.info, 2018.
3. "EC lab Tools", Cs.gmu.edu, 2008.
4. "Kanpur Genetic Algorithms Laboratory", Iitk.ac.in, 2008.
5. "Course webpage Evolutionary Algorithms", Liacs.leidenuniv.nl, 2017.