B.E. (Computer Science and Design)

2022 Regulations, Curriculum & Syllabi

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

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

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CONTENTS

VISION OF THE DEPARTMENT

To excel in the field of Computer Science and Design through the appropriate use of Computing and Design approaches.

MISSION OF THE DEPARTMENT

- To adopt the latest industry trends in teaching learning process in order to make students competitive in the job market.
- To build technologically proficient individuals in Computer Science and Design to meet industry and entrepreneurial ventures by providing infrastructure and human resources.
- To Prepare students for full and ethical participation in a diverse society and encourage lifelong learning.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To perform well in their professional career by acquiring enough knowledge in the domain of Computer Science and Design.

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.

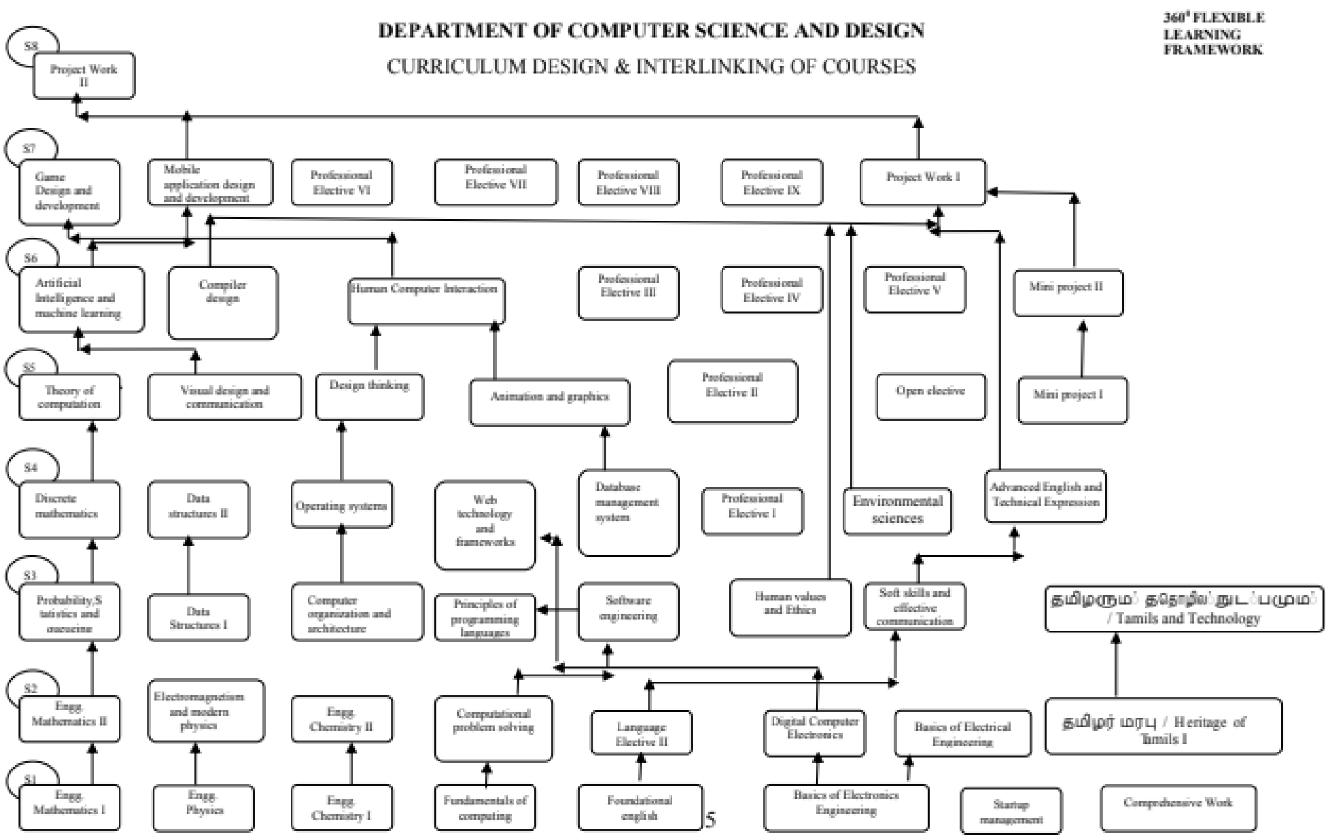
PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
2. Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
3. Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)											
	1	2	3	4	5	6	7	8	9	10	11	12
I	X	X	X	X	X	X	X					
II								X	X	X	X	
III	X	X	X		X							X

CONNECTIVITY CHART



B.E COMPUTER SCIENCE AND DESIGN
Minimum Credits to be Earned:163

I SEMESTER

CodeNo.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	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	BASIC OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	100	0	100	EEC
22HS003	தமிழர் மரபு HERITAGE OF TAMILS#*	1	0	0	1	1	100	0	100	HSS
22CD108	COMPREHENSIVE WORK$	0	0	2	1$	2	100	0	100	EEC
Total		**15**	**1**	**10**	**21**	**26**	-	-	-	-

II SEMESTER

CodeNo.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM ANDMODERN 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
22CD206	DIGITAL COMPUTER ELECTRONICS	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
22HS006	தமிழரும் ததொழில்நுட்பமும் TAMILS AND TECHNOLOGY*	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**10**	**23**	**28**	-	-	-	-

* The lateral entry students have to complete these courses during III and IV semester.

Students admitted during academic year 2022-2023 studied this course in semester II.

^ Students admitted during academic year 2022-2023 studied this course in semester III.

$ Applicable only for the students admitted during academic year 2022-2023.

III SEMESTER

CodeNo.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22CD301	PROBABILITY, STATISTICS AND QUEUING THEORY	3	1	0	4	4	40	60	100	ES
22CD302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	PC
22CD303	COMPUTER ORGANIZATION AND ARCHITECTURE*	3	1	0	4	4	40	60	100	PC
22CD304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22CD305	SOFTWARE ENGINEERING	3	0	0	3	3	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	40	100	HSS
Total		**17**	**2**	**6**	**22**	**25**	-	-	-	-

IV SEMESTER

CodeNo.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22CD401	DISCRETE MATHEMATICS	3	1	0	4	4	40	60	100	ES
22CD402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22CD403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22CD404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22CD405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	HSS
Total		**16**	**2**	**8**	**23**	**26**	-	-	-	-

* LTPC for this course is 3 0 0 3 for the students admitted during academic year 2022-2023.

V SEMESTER

CodeNo.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22CD501	THEORY OF COMPUTATION	3	1	0	4	4	40	60	100	PC
22CD502	VISUAL DESIGN AND COMMUNICATION	3	0	0	3	3	40	60	100	PC
22CD503	DESIGN THINKING	3	0	0	3	3	40	60	100	PC
22CD504	ANIMATION AND GRAPHICS	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CD507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**15**	**1**	**4**	**21**	**20**	**-**	**-**	**-**	**-**

VI SEMESTER

CodeNo.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CIA	SEE	Total	
22CD601	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE	3	0	2	4	5	50	50	100	PC
22CD602	PRINCIPLES OF COMPILER DESIGN	3	1	0	4	4	40	60	100	PC
22CD603	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELE CTIVE V	-	-	-	3	-	-	-	100	PE
22CD607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**9**	**1**	**4**	**21**	**14**	**-**	**-**	**-**	**-**

VII SEMESTER										
CodeNo.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CD701	GAME DESIGN AND DEVELOPMENT	3	1	0	4	5	40	60	100	PC
22CD702	MOBILE APPLICATION DESIGN AND DEVELOPMENT	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IX	-	-	-	3	-	-	-	100	PE
22CD707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**6**	**1**	**6**	**22**	**13**	-	-	-	**-**

VIII SEMESTER										
CodeNo.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CD801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		0	0	20	**10**	20	-	-	-	**-**

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
ELECTIVES										
LANGUAGE ELECTIVES										
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
DISCIPLINE ELECTIVES										
VERTICAL I – DATA SCIENCE										
22CD001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CD002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CD003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CD004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CD005	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CD006	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
VERTICAL II – FULL STACK DEVELOPMENT										
22CD007	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CD008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CD009	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22CD010	WEB APPLICATION AND SECURITY	2	0	2	3	3	50	50	100	PE
22CD011	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22CD012	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL III – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22CD013	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22CD014	CLOUD SERVICES ANDDATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CD015	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22CD016	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CD017	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22CD018	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL IV – CREATIVE MEDIA										
22CD019	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22CD008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CD020	AUGMENTED REALITY AND VIRTUAL REALITY	2	0	2	3	4	50	50	100	PE
22CD021	DIGITAL AUDIO AND VIDEO DESIGN	3	0	0	3	3	40	60	100	PE
22CD023	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
VERTICAL V – MARKETING AND MANAGEMENT										
22CD024	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	3	0	0	3	3	40	60	100	PE
22CD025	SUPPLY CHAIN MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CD026	SOCIAL TEXT AND MEDIA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CD027	FINANCIAL MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CD023	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
22CD028	MARKETING RESEARCH AND MARKETING MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CD022	VIDEO CREATION AND EDITING	2	0	2	3	4	50	50	100	PE
VERTICAL VI – MEDIA PROCESSING										
22CD029	MULTIMEDIA DATA COMPRESSION	3	0	0	3	3	40	60	100	PE
22CD030	STREAMING MEDIA TOOLS AND TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CD031	METAVERSE	2	0	2	3	4	50	50	100	PE
22CD032	IMAGE AND VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
22CD033	WEARABLE DEVICES APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CD034	3D PRINTING AND DESIGN	3	0	0	3	3	40	60	100	PE
VERTICAL VI – MEDIA PROCESSING (Honors)										
22CDH29	MULTIMEDIA DATA COMPRESSION	3	0	0	3	3	40	60	100	PE
22CDH30	STREAMING MEDIA TOOLS AND TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CDH31	METAVERSE	2	0	2	3	4	50	50	100	PE
22CDH32	IMAGE AND VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
22CDH33	WEARABLE DEVICES APPLICATIONS	3	0	0	3	3	40	60	100	PE

2CDH34	3D PRINTING AND DESIGN	3	0	0	3	3	40	60	100	PE
VERTICAL VI – MEDIA PROCESSING (Minor)										
22CDM29	MULTIMEDIA DATA COMPRESSION	3	0	0	3	3	40	60	100	PE
22CDM30	STREAMING MEDIA TOOLS AND TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CDM31	METAVERSE	2	0	2	3	4	50	50	100	PE
22CDM32	IMAGE AND VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
22CDM33	WEARABLE DEVICES APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CDM34	3D PRINTING AND DESIGN	3	0	0	3	3	40	60	100	PE
ONE CREDIT COURSES										
22CD0XA	STREAMING ANALYTICS WITH DEEP LEARNING	1	0	0	1	-	100	0	100	EEC
22CD0XB	GRAPHICS DESIGN TECHNIQUES USING ADOBE ILLUSTRATOR	1	0	0	1	-	100	0	100	EEC
22CD0XC	MOTION GRAPHICS USING ADOBE AFTER EFFECTS	1	0	0	1	-	100	0	100	EEC
22CD0XD	MANAGING CLOUD INFRASTRUCTURE WITH KUBERNETES FUNDAMENTALS	1	0	0	1	-	100	0	100	EEC
22CD0XE	DEVELOPMENT OF CLOUD WITH OPENSTACK	1	0	0	1	-	100	0	100	EEC
22CD0XA	STREAMING ANALYTICS WITH DEEP LEARNING	1	0	0	1	-	100	0	100	EEC
OPEN ELECTIVES										
22OCE01	ENERGY CONSERVATION AND MANAGEMENT	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
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	BIOPHOTONICS	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
22OBM01	OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES	3	0	0	3	3	40	60	100	OE
22OBM02	AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT	3	0	0	3	3	40	60	100	OE

22OBM03	HOSPITAL AUTOMATION	3	0	0	3	3	40	60	100	OE
22OAG01	RAINWATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	OE
22OEE01	VALUE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OEE02	ELECTRICAL SAFETY	3	0	0	3	3	40	60	100	OE
22OCB01	INTERNATIONAL BUSINESS MANAGEMENT	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)

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

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

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	PS01	PS02
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-

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 - Eigenvalues 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 - Orthogonality - 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 $y = ab^x$ 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)

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

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

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. 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.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12. 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. **Apply** the work-energy theorem to analyze and optimize mechanical system performance
2. **Analyze** free and forced mechanical oscillations in vibrational energy systems
3. **Analyze** the propagation of energy in mechanical systems through 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	3	2	1	1	-	-	-	-	2	-	-	1	-	-
2	3	2	1	2	-	-	-	-	2	-	-	1	-	-
3	3	2	2	1	-	-	-	-	2	-	-	1	-	-
4	3	2	2	1	-	-	-	-	2	-	-	1	-	-
5	3	2	2	1	-	-	-	-	2	-	-	1	-	-

UNIT I **5 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

5 Hours

EXPERIMENT 1

Assess the physical parameters of different materials for engineering applications like radius, thickness and diameter to design the electrical wires, bridges and clothes

5 Hours

EXPERIMENT 2

Evaluate the elastic nature of different solid materials for modern industrial applications like shock absorbers of vehicles

5 Hours

EXPERIMENT 3

Analyze the photonic behaviour of thin materials for advanced optoelectronic applications like adjusting a patient's head, chest and neck positions as a medical tool

5 Hours

EXPERIMENT 4

Investigate the phonon behavior of poor conductors for thermionic applications like polymer materials and textile materials

EXPERIMENT 5 **5 Hours**

Assess the elongation of different solid materials for industrial applications like buildings, bridges and vehicles

5 Hours

EXPERIMENT 6

Measure the compressibility of different liquids for modern industrial applications like navigation, medicine and imaging

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), BharathiBhawan 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
- Analyse 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)

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

PO2 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. Apply the principles of nuclear fusion and stellar evolution to explain the processes of hydrogen fusion in stars and the creation of elements
2. Apply the concept of atomic structure of elements in the periodic table to 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
1	2	1	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-

ORIGIN OF ELEMENTS

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

UNIT II **6 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

LABORATORY EXPERIMENTS **2 Hours**

Lab safety rules and guidelines for students - OSHA Guidelines

EXPERIMENT 1 **4 Hours**

Evaluate the dissolved oxygen (DO) levels in effluent samples collected from sewage treatment plant in BIT. Ensure the suitability of outlet water for the growth of aquatic animals (fishes).

EXPERIMENT 2 **4 Hours**

Investigate the amount of Iron (Fe^{2+}) in a mild steel alloy sample using a spectrophotometer.

EXPERIMENT 3 **4 Hours**

Estimate the amount of chromium present in industry effluent samples and bottled beverages.

EXPERIMENT 4 **4 Hours**

Ensure the suitability of drinking water in the RO water supply in BIT based on the presence of chloride ions.

EXPERIMENT 5 **4 Hours**

Assess the acidic nature of effluent water from industries using the conductometric titration method.

EXPERIMENT 6 **4 Hours**

Measure the stain removal efficiency of the prepared soaps from stained clothes.

EXPERIMENT 7 **4 Hours**

Assess the purity of commercially available active pharmaceutical ingredients (aspirin) as per the government-prescribed standards.

Total: 30+30=60 Hours

Reference(s)

1. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, 2nd Edition, Oxford university press, 2020.
2. Peter Atkins, Julio D Paula and James Keeler, Atkins' Physical Chemistry, 12th Edition, Oxford university press, 2019.
3. Gareth Price, Thermodynamics of chemical processes, 2nd Edition, Oxford university press, 2019.
4. D Tabor, Gases, liquids and solids and other states of matter, 3rd Edition, Oxford University press, 2018.
5. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017.
6. J.D. Lee, Concise inorganic chemistry, 5th edition (Reprint), Blackman Science Ltd, France, Wiley-India, 2016.

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 softwaredevelopment methodologies.

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.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	-	-	-	-	-	-	-	2	2	2
2	3	3	3	1	-	-	-	-	-	-	-	-	2	2	2
3	2	2	2	1	-	-	-	-	-	-	-	-	2	2	2
4	2	2	2	1	-	-	-	-	-	-	-	-	2	2	2
5	2	2	2	1	-	-	-	-	-	-	-	-	2	2	2

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 - its flow, functions and control - 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 lifecycle 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 and reading fluency in formal and informal contexts
- Prowess and develop abilities as critical readers and writers in interpreting complex texts

Programme Outcomes (POs)

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

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

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Interpret 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

15Hours

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- Paralinguistic / Vocalic- 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

UNITII

15Hours

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

UNITIII

15Hours

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.EnglishGrammar in Use: ASelf-StudyReferenceandPracticeBookforIntermediateStudents: with Answers. Cambridge: Cambridge UniversityPress,1985.
3. Prasad,Hari Mohan.AHand book of Spotting Errors.McgrawHill Education,2010
4. Reynolds,John.CambridgeIGCSEA,FirstLanguageEnglish.2018thed.,Hodder Education,2018.
5. Wiggins,GrantP.,andJayMcTighe.UnderstandingbyDesign.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.

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.

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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.

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.

6 Hours

EXPERIMENT 2

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

4 Hours

EXPERIMENT 3

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

4 Hours

EXPERIMENT 4

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

4 Hours

EXPERIMENT 5

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

Total: 30+30=60 Hours

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. BehzadRazavi, 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

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

Program Outcomes (POs)

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: 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.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	-	-	-	-

UNIT I **3 Hours**

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

EXPERIMENT 1 **1 Hours**

Analysis of various business sectors

EXPERIMENT 2 **2 Hours**

Developing a Design Thinking Output Chart

EXPERIMENT 3 **1 Hours**
Creating Buyer Personas

EXPERIMENT 4 **2 Hours**
Undertake Market Study to understand market needs and assess market potential

EXPERIMENT 5 **3 Hours**
Preparation of Business Model Canvas

EXPERIMENT 6 **3 Hours**
Developing Prototypes

EXPERIMENT 7 **2 Hours**
Organizing Product Design Sprints

EXPERIMENT 8 **2 Hours**
Preparation of Business Plans

EXPERIMENT 9 **2 Hours**
Preparation of Pitch Decks

Total: 45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. PavanSoni, 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 JithinSaji 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)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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	PS01	PS02
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-

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, 201

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)

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

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

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. 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.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12. 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 mechanisms of Coulomb's law and electric potential in various charge system
2. **Analyze** the magnetic properties of materials and their effects on external magnetic fields
3. **Analyze** the classification of electromagnetic waves based on frequency and wavelength
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. **Apply** the principles of electron and hole transport to study p-type and n-type semiconductors.

Articulation Matrix

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

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

EXPERIMENT 1 **5 Hours**

Analysis a I-V characteristics of a solar cell for domestic applications

EXPERIMENT 2 **5 Hours**

Determine the carrier concentration of charge carriers in semiconductors for automotive applications

EXPERIMENT 3

Investigate the photonic behavior of laser source for photo copier device

EXPERIMENT 4 **5 Hours**

Implement the principle of stimulated emission of laser for grain size distribution in sediment samples

EXPERIMENT 5 **5 Hours**

Assess the variation of refractive index of glass and water for optical communication

EXPERIMENT 6 **5 Hours**

Evaluate the band gap energy of semiconducting materials for display device applications

Total: 30+30=60 Hours

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), BharathiBhawan 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)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7 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. Analyze the specific operating conditions under which corrosion occurs and suggest a method to control corrosion
4. Analyze the 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
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

EXPERIMENT 1 **4 Hours**

Measure industrial effluent water pH and assess water quality against allowed standards

EXPERIMENT 2 **4 Hours**

Iron (Fe^{2+}) in Bhavani River water: Potentiometric Analysis & Pollution Assessment (CPCB Standards)

EXPERIMENT 3 **4 Hours**

Construct a Zn-Cu electrochemical cell and validate the output by connecting the LED light

EXPERIMENT 4 **5 Hours**

Evaluate the corrosion percentage in concrete TMT bars

EXPERIMENT 5 **4 Hours**

Determination of the percentage of corrosion inhibition in plain-carbon steel using natural inhibitors

EXPERIMENT 6 **4 Hours**

Electroplating of copper metal on iron vessels for domestic application

EXPERIMENT 7 **5 Hours**

Determination of acid-catalyzed hydrolysis kinetics in locally sourced fruit extracts

Total: 30+30= 60 Hours

Reference(s)

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

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.

Course Outcomes (COs)

1. Analyse 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. Analyse the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	1	1	2		-	-	-	-	-	-	-	2	2	2
2	3	3	3	3	-	-	-	-	-	-	-	-	2	2	2
3	2	2	2	3	-	-	-	-	-	-	-	-	2	2	2
4	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
5	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - logical sequencing - drawing flowchart - preparing 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

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse 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.

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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**

ELECTROMECHANICAL 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.

EXPERIMENT 1

Analyze and design of Electromechanical energy cons

EXPERIMENT 2

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

Total: 30+30=60 Hours

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 Dutta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

22CD206 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

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

Program Outcomes(POs)

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

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

PO3: Design 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.

PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	2	2	2	-	-	-	-	-	-	-	-	-	2	2	2
3	2	2	2	-	-	-	-	-	-	-	-	-	2	2	2
4	2	2	-	-	-	-	-	-	-	-	-	-	2	2	2
5	2	2	-	-	-	-	-	-	-	-	-	-	2	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

EXPERIMENT 1 **2 Hours**

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

EXPERIMENT 2 **3 Hours**

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

EXPERIMENT 3 **3 Hours**

Design and Simulation of 4-bit Ripple Carry Adder

EXPERIMENT 4 **3 Hours**
Design and Simulation of a 4-bit Arithmetic and Logic

EXPERIMENT 5 **4 Hours**
Design and Simulation of D Flip Flop and J K Flip Flop

EXPERIMENT 6 **4 Hours**
Design and Simulation of 8-bit Register

EXPERIMENT 7 **4 Hours**
Design and Simulation of an 8 bit SISO, SIPO, PISO, PIPO Shift Register

EXPERIMENT 8 **4 Hours**
Simulation of Data Read and Data Write from a RAM

EXPERIMENT 9 **3 Hours**
Simulation of Control Unit Functionality

Total:45+30= 75 Hours

Reference(s)

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

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

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

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.

