KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATION - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.E. MECHATRONICS ENGINEERING

KCG College of Technology was founded in 1998 to fulfill the Founder-Chairman, Dr. KCG Verghese's vision of **"To Make Every Man a Success and No Man a Failure".** It is a Christian minority institution, affiliated to Anna University (Autonomous), Chennai and approved by AICTE, New Delhi.

VISION OF KCG

KCG College of Technology aspires to become a globally recognized centre of excellence for science, technology & engineering education, committed to quality teaching, learning and research while ensuring for every student a unique educational experience which will promote leadership, job creation, social commitment and service to nation building.

MISSION OF KCG

- Disseminate knowledge in a rigorous and intellectually stimulating environment.
- Facilitate socially responsive research, innovation and entrepreneurship.
- Foster holistic development and professional competency.
- Nurture the virtue of service and an ethical value system in the young minds.

VISION OF MECHATRONICS ENGINEERING

The department aims to be recognised as a global centre of excellence with interdisciplinary approach for technical education, automation and research catering to the needs of industry and society.

MISSION OF MECHATRONICS ENGINEERING

Provide quality education in the field of Mechatronics engineering & related domains

- Impart high quality education in Mechatronics engineering
- Establish state of the art facilities for innovation research and consultancy.
- Mentor the students to develop research and entrepreneurial capabilities and contribute to the needs of industry and society.
- Inculcate an interdisciplinary approach to system design.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The graduates will:

PEO 1	Engage in product development and applications in the field of Automation and Mechatronics systems using tools to enhance productivity
PEO 2	Execute their knowledge of basic engineering sciences in Interdisciplinary systems
PEO 3	Take active leadership roles with societal and environmental implications accompanied by ethical behaviour and pursue lifelong learning in emerging technologies.

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

PO 01	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 02	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 03	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.
PO 04	Use research based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 05	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.
PO 06	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.
PO 07	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 08	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 09	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 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.
PO 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.
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 01	Apply their knowledge in basic sciences and mechatronic systems for solving complex problems
PSO 02	Design and program the mechatronic systems for industrial automation with embedded systems, PLC and control systems with MEMS, sensors and actuators
PSO 03	Engage in lifelong learning and follow ethics in their profession

KCG COLLEGE OF TECHNOLOGY
(AUTONOMOUS)
REGULATIONS 2023
B.E. MECHATRONICS ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULA FOR SEMESTERS I TO VIII

SEMESTER – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
	23IP101	Induction Programme		-	-	-	-	-
THEORY								
1	23HS101	Essential Communication	HSMC	3	0	0	3	3
2	23MA101	Matrices and Calculus	BSC	3	0	0	3	3
3	23AD101	Programming in Python	ESC	3	0	0	3	3
4	23HS102	Heritage of Tamils	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
5	23PH111	Engineering Physics	BSC	3	0	2	5	4
6	23CY111	Engineering Chemistry	BSC	3	0	2	5	4
PRACTICALS								
7	23AD121	Python Programming Laboratory	ESC	0	0	4	4	2
8	23HS121	Communication Skills Laboratory	EEC	0	0	2	2	1
9	23HS122	General Clubs/Technical Clubs/NCC/NSS/Extension	HSMC	0	0	2	2	1*
TOTAL				**16**	**0**	**12**	**28**	**21**

SEMESTER – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23HS201 /23HS202	Professional English / Foreign Language	HSMC	3	0	0	3	3
2	23MA203	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	23PH202	Applied Material Science	BSC	3	0	0	3	3
4	23ME201	Applied Mechanics	PCC	3	0		3	3
5	23HS203	Tamils and Technology	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
6	23ME211	Engineering Graphics	ESC	3	0	2	5	4
7	23EE283	Basic Electrical, Electronics Engineering and Measurements	ESC	2	0	2	4	3

PRACTICALS								
8	23ME221	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	23HS291	Soft Skill	HSMC	0	0	2	2	1*
TOTAL				**18**	**1**	**10**	**29**	**23**

SEMESTER III

L. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	23MA302	Transforms and Partial Differential Equations	BSC	3	1.	0	3	4
2.	23MT301	Manufacturing Technology	PCC	3	0	0	3	3
3.	23MT311	Electrical Drives and Actuators	PCC	3	0	0	3	3
4.	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
5.	23MT312	Digital Electronics and Microprocessor	PCC	3	0	2	5	4
6	23MT302	Kinematics and Dynamics of Machinery	PCC	3	0	2	5	4
PRACTICALS								
7.	23MT321	Manufacturing Technology Laboratory	PCC	0	0	4	4	2
8.	23MT322	Electrical Drives and Actuators Laboratory	PCC	0	0	4	4	2
9.	23ES391	Presentation Skills	EEC	0	0	2	2	1*
		TOTAL		**18**	**0**	**14**	**32**	**25**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23MA401	Optimization Techniques	BSC	3	1	0	4	4
2	23MT401	Sensors and Instrumentation	PCC	3	0	0	3	3
3	23MT402	Fluid Mechanics and Thermal Systems	PCC	3	0	0	3	3
4		Department Elective 1	DEC	3	0	0	3	3
5		Department Elective 2	DEC	3	0	0	3	3

THEORY AND PRACTICALS								
6	23CE412	Strength of Materials	PCC	3	0	2	5	4
PRACTICALS								
7	23MT421	Fluid Mechanics Laboratory	PCC	0	0	4	4	2
8	23MT422	Sensors and Instrumentation Laboratory	PCC	0	0	4	4	2
9	23ES491	Aptitude and Logical Reasoning - 1	EEC	0	0	2	2	1*
10	23MT423 /23MT424	Mini Project -1/ In Plant Training – 1	EEC	0	0	2	2	1
TOTAL				**18**	**1**	**14**	**33**	**25**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23RE501	Research Methodology and Intellectual Property Rights	ESC	2	0	0	2	2
2	23MT501	Robotics	PCC	3	0	0	3	3
3	23MT502	Mechatronics System Design	PCC	3	0	0	3	3
4		Non-Department Elective-1 (Emerging Technology)	NEC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23EE511	Control System Engineering	PCC	3	0	2	5	4
6	23MT511	Computer Aided Design and Manufacturing System	PCC	3	0	2	5	4
PRACTICALS								
7	23MT521	Robotics Laboratory	PCC	0	0	4	4	2
8	23MT522/ 23MT523	Mini Project – 2 /In Plant Training -2	EEC	0	0	4	4	1
9	23ES591	Aptitude and Logical Reasoning - 2	EEC	0	0	2	2	1*
TOTAL				**17**	**0**	**12**	**29**	**22**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Department Elective 3	DEC	3	0	0	3	3
2		Department Elective 4	DEC	3	0	0	3	3
3		Open Elective-2 (Management /Safety Courses)	NEC	3	0	0	3	3
THEORY AND PRACTICALS								
4	23CE611	Environmental Science and Engineering	ESC	3	0	2	5	4
5	23MT611	Industrial Automation	PCC	3	0	2	5	4
6	23MT612	Fluid Power Systems	PCC	3	0	2	5	4
PRACTICALS								
7	23MT621	Project Work - Phase 1	EEC	0	0	4	4	2
8	23MT622	Technical Training	EEC	0	0	2	2	1
TOTAL				**18**	**0**	**14**	**32**	**