Program Outcomes(POs)

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

PO10: 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.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

UNIT I **3 Hours**

LANGUAGE AND LITERATURE

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

UNIT II **3 Hours**

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**

FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV **3 Hours**

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**

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.
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.

22CD301 PROBABILITY,STATISTICS AND QUEUING THEORY 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables.
- Summarize and apply the methodologies of the statistics and queueing theory.
- Develop enough confidence to identify and model mathematical patterns in the real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Demonstrate the basic probability axioms and apply it in the core areas.
2. Apply the concepts of probability distributions in an appropriate place of computers and Engineering.
3. Analyze the basic statistical inference techniques for solving engineering problems.
4. Design an experiment using ANOVA technique and summarize the measurements for statistical quality control.
5. Apply the queueing methodologies to optimize the result of the waiting line.

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLE

Axioms of probability-Conditional probability-Total probability-Bayes theorem-Random variable-Probability mass function-Probability density functions-Properties-Moments - Moment generating functions and their properties.

UNIT II **9 Hours**

STANDARD DISTRIBUTIONS

Discrete distributions: Binomial - Poisson - Negative Binomial - Continuous distributions: Uniform - Exponential - Gamma - Normal distributions and their properties.

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 -Small sample tests: t-test for mean -F- test - Chi-square test for Goodness of fit and Independence of attributes.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS AND CONTROL CHART

One way and two way classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design - Control charts for measurements (X and R charts) - Control charts for attributes (p, c and np charts).

UNIT V **9 Hours**

QUEUING THEORY

Pure Birth and Death Process -Characteristics of Queuing models- Kendall's notation-Single and multi server Markovian queuing models- M/M/1 and M/M/C (Finite and infinite capacity)- Pollaczek-Khintchine formula.

Total: 45+15=60 Hours

Reference(s)

1. Richard A Johnson, Miller & Freund"s Probability and Statistics for Engineers, PHL Publisher, 1996.
2. Kishore S Trivedi, Probability and Statistics with Reliability Queuing and Computer Science Applications, John Wiley and Sons, Second Edition, 2012.
3. Arnold O Allen, Probability Statistics and Queuing Theory with Computer Applications, New Age International, 2003.
4. Jay L Devore, Probability and Statistics for Engineering and The Sciences, Thomson Learning, Seventh Edition, 2002.
5. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists,

22CD302 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)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

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	PSO3
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.

EXPERIMENT 1 **8 Hours**

Implement a Python program for the supermarket application using Stack and Queue for basket storage and checkout respectively.

EXPERIMENT 2 **4 Hours**

Implement a python program for using a singly linked list. managing a train station and need to keep track of passengers on a particular train.

EXPERIMENT 3 **4 Hours**

Create a python program that allows users to search for a person's phone number quickly in the phone directory.

EXPERIMENT 4 **2 Hours**

Implement a Python program to sort the student grades for the quiz competition.

EXPERIMENT 5 **2 Hours**

Implement a digital signature generator and verifier using hash functions and public-key cryptography. Users can sign documents and verify the authenticity of signed documents.

EXPERIMENT 6 **10 Hours**

Implement a Python program to give a direction for a Stranger. The landmark will be considered a node and the path between the two landmarks is the link

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.

22CD303 COMPUTER ORGANIZATION AND ARCHITECTURE 3 1 0 4

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 thebest processor/computing system.

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO12: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

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 computers 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	PSO3
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 - NVIDIAs CUDA Toolkit - CUDA Programming

UNIT V **10 Hours**

MODERN COMPUTER ARCHITECTURE

Domain-Specific Computer Architectures - Sony PlayStation design PS3/PS5, MAC M1 chip, Xbox, Cerebos - 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 Reprint2015
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 smart phones, PCs, and cloud servers - Second Edition,2022.

22CD304 PRINCIPLES OF PROGRAMMING LANGUAGES 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)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for
the public health and safety, and the cultural, societal, and environmental considerations. PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

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	PSO3
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 2 **3 Hours**

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

EXPERIMENT 3 **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 4 **3 Hours**

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

EXPERIMENT 5 **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 6 **6 Hours**

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

EXPERIMENT 7 **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. Steve McConnell , Code Complete, Microsoft Press, 2004.
2. Robert. W. Sebesta 10/E , Concepts of Programming Languages , Pearson Education.
3. D. A. Watt, Wiley Dreamtech, Programming Language Design Concepts, 2007.
4. A.B. Tucker, R. E. Noonan, TMH , Programming Languages, 2nd Edition.
5. Thomson, Programming Languages, K. C. Louden, 2nd Edition, 2003

22CD305 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)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for
the public health and safety, and the cultural, societal, and environmental considerations. PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for
sustainable development.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

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	PSO3
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. Roger S.Pressman, Software Engineering: A Practitioners Approach, McGraw Hill International edition, Seventh edition, 2020
2. Ali Bahrami, Object Oriented Systems Development, Tata McGraw-Hill, 2010
3. Ian Sommerville, Software Engineering, 8th Edition, Pearson Education,2016.
4. Stephan Schach, Software Engineering, Tata McGraw Hill, 2007
5. Pfleeger and Lawrence Software Engineering: Theory and Practice, Pearson Education, second edition, 2010.

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)

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

PO10: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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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	PSO3
1	-	-	-	-	-	-	-	3	2	1	-	-	-	-	1
2	-	-	-	-	-	-	-	3	2	1	-	-	-	-	1
3	-	-	-	-	-	-	-	3	2	1	-	-	-	-	1
4	-	-	-	-	-	-	-	3	2	1	-	-	-	-	1
5	-	-	-	-	-	-	-	3	2	1	-	-	-	-	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 COEXISTENCE

Understanding the harmony in the 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.): Books Clinical 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)

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

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

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. Analyse 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

Total: 30 Hours

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 forIntermediate 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, BarunK.Mitra, Oxford University Press, 2012
6. Business English by Ken Taylor, Orient Blackswan, 2011

22HS006 TAMILS AND TECHNOLOGY 1 0 0 1

Course Objectives

1. Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
2. Investigate the building materials and the historical context of Hero stones during the Sangam Age by Analysing the details of stage constructions in Silapathikaram and their cultural significance.
3. Examine ancient knowledge of oceans and its impact on Tamil society.

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.

Program Outcomes (POs)

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: 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.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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 & 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 - Gemstone types described in Silapathikaram.

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.

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

22CD401 DISCRETE MATHEMATICS 3 1 0 4

Course Objectives

- Implement the definitions of relevant vocabulary from graph theory and combinatorics and be able to perform related calculations
- Understand and use the terms Cardinality, finite, countably infinite and uncountably infinite, and determine which of these characteristics is associated with a given set
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply the concepts of Boolean algebra and characteristics in computers.
2. Exemplify the formalized arguments to classify and assess real-world arguments.
3. Demonstrate the characteristics of predicate logic in computer engineering.
4. Apply different properties of injection, surjection, bijection, composition and inverse functions in software engineering.
5. Analyze the concepts of permutations, combinations and mathematical induction in the phenomena of the real world.

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	1	2	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

BOOLEAN ALGEBRA

Introduction of Boolean algebra - Truth table - Basic logic gate - Basic postulates of Boolean algebra - Principle of duality- Canonical form - Karnaugh map.

UNIT II **9 Hours**

PROPOSITIONAL CALCULUS

Propositions- Logical connectives-Compound propositions-Conditional and biconditional propositions- Truth tables - Tautologies and Contradictions - Logical and equivalences and implications-DeMorgans Laws-Normal forms-Principal conjunctive and disjunctive normal forms - Rules of inference-Arguments-Validity of arguments.

UNIT III **9 Hours**

PREDICATE CALCULUS

Predicates-Statement Function - Variables-free and bound variables- Quantifiers- Universe of discourse-Logical equivalences and implications for quantified statements- Theory of inference- The rules of universal specification and generalization-Validity of arguments.

UNIT IV **9 Hours**

SET THEORY AND FUNCTIONS

Set Operations-properties-Power set-Relations-Graph and matrix of a relation- Partial Ordering- Equivalence relations-Partitions- Functions -Types of Functions- composition of relation and functions- inverse functions.

UNIT V **9 Hours**

COMBINATORICS

Basics of Counting - Counting arguments- Pigeonhole Principle- Permutations and Combinations- Recursion and recurrence relations-Generating Functions- Mathematical Induction- Inclusion - Exclusion

Total: 45+15=60 Hours

Reference(s)

1. Trembly J P and Manohar R, Discrete Mathematical Structures with Applications to computer Science, Tata McGraw Hill Publications Co. Ltd., New Delhi 30th Re-print 2007.
2. Alan Doerr and Kenneth Levasseur, Applied Discrete Structures for Computer Science, Galgotia Publications Pvt. Ltd. Delhi. 2010.
3. Ralph P Girmaldi and Ramana B.V. Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education Asia, Delhi, 2007.
4. Kolman Busby Ross, Discrete Mathematical Structures , Prentice-Hall India, New Delhi, Fifth Edition, 2007.
5. Rosen K.H Discrete Mathematics and its Applications, Tata McGraw Hill Publications, New Delhi. 7th Edition, 2011.

22CD402 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.

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.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments,analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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. PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	2	-	2
2	1	2	2	2	2	-	-	-	-	-	2	2	2	-	2
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-	2
4	3	3	3	3	2	-	-	-	-	-	3	3	2	-	2
5	3	2	3	3	3	-	-	-	-	-	3	3	2	-	2

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-Dijkstras Algorithm-Travelling Salesman Problem-Analysis of shortest path algorithms.

UNIT III **9 Hours**

GRAPH MST

Minimum Spanning Tree: Prims Algorithm-Kruskals 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.

4 Hours

EXPERIMENT 1

Implement a trie data structure to efficiently support autocomplete suggestions based on user input in google docs.

4 Hours

EXPERIMENT 2

Implement an Algorithm to find the shortest route and travel time between two locations within a city's transportation network.

10 Hours

EXPERIMENT 3

Design a cost-efficient telecommunication network to connect multiple cities using Kruskal's algorithm.

EXPERIMENT 4 **4 Hours**

Implement a chess game application using backtracking.

EXPERIMENT 5 **4 Hours**

Implement a segment tree for range sum query in a Real-time data analytics platform for student management systems.

4 Hours

EXPERIMENT 6

Implement a geographic information system (GIS) for locating a city as node using quad tree.

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

22CD403 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.

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.

Program Outcomes (POs)

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

PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments,analysis and interpretation of data, and synthesis of the information to provide validconclusions.

PO5: 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.

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

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

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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. PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	-	2	-	2	-	2	2	2	-	2
2	3	3	2	2	3	-	2	-	2	-	-	2	2	-	2
3	2	2	2	-		-	2	-	2	-	-	2	2	-	2
4	2	2	2	-	3	-	2	-	2	-	-	2	2	-	2
5	2	2	2	-		-	-	-	2	-	-		2	-	2

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

   https://www.redhat.com/en/topics/virtualization

22CD404 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

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.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system componentsor processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments,analysis and interpretation of data, and synthesis of the information to provide validconclusions.
PO5: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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. PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	2	-	2
2	2	2	2	2	2	-	-	-	-	-	2	2	2	-	2
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-	2
4	3	3	3	3	2	-	-	-	-	-	3	3	2	-	2
5	3	2	3	3	3	-	-	-	-	-	3	3	2	-	2

UNIT I **5 Hours**

INTRODUCTION TO WEB APPLICATION

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-Languages-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.

EXPERIMENT 1 **6 Hours**

Create a Multipage Website that serves as a personal portfolio using the browser's developer tools and CSS to enhance the web page.

3 Hours

EXPERIMENT 2

Implement an animated web application for Rock, Paper, Scissors game to handle input validation ensuring that the user's choice is one of Rock, Paper, or Scissors.

3 Hours

EXPERIMENT 3

Create a simple inventory management system to generate QR code for each product thereby allowing user validation using PHP.

3 Hours

EXPERIMENT 4

Develop a secure online banking system using a server-side framework like Flask, Django, or Ruby to avoid risk to financial systems.

7 Hours

EXPERIMENT 5

Develop a Full Stack Web Application for task management system in a corporate environment for tracking project progress and streamlining work assignments.

4 Hours

EXPERIMENT 6

Create a RESTful API for an online store used to manage different products using Node.js or Express.

EXPERIMENT 7 **4 Hours**

Develop a real-time chat application with a continuous integration and continuous deployment (CI/CD) pipeline and set up monitoring to ensure optimal performance.

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

22CD405 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.

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.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system component sor processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments,analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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. PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
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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	2	-	2
2	2	2	2	2	2	-	-	-	-	-	2	2	2	-	2
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-	2
4	3	3	3	3	2	-	-	-	-	-	3	3	2	-	2
5	3	2	2	3	3	-	-	-	-	-	3	3	2	-	2

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

EXPERIMENT 1 **4 Hours**

Create a relational database with tables for storing employee details and perform CRUD operations.

EXPERIMENT 2 **6 Hours**

Create a relational database for e-commerce applications and add primary key, foreign key, check constraints and triggers.

EXPERIMENT 3 **6 Hours**

Create an ER diagram for the library management system and implement the database schema in RDBMS

EXPERIMENT 4 **6 Hours**

Create a MongoDB database for an event management system.

EXPERIMENT 5 **4 Hours**

Design a distributed database for an e-commerce platform to handle order processing.

EXPERIMENT 6 **4 Hours**

Develop an in-memory caching solution using Redis for a content publishing platform (Blog).

EXPERIMENT 7 **3 Hours**

Develop a secure RDBMS solution for a banking financial transactions system.

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 -

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)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7: 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 principles of natural resource management to analyze exploitation cases in forestry, water, minerals, and agricultural sectors, assessing their environmental impacts.
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Analyze the existing environmental challenges related to pollution and its management
4. Analyze the impacts of unsustainable practices, waste management, climate change, and water conservation on environmental sustainability
5. Analyze the impact 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 and C.P. Kaushik, Environmental Science and Engineering, 4th Edition, New Age International Publishers, New Delhi, 2014.
2. T.G.Jr. Miller and Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014.
3. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014.
4. Raven, P.H , Hassenzahl, D.M. and Berg, L.R., Environment, 8th edition. John Wiley & Sons, 2012.
5. Pepper I.L, Gerba C.P. and Brusseau M.L, Environmental and Pollution Science. Academic Press, 2011.

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)

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

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

Course Outcomes (COs)

1. Infer 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. Analyse 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 – 1 - 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 2 - 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

Total: 30 Hours

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

22CD501 THEORY OF COMPUTATION 3 1 0 4

Course Objectives

- Understand the mathematical models of computation and formal language
- Understand the capability of Turing machines and to design TM for a given language
- Understand the decidability and intractability of computational problems

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

Course Outcomes (COs)

1. Apply the finite automata to solve computable problems efficiently.
2. Analyze the regular expressions for effective pattern recognition.
3. Apply the pushdown automata for language recognition and processing.
4. Analyze Turing machines for language acceptance and computational feasibility.
5. Evaluate the undecidability of languages and their implications in computation.

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	2	3	2	-	-	-	-	-	-	-	-	-	2	-	-
3	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
5	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-

UNIT I **9 Hours**

FINITE AUTOMATA

Introduction-Basic Mathematical Notation and techniques-Finite State systems-Basic Definitions-Finite Automaton-DFA & NFA- Regular Languages-Regular Expression- Equivalence of NFA and DFA-Equivalence of finite Automaton and regular expressions- Minimization of DFA-Pumping Lemma for Regular sets.

UNIT II **9 Hours**

CONTEXT FREE GRAMMAR

Grammar Introduction-Types of Grammar-Context Free Grammars(CFG) and Languages-Derivations and Languages-Ambiguity-Relationship between derivation and derivation trees -Simplification of CFG-Greibach Normal form-Chomsky normal form.

UNIT III **9 Hours**

PUSHDOWN AUTOMATA

Pushdown Automata-Definitions-Moves-Instantaneous descriptions -Deterministic pushdown automata-Equivalence of Pushdown automata and CFL-pumping lemma for CFL.

UNIT IV **9 Hours**

TURING MACHINES

Definitions of Turing machines-Models-Computable languages and functions-Techniques for Turing machine construction-Multi head and Multi tape Turing Machines-The Halting problem.

UNIT V **9 Hours**

UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS

Unsolvable Problems and Computable Functions-Recursive and recursively enumerable languages-Universal Turing machine. Measuring and Classifying Complexity:-P and NP completeness-Polynomial time reductions.

Total: 45+15=60 Hours

Reference(s)

1. Hopcroft J.E, Motwani R, and Ullman J D,Introduction to Automata Theory, Language and Computations, 3rd Edition, Pearson Education (ISBN 1292039051), 2014.
2. Martin J, Introduction to Languages and the Theory of Computation, 3rd Edition, TMH, 2007.
3. Kamala Krithivasan and Rama R, Introduction to Formal Languages, Automata Theory and Computation, Pearson education 2009.
4. Peter Linz,An Introduction to Formal Languages and Automata, Fifth edition, 2012.
5. Harry R Lewis and Christos H Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India, Pearson Education, New Delhi, 2003.
6. Mishra K L P and Chandrasekaran N, Theory of Computer Science-Automata, Languages and Computation, Third Edition, Prentice Hall of India, 2004.

22CD502 VISUAL DESIGN AND COMMUNICATION 3 0 0 3

Course Objectives

- To understand the principles of the visual language and their semantic use.
- To communicate more concisely and in a visually appropriate manner, it is necessary to use commonly understood principles, perspective and design layout standards.
- To understand the fundamentals of Typography and Photography

Course Outcomes (COs)

1. Develop the ability to create visual compositions using basic elements and by appyling appropriate principles of visual composition to communicate
2. Develop the ability to perceive, visualize, and communicate visual elements as visual narratives
3. Develop the ability to apply the dynamics of visual design in Typography and Photography.
4. Develop the ability to address simple communication problems through a visualization process and construct mental imageries
5. Demonstrate the ability to plan, develop, design and execute communication products

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

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	1	-	-	-	-	-	-	-	-	-	-	-	2	-
3	2	2	-	-	-	-	3	-	-	-	-	-	-	2	-
4	1	-	-	-	-	-	3	-	-	-	-	-	-	2	-
5	2	-	-	-	-	-	3	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INTRODUCTION TO VISUAL DESIGN

Importance of understanding visual language-its relation in context to nature and environment-Exploring and understanding Dots, Lines, Forms, Space, Pattern, Texture and Colour as an elements of visual language

UNIT II **9 Hours**

INTRODUCTION TO THE PRINCIPLES OF VISUAL LANGUAGE

Visual explorations and experiments with Form, Colour, and Space, Texture, in relation to the context and environments-Concepts of harmony, balance, contrast, proportion, order, symmetry, asymmetry, rhythm, tension, juxtaposition, proximity, size, scale, proportion, orientation, alignment, variety, gradation, dominance, subordination, transition etc.

UNIT III **9 Hours**

INTRODUCTION TO FUNDAMENTALS OF TYPOGRAPHY

Introduction to Type and its History-Type as a form and means of communication in our environment-Introduction to Indian type: Vernacular letter-forms-Classification of types: Typefaces, type families and type designers-Anatomy of the type: x-height, ascenders, descenders, counter, cap-height, baseline, etc-Typographic variables:Kerning, tracking, leading, spacing etc.-Semantics of type: Legibility & readability issues in type and meaning attributed to type. Expressive Typography-Introduction to printing techniques.

UNIT IV **9 Hours**

INTRODUCTION TO PHOTOGRAPHY

Introduction and Orientation: Art and Science of Photography. Drawing out parallels / differences between the EYE and the CAMERA-Camera: Understanding the various controls on a Digital SLR Camera Features and Details. Shooting Modes. Aperture and Depth of Field. Shutter Speed. Critical Shutter Speeds and Effects-Exposure: Exposure as function of Quantity of Light and Time. Getting used to shooting in Manual Mode and learning to measure light using the cameras built-in exposure meter-Film Speed/Sensor Sensitivity: Understanding the role of sensitivity in Exposure. ISO/ASA and Digital Noise-Lenses: Different Types of Lenses. Classification of Lenses by Focal Lengths. Angle of View. Fixed Focal Length and Zoom Lenses. Close up and Macro Lenses-Light and Color Temperature- Digital Post-Production: Introduction to File-Formats. RAW vs.JPEG.Understanding resolution, resizing and basic image post processing using Photoshop. Exploring the software to visualize and create digital mosaics.

UNIT V **9 Hours**

INTRODUCTION TO VIDEOGRAPHY

Concept development-Storyboarding-Video Shooting-Framing, Camera movement etc-Video Editing-Defining communication-Sender, Channel and Receiver-Semiotics-Study of sign process (semiosis), meaning making and meaningful communication. Sign, Signifier, Signified-Denotation and Connotation-Story, narrative and see different perspectives- Identifying problems, opportunities and improvements. Differentiating problem,need and conflict-Persona study-Scenario study

Total: 45 Hours

Reference(s)

1. Wallschlaeger, Charles, &Busic-Synder, Cynthia, Basic Visual Concepts and Principles for Artists, Architects and Designers, McGraw-Hill, (1992).
2. Buxton, Bill, Sketching User Experience: Getting the Design Right and the Right Design (Interactive Technologies),Morgan Kaufmann, (2007).
3. Caplin, Steve; Banks, Adam,The Complete Guide to Digital Illustration, Publisher: Watson - Guptill Publications, 2003).

22CD503 DESIGN THINKING 3 0 0 3

Course Objectives

- Understand and compare the important of design thinking
- Identify the steps in the design thinking (DT) process

Course Outcomes (COs)

1. Interpret the importance of design thinking and steps in the DT process
2. Analyze empathize phase of design thinking
3. Compare the different perspectives on personas in the define phase
4. Analyze the ideate phase of design thinking
5. Recognize the importance of the prototype and testing phase in DT

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO6: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modernand complex engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	3	-	-	1	-	-	-	-	2	1	2	-	-
2	2	-	3	-	-	1	-	-	-	-	2	1	2	-	-
3	2	-	2	-	-	1	-	-	-	-	2	1	2	-	-
4	2	-	3	-	-	1	-	-	-	-	2	1	2	-	-
5	2	-	1	-	-	1	-	-	-	-	2	1	2	-	-

UNIT I **9 Hours**

INTRODUCTION

Introduction-Importance of Design Thinking (DT) -Design Thinking for business-Design Thinking for an Individual-Steps in the DT process- Empathize-Define-Ideate-Prototype- Test.

UNIT II **9 Hours**

EMPATHY PHASE

Empathy Phase:-Steps in the empathize phase of DT-Empathy-What, How, Why-Different types to developing Empathy towards People-Steps required to conduct an immersion activity-How to empathize-Introduction to Immersion Activity-Conducting an immersion activity-DT question template for Immersion activity

UNIT III **9 Hours**

DEFINE PHASE

Creating personas-Steps to create personas in the define phase of DT-Creating your own Persona-Four Different Perspectives on Personas-Goal-directed Personas, Role-Based Personas, Engaging Personas, Fictional Personas-Steps to create your Engaging Personas and Scenarios-Steps to create problem statements in the define phase of DT-Problem statements- Defining problem statements-Problem statements in define phase of DT

UNIT IV **9 Hours**

IDEATE PHASE

How to Ideate-Steps in the ideate phase of DT-Applying the steps in the ideate phase of DT-Ideation games-Six Thinking Hats and Million-dollar idea -Ideate to find solution- Characteristics Required for Successful Ideation-Doodling for expressing ideas-Importance of storytelling in presenting ideas and prototypes-Storytelling in DT

UNIT V **9 Hours**

PROTOTYPE AND TESTING PHASE

Importance of the prototype phase in DT-Prototype your idea-Create a prototype-Types of Prototyping-Low-Fidelity Prototyping and High-Fidelity Prototyping-Guidelines for Prototyping-Service value proposition-Creating a value proposition statement-Testing in Design Thinking-Test the Prototype-Role of DT in your work -DT for better coding -Agile and DT complement each other to deliver customer Satisfaction-Satori

Total: 45 Hours

Reference(s)

1. Mauricio Vianna, YsmarVianna, Isabel K. Adler, Brenda Lucena and Beatriz Russo, Design Thinking: Business innovation, First Edition,MJV Press, 2014.
2. Mads Soegaard, The Basics of User Experience Design by Interaction Design Foundation, Kindle Edition,2018
3. NirEyal, Hooked: How to Build Habit-Forming Products, Kindle Edition, Penguin Publishers,2011
4. Judkins, The Art of Creative Thinking, Kindle Edition, Hachette Book Publishing,2015
5. Dan Senor and Saul Singer, Start Up Nation, , Kindle Edition, Twelve Publishers,2011.
6. Simon Sinek, Start with Why, Kindle Edition, Portfolio Publishers, 2011.

22CD504 ANIMATION AND GRAPHICS 3 0 2 4

Course Objectives

- Gain knowledge about graphics hardware devices and software used.
- Understand the two and three dimensional graphics and their transformations.
- Appreciate illumination and color models.
- Be familiar with understanding animation techniques.

Course Outcomes (COs)

1. Outline the basics of graphics and graphics software.
2. Design two dimensional graphics and transformations.
3. Design three dimensional graphics and transformations.
4. Demonstrate illumination and color models.
5. Design animation sequences.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design 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.
PO5: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	2	1	-	2	-	-	-	-	-	-	-	-	2	-
2	1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
3	1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
4	1	2	2	-	2	-	-	-	-	-	-	-	-	2	-
5	2	2	3	-	2	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INTRODUCTION

Survey of computer graphics, Overview of graphics systems-Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software, Output primitives-points and lines, line drawing algorithms, loading the frame buffer, line function, circle and ellipse generating algorithms, Pixel addressing and object geometry, filled area primitives.

UNIT II **9 Hours**

TWO DIMENSIONAL GRAPHICS

Two dimensional geometric transformations-Matrix representations and homogeneous coordinates, composite transformations, Two dimensional viewing-viewing pipeline, viewing coordinate reference frame, widow-to-viewport coordinate transformation, Two dimensional viewing functions, clipping operations-point, line, and polygon clipping algorithms.

UNIT III **10 Hours**

THREE DIMENSIONAL GRAPHICS

Three dimensional concepts, Three dimensional object representations-Polygon surfaces- Polygon tables-Plane equations-Polygon meshes, Curved Lines and surfaces, Quadratic surfaces, Blobby objects, Spline representations- Bezier curves and surfaces-B-Spline curves and surfaces. TRANSFORMATION AND VIEWING-Three dimensional geometric and modeling transformations-Translation, Rotation, Scaling, composite transformations, Three dimensional viewing-viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

UNIT IV **7 Hours**

ILLUMINATION AND COLOUR MODELS

Light sources-basic illumination models-halftone patterns and dithering techniques,Properties of light-Standard primaries and chromaticity diagram,Intuitive colour concepts-RGB colour model-YIQ colour model-CMY colour model-HSV colour model-HLS colour model,Colour selection.

UNIT V **10 Hours**

ANIMATIONS

ANIMATION GRAPHICS: Design of Animation sequences-animation function-raster animation-key frame systems-motion specification-morphing-tweening-COMPUTER GRAPHICS REALISM: Tiling the plane-Recursively defined curves-Koch curves-C curves- Dragons-space filling curves-fractals-Grammar based models-fractals-turtle graphics-ray tracing.

EXPERIMENT 1 **3 Hours**

Study of Fundamental Graphics Functions

EXPERIMENT 1 **3 Hours**

Study of Fundamental Graphics Functions

EXPERIMENT 2 **3 Hours**

Implementation of Line drawing algorithms: DDA Algorithm, Bresenham's Algorithm.

EXPERIMENT 3 **3 Hours**

Implementation of Circle drawing algorithms: Bresenham's Algorithm, Mid-Point Algorithm

EXPERIMENT 4 **3 Hours**

Programs on 2D and 3D transformations

EXPERIMENT 5 **3 Hours**

Write a program to implement Cohen Sutherland line clipping algorithm.

EXPERIMENT 6 **3 Hours**

Write a program to draw Bezier curve

EXPERIMENT 7 **3 Hours**

Using Flash/Maya perform different operations (rotation, scaling move etc..) on objects

EXPERIMENT 8 **3 Hours**

Create a Bouncing Ball using Key frame animation and Path animation.

Total: 75 Hours

Reference(s)

1. John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley ,Computer Graphics: Principles and Practice, 3rd Edition, Addison-Wesley Professional,2013. (UNIT I, II, III, IV).
2. Donald Hearn and Pauline Baker M, Computer Graphics, Prentice Hall, New Delhi, 2007(UNIT V).
3. Donald Hearn and M. Pauline Baker, Warren arithers, Computer Graphics With Open GL, 4th Edition, Pearson Education, 2010.
4. Jeffrey McConnell, Computer Graphics: Theory into Practice, Jones and Bartlett Publishers,2006.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard,KelvinSung, and AK Peters, Fundamental of Computer Graphics, CRC Press, 2010.

22CD507 MINI PROJECT I 0 0 2 1

Course Objectives

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

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.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: 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.

PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2	-	-	2	2	2	-	-	1	1	1
2	1	2	1	1	2	-	-	2	2	2	-	-	1	1	1
3	1	2	1	1	2	-	-	2	2	2	2	-	1	1	1
4	1	2	1	1	2	-	-	2	2	2	2	-	1	1	1
5	1	2	-	-	2	-	-	2	2	2	-	-	1	1	1

22CD601 FOUNDATIONS OF ARTIFICIAL INTELLIGENCE 3 0 2 4

Course Objectives

- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks

Course Outcomes (COs)

1. Understand appropriate search algorithms for problem solving.
2. Apply reasoning under uncertain conditions.
3. Apply supervised learning models for various problems.
4. Apply ensembling and unsupervised models to solve problems.
5. Build deep learning neural network models.

Program Outcomes (POs)

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

PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	-	-	-	-	-	-	-	2	-	-
2	3	2	2	1	1	-	-	-	-	-	-	-	2	-	-
3	2	3	3	2	2	-	-	-	-	-	-	-	2	-	-
4	2	3	3	2	2	-	-	-	-	-	-	-	2	-	-
5	2	3	3	2	2	-	-	-	-	-	-	-	2	-	-

UNIT I **9 Hours**

PROBLEM SOLVING

Introduction to AI-AI Applications-Problem solving agents-search algorithms- uninformed search strategies-Heuristic search strategies-Local search and optimization problems-adversarial search-constraint satisfaction problems(CSP)

UNIT II **9 Hours**

PROBABILISTIC REASONING

Acting under uncertainty-Bayesian inference-naive bayes models-Probabilistic reasoning-Bayesian networks-exact inference in BN-approximate inference in BN- causal networks.

UNIT III **9 Hours**

SUPERVISED LEARNING

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

UNIT IV **9 Hours**

ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING

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

UNIT V **9 Hours**

NEURAL NETWORKS

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

EXPERIMENT 1 **3 Hours**

Implementation of Uninformed search algorithms (BFS, DFS)

EXPERIMENT 2 **3 Hours**

Implementation of Informed search algorithms (A*, memory-bounded A*)

EXPERIMENT 3 **2 Hours**
Implement naive Bayes models

EXPERIMENT 4 **3 Hours**
Implement Bayesian Networks

EXPERIMENT 5 **3 Hours**
Build Regression models

EXPERIMENT 6 **3 Hours**
Build decision trees and random forests

EXPERIMENT 7 **3 Hours**
Build Support vector machine models

EXPERIMENT 8 **3 Hours**
Implement ensembling techniques

EXPERIMENT 9 **3 Hours**
Implement clustering algorithms

EXPERIMENT 10 **3 Hours**
Implement EM for Bayesian networks

EXPERIMENT 11 **3 Hours**
Build simple NN models

EXPERIMENT 12 **2 Hours**
Build deep learning NN models

Total: 45+30=75 Hours

Reference(s)

1. Stuart Russell and Peter Norvig, Artificial Intelligence-A Modern Approach, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin,Introduction to Machine Learning, MIT Press, Fourth Edition, 2020.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education,2007
4. Kevin Night, Elaine Rich, and Nair B., Artificial Intelligence, McGraw Hill, 2008
5. Patrick H. Winston, Artificial Intelligence, Third Edition, Pearson Education, 2006
6. Deepak Khemani, Artificial Intelligence, Tata McGraw Hill Education, 2013(http://nptel.ac.in/)

22CD602 PRINCIPLES OF COMPILER DESIGN 3 1 0 4

Course Objectives

- Understand the principles, algorithms, and data structures involved in the design and construction of compilers
- Acquire knowledge in construction of scanners, parsers and in intermediate code generation
- Familiar with the code generation schemes and optimization methods.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1. 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. Analyze the role of each phase of a compiler and the compiler construction tools.
2. Apply finite automata to design lexical analyzers.
3. Implement parsers for context-free grammars.
4. Develop intermediate code using syntax-directed translation.
5. Apply optimization techniques to enhance code efficiency.

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	-	1	1	-
2	3	3	2	-	1	2	-	-	2	2	-	1	2	-
3	2	2	2	-	2	2	-	-	2	1	-	2	2	-
4	1	2	2	-	1	2	-	-	2	2	-	1	1	-
5	1	2	2	-	2	1	-	-	2	2	-	2	1	-

UNIT I **8 Hours**

INTRODUCTION TO FORMAL LANGUAGES AND COMPILERS

Formal Language - Elements of Language - Formal Grammar - Chomsky Classification. Compilers: Language Processors - Structure of a Compiler - Grouping of Phases into Passes - Compiler Construction Tools.

UNIT II **9 Hours**

LEXICAL ANALYSIS

Lexical Analysis: Role of Lexical Analyzer - Input Buffering - Specification of tokens - Recognition of Tokens. Finite automata - Regular expression to finite automata- Optimization of DFA based Pattern Matches-Lexical Analyzer Generator Lex.

UNIT III **11 Hours**

SYNTAX ANALYSIS

Introduction-Role of the parser - Context-Free Grammars -Writing a Grammar-Top Down parsing - LL(1) Grammars- Non-recursive Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing-LR Parsers: Simple LR Parser - Canonical LR Parser - LALR Parser - Parser Generator YACC

UNIT IV **8 Hours**

INTERMEDIATE CODE GENERATION

Variants of Syntax Trees- Three-Address Code - Types and Declarations - Translation of Expressions - Control Flow - Switch-Statements - Backpatching

UNIT V **9 Hours**

CODE GENERATION

Issues in the Design of a Code Generator - The Target Language - Basic Blocks and Flow Graphs-Optimization of Basic Blocks - A Simple Code Generator- Principal Sources of Optimization.

Total: 45+15=60 Hours

Reference(s)

1. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman Compilers: Principles, Techniques and Tools, 2nd Edition, Pearson, 2012.
2. Torbengidius Mogensen, Basics of Compiler Design, Springer, 2011.
3. Charles N, Ron K Cytron, Richard J LeBlanc Jr., Crafting a Complier, Pearson Education, 2010
4. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008
5. Kennath C. Louden, Compiler Construction Principles and Practice. New Delhi: Vikas publishing House, 2006.
6. Allen I. Holub, Compiler Design in C, Prentice Hall of India, 2007.

22CD603 HUMAN COMPUTER INTERACTION 3 0 0 3

Course Objectives

- Learn the foundations of Human Computer Interaction.
- Be familiar with the design technologies for individuals and persons with disabilities.
- Be aware of applications of mobile HCI.
- Learn the guidelines for creating user interface.

Course Outcomes (COs)

1. Apply HCI principles to enhance user interaction in a digital system.
2. Design effective HCI for individuals and groups using the design rules.
3. Apply models and theories of HCI to design an intuitive user interface.
4. Design an optimized multimedia, e-commerce, or e-learning website by applying HCI principles and evaluating their impact.
5. Develop and design meaningful user interfaces.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Design and create solutions for complex engineering problems by applying first principles of mathematics, natural sciences, and engineering sciences, supported by a review of research literature.
PO3: Design solutions for complex engineering problems and design system componentsor processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	2	-	-	-	-	-	-	-	-	-	-	2	-	-
2	1	2	3	-	-	-	-	-	-	-	-	-	2	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	2	-	3	-	-	-	-	-	-	-	-	-	3	-	-
5	2	-	3	-	-	-	-	-	-	-	-	-	3	-	-

UNIT I **9 Hours**

FOUNDATIONS OF HCI

The Human I/O channels-Memory-Reasoning and problem solving-The Computer Devices-Memory-processing and networks- Interaction Models-frameworks- Ergonomics-styles-elements-interactivity-Paradigms-Case Studies

UNIT II **9 Hours**

DESIGN

Interactive Design-Basics-process-scenarios-navigation-screen design-Iteration and prototyping-HCI in software process Software life cycle-usability engineering- Prototyping in practice-design rationale-Design rules-principles, standards, guidelines, rules-Evaluation Techniques-Universal Design

UNIT III **9 Hours**

MODELS AND THEORIES

HCI Models-Cognitive models-Socio-Organizational issues and stakeholder requirements-Communication and collaboration models-Hypertext, Multimedia and WWW

UNIT IV **9 Hours**

MOBILE HCI

Mobile Ecosystem-Platforms, Application frameworks-Types of Mobile Applications-Widgets,Applications,Games-Mobile Information Architecture, Mobile 2.0, Mobile Design-Elements of Mobile Design,Tools-Case Studies

UNIT V **9 Hours**

WEB INTERFACE DESIGN

Designing Web Interfaces-Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow-Case Studies

Total: 45 Hours

Reference(s)

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
2. Brain Fling,Mobile Design and Development,First Edition,OReily Media Inc 2009
3. Bill Scott and Theresa Neil,Designing Web interfaces,First Edition,OReily Media Inc,2009

22CD607 MINI PROJECT II 0 0 2 1

Course Objectives

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

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.

Program Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments,analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO11: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2:Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3:Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	2	3	3	3	3	-	-	-	-	-	-	-	2	2	2
3	3	3	3	3	3	-	-	-	-	-	2	-	3	3	3
4	3	3	3	3	3	-	-	-	-	-	2	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

22CD701 GAME DESIGN AND DEVELOPMENT 3 1 0 4

Course Objectives

- To provide an overview of game design and development.
- To provide an architecture of game engine.
- To provide basics of game programming.

Course Outcomes (COs)

1. Understand the concepts of 3D graphics for Game design and development.
2. Analyze the architecture and processes for game design.
3. Analyze the Core architectures of Game Programming
4. Analyze the Game programming platforms, frame works and engines.
5. Create and develop interactive 2D and 3D Games.

Program Outcomes (POs)

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		2	-	2	2	-	-	-	-	-	-	-	1	2	2
2		2	-	2	2	-	-	-	-	-	-	-	1	2	2
3		3	-	3	3	-	-	-	-	-	-	-	1	3	3
4		2	-	2	2	-	-	-	-	-	-	-	1	3	3
5		2	-	2	2	-	-	-	-	-	-	-	1	3	3

UNIT I **9 Hours**

THREE D GRAPHICS FOR GAME PROGRAMMING

Game-Definition-Genres of games-Basics of Two D and Three D Graphics-Game Objects design-Two D and Three D Transformations-Projections-Colour Models-Illumination and Shader Models-Animation-Controller based Animation

UNIT II **9 Hours**

GAME ENGINE DESIGN

Game engine architecture-Engine support systems-Resources and File systems-Game loop and real-time-simulation-Human Interface devices-Collision and rigid body dynamics-Game profiling

UNIT III **9 Hours**

GAME PROGRAMMING

Application layer-Game logic-Game views-managing memory-controlling the main loop-loading and caching game data-User Interface management-Game event management

UNIT IV **9 Hours**

GAMING PLATFORMS AND FRAMEWORKS

Two D and Three D Game development using Flash-DirectX-Java-Python-Game engines-Unity DX Studio

UNIT V **9 Hours**

GAME DEVELOPMENT

Developing TwoD and ThreeD interactive games using DirectX or Python-Isometric and Tile based Games-Puzzle games-Single player games-Multiplayer games

Total:45+15=60 Hours

Reference(s)

1. Mike Mc Shaffrfy and David Graham, Game Coding Complete, Fourth Edition,Cengage Learning, PTR, 2012.
2. Jason Gregory,Game Engine Architecture, CRC Press and A K Peters, 2009.
3. David H. Eberly,3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics, 2nd Editions, Morgan Kaufmann, 2006.
4. Ernest Adams and Andrew Rollings, Fundamentals of Game Design, 2nd Edition Prentice Hall and New Riders, 2009.
5. Eric Lengyel,Mathematics for 3D Game Programming and Computer Graphics, 3rd Edition, Course Technology PTR, 2011.
6. Jesse Schell, The Art of Game Design: A book of lenses, 1 st Edition, CRC Press, 2008.

22CD702 MOBILE APPLICATION DESIGN AND DEVELOPMENT 3 0 2 4

Course Objectives

- To Provide an Overview of designing mobile applications.
- Learn how to integrate mobile applications with backend services and APIs.
- To be able to implement and deploy mobile applications.

Course Outcomes (COs)

1. Understand the requirements for mobile applications.
2. Apply and design mobile applications using basic design rules.
3. Apply and design mobile applications using advanced design rules.
4. Create mobile applications for Android.
5. Create mobile applications for IOS.

Program Outcomes (POs)

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	-	2	2	-	-	-	-	-	-	-	-	2	2
3		3	-	3	3	-	-	-	-	-	-	-	-	3	3
4		2	-	2	2	-	-	-	-	-	-	-	-	3	3
5		2	-	2	2	-	-	-	-	-	-	-	-	3	3

UNIT I **9 Hours**

INTRODUCTION

Introduction to mobile applications-Embedded systems-Market and business drivers for mobile applications-Publishing and delivery of mobile applications-Requirements gathering and validation for mobile applications

UNIT II **9 Hours**

BASIC DESIGN

Introduction-Basics of embedded systems design-Embedded OS-Design constraints for mobile applications both hardware and software related-Architecting mobile applications-user interfaces for mobile applications-touch events and gestures-Achieving quality constraints- performance-usability-security-availability and modifiability

UNIT III **9 Hours**

ADVANCED DESIGN

Designing applications with multimedia and web access capabilities-Integration with GPS and social media networking applications-Accessing applications hosted in a cloud computing environment-Design patterns for mobile applications

UNIT IV **9 Hours**

MOBILE APP DEVELOPMENT USING ANDROID

Introduction-Establishing the development environment-Android architecture-Activities-and views-Interacting with UI-Persisting data using SQLite-Packaging and deployment-Interaction with server side applications-Using Google Maps GPS and Wifi-Integration with social media applications

UNIT V **9 Hours**

MOBILE APP DEVELOPMENT USING 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 Wifi-iPhone marketplace

EXPERIMENT 1 **6 Hours**

Create an activity to display the contact picked by the user

EXPERIMENT 2 **6 Hours**

Implement an application that creates an alert message

EXPERIMENT 3 **6 Hours**

Establish the communication between activities using Indent

EXPERIMENT 4 **3 Hours**

Design an application with Views and ViewGroups to perform user interactions

EXPERIMENT 5 **3 Hours**

Implement the various menus for an application

EXPERIMENT 6 **3 Hours**

Display number names using Toast message

EXPERIMENT 7 **3 Hours**

Develop a simple calculator

Total: 45+30=75 Hours

Reference(s)

1. https://developer.android.com/develop/index.html
2. Jeff McWherter and Scott Gowell,Professional Mobile Application Development, Wrox, 2012
3. Charlie Collins, Michael Galpin and Matthias Kappler, Android in Practice, DreamTech, 2012
4. James Dovey and Ash Furrow,Beginning Objective C, Apress, 2012
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, Beginning iOS 6 Development: Exploring the iOS SDK, Apress, 2013

22CD707 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

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 a report and present the oral demonstrations.

Program Outcomes (POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

PO8:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

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

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	3	1	3	3	3	3	3		2	3	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
5	2	2			2	3		3	3	3		2	3	3	3

Total: 4 Hours

22CD801 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

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

PO8:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

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

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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 a report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	3	1	3	3	3	3	3	-	2	3	3	3
2	2	2	3	3	1	3	3	3	3	3	-	2	3	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
5	2	2	-	-	2	3	-	3	3	3	-	2	3	3	3

Total: 20 Hours

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 to comprehend complex content
- Enhance confidence in expressing with clarity and elegance with enthusiastic and reflective use of the language

Programme Outcomes (POs)

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

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

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Engage with the English language in functional contexts
2. Express in both descriptive and narrative formats
3. Interpolate 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 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 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.

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

Programme Outcomes (POs)

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

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

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

Programme Outcomes (POs)

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

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

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. Illustrate 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

Programme Outcomes (POs)

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

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

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

Programme Outcomes (POs)

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

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

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 Infer short passages on familiar topics
5. Interpret 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.

22CD001 EXPLORATORY DATA ANALYSIS 2 0 2 3

Course Objectives

- Outline an overview of exploratory data analysis
- Implement data cleaning and preparation techniques
- Perform descriptive statistics and data visualization techniques to present insights from the data
- Apply univariate, bivariate, multivariate, correlation, and time series data exploration and analysis techniques
- Use dimensionality reduction techniques for simplifying complex datasets and visualize high-dimensional data

Programme Outcomes (POs)

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO2 Identify and analyze large and heterogeneous data by applying suitable machine and deep learning algorithms and analytical tools to enable information retrieval and decision making in scientific and business applications.

Course Outcomes (COs)

1. Analyze the fundamentals of exploratory data analysis
2. Apply the data cleaning and preparation techniques on the provided dataset.
3. Apply advanced data visualization techniques to explore complex relationships and patterns in the data
4. Analyze the relationships between variables using EDA analysis techniques to gain insights into complex data patterns
5. Apply dimensionality reduction techniques, such as Principal Component Analysis (PCA), to simplify complex datasets and extract essential features

Articulation Matrix

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

UNIT I **6 Hours**

EXPLORATORY DATA ANALYSIS

Overview of Exploratory Data Analysis- importance of EDA - data analysis process: data collection, data cleaning, and data exploration- Introduction to common data types and formats - Introduction to Python - data analysis libraries

UNIT II **6 Hours**

DATA CLEANING AND PREPARATION

Introduction to data quality issues and common data cleaning techniques - Handling missing data and outliers - Data transformation techniques - Feature engineering and variable creation

UNIT III **6 Hours**

DESCRIPTIVE STATISTICS AND DATA VISUALIZATION

Descriptive statistics: measures of central tendency, dispersion, and shape - Data visualization principles and best practices - Exploratory data visualization using Matplotlib and Seaborn

UNIT IV **6 Hours**

EXPLORATORY DATA ANALYSIS TECHNIQUES

Univariate analysis: exploring single variables - Bivariate analysis: exploring relationships between variables - Multivariate analysis: analyzing relationships among multiple variables - Exploring time series data.

UNIT V **6 Hours**

DIMENSIONALITY REDUCTION TECHNIQUES

Introduction to dimensionality reduction - Principal Component Analysis (PCA) and its applications - Distributed Stochastic Neighbor Embedding (t-SNE) for visualization

EXPERIMENT 1 **6 Hours**

Apply the data preprocessing methods on the given Student test performance dataset and visualize the results.

EXPERIMENT 2 **6 Hours**

Perform univariate analysis to analyze the distribution of each variable in student’s exam results dataset and visualize the results

EXPERIMENT 3 **6 Hours**

Visualize the relationship between the features on students' exam results analysis dataset using bivariate analysis

EXPERIMENT 4 **6 Hours**

Visualize the relationship between the features on students' exam results analysis dataset using multivariate analysis.

EXPERIMENT 5 **6 Hours**

Implement the program to reduce the dimensionality of the MNIST dataset and visualize the reduced data using a scatter plot.

Total: 60 Hours

Reference(s)

1. Provost Foster and Tom Fawcett. Data Science for Business: What you need to know about data mining and data-analytic thinking O Reilly Media Inc. 2013. (Unit 1)
2. McKinney Wes Python for Data Analysis O Reilly Media Inc 2022 Unit 1 3 5
3. Knaflic Cole Nussbaumer Storytelling with data A data visualization guide for business professionals John Wiley & Sons 2015 (Unit 2)
4. Kazil Jacqueline and Katharine Jarmul Data wrangling with python tips and tools to make your life easier O Rilly Media Inc 2016 (Unit 3)
5. Wickham Hadley and Garrett Grolemund R for data science import tidy transform visualize and model data O Reilly Media Inc 2016 (Unit 4, 5)
6. Matthew O Ward Georges Grinstein, Daniel Keim Interactive Data Visualization Foundations Techniques and Applications 2nd Edition CRC press 2015

22CD002 RECOMMENDER SYSTEMS 3 0 0 3

Course Objectives

- Understand the foundations of the recommender system.
- Learn the significance of machine learning and data mining algorithms for Recommender systems
- Learn about collaborative filtering
- Design and implement a recommender system.
- Learn collaborative filtering.

Programme Outcomes (POs)

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO2 Identify and analyze large and heterogeneous data by applying suitable machine and deep learning algorithms and analytical tools to enable information retrieval and decision making in scientific and business applications.

Course Outcomes (COs)

1. Analyze different recommender system types, data mining methods, and dimensionality reduction techniques.
2. Apply content-based filtering by building item and user profiles using similarity and classification methods.
3. Analyze collaborative filtering techniques, including rating normalization, similarity computation, and neighborhood selection.
4. Apply attack detection and robust recommendation strategies to enhance system security.
5. Analyze evaluation metrics and paradigms to assess recommender system performance and limitations.

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	1	-	-	-	-	-	2
2	1	2	1	1	1	-	1	1	-	-	-	-	-	2
3	2	3	1	1	1	-	1	1	-	-	-	-	-	3
4	3	2	2	2	1	-	2	1	-	-	-	-	-	2
5	2	2	1	2	1	-	2	1	-	-	-	-	-	2

UNIT I **9 Hours**

INTRODUCTION

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

UNIT II **9 Hours**

CONTENT-BASED RECOMMENDATION SYSTEMS

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

UNIT III **9 Hours**

COLLABORATIVE FILTERING

A systematic approach Nearest-neighbor collaborative filtering (CF) user-based and item-based CF components of neighborhood methods (rating normalization similarity weight computation and neighborhood selection

UNIT IV **9 Hours**

ATTACK-RESISTANT RECOMMENDER SYSTEMS

Introduction Types of Attacks Detecting attacks on recommender systems Individual attack Group attack Strategies for robust recommender design Robust recommendation algorithms.

UNIT V **9 Hours**

EVALUATING RECOMMENDER SYSTEMS

Evaluating Paradigms User Studies Online and Offline evaluation Goals of evaluation design Design Issues Accuracy metrics Limitations of Evaluation measures

Total: 45 Hours

Reference(s)

1. Charu C Aggarwal Recommender Systems the Textbook Springer 2016
2. Dietmar Jannach Markus Zanker Alexander Felfernig and Gerhard Friedrich Recommender Systems An Introduction Cambridge University Press (2011) 1st ed.
3. Francesco Ricci Lior Rokach Bracha Shapira Recommender Systems Handbook 1st ed Springer (2011).
4. Jure Leskovec Anand Rajaraman Jeffrey David Ullman Mining of massive datasets 3rd edition Cambridge University Press 2020.

22CD003 BIG DATA ANALYTICS 3 0 0 3

Course Objectives

- Acquire a deep understanding of big data and NoSQL.
- Develop expertise in MapReduce analytics using Hadoop and related tools
- Explore the Hadoop related tools for Big Data Analytics.

Programme Outcomes (POs)

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1 Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.
PSO2 Identify and analyze large and heterogeneous data by applying suitable machine and deep learning algorithms and analytical tools to enable information retrieval and decision making in scientific and business applications.

Course Outcomes (COs)

1. Analyze the big data technologies and use cases for respective business domains.
2. Analyze the NoSQL databases and its related concepts.
3. Apply Map reduce workflows for web applications.
4. Analyze the basic concepts of Hadoop.
5. Apply Hadoop related tools for Big Data Analytics.

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	1
2	2	2	3	-	3	-	2	-	-	-	-	-	2	2
3	1	3	3	-	3	-	1	-	-	-	-	-	2	2
4	2	2	2	-	3	-	2	-	-	-	-	-	1	2
5	2	2	1	-	3	-	2	-	-	-	-	-	1	3

UNIT I **9 Hours**

INTRODUCTION TO BIG DATA

Introduction to big data Convergence of key trends Unstructured data Industry examples of big data Web analytics Big data applications Big data technologies Introduction to Hadoop Open source technologies Cloud and big data Mobile business intelligence Crowd sourcing analytics Inter and trans firewall analytics

UNIT II **9 Hours**

NOSQL DATA MANAGEMENT

Introduction to NoSQL Aggregate data models Key value and document data models Relationships Graph databases Schema less databases Materialized views Distribution models Master-slave replication Consistency Cassandra Cassandra data model Cassandra examples Cassandra clients

UNIT III **9 Hours**

MAP REDUCE APPLICATIONS

MapReduce workflows Unit tests with MRUnit Test data and local tests Anatomy of MapReduce job run Classic Map reduce YARN Failures in classic Map-reduce and YARN Job scheduling Shuffle and sort Task execution MapReduce types Input formats Output formats

UNIT IV **9 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 Java interface Data flow Hadoop I/O Data integrity Compression Serialization Avro File based data structures Cassandra Hadoop integration.

UNIT V **9 Hours**

HADOOP RELATED TOOLS

Hbase Data model and implementations Hbase clients Hbase examples Praxis. Pig Grunt Pig data model Pig Latin Developing and testing Pig Latin scripts. Hive Data types and file formats HiveQL data definition HiveQL data manipulation HiveQL queries.

Total: 45 Hours

Reference(s)

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today"s Businesses", Wiley,2013
2. Eric Sammer, "Hadoop Operations", O"Reilley, 2012.
3. Sadalage Pramod J. NoSQL distilled 2013
4. E. Capriolo D. Wampler and J. Rutherglen Programming Hive O Reilley 2012.
5. Lars George HBase The Definitive Guide O Reilley 2011
6. Eben Hewitt Cassandra The Definitive Guide O Reil

22CD004 NEURAL NETWORKS AND DEEP LEARNING 2 0 2 3

Course Objectives

- Understand the major concepts in deep neural networks.
- Apply Convolutional Neural Network architectures for any real-life applications
- Analyze the key computations underlying deep learning to build and train deep neural networks for various tasks.

Programme Outcomes (POs)

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

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

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1 Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Build Artificial neural network by analyzing the concept behind the model.
2. Analyze the algorithms used for associative memory and unsupervised learning networks.
3. Apply Convolutional Neural Networks and its variants for web and mobile applications.
4. Build and train the deep learning neural network models.
5. Apply autoencoders and generative models for given application.

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	-
2	2	2	3	-	3	-	2	2	-	-	-	-	2	-
3	1	3	3	-	3	-	2	2	-	-	-	-	2	-
4	2	2	2	-	3	-	2	2	-	-	-	-	2	-
5	2	2	1	-	3	-	2	2	-	-	-	-	2	-

UNIT I **6 Hours**

INTRODUCTION TO NEURAL NETWORKS

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network

UNIT II **6 Hours**

ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance TheoryNetwork.

UNIT III **6 Hours**

THIRD-GENERATION NEURAL NETWORKS

Spiking Neural Networks-Convolutional Neural Networks Deep Learning Neural Networks-Extreme Learning Machine Model Convolutional Neural Networks The Convolution Operation Mo ivation Pooling Variants of the basic Convolution Function Structured Outputs Data Types Efficient Convolution Algorithms Neuroscientific Basis Applications Computer Vision Image Generation Image Compression

UNIT IV **6 Hours**

DEEP FEEDFORWARD NETWORKS

History of Deep Learning A Probabilistic Theory of Deep Learning Gradient Learning Chain Rule and Backpropagation Regularization Dataset Augmentation Noise Robustness Early Stopping Bagging and Dropout batch normalization VC Dimension and Neural Nets

UNIT V **6 Hours**

RECURRENT NEURAL NETWORKS

Recurrent Neural Networks Introduction Recursive Neural Networks Bidirectional RNNs Deep Recurrent Networks Applications Image Generation Image Compression Natural Language Processing Complete Auto encoder Regularized Autoencoder Stochastic Encoders and Decoders Contractive Encoders

Total: 30 Hours

EXPERIMENT 1 — 3 Hours

Implement simple vector addition in TensorFlow.

EXPERIMENT 2 — 3 Hours

Implement a regression model in Keras.

EXPERIMENT 3 — 3 Hours

Implement a perceptron in TensorFlow/Keras Environment.

EXPERIMENT 4 — 3 Hours

Implement a Feed-Forward Network inTensorFlow/Keras.

EXPERIMENT 5 **3 Hours**
Implement an Image Classifier using CNN in TensorFlow/Keras.

EXPERIMENT 6 **3 Hours**
Improve the Deep learning model by fine tuning hyperparameters

EXPERIMENT 7 **3 Hours**
Implement a Transfer Learning concept in Image Classification.

EXPERIMENT 8 **3 Hours**
Using a pre trained model on Keras for Transfer Learning

EXPERIMENT 9 **3 Hours**
Perform Sentiment Analysis using RNN

EXPERIMENT 10 **3 Hours**
Implement an LSTM based Autoencoder in TensorFlow/Keras.

Total: 60 Hours

Reference(s)

1. S Rajasekaran, G A Vijayalakshmi Pai, Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications, PHI Learning, 2017
2. Charu C. Aggarwal, Neural Networks and Deep Learning A Textbook, Springer International Publishing, 1st Edition, 2018
3. James A Freeman, David M S Kapura, Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
5. Francois Chollet, Deep Learning with Python, Second Edition, Manning Publications, 2021
6. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020

22CD005 NATURAL LANGUAGE PROCESSING 2 0 2 3

Course Objectives

- Understand the fundamental concepts for natural language processing and automatic speech recognition
- Understand technologies involved in developing speech and language applications.
- Demonstrate the use of deep learning for building applications in speech and natural language processing

Programme Outcomes (POs)

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

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

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO10 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.

PSO1 Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in natural language processing.
2. Apply text processing and feature representation techniques for text mining.
3. Apply NLP for sentiment classification, named entity recognition, text summarization, machine translation, and modern deep learning models.
4. Apply fundamental principles of speech production and perception and analyze speech signals.
5. Design automatic speech recognition systems and develop applications for speaker recognition

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	2	-	3	-	-	2	-
3	1	3	3	-	3	-	2	2	-	2	-	-	2	-
4	2	2	2	-	3	-	2	2	-	2	-	-	2	-
5	2	2	1	-	3	-	2	2	-	2	-	-	2	-

UNIT I **6 Hours**

INTRODUCTION TO NATURAL LANGUAGE PROCESSING

Overview of NLP - Introduction to Levels of NLP - Morhpology: Derivational & Inflectional Morphology - POS tagging - Parsing: Shallow and Dependency Parsing, Semantics: Word Level Semantics and Thematic roles.

UNIT II **6 Hours**

TEXT PROCESSING AND FEATURE REPRESENTATION

Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fast text.

UNIT III **6 Hours**

APPLICATIONS OF NLP

Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models - Machine Translation - Encoder & Decoder Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.

UNIT IV **6 Hours**

SPEECH PROCESSING AND FEATURE REPRESENTATION OF SPEECH SIGNAL

Fundamentals of speech production – Perception of sound – Vocal tract model – Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis - Mel Frequency Cepstral Coefficients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.

UNIT V **6 Hours**

AUTOMATIC SPEECH AND SPEAKER RECOGNITION

Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model -- CNN based speech recognition - RNN language Models – Evaluation metrics, Speaker - recognition model – Alexa/Google assistant-based application development.

EXPERIMENT 1 **3 Hours**

POS Tagging and Parsing using various python packages.

EXPERIMENT 2 **3 Hours**

Implementing N-gram language models for next word prediction.

EXPERIMENT 3 **3 Hours**

Implementing Word embedding based text classification.

EXPERIMENT 4 **3 Hours**
Implementing CNN for sentiment analysis.

EXPERIMENT 5 **3 Hours**
Implementing RNN for Named Entity recognition.

EXPERIMENT 6 **3 Hours**
Implementing text summarization using deep learning.

EXPERIMENT 7 **3 Hours**
Implementing chatbot using deep learning.

EXPERIMENT 8 **3 Hours**
Developing speech recognition system to recognize voice commands

EXPERIMENT 9 **3 Hours**
Developing speech recognition system to recognize continuous speech

EXPERIMENT 10 **3 Hours**
Implementing CNN based speech recognition using mel spectral images.

Total: 60 Hours

REFERENCE(S)

1. Dan Jurafsky, James H. Martin "Speech and Language Processing", Draft of 3rd Edition,Prentice Hall 2022.
2. Jacob Benesty, M. M. Sondhi, Yiteng Huang "Springer Handbook of Speech Processing", Springer, 2008.
3. Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and Speech Recognition" Springer, ,2019.
4. Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O'Reilly Media. 2009.
5. Ben Gold, Nelson Morgan, Dan Ellis "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley & Sons, 2011.

22CD006 COMPUTER VISION 2 0 2 3

Course Objectives

- Understand the fundamental concepts related to Image formation and processing
- Learn feature detection, matching and detection
- Become familiar with feature-based alignment, motion estimation and 3D reconstruction
- Understand image-based rendering and recognition.
- Learn to detect and analysis objects from motion or scene

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in image processing and computer vision.
2. Implement image processing techniques in OpenCV.
3. Apply 2D feature-based based image alignment, segmentation, motion estimations and 3D image reconstruction techniques
4. Design and develop innovative image processing and computer vision applications.
5. Apply the concept in understanding the scene and process the background part of the image

Articulation Matrix

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

UNIT I **6 Hours**

INTRODUCTION TO IMAGE FORMATION AND PROCESSING

Computer Vision Geometric primitives and transformations Photometric image formation The digital camera Point operators Linear filtering More neighborhood operators Fourier transforms Pyramids and wavelets Geometric transformations Global optimization.

UNIT II **6 Hours**

FEATURE DETECTION, MATCHING AND SEGMENTATION

Points and patches - Edge detection - Edges Lines Segmentation - Region Based Segmentation - Graph Based segmentation - Active contours - Split and merge Mean shift and mode finding - Normalized cuts Graph cuts and energy-based methods.

UNIT III **6 Hours**

FEATURE-BASED ALIGNMENT AND 3D RECONSTRUCTION

2D and 3D feature-based alignment Pose estimation Geometric intrinsic calibration - Triangulation Two frame structure from motion - Shape from X Active range finding - Surface representations - Point based representations - Volumetric representations - Model based reconstruction.

UNIT IV **6 Hours**

IMAGE-BASED RENDERING AND RECOGNITION

View interpolation Layered depth images Light fields - Video based Rendering - Object detection - Face recognition - Instance recognition - Category recognition Context and scene understanding.

UNIT V **7 Hours**

MOTION ANALYSIS AND SCENE ANALYSIS

Optical Flow – Detection and Correspondence of Interest Points - Detection of Motion Patterns – Video

Tracking – Motion Models to aid tracking: Kalman Filters - stereo mapping - image fusion - Detection of known objects by linear filters - Detection of unknown objects - Corner detection - image tagging.

EXPERIMENT 1 **3 Hours**
Perform histogram equalization on the image.

EXPERIMENT 2 **3 Hours**
Perform the edge detection process and extract edges from the input image

EXPERIMENT 3 **5 Hours**
Perform segmentation, extract and display the segmented region.

EXPERIMENT 4 **3 Hours**
Program to detect an object from the input frame.

EXPERIMENT 5 **5 Hours**
Program to track the object between two frames from image/video.

EXPERIMENT 6 **5 Hours**
Program to demonstrate understanding of a scene and generate captions.

EXPERIMENT 7 **5 Hours**
Program to classify defective objects from the correct object.

Total: 60 Hours

REFERENCE(S)

1. Richard Szeliski, Computer Vision Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer, 2006.
5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
6. Jurgen Beyerer, Fernando Puente Leon, Christian Frese," Machine Vision Automated Visual Inspection: Theory, Practice and Applications", 2016, Springer
7. AI Bovik, "The Essential Guide to Image Processing", 2009, Academic Press

22CD007 AGILE SOFTWARE DEVELOPMENT 3 0 0 3

Course Objectives

- Understand agile software development practices.
- Understand the Agile Scrum framework and development practices.
- Apply software design principles and refactoring techniques to achieve agility.
- Understand Agile requirements and perform testing activities within an agile project.
- Understand the benefits and pitfalls of working in an Agile team in terms of quality assurance.

Programme Outcomes (POs)

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

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

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Apply the Agile principles and manifesto in the software development.
2. Analyze the working methodology of types of Agile frameworks
3. Apply agility in software development processes.
4. Analyze the impact of agility in requirement engineering.
5. Analyze techniques used by Agile team for improving quality.

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	2	2	-	-	2	-	-	-	-	-	-	2	-
3	1	2	2	-	2	2	-	-	-	-	-	2	2	-
4	1	2	2	-	2	2	-	-	-	-	-	2	2	-
5	1	1	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 value

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 - Earls 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 modeling 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 manager""s Guide, Addison - Wesley, 2004
5. Kevin C. Desouza, - Agile information systems: conceptualization, construction, and managemen, Butterworth - Heinemann, 2007

22CD008 UI AND UX DESIGN 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

PSO2. Identify and analyze large and heterogeneous data by applying suitable machine and deep learning algorithms and analytical tools to enable information retrieval and decision making in scientific and business applications.

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	2	-	-	2	-	-	-	-	-	-	-	1	1
2	1	2	2	-	3	-	-	2	-	-	-	-	2	1
3	1	3	3	-	2	-	-	3	-	-	-	-	2	1
4	1	2	2	-	2	-	-	2	-	-	-	-	1	2
5	1	2	2	-	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 e-commerce, 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.

22CD009 WEB FRAMEWORKS 3 0 0 3

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- Understand the significance of using MongoDB as a database system
- 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)

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

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

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

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

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

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

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. Design single page applications with reusable UI components using React CSS and SaaS
5. Apply 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	2	-	-	2	-
2	1	1	1	-	3	-	-	-	2	2	-	-	3	-
3	1	2	2	-	2	-	-	-	2	2	-	-	3	-
4	1	1	1	-	3	-	-	-	2	2	-	-	2	-
5	1	1	1	-	3	-	-	-	1	1	-	-	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

22CD010 WEB APPLICATION AND SECURITY 2 0 2 3

Course Objectives

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

Course Outcomes (COs)

1. Understanding the basic concepts of web application security and the need for it
2. Be acquainted with the process for secure development and deployment of web applications
3. Acquire the skill to design and develop Secure Web Applications that use Secure APIs
4. Be able to get the importance of carrying out vulnerability assessment and penetration testing
5. Acquire the skill to think like a hacker and to use hackers tool sets

Program Outcomes (POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PO12: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	-	-	-	-	-	-	1	-	-	2
2	2	1	2	1	3	-	-	-	-	-	-	-	-	-	2
3	1	1	1	2	3	-	-	-	-	-	-	1	-	-	3
4	1	2	1	1	2	-	-	-	-	-	-	-	-	-	3
5	1	2	2	2	2	-	-	-	-	-	-	1	-	-	3

UNIT I **6 Hours**

FUNDAMENTALS OF WEB APPLICATION SECURITY

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II **5 Hours**

SECURE DEVELOPMENT AND DEPLOYMENT

Web Applications Security-Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III **6 Hours**

SECURE API DEVELOPMENT

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV **6 Hours**

VULNERABILITY ASSESSMENT AND PENETRATION TESTING

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V **7 Hours**

HACKING TECHNIQUES AND TOOLS

Social Engineering, Injection, Cross-Site Scripting (XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

EXPERIMENT 1 **6 Hours**

Install wireshark and explore the various protocols

a. Analyze the difference between HTTP vs HTTPS

b. Analyze the various security mechanisms embedded with different protocols

EXPERIMENT 2 **6 Hours**

Identify the vulnerabilities using OWASP ZAP tool

EXPERIMENT 3 **6 Hours**

Create simple REST API using python for following operation a) GET, b) PUSH, c) POST d) DELETE

EXPERIMENT 4 **6 Hours**

Install Burp Suite to do following vulnerabilities: a) SQL injection b) cross-site scripting (XSS)

EXPERIMENT 5 **6 Hours**

Attack the website using Social Engineering method

Reference(s)

Total: 60 Hours

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.
4.Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
5. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
6. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
7. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron
8. Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

22CD011 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)

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

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

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

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	-	-	2	-	-	-	-	1	-
3	2	2	2	-	2	-	-	2	-	-	-	-	1	-
4	2	3	2	-	3	-	-	2	-	-	-	-	1	-
5	3	2	1	-	3	-	-	2	-	-	-	-	2	-

UNIT I 9 Hours

INTRODUCTION

Basic definitions - Software Testing Principles - The Tester"s 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

UNIT II **9 Hours**

TEST CASE DESIGN STRATEGIES

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 Grey-box - Functional testing - Non-functional 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

Reference(s) **Total: 45 Hours**

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing - Principles and Practices", Pearson Education, 2006
2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007
3. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003
4. Edward Kit, "Software Testing in the Real World - Improving the Process", Pearson Education, 1995
5. Boris Beizer, "Software Testing Techniques", Second Edition, Van Nostrand Reinhold, New York, 1990
6. Aditya P. Mathur, "Foundations of Software Testing - Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008

22CD012 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

Course Outcomes (COs)

1. Analyze the 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. Build Jenkins workspace for Automated Continuous Deployment
4. Perform configuration management using Ansible
5. Apply Azure DevOps to leverage Cloud-based DevOps tools.

Programme Outcomes (POs)

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

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

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

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 a Jenkins job-Introduction to Plugins-Adding Plugins to Jenkins-commonly used plugins (Git Plugin,Parameter Plugin-HTML Publisher-Copy Artifact, and Extended choice parameters). Configuring Jenkins to work with Java- Git-and Maven-Creating a Jenkins Build and Jenkins workspace.

UNIT IV **9 Hours**

CONFIGURATION MANAGEMENT USING ANSIBLE

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

22CD013 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.

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.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	2	3	-	-	-	-	-	-	-	-	-	-	2
2	-	-	1	3	2	-	-	-	-	-	-	-	-	-	2
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 AND CONFIGURATIONS

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 AND APPLICATIONS IN VIRTUAL MACHINES

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, JagannathKallakurchi,DonaldJ.Houde,Dr.devan Shah, Cloud Computing Black Book, Dreamtech press, 2015
3. RajkumarBuyya, 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

22CD014 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
- Create an application by utilizing cloud platforms such as Google App Engine, Microsoft Azure and OpenStack
- 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

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.

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	1	-	-	-	-	-	-	-	-	-	2
2	3	1	2	3	2	-	-	-	-	-	-	-	-	-	2
3	1	1	3	1	3	-	-	-	-	-	-	-	-	-	2
4	1	1	1	2	3	-	-	-	-	-	-	-	-	-	2
5	1	3	3	2	2	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

CLOUD COMPUTING REFERENCE ARCHITECTURE (CCRA)

Introduction to Cloud Computing Reference Architecture (CCRA), Benefits of CCRA, Architecture Overview,Versionsand 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

22CD015 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

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.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	3	3	-	-	-	-	-	-	-	-	-	2
2	3	1	2	3	3	-	-	-	-	-	-	-	-	-	2
3	1	1	3	2	2	-	-	-	-	-	-	-	-	-	2
4	3	2	1	2	2	-	-	-	-	-	-	-	-	-	2
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) Reilly, 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. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Rittinghouse, 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.

22CD016 CLOUD AUTOMATION TOOLS AND APPLICATIONS 3 0 0 3

Course Objectives

- Learn the options for running automation tools, and load balancers in the cloud-native applications.
- Learn the configuration management in the cloud.
- Know the importance of cloud automation.
- Learn what types of cloud automation tools can be used.
- Learn load balancing and auto scaling in the cloud.

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.

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	2	1	3	-	-	-	-	-	-	-	-	-	2
2	-	2	-	-	3	-	-	-	-	-	-	-	-	-	2
3	-	-	3	2	3	-	-	-	-	-	-	-	-	-	2
4	-	-	2	-	3	-	-	-	-	-	-	-	-	-	2
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 CloudFormationArtifacts, 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. YogeshRaheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

22CD017 SOFTWARE DEFINED NETWORKS 2 0 2 3

Course Objectives

- Understand the need for SDN and its data plane operations
- Understand the functions of control plane
- Comprehend the migration of networking functions to SDN environment
- Explore various techniques of network function virtualization
- Comprehend the concepts behind network virtualization

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

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	3	1	3	-	-	-	-	-	-	-	-	-	2
2	2	1	2	2	3	-	-	-	-	-	-	-	-	-	2
3	2	2	2	3	3	-	-	-	-	-	-	-	-	-	2
4	2	2	2	3	1	-	-	-	-	-	-	-	-	-	2
5	3	3	1	1	3	-	-	-	-	-	-	-	-	-	2

UNIT I **6 Hours**

INTRODUCTION TO SDN

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 CustomerPremises Equipment, Virtual Evolved Packet Core, Virtualized Network Monitoring and Traffic Analysis, Network Slicing, EdgeComputing and NFV.

EXPERIMENT 1 **6 Hours**

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

EXPERIMENT 2 **6 Hours**

Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlowmessages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.

6 Hours

EXPERIMENT 3

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

6 Hours

EXPERIMENT 4

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

EXPERIMENT 5 **6 Hours**

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, 1 st Edition, CRC Press, 2014.
2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Oswald Coker, SiamakAzodolmolky, Software-Defined Networking with OpenFlow, 2 nd Edition, OReilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks: A Comprehensive Approach, 2 nd 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, 1 st Edition, 2015.

22CD018 SECURITY AND PRIVACY IN CLOUD 3 0 0 3

Course Objectives

- Introduce Cloud Computing terminology, definition & concepts
- Understand the security design and architectural considerations for Cloud
- Understand the Identity, Access control in Cloud
- Follow best practices for Cloud security using various design patterns
- Able to monitor and audit cloud applications for security

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.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	-	-	-	2
2	1	3	2	3	1	-	-	-	-	-	-	-	-	-	2
3	3	2	2	3	2	-	-	-	-	-	-	-	-	-	2
4	2	1	2	3	3	-	-	-	-	-	-	-	-	-	2
5	1	3	3	1	1	-	-	-	-	-	-	-	-	-	2

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-Inter-tenant 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 SystemPrivileges-Events and Alerts-Auditing-Record generation, Reporting and Management, Tamper-Proofing Audit logs, Qualityof 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. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
5. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.

22CD019 MULTIMEDIA AND ANIMATION 2 0 2 3

Course Objectives

- Understand the basic knowledge of multimedia Systems and related technologies.
- Learn about multimedia elements in a comprehensive way.
- Understand the basics of digital 2D animation to create story and multimedia production
- Design the technical and artistic skills to produce 3D animations.

Course Outcomes (COs)

1. Analyze the usage of the multimedia elements for computer Image Processing.
2. Analyze the different encode and decode techniques.
3. Apply the author 2D and 3D creative and interactive presentations for different target multimedia applications.
4. Apply 2D animation and develop the storyboards.
5. Create and animate the 3D models using software tools.

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	-	2	-	-	-	-	-	-	-	-	2	-
2	2	2	2	2	2	-	-	-	-	-	-	-	-	3	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	2	-	-	-	-	-	-	-	-	-	-	3	-
5	2	3	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **6 Hours**

INTRODUCTION TO MULTIMEDIA ELEMENTS

Multimedia-Medium-Properties of a Multimedia System-Traditional Data Stream Characteristics-Text-Basic Sound Concepts-Speech,Image-Computer Image Processing

UNIT II **6 Hours**

MULTIMEDIA COMPRESSION

Storage Space-Coding Requirements-Hybrid Coding-JPEG: Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode-H.261-MPEG: Video Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21.

UNIT III **6 Hours**

MULTIMEDIA AUTHORING

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations.

UNIT IV **6 Hours**

2D ANIMATION

Introduction to 2D Animation, Colour theory & basics, Layout & Designing Basic of sketching, Composition of basic elements, Graphics and advertising- Creating Digital Layout, Professional image editing, Story Boarding, stop motion animation, Production / Post-Production-Background composition, 2D animation and techniques.

UNIT V **6 Hours**

3D ANIMATION

3D Modeling - Modeling Techniques, Types of Modeling - 3D Shading-Use of Material, Shader and Texture editing, Introduction to 3D Animation -3D Animation and Rigging, Setting up controllers for joints, Simple Skeleton structure with proper joint orientation, 3D Lighting and Rendering.

3 Hours

EXPERIMENT 1

Image Editing and Manipulation Basic Operations on images using any image editing software.

EXPERIMENT 2 **3 Hours**

Implementation of audio and Video Editing techniques

EXPERIMENT 3 **3 Hours**

Sketching of cartoon characters

EXPERIMENT 4 **3 Hours**

Design 2D Logo using the image editing tool.

EXPERIMENT 5 **3 Hours**

Creating gif animated images in 2D Animation

EXPERIMENT 6 **3 Hours**

Exploring the Interface of 3D application

EXPERIMENT 7 **3 Hours**

Create different types of Materials and Shading

EXPERIMENT 8 **3 Hours**

Create a simple walk cycle using the character Rigs

EXPERIMENT 9 **3 Hours**

Create a 3-point Light Setup

EXPERIMENT 10 **3 Hours**

Create particle Simulation

Total: 30+30=60 Hours

Reference(s)

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia, Third Edition,Springer Texts in Computer Science, 2021.
2. Maraffi, Chris, Maya Character Creation: Modeling and Animation Controls. New Riders,2008.
3. John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation,CRC press, 3rd Edition, 2016.

4. Rogers David, Animation: Master A Complete Guide (Graphics Series), Charles River Media, 2006.
5. Rick parent, Computer Animation: Algorithms and Techniques, Morgan Kauffman, 3rd Edition, 2012.

22CD008 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

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.

Program Outcomes (POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design 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.
PO5: 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.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	1	2	2	-	1	-	-	-	-	-	-	-	2	-	-
3	-	3	3	-	1	-	-	-	-	-	-	-	2	-	-
4	-	2	2	-	-	-	-	-	-	-	-	-	1	-	-
5	-	2	2	-	-	-	-	-	-	-	-	-	1	-	-

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 e-commerce, 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.
2. Wilbent. O. Galitz ,The Essential Guide To User Interface Design, John Wiley&Sons, 2001.
3. Alan Cooper,The Essential Of User Interface Design, Wiley Dream Tech Ltd.,2002.
4. Baecker, Ronald M., Jonathan Grudin, et al. Readings in Human-Computer Interaction: Toward the Year 2000.
5. Shneiderman, Ben, and Catherine Plaisant. Designing the User Interface: Strategies for Effective Human-Computer Interaction. 4th ed. Addison Wesley, 2004.

22CD020 AUGMENTED REALITY AND VIRTUAL REALITY 2 0 2 3

Course Objectives

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.

Course Outcomes (COs)

1. Analyze the tools and technologies related to AR/VR.
2. Design various models using modeling techniques.
3. Apply programming concepts and techniques specific to VR development, including 3D graphics.
4. Develop AR/VR applications in different domains.
5. Apply the technologies related to AR to build AR-enabled devices.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design 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.
PO5: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

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	2	2	-	2	-	-	-	-	-	-	-	-	2	-
3	3	3	3	-	3	-	-	-	-	-	-	-	-	3	-
4	3	3	3	-	3	-	-	-	-	-	-	-	-	3	-
5	3	3	3	-	3	-	-	-	-	-	-	-	-	3	-

UNIT I **6 Hours**

INTRODUCTION

Introduction to Virtual Reality and Augmented Reality-Definition-Introduction to Trajectories and Hybrid Space-Three I s of Virtual Reality-Virtual Reality Vs 3D Computer Graphics-Benefits of Virtual Reality-Components of VR System-Introduction to AR-AR Technologies-Input Devices-Types of Trackers-Human Visual System-Personal Graphics Displays-Human Auditory System.

UNIT II **6 Hours**

VR MODELING

Modelling-Geometric Modelling-Virtual Object Shape-Object Visual Appearance- Kinematics Modelling-Transformation Matrices-Object Position-Transformation Invariants- Object Hierarchies-Physical Modelling-Behavior Modelling-Model Management.

UNIT III **6 Hours**

VR PROGRAMMING

VR Programming-Toolkits and Scene Graphs-World ToolKit-Java 3D -Comparison of World ToolKit and Java 3D.

UNIT IV **6 Hours**

APPLICATIONS

Human Factors in VR-Methodology and Terminology-VR Health and Safety Issues-VR and Society-Medical Applications of VR-Education, Arts and Entertainment-Military VR Applications-Emerging Applications of VR.

UNIT V **6 Hours**

AUGMENTED REALITY

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices.

EXPERIMENT 1 **3 Hours**

Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.

3 Hours

EXPERIMENT 2

Use the primitive objects and apply various projection types by handling camera.

3 Hours

EXPERIMENT 3

Download objects from asset store and apply various lighting and shading effects

3 Hours

EXPERIMENT 4

Model three dimensional objects using various modelling techniques and apply textures over them.

3 Hours

EXPERIMENT 5

Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.

EXPERIMENT 6 **3 Hours**

Add audio and text special effects to the developed application.

3 Hours

EXPERIMENT 7

Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity

3 Hours

EXPERIMENT 8

Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.

3 Hours

EXPERIMENT 9

Develop AR enabled simple applications like human anatomy, DNA/RNA structure visualization and surgery simulation

EXPERIMENT 10 **3 Hours**

Develop simple MR enabled gaming applications

Reference(s)

Total: 30+30=60 Hours

1. Charles Palmer, John Williamson, Virtual Reality Blueprints: Create compelling VR experiences for mobile, Packt Publisher, 2018.
2. Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles & Practice, Addison Wesley, 2016.
3. John Vince, Introduction to Virtual Reality, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality-Interface, Application,Design, Morgan Kaufmann, 2003.

22CD021 DIGITAL AUDIO AND VIDEO DESIGN 3 0 0 3

Course Objectives

- Introduce the fundamental principles of Audio processing.
- Provide an overview of Audio enhancement and Audio compression techniques
- Review latest trends and future technologies in Audio processing.
- Introduce the fundamental concepts of Video processing and video coding.

Course Outcomes (COs)

1. Describe the basics of digital audio.
2. Identify the sound synthesis in music and the principles of MIDI.
3. Analyze the principles of stereo and surround sound.
4. Explain the fundamentals of video and its standards.
5. Illustrate the process of video coding and compression.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO6: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	-	-	-	-	1	1	-	3	-
2	2	-	2	-	-	3	-	-	-	-	3	3	-	3	-
3	2	-	2	-	-	2	-	-	-	-	3	3	-	3	-
4	2	-	2	-	-	2	-	-	-	-	3	3	-	3	-
5	2	-	3	-	-	3	-	-	-	-	3	3	-	3	-

UNIT I **9 Hours**

DIGITAL AUDIO

Basics of Digital Audio - Digitization of Sound- Auditory Perception - Sampling, Normalization, Noise Reduction and Visualization. Digital and Analog audio Recording, A/D and D/A Converter, Pitch Shifting and Time Stretching, Audio Data Reduction.

UNIT II **9 Hours**

MUSICAL SOUND SYNTHESIS AND MIDI

Acoustic Instruments, Sound Synthesis in Music, MIDI Principles - Hardware aspects, Structure of MIDI Messages, General MIDI, MIDI-to-Wav Conversion.

UNIT III **9 Hours**

STEREO AND SURROUND SOUND

Two-Channel Stereo - Principles of Loudspeaker and Microphone, Stereo and Loudspeaker Stereo, Two-Channel Signal Formats and Microphone techniques, Binaural Recording and Dummy Head Techniques, Surround Sound - Three Channel Stereo, Four Channel Surround, 5.1 Channel Surround, and other Multichannel Configurations. Surround Sound Systems, Matrix Surround Sound Systems, Dolby Digital, DTS, Ambisonics.

UNIT IV **9 Hours**

VIDEO FUNDAMENTALS

Basic concepts and Terminology-Analog video standards-Digital video basics-Analog to Digital conversion-Color representation and chroma subsampling-Digital video formats and standards-Changing Video sampling rate and standards.

UNIT V **9 Hours**

MPEG VIDEO CODING

Basic Video coding and Audio Compression Techniques-Motion Detection-MPEG Video and audio Compression-Real-time video compression.

Total: 45 Hours

Reference(s)

1. Francis Rumsey & Tim McCormick Sound and Recording, Sixth Edition, 2009, Focal Press,Elsevier Ltd.
2. Ian Mcloughlin Applied Speech and Audio Processing with MATLAB Examples Cambridge University Press, Cambridge, New York, 2009.
3. Oges Marques, Practical Image and Video Processing Using MATLAB, Wiley-IEEE Press, 2011.

22CD022 VIDEO CREATION AND EDITING 2 0 2 3

Course Objectives

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

Course Outcomes (COs)

1. Compare the strengths and limitations of Nonlinear editing.
2. Identify the infrastructure and significance of storytelling.
3. Apply suitable methods for recording to CDs and VCDs.
4. Address the core issues of advanced editing and training techniques.
5. Design and develop projects using AVID XPRESS DV 4.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design 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.
PO5: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	3	-	-	-	-	-	-	-	-	3	-
2	2	2	2	-	2	-	-	-	-	-	-	-	-	2	-
3	2	2	2	-	2	-	-	-	-	-	-	-	-	2	-
4	2	2	2	-	2	-	-	-	-	-	-	-	-	2	-
5	2	2	2	-	2	-	-	-	-	-	-	-	-	2	-

UNIT I **6 Hours**

FUNDAMENTALS

Evolution of filmmaking-linear editing-non-linear digital video-Economy of Expression-risks associated with altering reality through editing.

UNIT II **6 Hours**

STORYTELLING

Storytelling styles in a digital world through jump cuts, L cuts, match cuts, cutaways, dissolves, split edits-Consumer and pro NLE systems-digitizing images-managing resolutions-Understanding video color-Color Correcting Basics-Color Enhancement Effects mechanics of digital editing-pointer files-media management.

UNIT III **6 Hours**

USING AUDIO AND VIDEO

Audio: Timeline Audio Tracks-Editing Audio-Gaining, Fading and Balancing Audio-Video: Capturing digital and analog video-importing audio on putting video-exporting digital video to tape-recording to CDs and VCDs.

UNIT IV **6 Hours**

WORKING WITH FINAL CUT PRO

Working with clips and the Viewer-working with sequences, the Timeline, and the canvas- Basic Editing-Adding and Editing Testing Effects-Advanced Editing and Training Techniques-Working with Audio-Using Media Tools-Viewing and Setting Preferences.

UNIT V **6 Hours**

WORKING WITH AVID XPRESS DV 4

Starting Projects and Working with Project Window-Using Basic Tools and Logging- Preparing to Record and Recording-Importing Files-Organizing with Bins-Viewing and Making Footage-Using Timeline and Working in Trim Mode-Working with Audio-Output Options.

EXPERIMENT 1 **3 Hours**

Write a Movie Synopsis (Individual/Team Writing)

EXPERIMENT 2 **3 Hours**

Present team stories in class

EXPERIMENT 3

Script/Storyboard Writing(Individual Assignment) **4 Hours**

EXPERIMENT 4 **4 Hours**
Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts

EXPERIMENT 5 **4 Hours**
Production: Single camera production personnel

EXPERIMENT 6 **3 Hours**
Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching

EXPERIMENT 7 **4 Hours**
Write Documentary

EXPERIMENT 8 **5 Hours**
Post-production: Editing, Sound design, Finishing

Total: 30+30=60 Hours

Reference(s)

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.
3. Keith Underdahl, Digital Video for Dummies, Third Edition, Dummy Series, 2001.
4. Robert M. Goodman and Partick McGarth, Editing Digital Video: The Complete Creative and Technical Guide, Digital Video and Audio, McGraw Hill 2003.

22CD023 DIGITAL MARKETING 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

Course Outcomes (COs)

1. Understand and apply the digital marketing strategies.
2. Compare the strengths and limitations of search engine optimisation.
3. Apply the suitable techniques for E-Mail Marketing.
4. Apply the digital marketing strategies in social media applications.
5. Analyze the strategies used in different digital transformation techniques.

Program Outcomes(POs)

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

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

PO3: Design 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.

PO5: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	-	1	-	-	-	-	-	-	-	-	-	2
2	2	2	3	-	3	-	-	-	-	-	-	-	-	-	2
3	1	3	3	-	3	-	-	-	-	-	-	-	-	-	3
4	2	2	2	-	3	-	-	-	-	-	-	-	-	-	3
5	2	2	1	-	3	-	-	-	-	-	-	-	-	-	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.

22CD024 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS 3 0 0 3

Course Objectives

- To provide knowledge about management issues related to staffing, training, performance, compensation, human factors consideration and compliance with human resource requirements.
- To gain knowledge needed for success as a human resource professional.
- To develop the skills needed for a successful HR manager
- To implement the concepts learned in the workplace.

Course Outcomes (COs)

1. Gain knowledge on the various aspects of HRM
2. Gain knowledge needed for success as a human resources professional.
3. Develop the skills needed for a successful HR manager
4. Prepared to implement the concepts learned in the workplace.
5. Aware of the emerging concepts in the field of HRM

Program Outcomes(POs)

PO11: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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
3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
4	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3

UNIT I **9 Hours**

PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT

Evolution of human resource management-The importance of the human capital-Role of human resource manager-Challenges for human resource managers-trends in Human resource-Computer applications in human resource management-Human resource accounting

UNIT II **9 Hours**

HUMAN RESOURCE PLANNING AND RECRUITMENT

Importance of Human Resource Planning-Forecasting human resource requirement-matching supply and demand-Internal and External sources-Organizational Attraction-Recruitment, Selection, Induction and Socialization- Theories, Methods and Process

UNIT III **9 Hours**

TRAINING AND DEVELOPMENT

Types of training methods-purpose-benefits-resistance. Executive development programme-Common Practices-Benefits-Self Development-Knowledge management

UNIT IV **9 Hours**

EMPLOYEE ENGAGEMENT

Compensation plan-Reward-Motivation-Application of theories of motivation -Career management- Mentoring-Development of mentor-Protege relationships- Job Satisfaction, Employee Engagement, Organizational Citizenship Behaviour-Theories, Models

UNIT V **9 Hours**

PERFORMANCE EVALUATION AND CONTROL

Method of performance evaluation-Feedback-Industry practices. Promotion, Demotion, Transfer and Separation-Implication of job change. The control process-Importance- Methods-Requirement of effective control systems grievances-causes-implications-Redressal methods

Total: 45 Hours

Reference(s)

1. Dessler Human Resource Management, Pearson Education Limited, 14th Edition, 2015.
2. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
3. Bernadin , Human Resource Management ,Tata Mcgraw Hill ,8th edition 2012.
4. Wayne Cascio, Managing Human Resource, McGraw Hill, 2007.
5. Ivancevich, Human Resource Management, McGraw Hill 2012.

22CD025 SUPPLY CHAIN MANAGEMENT 3 0 0 3

Course Objectives

- Comprehensive understanding of the different components of a supply chain.
- Apply supply chain management principles to improve the efficiency and effectiveness of a business.
- Develop students critical thinking and problem-solving skills.

Course Outcomes (COs)

1. Understand the key concepts of supply chain management.
2. Develop a supply chain strategy to achieve strategic goals.
3. Plan the supply chain to identify key stakeholders.
4. Implement the supply chain plan.
5. Analyze supply chain performance and develop a supply chain culture.

Program Outcomes(POs)

PO11: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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
3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
4	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3

UNIT I **9 Hours**

SUPPLY CHAIN STRATEGY

Understanding Supply Chain : Objectives, Importance, Decision Phases, Process Views- Supply Chain Strategies: Competitive And Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope, Challenges-Supply Chain Drivers And Metrics :Financial Measures, Drivers of Supply Chain Performance, Framework For Structuring Drivers

UNIT II **9 Hours**

SUPPLY CHAIN NETWORK DESIGN

Role of Distribution In Supply Chain-Factors Influencing Distribution Network Design- Design Options For Distribution Network-Role Of Network Design In The Supply Chain- Factors Influencing Network Design Decisions-Framework For Network Design Decisions- Models For Facility Location And Capacity Location-Impact Of Globalization On Supply Chain Networks

UNIT III **9 Hours**

DEMAND SUPPLY PLANNING

Demand Forecasting In Supply Chain : Role Of Forecasting In Supply Chain, Characteristics of Forecasts-Forecasting Methods-Role Of IT In Forecasting-Aggregate Planning In The Supply Chain : Role-Characteristics-Aggregate Planning-Role of IT In Aggregate Planning- Sales And Operation Planning-Coordination In Supply Chain

UNIT IV **9 Hours**

INVENTORY MANAGEMENT

Role of cycle inventory-estimating cycle inventory-short term discounting-managing multi echelon cycle inventory-role of safety inventory-impacts on safety inventory-managing safety inventory in multi echelon supply chain- role of it in inventory management-estimating and managing safety inventory-Product Availability-Transportation

UNIT V **9 Hours**

CROSS FUNCTIONAL SCM

Source Decisions: Role-Sourcing-Logistics Providers and Suppliers-Pricing And Revenue Management: Role-Usage-Information Technology In Management : Role-Supply chain IT Framework-Customer/Supplier Relationship management-Sustainability And The Supply Chain : Role-Keymetrics-Sustainability And Supply Chain Drivers-closed loop supply chain

Total: 45 Hours

Reference(s)

1. Supply Chain Management: Strategy, Planning, and Operation, Global Edition, 7th edition, Pearson,2020.
2. Supply Chain Management Strategy, Planning, and Operation, Global Edition Sunil Chopra,2019
3. Logistics and Supply Chain Management: Systems mechanism within the Globe and Direct Delivery for effective globalization, creatspaceself publisher; 4th edition , 2018
4. Handbook of Research on Global Supply Chain Management

22CD026 SOCIAL TEXT AND MEDIA ANALYTICS 3 0 0 3

Course Objectives

- Understand the basic ideas of Text mining.
- Analyze the methods and approaches used in analytics.
- Gain knowledge on various types of analytics like web, social network, and social media.

Course Outcomes (COs)

1. Demonstrate the concepts and applications of text mining
2. Explain Content analysis and Sentiment analysis
3. Illustrate web analytics with a suitable model
4. Illustrate social network analytics with suitable example.
5. Illustrate social media analytics with suitable example.

Program Outcomes(POs)

PO11: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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
3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
4	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3

UNIT I **8 Hours**

TEXT MINING

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

UNIT II **9 Hours**

METHODS

Content Analysis-Natural Language Processing-Clustering & Topic Detection-Simple Predictive Modelling-Sentiment Analysis; Sentiment Prediction.

UNIT III **9 Hours**

WEB ANALYTICS

Web analytics tools-Clickstream analysis-A/B testing, online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

UNIT IV **10 Hours**

SOCIAL NETWORK ANALYTICS

Social contexts: Affiliation and identity - Social network analysis - Social network and web data and methods. Graphs and Matrices - Basic measures for individuals and networks.

UNIT V **9 Hours**

SOCIAL MEDIA ANALYTICS

Information visualization - Making connections: Link analysis - Random graphs and network evolution.

Total: 45 Hours

Reference(s)

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.
3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability, 2009.
4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
5. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
6. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003.

22CD027 FINANCIAL MANAGEMENT 3 0 0 3

Course Objectives

- Understand basics of Financial Management and Time Value of Money
- Analyze the Securities Value and its Risk & Return
- Analyze the Long-Term and Short-Term Investment Decisions

Course Outcomes (COs)

1. Able to perform the basic Financial Functions and apply the concept of Time Value of Money while taking the Financial Decisions
2. Perform the Security Valuation and construct the Portfolio for given level and risk and expected rate of return
3. Manage the risk using Operating and Financial Leverages and calculate the Cost of Capital
4. Able to apply appropriate Capital Budgeting Techniques while taking Investment Decision
5. Ensure the short-term liquidity by appropriately managing the Working Capital

Program Outcomes(POs)

PO11: 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.

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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
3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
4	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3

UNIT I **9 Hours**

INTRODUCTION

Introduction to Financial Management-Goals of the firm-Financial Environments. VALUE OF MONEY: Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.

UNIT II **9 Hours**

VALUATION OF SECURITIES

Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM. RISK AND RETURN: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, the Capital Asset Pricing Model (CAPM)

UNIT III **9 Hours**

OPERATING AND FINANCIAL LEVERAGE

Operating Leverage, Financial Leverage, Total Leverage, and Indifference Analysis in leverage study. COST OF CAPITAL: Concept, Computation of Specific Cost of Capital for Equity,Preference-Debt, Weighted Average Cost of Capital, Factors affecting Cost of Capital 4L

UNIT IV **9 Hours**

CAPITAL BUDGETING

The Capital Budgeting Concept & Process-An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital BudgetingTechniques, Project Evaluation and Selection-Alternative Methods

UNIT V **9 Hours**

WORKING CAPITAL MANAGEMENT

Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital. CASH MANAGEMENT: Motives for holding cash, speeding up Cash Receipts, slowing down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain,and Factoring. ACCOUNTS RECEIVABLE MANAGEMENT: Credit and CollectionPolicies,
Analysing the Credit Applicant, Credit References, Selecting optimum Credit period

Total: 45 Hours

Reference(s)

1. Chandra, Prasanna - Financial Management - Theory & Practice, Tata McGraw Hill.
2. Srivastava, Misra: Financial Management, OUP
3. Van Horne and Wachowicz : Fundamentals of Financial Management, Prentice Hall/ Pearson Education.

22CD023 DIGITAL MARKETING 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

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 optimisation.
3. Apply the suitable techniques for E-Mail Marketing.
4. Discover 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.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design 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.
PO5: 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.
PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	-	1	-	-	-	-	-	-	-	-	-	2
2	2	2	3	-	3	-	-	-	-	-	-	-	-	-	2
3	1	3	3	-	3	-	-	-	-	-	-	-	-	-	3
4	2	2	2	-	3	-	-	-	-	-	-	-	-	-	3
5	2	2	1	-	3	-	-	-	-	-	-	-	-	-	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 campaigneffectiveness. 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.

Reference(s) **Total: 45 Hours**

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.

22CD028 MARKETING RESEARCH AND MARKETING MANAGEMENT 3 0 0 3

Course Objectives

- To gain insight on fundamental concepts of marketing
- Comprehend the dynamics of marketing and analyze how its various components interact with each other in the real world
- Impart knowledge about the principles of marketing research

Course Outcomes (COs)

1. Understand the concepts and core concepts of Marketing and applications.
2. Analyze how various components of marketing interact with each other in the real world.
3. Analyze the marketing concepts involved in research for effective decision making
4. Analyze the fundamentals of business markets.
5. Evaluate various strategies of Internet Marketing.

Program Outcomes(POs)

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

PSO3: Acquire knowledge in diverse areas of Computer Science and Design to promote skills essential for career, entrepreneurship and higher studies.

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	-	-	-	-	-	-	-	-	-	-	2
4	-	-	-	3	-	-	2	-	-	-	-	-	-	-	2
5	-	-	2	-	-	-	2	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

MARKETING CONCEPTS AND APPLICATIONS

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector-Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social- Understanding the consumer: Determinants of consumer behavior, Factors influencing consumer behavior- Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning

UNIT II **9 Hours**

MARKETING MIX

Marketing Mix Concept, elements, 7 Ps of marketing-Product Management: Product decision and strategies, Packaging, Product Life cycle concept, New Product development & strategy, Stages in New Product development, Branding.

UNIT III **9 Hours**

MARKETING RESEARCH

Introduction, type of Market Research, Scope,Objectives and Limitations Marketing Research Techniques, Survey Questionnaire design and drafting, Pricing Research, Media Research, qualitative Research. Data analysis- Use of various statistical tools,descriptive and inference statistics, statistical hypothesis testing,multivariateanalysis,discriminantanalysis,clusteranalysis,segmenting and positioning,factor analysis

UNIT IV **9 Hours**

BUSINESS TO BUSINESS MARKETING

Fundamental of business markets,Organizational buying process. Business buyer needs. Market and sales potential.Product in business markets.Relationship, networks and customer relationship management. Business to Business marketing strategy

UNIT V **9 Hours**

INTERNET MARKETING

Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing

Reference(s) **Total: 45 Hours**

1. RajanSaxena , Marketing Management, McGraw Hill Education,6th edition, 2019
2. S.A. Sherlekar, Marketing Management, Himalaya Publishing House, 2014
3. Research for Marketing Decisions by Paul Green, Donald, Tull
4. Business Statistics, A First Course, David M Levine at al, Pearson Publication
5. Marketing Management , Philip Kotler
6. Service Marketing , S.M. Zha

22CD029/22CDH29/22CDM29 MULTIMEDIA DATA COMPRESSION 3 0 0 3

Course Objectives

- Acquire knowledge basics of compression techniques.
- Understand the categories of compression for Data.
- Explore the modalities of image and video compression algorithms.
- Understand basics of consistency of data availability in storage devices.

Course Outcomes (COs)

1. Describe the importance of multimedia compression and compare the various compression algorithms.
2. Illustrate the applications of various Data compressions techniques
3. Compare various compression algorithms for Image and Video compression.
4. Analyze the various audio compression techniques.
5. Design and develop multimedia application in various domains.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO6: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	-	-	-	-	1	1	-	1	-
2	2	-	3	-	-	3	-	-	-	-	2	2	-	2	-
3	2	-	2	-	-	3	-	-	-	-	2	2	-	2	-
4	2	-	2	-	-	3	-	-	-	-	3	3	-	3	-
5	2	-	3	-	-	3	-	-	-	-	3	3	-	3	-

UNIT I **9 Hours**

INTRODUCTION TO MULTIMEDIA COMPRESSION

Multimedia-Special features of multimedia-Graphics, Image and Video representations-Fundamental concepts of video, digital audio-Need for compression-Taxonomy of compression Algorithms- Error Free Compression-Lossy Compression.

UNIT II **9 Hours**

DATA COMPRESSION

Introduction-Lossless and Lossy Compression-Basics of Huffmanncoding-Arithmetic coding-Dictionary techniques-Context based compression-Applications

UNIT III **9 Hours**

IMAGE AND VIDEO COMPRESSION

Image Compression: Lossless Image compression-JPEG-CALIC-JPEG LS-Prediction using conditional averages-Progressive Image Transmission-Lossless Image compression formats-Applications- Facsimile encoding. Video Compression: Introduction-Motion Compensation-Video Signal Representation-H.261-MPEG-1-MPEG-2-H.263.

UNIT IV **9 Hours**

AUDIO COMPRESSION

Audio compression-DPCM-Adaptive PCM-adaptive predictive coding-linear Predictive coding code excited LPC-perpetual coding. Audio compression Techniques-ÃŽÂ¼ Law and A Law companding-Speech compression-Frequency domain and filtering- Basic sub band coding-Application to speech coding-G.722-Application to audio coding-MPEG audio

UNIT V **9 Hours**

MULTIMEDIA COMMUNICATION

Tele Services-Implementation of Conversational Services, Messaging Services, Retrieval Services, Tele Action Services, Tele Operation Services-Media Consumption-Media Entertainment-Virtual Reality-Interactive Audio-Interactive Video-Games.

Total: 45 Hours

Reference(s)

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2. Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008.
3. David Salomon, A concise introduction to data compression, 2008.
4. Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
5. Ralf Steinmetz, KlaraNahrstedt, Multimedia computing, communications, and applications, Pearson India, 2009.
6. Ranjan Parekh, Principles of Multimedia, Second Edition, McGraw Hill Education,2017.

22CD030/22CDH30/22CDM30 STREAMING MEDIA TOOLS AND TECHNOLOGIES 2 0 2 3

Course Objectives

- Understand the basics of Audio and Video Streaming
- Understand the basics of Streaming media
- Familiar with Streaming Technologies and tools

Course Outcomes (COs)

1. Understand the basics of Audio and Video Streaming
2. Develop Streaming media Applications
3. Implement applications using streaming technologies.
4. Demonstrate the use of streaming stages and tools
5. Analyze streaming services

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PO12: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	1	-	-	-	-	-	-	1	-	2	-
2	3	2	1	1	1	-	-	-	-	-	-	1	-	2	-
3	3	2	2	1	2	-	-	-	-	-	-	1	-	3	-
4	3	2	2	1	2	-	-	-	-	-	-	1	-	3	-
5	3	3	1	2	2	-	-	-	-	-	-	1	-	3	-

UNIT I **6 Hours**

BASICS OF AUDIO AND VIDEO STREAMING

Introduction-IP Networks-World Wide Web-Video formats-Video compression-Audio compression

UNIT II **6 Hours**

BASICS OF STREAMING MEDIA

Introduction to streaming media-Video streaming-Audio Streaming-Stream serving-Live webcasting-Media Players

UNIT III **6 Hours**

STREAMING TECHNOLOGIES AND APPLICATIONS

Associated Technologies and Applications-Rights Management-Content Distribution-Applications of Streaming Media

UNIT IV **6 Hours**

STREAMING STAGES AND TOOLS

Broadcasting Area-setting up your home studio-Preparing stage-starting your first video broadcast-Top live streaming third party apps :vMix v.2x-OBS studio-FFSplit-VidBlaster- Xsplit-ManyCam-Wirecast v.7 studio

UNIT V **6 Hours**

STREAMING SERVICES

Software as a Service websites-Top 7 live streaming websites: Light stream-Smiletime- BlueJeans-BeLiveTv-Vidpresso Live-Zoom webinar addon-Crowdcast

4 Hours

EXPERIMENT 1

Use any popular open source tool like HandBrake to compress, modify format and other attributes of audio and video.

EXPERIMENT 2 **4 Hours**

Set up a DLNA service for streaming media from windows 10

EXPERIMENT 3 **4 Hours**

Implement media casting using Google Cast SDK on TV like device

EXPERIMENT 4 **4 Hours**

Setup streaming media servers using open sources tools like kodi, Stremio etc.,

4 Hours

EXPERIMENT 5

Use any Screen Capture software tools like OBS studio, FFsplit etc., to create live video streaming and broadcasting.

EXPERIMENT 6 **5 Hours**

Create simple live webcast

5 Hours

EXPERIMENT 7

Create an example tutorial content by combing the tutor with screen capture using any of the tools and make them available for streaming

Total:30+30= 60 Hours

Reference(s)

1. David Austerberry, The Technology of Audio and Video Streaming, Second Edition, Taylor and Francis 2013.
2. Lenald Best, Bests Guide to Live Stream Video Broadcasting, BCB Live Teaching series,2017.
3. Helen M Heneveld Audio, Video and Streaming Media Technologies, Smart Home and office technologies, 2018.
4. Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor & Francis,2019
5. Tay Vaughan, Multimedia: Making it Work, McGraw Hill Education, Ninth Edition, 2017.

22CD031/22CDH31/22CDM31 METAVERSE 2 0 2 3

Course Objectives

- Understand the History of Metaverse.
- Explore the role of Metaverse to connect the real world and blockchain.
- Understand the advanced development of blockchain in the future.
- Study an open ecosystem of smart properties and assets.

Course Outcomes (COs)

1. Understand the evolution of Metaverse.
2. Analyze the technologies involved in Metaverse.
3. Apply the adoption of blockchain by Metaverse.
4. Apply Metaverse for AR,VR and MR applications.
5. Analyze use cases of Metaverse in Gaming and Social Media.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO12: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	-	1	-	3	-
2	3	3	3	3	2	-	-	-	-	-	-	2	-	3	-
3	3	3	3	3	2	-	-	-	-	-	-	2	-	3	-
4	3	3	3	3	2	-	-	-	-	-	-	3	-	3	-
5	3	3	3	3	2	-	-	-	-	-	-	3	-	3	-

UNIT I **6 Hours**

INTRODUCTION TO METAVERSE

Introduction to Metaverse and immersive experience-History of metaverse-Metaverse value chain with 7 layer.

UNIT II **6 Hours**

TECHNOLOGIES INVOLVED IN THE METAVERSE

Metaverse as a product of Extended Reality- Augmented Reality (AR)- Virtual Reality (VR)- Benefits of AR/VR-Difference between AR/ VR - Mixed Reality (MR)-Artificial Intelligence (AI)- Introduction in Metaverse-Financial and Economics of Metaverse-Benefits of Metaverse.

UNIT III **6 Hours**

BLOCKCHAIN ADOPTION IN METAVERSE

Blockchain Overview-History of Blockchain-Need of Decentralization in MV-Smart Contract Capabilities in Blockchain - Blockchain in Metaverse -Understanding Tokens- Understanding the NFT-NFT Token Standards-NFTs in MV-Cryptocurrency in MV.

UNIT IV **6 Hours**

AR, VR, AND MR IN METAVERSE

Everything about VR (Virtual Reality)-Everything about AR (Augmented Reality)- Everything aboutMR (Mixed Reality)-Block chain Identity Management in Metaverse -NFT (non-fungibletoken)for Metaverse-Introduction to NFTs-History of NFTs-Benefits of NFTs.

UNIT V **6 Hours**

USE-CASES

Gaming in Metaverse-Meetings in Metaverse-Virtual Learning in Metaverse-Social Interactionsin Metaverse-Virtual Real-estate in Metaverse-e-commerce in Metaverse-Travel in Metaverse-Personalized Avatars-Digital Identity in Metaverse.

6 Hours

EXPERIMENT 1

Installations:

Hardware Required: Android phone, Cardboard Viewer, PC with Dedicated Graphics Card and atleast 32GB RAM.
Software required: Android Studio, Cardboard SDK, Android NDK, Google Carboard XR plugin for Unity, Unity, Nethereum library to (as needed)

6 Hours

EXPERIMENT 2

Using Google Cardboard SDK for Creating simple AR/VR (XR) applications in Unit

EXPERIMENT 3 **6 Hours**

Creating blockchain applications in metaverse, by creating virtual assets, smart Contracts for exchange of assets using utility tokens and NFTs.

EXPERIMENT 4 **6 Hours**

Create any Metaverse based application for an educational institution.

EXPERIMENT 5 **6 Hours**

Create any Metaverse based application for a healthcare application.

Total:30+30= 60 Hours

Reference(s)

1. The Metaverse: And How It Will Revolutionize Everything Kindle Edition by Matthew Ball , Publisher : Liveright ,2022
2. The Metaverse Handbook: Innovating for the Internets Next Tectonic Shift Kindle Edition by QuHarrison Terry (Author), Scott Keeney (Author), Paris Hilton (Foreword), Publisher: Wiley; 1st edition ,2022
3. Metaverse Made Easy: A Beginner"s Guide to the Metaverse, Dr.LiewVoonKiong,Publisher, LiewVoonKiong, 2022
4. Metaverse For Beginners and Advanced: A Complete Journey Into the Metaverse Virtual World (Web 3.0), DarellFreeman,PublisherDarell Freeman,2022
5. Metaverse Glossary - Your Gateway to the Future ,RavindraDastikop, Evincepub Publishing,2022
6. The Metaverse: Prepare Now for the Next Big Thing Paperback ,Terry Winters , Winters media Publications 2021

22CD032/22CDH32/22CDM32 IMAGE AND VIDEO ANALYTICS 3 0 0 3

Course Objectives

- Understand the basics of image processing techniques for computer vision.
- Learn the techniques used for image pre-processing.
- Discuss the various object detection techniques.
- Understand the various Object recognition mechanisms.
- Elaborate on the video analytics techniques.

Course Outcomes (COs)

1. Understand the importance of multimedia concepts and data structures involved.
2. Analyze the image preprocessing techniques
3. Analyze the methods used in object detection.
4. Apply the machine learning algorithms for face and gesture recognition.
5. Apply the machine learning algorithms for video analytics applications.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO6: 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.
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.
PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	-	-	-	-	1	1	-	3	-
2	2	-	3	-	-	3	-	-	-	-	2	2	-	3	-
3	2	-	2	-	-	3	-	-	-	-	2	2	-	3	-
4	2	-	2	-	-	3	-	-	-	-	3	3	-	3	-
5	2	-	3	-	-	3	-	-	-	-	3	3	-	3	-

UNIT I **9 Hours**

INTRODUCTION

Basic concepts-Image functions and types-Computer Vision-Image representation and image analysis tasks-Image representations- digitization-properties-color images-Data structures for Image Analysis-Levels of image data representation-Traditional and Hierarchical image data structures.

UNIT II **9 Hours**

IMAGE PRE-PROCESSING

Pixel brightness transformations-Geometric transformations-Local pre-processing-Image smoothing-Edge detectors-Zero-crossings of the second derivative-Scale in image processing-Canny edge detection-Parametric edge models-Edges in multi-speralct images- Local pre-processing in the frequency domain-Line detection by local pre-processing operators-Image restoration.

UNIT III **9 Hours**

OBJECT DETECTION USING MACHINE LEARNING

Object localization-Object detection-Object detection methods-Deep Learning framework for Object detection-bounding box approach-Intersection over Union (IoU)-Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV **9 Hours**

FACE RECOGNITION AND GESTURE RECOGNITION

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition-Deep

Face solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet-Gesture Recognition.

UNIT V **9 Hours**

VIDEO ANALYTICS

Video Processing-use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-Implementation using RestNet and Inception v3.

Reference(s) **Total: 45 Hours**

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, 4nd edition, Thomson Learning, 2013.
2. VaibhavVerdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021
3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer Verlag London Limited,2011.
4. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, Video Analytics for Business Intelligence,Springer, 2012.
5. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.
6. E. R. Davies, (2012), Computer & Machine Vision, Fourth Edition, Academic Press.

22CD033/22CDH33/22CDM33 WEARABLE DEVICES AND APPLICATIONS 3 0 0 3

Course Objectives

- Understand the basics of Wearable Computing, Wearable Devices and Technologies.
- Explore about basics of Security Challenges.
- Understand the concepts of Applications of wearables in Health Care.
- Acquire knowledge about the advanced applications of Wearable Computing.

Course Outcomes (COs)

1. Understand the basics of Wearable Computing
2. Explain the various devices and technologies of Wearable computing
3. Analyze the challenges of Security issues in Wearable computing
4. Discuss the applications of Wearable computing in health sector
5. Discover the advanced trends in wearable computing

Program Outcomes(POs)

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

PO3: 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.

PO6: 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.

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	-	-	-	-	1	1	-	3	-
2	2	-	3	-	-	3	-	-	-	-	2	2	-	3	-
3	2	-	2	-	-	3	-	-	-	-	2	2	-	3	-
4	2	-	2	-	-	3	-	-	-	-	3	3	-	3	-
5	2	-	3	-	-	3	-	-	-	-	3	3	-	3	-

UNIT I **9 Hours**

WEARABLE COMPUTING

Introduction to Wearable Computers-Design Considerations-Wearable Interactions-Design Guidelines and Evaluation-Future Trends in Wearable Computing-Benefits

UNIT II **9 Hours**

WEARABLE DEVICES AND TECHNOLOGIES

Health and Fitness Wearables-The Promise and Perils of Wearable Technologies- Confidential Data Storage system for wearable platforms-Management and Security issues in Wearable platforms.

UNIT III **9 Hours**

SECURITY CHALLENGES

Authenticity Challenges of Wearable Technologies-Wearable Computing: Security Challenges, BYOD,Privacy, and Legal Aspects-Security, Privacy, and Ownership Issues With the Use of Wearable Health Technologies-Wearable Devices: Ethical Challenges and Solutions.

UNIT IV **9 Hours**

HEALTH CARE APPLICATION

IoT for Ambient Assisted Living: Care4Me-A Healthcare Support System-Study of Real- Time Cardiac Monitoring System: A Comprehensive Survey-Co-Designing Wearable Technology Together with Visually Impaired Children

UNIT V **9 Hours**

ADVANCED APPLICATIONS

Securing the Human Cloud: Applying Biometrics to Wearable Technology-Context-Aware Mobile and Wearable Device Interfaces-An Overview of Telemedicine Technologies for Healthcare Applications-Internet of Things in E-Health: An Application of Wearables in Prevention and WellBeing-Wearable ECG Monitoring and Alerting System Associated With Smartphone

Total: 45 Hours

Reference(s)

1. Vivian Genaro Motti, Wearable Interaction, Springer Nature, 2020.
2. Marc L. Resnick (Bentley University, USA) and Alina M. Chircu, Wearable Devices: Ethical Challenges and Solutions, IGI Global Publisher 2018.
3. Edward Sazonov and Michael R. Neuman (Editors), Wearable Sensors Fundamentals, Implementation and Applications, Elsevier, 2015.
4. Wearable Applications Research, devices and Interactions, Internet of Medical Things Paradigm of Wearable Devices, 1st Edition, 2021 by CRC Press.
5. Wearable Technologies: Concepts, Methodologies, Tools, and Applications (Critical Explorations) 1st Edition,2018
6. Information Resources Management Association (Author, Editor), Wearable Technologies: Concepts, Methodologies, Tools, and Applications (Critical Explorations) 1st Edition, 2018.

22CD034/22CDH34/22CDM34 3D PRINTING AND DESIGN 3 0 0 3

Course Objectives

- Learn basics of 3D printing.
- Explain the principles of 3D printing technique.
- Illustrate the inkjet technology and laser technology.
- Analyze the applications of 3D printing.

Course Outcomes (COs)

1. Understand the basic concepts of 3D printing technology.
2. Outline the processes and materials used in 3D printing.
3. Explain the concepts and working principles of 3D printing using inkjet technique.
4. Explain the working principles of 3D printing using laser technique.
5. Analyze the various method for designing and modeling for industrial applications.

Program Outcomes(POs)

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

PO3: 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.

PO6: 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.

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	-	-	-	-	1	1	-	3	-
2	2	-	3	-	-	3	-	-	-	-	2	2	-	3	-
3	2	-	2	-	-	3	-	-	-	-	2	2	-	3	-
4	2	-	2	-	-	3	-	-	-	-	3	3	-	3	-
5	2	-	3	-	-	3	-	-	-	-	3	3	-	3	-

UNIT I 9 Hours

INTRODUCTION

Introduction; Design considerations-Material, Size,Resolution, Process; Modelling and viewing-3D; Scanning; Model preparation-Digital; Slicing; Software; File formats

UNIT II **9 Hours**

PRINCIPLE

Processes-Extrusion, Wire, Granular, Lamination, Photo polymerisation; Materials-Paper, Plastics,Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene MaterialSelection-Processes, applications, limitations;

UNIT III **9 Hours**

INKJET TECHNOLOGY

Printer-Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations-Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On- Demand; Material Formulation for jetting; Liquid based fabrication-Continous jet, Mulitjet; Powder based fabrication-Colourjet-Applications to manufacturing.

UNIT IV **9 Hours**

LASER TECHNOLOGY

Light Sources-Types, Characteristics; Optics-Deflection, Modulation; Material feeding and flow-Liquid, powder; Printing machines-Types, Working Principle, Build Platform, Print bed Movement,Support structures-Applications.

UNIT V **9 Hours**

INDUSTRIAL APPLICATIONS

Securing the Human Cloud: Applying Biometrics to Wearable Technology-Context-Aware Mobile and Product Models, manufacturing-Printed electronics, Biopolymers, Packaging, Healthcare, Food,Medical, Biotechnology, Displays; Future trends;cloud based additive manufacturing-Research-Agile tooling.

Total: 45 Hours

Reference(s)

1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2. Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons,2013.
3. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
4. Joan Horvath, Mastering 3D Printing, APress, 2014

22CD0XA STREAMING ANALYTICS WITH DEEP LEARNING 1 0 0 1

Course Objectives

- To understand the basic configuration of video analytics
- To get exposed to the various applications of video analytics

Course Outcomes (COs)

1. Develop video analytic algorithms for security applications
2. Design video analytic algorithms for business intelligence

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

PO8:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO10: 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.

PO12: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	-	1	2	2	-	1	-	1	-	-	-	-	-	2	-

Computer Vision – Image representation and image analysis tasks- Image representations - digitization – properties – color images – Data structures for Image Analysis – Levels of image data representation - Object detection- Object detection methods – Deep Learning framework for Object detection bounding box approach-Intersection over Union (IoU) -Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures- Customer behavior analysis - people counting- Traffic rule violation detection- traffic congestion identification for route planning- driver assistance- lane change warning

Total: 15 Hours

Reference(s)

[1].Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, 4nd edition, Thomson Learning, 2013.

[2].Vaibhav Verdhan, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021

[3].Nilanjan Dey , Amira Ashour and Suvojit Acharjee, Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016

[4].Zhihao Chen, Ye Yang, Jingyu Xue, Liping Ye, Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014

22CD0XB GRAPHICS DESIGN TECHNIQUES USING ADOBE ILLUSTRATOR

1 0 0 1

Course Objectives

- To learn the basics of Adobe Illustrator.
- To design graphics using Adobe Illustrator.

Course Outcomes (COs)

1. Design Graphics using the basic tools of Adobe Illustrator.
2. Create illustrations using advanced graphics design techniques of Adobe Illustrator.

Program Outcomes(POs)

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	2	2	3	-	-	-	-	-	2	3	-	2	-
2	1	-	2	2	3	-	-	-	-	-	3	3	-	2	-

Introduction to Adobe Illustrator – Understanding the Workspace – Creating and navigating a document – Basic shapes and selection tools – Grouping and ungrouping objects - Colors and Fills – Typography and Text tools – Advanced Techniques – Creating Illustrations.

Reference(s) **Total: 15 Hours**

1. Adobe Illustrator Classroom in a Book by Brain Wood (Published by Pearson Education), 2023
2. Learn Adobe Illustrator CC for Graphic Design and Illustration, by Chad Chelius , Rob Schwartz, 2020

22CD0XC MOTION GRAPHICS USING ADOBE AFTER EFFECTS 1 0 0 1

Course Objectives

- To learn the basics of Adobe After Effects.
- To create animations using Adobe After Effects.

Course Outcomes (COs)

1. Design Graphics using the basic tools of Adobe After Effects.
2. Create illustrations using advanced graphics design techniques of Adobe After Effects.

Program Outcomes(POs)

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

PSO2: Apply the power of computing and digital media tools to provide solutions to challenging interactive technologies.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	-	2	2	3	-	-	-	-	-	2	3	-	2	-
2	1	-	2	2	3	-	-	-	-	-	3	3	-	2	-

Introduction to Motion Graphics – Getting started with After Effects – Basic Animation in After Effects – Advanced Motion Graphics Techniques – Working with Text and Typography – Effects and Transitions – Exporting and Rendering.

Reference(s) **Total: 15 Hours**

1. Adobe After Effects Classroom in a Book, by Lisa Fridsma 2023.
2. Adobe After Effects 2023 Guide For Beginners: Digital Animation, Digital Visual Effects, Motion Graphics, and Vector Graphic Designing Training Workbook | Beginner to Expert Guide, by Jenar Bealtrien, 2023.

22CD0XD MANAGING CLOUD INFRASTRUCTURE WITH KUBERNETES FUNDAMENTALS

1 0 0 1

Course Objectives

- To introduce fundamental concepts of containerization and Kubernetes in cloud computing.
- To provide hands-on experience in deploying and managing applications with Kubernetes.
- To understand key Kubernetes concepts such as pods, deployments, services, and scaling.

Course Outcomes (COs)

1. Explain the fundamental concepts of containerization and Kubernetes.
2. Deploy and manage containerized applications using Kubernetes.
3. Understand the principles of scaling and load balancing in a Kubernetes environment.

Program Outcomes(POs)

PO1:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: 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.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	2				2				1	-	-
2	3	3	3	3	3				2				1	-	-
3	3	3	3	3	3				3				1	-	-

Introduction to Containers and Kubernetes-Overview of Containerization- Introduction to Kubernetes- Architecture and Components of KubernetesDeploying Applications with Kubernete. Creating and Managing Pods- Deployments and ReplicaSets- Services and Networking in Kubernetes-Scaling and Load Balancing-Horizontal Pod Autoscaling- Cluster Scaling Strategies- Load Balancing in KubernetesPractical Sessions- Setting up a Kubernetes Cluster- Deploying a Simple Application - Scaling and Load Balancing in Kubernetes.

Total: 15 Hours

Reference(s)

1. "Kubernetes Up & Running" by Kelsey Hightower, Brendan Burns, and Joe Beda.
2. "The Kubernetes Book" by Nigel Poulton.
3. "Cloud Native Infrastructure" by Justin Garrison and Kris Nova.
4. https://cloud.google.com/architecture/managing-cloud-infrastructure-using-kpt
5. https://www.tutorialspoint.com/kubernetes/kubernetes_monitoring.htm

22CD0XE DEVELOPMENT OF CLOUD WITH OPENSTACK

1 0 0 1

Course Objectives

- To understand the fundamentals of cloud computing.
- To explore the architecture and components of OpenStack.
- To configure and deploy OpenStack in a virtualized environment.
- To manage and optimize virtual machines using OpenStack services.

Course Outcomes (COs)

1. Understand the fundamentals of cloud computing concepts.
2. Demonstrate proficiency in configuring and deploying OpenStack.
3. Effectively manage virtual machines using OpenStack services.

Program Outcomes(POs)

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

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

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

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

PSO1: Apply the skill of Design and Creative thinking to provide digital solutions to modern and complex engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	2	-	-	-	2	-	-	-	1	-	-
2	3	3	3	3	3	-	-	-	2	-	-	-	1	-	-
3	3	3	3	3	3	-	-	-	3	-	-	-	1	-	-

Introduction to OpenStack-History,-Evolution - Key Components-Architecture- Controller Nodes-Compute Nodes-Network Nodes-Dashboard and API Services-Overview of Horizon Dashboard-Working with OpenStack APIs. Setting Up a Virtualized Environment-Installing Virtualization Software (e.g., VirtualBox)- Creating Virtual Machines for OpenStack- Installing - Configuring OpenStack-Deploying OpenStack Services- Configuring Networking
- Security Groups

Total: 15 Hours

Reference(s)

1. OpenStack Operations Guide by Tom Fifield, Diane Fleming, Anne Gentle
2. OpenStack in Action by V. K. Cody Bumgardner
3. https://www.javatpoint.com/openstack
4. OpenStack official documentation: https://docs.openstack.org/

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

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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	PSO1	PSO2
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.

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.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

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	PSO1	PSO2
1	3	2	1	-	-	-	-	-	-	-	-	-	-	2
2	1	3	1	-	-	-	-	-	-	-	-	-	-	2
3	1	1	2	-	1	-	-	-	-	-	-	-	-	2
4	1	1	2	-	3	-	-	-	-	-	-	-	-	2
5	1	1	3	-	2	-	-	-	-	-	-	-	-	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.

9 Hours

UNIT II

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

Programme Outcomes (POs)

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

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

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PSO2: Develop practical competencies in Software and Hardware Design

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	PSO1	PSO2
1	3	2	2	-	-	-	-	-	-	-	-	-	-	1
2	3	2	-	-	-	-	-	-	-	-	-	-	-	1
3	3	2	-	-	-	-	-	-	-	-	-	-	-	1
4	2	2	2	-	-	-	-	-	-	-	-	-	-	1
5	3	2	-	-	-	-	-	-	-	-	-	-	-	1

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.

22OEI01 PROGRAMMABLE LOGIC CONTROLLER 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

Programme Outcomes (POs)

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

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

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

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

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

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	-	-	-	-	-	1	1
2	2	1	-	2	2	-	3	-	-	-	-	-	-	1
3	2	1	-	2	2	-	3	-	-	-	-	-	2	1
4	2	1	-	2	2	-	3	-	-	-	-	-	2	1
5	2	1	-	2	2	-	3	-	-	-	-	-	2	1

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

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Conclude the static and dynamic characteristics of measuring instruments
2. Compare the characteristics and working principles of Resistance, Inductance and Capacitance type sensors
3. Construct the interfacing and signal conditioning circuit for measurement system using different types of sensor
4. Analyze and select the suitable sensor for different industrial applications
5. Combine the modern technologies and smart materials to design various sensors

Articulation Matrix

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

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.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Outline the concepts of traditional instruments and virtual instruments
2. Conclude the overview of modular programming and the structuring concepts in VI programming
3. Attribute the procedure to install DAQ in various OS and its interfacing methods
4. Implement the VI toolsets for specific applications
5. Generate the applications using Virtual Instrumentation software

Articulation Matrix

CONo	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**

VI 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 equipments 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, Newyork, 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

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Attribute the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Conclude the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

CONo	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 offibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicingand 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, gynaecology 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.

22OME01 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)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

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
1	2	2	2	-	2	-	-	-	-	-	-	-	1	1
2	2	2	2	-	2	-	-	-	-	-	-	-	1	1
3	2	2	2	-	2	-	-	-	-	-	-	-	1	1
4	2	2	2	-	2	-	-	-	-	-	-	-	-	-
5	2	2	2	-	2	-	-	-	-	-	-	-	1	1

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

22OME02 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)

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

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

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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
1	2	3	1	-	1	-	-	-	-	-	-	-	-	-
2	3	3	1	-	2	-	-	-	-	-	2	-	-	-
3	1	3	3	-	2	-	-	-	-	-	-	-	-	-
4	2	3	1	-	2	-	-	-	-	-	-	-	-	-
5	2	3	1	-	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

22OME03 **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)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2: Develop practical competencies in Software and Hardware Design

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
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.

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.

22OME04 **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)

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

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

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

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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
1	-	-	-	-	2	1	-	1	-	-	-	-	-	-
2	-	-	-	-	1	-	-	3	-	-	-	-	-	-
3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	2	3	-	-	-	-	-	-	2	-	-	-	-	-
5	-	-	-	-	2	-	-	-	-	3	-	-	-	-

UNIT I **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

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.

Program Outcomes (POs)

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

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

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

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	-	-	-	-	-	-	-	-
2	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-
3	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-
4	2	-	-	-	-	-	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.

UNIT III **9 Hours**

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.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of bio-refineries, co-products of bio-refineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of bio-refineries.

Total: 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.

Program Outcomes (POs)

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

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

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

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

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	PSO3
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.

22OFD02 FOOD LAWS AND REGULATIONS 3 0 0 3

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

Program Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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	PSO3
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

Program Outcomes (POs)

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

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

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

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

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

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	PSO3
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 OIL SEED 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

Program Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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	PSO3
1	3	2	-	2	-	2	-	-	-	-	-	-	-	-	-
2	1	2	-	2	-	1	-	-	-	-	-	-	-	-	-
3	2	2	-	1	-	2	-	-	-	-	-	-	-	-	-
4	2	3	-	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 handicraft techniques
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Program Outcomes (POs)

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

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

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

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

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

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

PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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	PSO3
1	3	1	3	-	-	-	2	-	2	2	-	2	-	-	-
2	3	2	3	-	-	-	1	-	2	3	-	2	-	-	-
3	3	2	3	-	-	-	2	-	2	3	-	2	-	-	-
4	3	2	3	-	-	-	2	-	2	3	-	2	-	-	-
5	3	2	3	-	-	-	2	-	2	3	-	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 Encyclopaedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopaedia 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

Program Outcomes (POs)

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

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

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

PO5. 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.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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	PSO3
1	3	2	3	-		1	-	-	-	-	-	-	-	-	-
2	3	2	3	-	2	3	-	2	-	-	-	-	-	-	-
3	3	3	3	-	2	2	-	2	-	-	-	-	-	-	-
4	3	3	3	-	2	3	-	2	-	-	-	-	-	-	-
5	3	2	-	-	2	-	-	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

Program Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5. 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.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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	PSO3
1	2	3	2	-	-	-	-	1	-	-	-	-	-	-	-
2	2	3	2	-	-	-	-	-	2	-	-	-	-	-	-
3	2	3	2	-	3	-	-	-	-	-	-	-	-	-	-
4	2	2	2	-	-	-	-	-	2	-	-	-	-	-	-
5	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 NANO MATERIALS 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

Programme Outcomes (POs)

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

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

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. 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.

PO12. 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 origin of nanomaterials from ancient applications to modern nanotechnology
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Analyze the magnetic properties of nanomaterials and their applications in data storage and spintronics
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	PSO2
1	3	2	2	1	1	-	-	-	-	-	-	1	-	-
2	3	2	2	1	1	-	-	-	-	-	-	1	-	-
3	3	2	2	1	1	-	-	-	-	-	-	1	-	-
4	3	2	2	1	1	-	-	-	-	-	-	1	-	-
5	3	2	2	1	1	-	-	-	-	-	-	1	-	-

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

Programme Outcomes (POs)

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

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

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. 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.

PO12. 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 formation of drift current due to the movement of charge carriers under an electric field
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Analyze the operation of a Bipolar Junction Transistor (BJT) in active, cutoff, and saturation modes
4. Apply the principles of charge storage in floating-gate transistors for non-volatile memory applications
5. Outline the efficiency factors affecting the performance of opto-electronic devices

Articulation Matrix

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

UNIT IV **9 Hours**

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

UNIT V **9 Hours**

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

Programme Outcomes (POs)

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

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

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. 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.

PO12. 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 role of energy levels and excitation processes in laser action
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	3	2	2	1	-	-	-	-	-	-	-	1	-	-
2	3	2	2	1	-	-	-	-	-	-	-	1	-	-
3	3	2	2	1	-	-	-	-	-	-	-	1	-	-
4	3	2	2	1	-	-	-	-	-	-	-	1	-	-
5	3	2	2	1	-	-	-	-	-	-	-	1	-	-

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 BIOPHOTONICS 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 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.

Programme Outcomes (POs)

PO Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamen engineering specialization to the solution of complex engineering problems.

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

PO Design solutions for complex engineering problems and design system components or processes specified needs with appropriate consideration for the public health and safety, and the cultural, environmental considerations.

PO Use research–based knowledge and research methods including design of experiments, interpretation of data, and synthesis of the information to provide valid conclusions.

PO Create, select, and apply appropriate techniques, resources, and modern engineering and IT to prediction and modelling to complex engineering activities with an understanding of the limitation

Course Outcomes (COs)

1. Analyze the fundamental laws of optics and their role in light interaction with biological cells and tissues
2. Apply the principles of light interaction with biological tissues to enhance imaging resolution and contrast
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	1	3	2	2	1	-	-	-	-	-	-	-	-	-
2	2	3	2	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	1	-	-	-	-	-	-	-	-	-
4	4	3	2	2	1	-	-	-	-	-	-	-	-	-
5	5	3	2	2	1	-	-	-	-	-	-	-	-	-

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: Fibre-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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Analyze the structural and mechanical differences between soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Analyz**e** the optical and electro-optical properties of liquid crystals used in display technologies
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

9 Hours

UNIT II

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

UNIT IV **9 Hours**

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

UNIT V **9 Hours**

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

Programme Outcomes (POs)

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

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7 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 fundamental principles of corrosion science to calculate corrosion rates, analyze metal degradation and interpret Pourbaix diagrams to predict corrosion behavior in various industrial environments.
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Analyze the mechanism of corrosion on steel, iron, zinc and copper metal surfaces
4. Analyze the rate of corrosion on metals using electrochemical methods of testing
5. Analyze 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

Programme Outcomes (POs)

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

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3 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. Apply knowledge of polymerization mechanisms to predict the formation of different polymer products under various reaction conditions and catalysts
2. Apply suitable polymerization techniques to synthesize the high quality polymers
3. Apply the structural, thermal, and mechanical properties of polymers for different industrial 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.

Programme Outcomes (POs)

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

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7 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 parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Compare 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. Analyze fuel cells based on its construction, production of current and applications.
4. Analyze the methods of storing hydrogen fuel with its environmental applications.
5. Analyze the future prospects of renewable energy, hydrogen economy, and the efficiency of various generations of solar cells in energy production.

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 - photobiochemical conversion cell.

Total: 45 Hours

Reference(s)

1. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018

22OMA01 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Programme Outcomes (POs)

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

22OGE01 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.

Program Outcomes (POs)

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

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

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.

22OGE02 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

Program Outcomes (POs)

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

PO9. 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. 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. Analyze the different modes of operation management.

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**

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, Tata McGraw Hill: 2006

22OGE03 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

Program Outcomes (POs)

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9. 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. 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

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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.
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.
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. Apply the understanding of religion-cultural diversity of the country and its impact on the lives of the people and their beliefs
2. Build 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. Analyze the organizational structure, entry modes, and operational roles of Indian armed forces, CAPF, and NCC while developing leadership capabilities.

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, Halasanaetc.

Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, ZigZagBalance, 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/

22OBM01 OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES **3 0 0 3**

Course Objectives

- Students will be able to know about Occupational safety and health (OSH)
- Students will be able to discuss about risks faced by emergency responders during disease outbreaks and other emergencies
- Students will be able to create awareness on necessary strategies for managing OSH in emergency situations

Programme Outcomes (POs)

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Practice the occupational safety measures by the scientific knowledge to overcome the risks faced by emergency responders
2. Apply appropriate strategies and tools in Occupational safety and healthcare
3. Analyse common risks for safety and health in emergencies
4. Adapt appropriate occupational safety practices in chemical accidents
5. Guide Occupational safety measures in radiation incidents

Articulation Matrix

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

UNIT I **9 Hours**

MANAGEMENT ASPECTS

Management system approach to occupational safety and health hazards and risks – rights, duties and responsibilities of employers and workers during outbreaks and emergencies – Emergency responders health monitoring and surveillance

UNIT II **9 Hours**

STRATEGIES AND TOOLS

International Health Regulations, 2005 – Incident command system for managing outbreaks and emergencies – Occupational safety and health controls – Strategies for infection prevention and control

UNIT III **9 Hours**

COMMON RISKS FOR SAFETY AND HEALTH IN EMERGENCIES

Vector-borne diseases, water and food-borne diseases, Vaccine-preventable diseases – Heat stress - Slips, trips and falls - Road traffic injuries – Ergonomic hazards - Violence – Psychological stress during outbreaks and injuries

UNIT IV **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN CHEMICAL INCIDENTS

Emergencies caused by chemical incidents – occupational safety and health hazards and risks of chemicals – Personal Protective Equipment – Decontamination of emergency response personnel – medical surveillance of emergency responders

UNIT V **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN RADIATION INCIDENTS

Sources and scenarios of radiation incidents – guidance for protection of emergency responders -Occupational health surveillance of persons occupationally exposed to radiation in emergencies

Total: 45 Hours

Reference(s)

1. Emergency responder health monitoring and surveillance. National Response Team technical assistance document. Atlanta (GA): National Institute for Occupational Safety andHealth; 2012.
2. Emergency response framework (ERF). Geneva: World Health Organization; 2013
3. Guidelines on occupational safety and health management systems, second edition.Geneva: International Labour Organization; 2009.
4. OSH management system: a tool for continual improvement. Geneva: International Labour Organization; 2011
5. OECD Environmental Outlook to 2050: the consequences of inaction. Paris: Organization for Economic Co-operation and Development; 2012.

22OBM02 AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT 3 0 0 3

Course Objectives

- Understand the ambulance & transport management and allied services.
- Compare the ambulance design and equipment, transportation and corporate Profit.
- Carry-out various acts governing transport management.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Identify ambulance services, types and allied services
2. Formulate minimum ambulance rescue equipment and developing a transportation Strategy.
3. Understand the Emergency response team, Transportation interfaces, Transportation Service Characteristics& regulatory reforms involved.
4. Identify ambulance services, types and allied services
5. Formulate minimum ambulance rescue equipment and developing a transportation Strategy.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction-transportation ambulance types-Advanced Life Support Ambulance-Basic Life Support Ambulance-Patient Transport Ambulance-Emergency services-Ambulances-Allied services-telephone management

UNIT II **9 Hours**

AMBULANCE DESIGN AND EQUIPMENT

Design and Equipment of Ambulances -Minimum Ambulance Rescue Equipment-Emergency drugs medicines Recruitment validation Training to handle in house Ambulance emergency procedures Checklist measures Roles of paramedics, midwives, community nurses, hospice workers in emergency handling via ambulance

UNIT III **9 Hours**

TRANSPORTATION REGULATION FOR EMERGENCY MEDICAL SERVICE

Crisis Management-Anxiety & Stress Management-the Emergency response team-police assistance-Information handling & processing-Establishing customer service levels - Developing and Reporting customer service standards - Impediments to an Effective customer Service strategy - Improving customer Service Performance Transportation

UNIT IV **9 Hours**

AMBULANCE PREVENTIVE MAINTENANCE

Legal obligationsSwitch Console Front, Main Electrical, Patient Compartment Climate Oxygen system On board Suction system 110/12 VOLT system, Modular Body, Medical Equipment - Cot & Stretcher, safety belts-driver(s), passenger, Patients-child restraint device- incubator

UNIT V **9 Hours**

THE MOTOR VEHICLE ACT

The Motor Vehicle Act, 1988- Rules of the road Regulations 1989- Overall Dimensions of Motor Vehicles (Prescription of conditions for exemption) Rules 1991-Use of Red light on the top front of the vehicle

Total: 45 Hours

Reference(s)

1. Fawcett,"Supply Chain Management", Pearson Education India, 01-Sep-2008 - 600 pages.
2. B. Feroz, A. Mehmood, H. Maryam, S. Zeadally, C. Maple and M. A. Shah, "Vehicle-Life Interaction in Fog-Enabled Smart Connected and Autonomous Vehicles," in IEEE Access, vol. 9, pp. 7402-7420, 2021, doi: 10.1109/ACCESS.2020.3049110.
3. R. Jin, T. Xia, X. Liu, T. Murata and K. -S. Kim, "Predicting Emergency Medical Service Demand With Bipartite Graph Convolutional Networks," in IEEE Access, vol. 9, pp. 9903-9915, 2021, doi: 10.1109/ACCESS.2021.3050607.
4. Les Pringle,"Call the Ambulance",Transworld Publishers, 2010.
5. Edward J. Bardi, John Joseph Coyle, Robert A. Novack"Management of Transportation", Thomson/South-Western, 2006

22OBM03 HOSPITAL AUTOMATION 3 0 0 3

Course Objectives

- Introduce the concepts of hospital systems and need for central monitoring
- Exemplify the power generation, utility and protection systems.
- Apply the distributed and central monitoring functions in hospital environment

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Identify the factors in central power generating and monitoring systems
2. Analyze the sensors and actuators for the automation systems
3. Classify the equipment types and its applications.
4. Apply software tools and digital computer for monitoring of parameters and medical data handling
5. Design central monitoring station for hospitals for control and surveillance applications

Articulation Matrix

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

UNIT I **9 Hours**

AUTOMATION IN HEALTHCARE

Introduction to automation Role of automation in healthcare Remote Patient Monitoring Maximizing resources on patient care Reducing variability, Automating clinician and patient interactions through products.

UNIT II **9 Hours**

POWER GENERATION AND MEDICAL GAS PRODUCTION

Power generator, Battery : Maintenance and troubleshooting, energy conservation and monitoring system - Automation in dryer, compressor, air conditioning, lighting, heating systems.

9 Hours

UNIT III
AUTOMATION IN PIPING

Monitoring of flow and pressure of medical gas System components Vacuum control units Automatic changeover system - Types of Outlets - Leakage test- Prevention and safety automation.

UNIT IV
INSTRUMENTATION SYSTEMS **9 Hours**

Optical sensors , Pressure Sensors - Ultrasonic Sensors - Tactile Sensors - Thermal sensors -Biosensor - Linear Actuators, Central monitoring station - Alarm system - Regulation and standards.

UNIT V APPLICATIONS **9 Hours**

Business intelligence & executive dashboards - Radio-Frequency Identification (RFID)- based patient and asset tracking solutions - Tablet-based applications for bed side access to doctors/nurses - Healthcare CRM for patient relationship management - Patient kiosk, tele-health – HIS integration.

Total: 45 Hours

Reference(s)

1. Khandpur RS, Handbook of Biomedical Instrumentation, Prentice Hall of India, New Delhi, 3 rd edition, 2014.
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education India, Delhi, 4 th edition 2008
3. Curtis Johnson D Process Control Instrumentation Technology, Prentice Hall of India, 8th edition 2006
4. John V. Grimaldi and Rollin H. Simonds., Safety Management, All India Travelers Book seller, New Delhi, 1989
5. N.V. Krishnan, Safety in Industry, Jaico Publisher House, 1996.

22OAG01 RAINWATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

- To enhance the awareness about water resources management and conservation.
- To acquire knowledge about water harvesting techniquesand their implementation. To practice the design aspects of sustainable rainwater harvesting solutions for communities.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the sources, availability and challenges in water resources management
2. Assess various water harvesting systems in practice
3. Execute design considerations for comparing surface runoff harvesting methods
4. Compare the characteristics and impacts of flood water harvesting techniques
5. Evaluate various rainwater harvesting methods for groundwater recharging

Articulation Matrix

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

UNIT I **8 Hours**

WATER RESOURCES AND CONSERVATION CHALLENGES

Global water distribution – primary and secondary sources of water – technical, social and cultural aspects; Global challenges in water and climate – water scarcity – water pollution – Indian scenario; Water resources management – public participation – integrated approach; Water governance – water sharing plans – policy, schemes and concerns

UNIT II **10 Hours**

WATER RESOURCES AND CONSERVATION CHALLENGES

Principles of water harvesting for rural and urban – collection at micro and macro levels, flow control, storage and uses; Rainwater harvesting systems – traditional and contemporary – groundwater recharge; Water resources inventory – site analysis – database collection – water allocation principles based on demand and supply; Traditional water harvesting systems – practices in India – references in old texts – reasons for their deterioration – way forward; Watershed-based approach – project planning at micro and macro levels – community participation – rain centres.

UNIT III **9 Hours**

SURFACE RUNOFF HARVESTING

Short-term and micro-level harvesting techniques for runoff – terracing and bunding – rock and ground catchments; Long-term and macro-level harvesting techniques for runoff – farm ponds – percolation ponds and nala bunds; Design considerations – site selection – selection of runoff coefficients – computation of rainwater runoff volume – hydrograph analysis – cost estimation; Design of storage structures – storage capacity – selection of component – methods of construction

UNIT IV **9 Hours**

FLOOD WATER HARVESTING

Floods – causes of urban floods and droughts – characteristics of water spread – impacts; Flood water harvesting – permeable rock dams – water spreading bunds – flood control reservoir; Design considerations – computation of flood water quantity; Trenching and Diversion Structures – types – site selection – design criteria – most economic section – design consideration of ditch system

UNIT V **9 Hours**

GROUNDWATER HARVESTING

Rooftop rainwater harvesting – recharge pit – recharge trench – tube well – recharge well; artificial recharge – gully plug – dug well – percolation tank – nala bunds – recharge shaft; Groundwater harvesting – aquifer characteristics – subsurface techniques – infiltration wells – recharge wells – groundwater dams; Design of drainage system – types – design criteria – filter design – causes of failures

Total: 45 Hours

Reference(s)

1. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012.
2. Lancaster, Brad. Rainwater Harvesting for Drylands and Beyond, Volume 1, 3rd edition, Rainsource Press. 2019.
3. Das M, Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Michael AM, Ojha TP, Principles of Agricultural Engineering, Volume II, 4th Edition, Jain Brothers, New Delhi, 2003.
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014.
6. Singh G, Venkataramanan C, Sastry G, Joshi BP, Manual of Soil and Water Conservation Practices, CSWCR&TI, Dehradun, 1990

22OEE01 VALUE ENGINEERING 3 0 0 3

Course Objectives

- To understand the concept of value engineering in order to reduce cost of product or process or service.
- To implement creative and innovative techniques using FAST diagram.
- To study benefits of Value Engineering for various industries.

Programme Outcomes (POs)

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

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the concepts of value and value engineering to prepare a job plan.
2. Analyze the cost and worth of a product/service using the principles of economics.
3. Evaluate the value of a product/service to take managerial decisions.
4. Apply the soft skills in understanding team building, team work and report writing.
5. Asses the functions and values of product/services in industries using case studies.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO VALUE ENGINEERING

Historical perspective of Value Engineering, Aims and objectives of Value Engineering, Concept of Value, Value Engineering concerned with Economic Value, Value Engineering Job plan.

UNIT II **9 Hours**

FUNCTIONAL ANALYSIS

Function-Cost-Worth analysis: Function Analysis System Technique (FAST); Review of principles of engineering economics

UNIT III **10 Hours**

EVALUATION OF VALUE ENGINEERING

Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value

UNIT IV **9 Hours**

HUMAN ASPECTS IN VALUE ENGINEERING

Team building; Life cycle costing; Managing Value Engineering Study; Value Engineering Report writing; Presentation Skill - Individual and Team Presentations; Implementation and follow-up.

UNIT V **9 Hours**

BENEFITS OF VALUE ENGINEERING

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe Value Engineering Case studies in the Industries like Manufacturing; Construction; Health Care; Process.

Total: 45 Hours

Reference(s)

1. Kumar Mukhopadhyaya, Value Engineering Mastermind - From Concepts to Certification, Response. Business Books from SAGE, Los Angeles / London / New Delhi / Singapore / Washington DC, 2014.
2. Anil Kumar Mukhopadhyaya, Value Engineering -Concepts, Techniques and Applications, Response Books, A Division of SAGE Publications, New Delhi / Thousand Oaks / London, 2003
3. R. D. Miles, Techniques of Value analysis & Engineering, McGraw Hill, 2000.
4. E. Midge Arthur, Value Engineering -A Systematic Approach, McGraw Hill Book Co., New York, 2000.
5. Zimmerman, Value Engineering - A Practical Approach, CBS Publishers & Distributors, New Delhi, 2000.

22OEE02 ELECTRICAL SAFETY 3 0 0 3

Course Objectives

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the basic concepts in electrical circuit and hazards involved in it.
2. Analyze the electrical hazards in the workplace and its impacts.
3. Examine the operation of various protection systems from electrical hazards.
4. Analyze the various safety procedures involved in the industries.
5. Explore the different hazardous zones in Industries and their safety measures.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Objectives of safety and security measures - Hazards associated with electric current and voltage - principles of electrical safety - working principles of major electrical equipment - Typical supply situation - Indian electricity act and rules - statutory requirements from electrical inspectorate-International standards on electrical safety.

UNIT II **9 Hours**

ELECTRICAL HAZARDS

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity- Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges- over current and short circuit current-heating effects of current- Lightning, hazards, lightning arrestor, - national electrical safety code ANSI.

UNIT III **9 Hours**

ELECTRICAL SAFETY EQUIPMENT

Fuse, circuit breakers and overload relays - safe distance from lines - capacity and protection of conductor joints and connections, overload and short circuit protection - earth fault protection. FRLS insulation - insulation and continuity test - system grounding - equipment grounding - earth leakage circuit breaker (ELCB) - ground fault circuit interrupter - electrical guards - Personal protective equipment.

UNIT IV **9 Hours**

ELECTRICAL SAFETY OPERATION AND MAINTENANCE

Role of environment in selection - protection and interlock - discharge rod and earthing devices - safety in the use of portable tools - preventive maintenance - installation – earthing, specifications, earth resistance, earth pit maintenance - Fire Extinguishers - CO2 and Dry Powder schemes.

UNIT V **9 Hours**

HAZARDOUS AREAS

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies – electrical safety standards. (IS, API and OSHA standards)

Total: 45 Hours

Reference(s)

1. Fordham Cooper, W., “Electrical Safety Engineering, Butterworth and Company”, London, Third Edition, 2013.
2. “Indian Electricity Act and Rules”, Government of India.
3. “Power Engineers”, Handbook of TNEB, Chennai, 2010.
4. “Accident prevention manual for industrial operations”, N.S.C., Chicago, 1982.
5. John Cadick, P.E., Mary Capelli-Schellpfeffer, Dennis K. Neitzel, Al Winfield, “Electrical Safety Handbook”, Fourth Edition, Tata Mcgraw Hill, 2014.

22OCB01 INTERNATIONAL BUSINESS MANAGEMENT 3 0 0 3

Course Objectives

- To enable the students to understand the fundamentals of international business
- To provide competence to the students on making international business decisions
- To enable the students to understand the financial and promotional assistance available for exporters

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Demonstrate the role and importance of digital marketing in today's rapidly changing business environment
2. Discover the techniques to help organizations to utilize social media for digital marketing
3. Analyze the key elements and campaign effectiveness of E-Mail marketing and mobile marketing
4. Evaluate the effectiveness of a digital marketing campaign using Google Analytics
5. Apply advanced practical skills to plan, predict and manage digital marketing campaign

Articulation Matrix

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

UNIT I **9 Hours**
INTRODUCTION
Definition, Drivers of International Business, Domestic Vs. International Business, Trade and Investment Theories: Interventionist Theories, Free Trade Theories, Theories Explaining Trade Patterns: PLC Theory, The Porter Diamond, Factor Mobility Theory.

UNIT II **9 Hours**
GLOBALIZATION
Globalization: Implications, Challenges - Protectionism: Tariff Barriers, Non-Tariff Barriers- Forms of Integration, Role of WTO and IMF in International Business, Economic, Political, Cultural and Technological Environments

UNIT III **9 Hours**
INTERNATIONAL BUSINESS STRATEGIES
Market Entry Strategies, Multinational Strategy, Production Strategy, Marketing Strategy, Human Resource Strategy.

UNIT IV **9 Hours**
FOREIGN EXCHANGE
Foreign Exchange Market – Functions, Theories of Exchange Rate Determination, Exchange Rate Forecasting, Convertibility of Currency, Risks associated with Foreign Exchange.

UNIT V **9 Hours**
EXPORTS AND ETHICS IN INTERNATIONAL BUSINESS
Exports – Risks, Management of Exports, Regulatory frameworks, Export financing, Countertrade, Ethics – Issues, Dilemma and Theory.

Total: 45 Hours

Reference(s)

1. John D Daniels, Lee Raudabaugh, and Sullivan, “International Business”, New Delhi: Pearson Education, 2018.
2. Charles W L Hill and Arun Kumar Jain, “International Business”, New Delhi: Tata McGraw Hill, 2017.
3. Francis Cherunilam, “International Business”, New Delhi: Prentice Hall of India, 2020.
4. Simon Collinson, Rajneesh Narula, Alan M. Rugman, “International Business”, New Delhi: Pearson Education, 2020.
5. K. Aswathappa, “International Business”, New Delhi: Tata McGraw Hill, 2020.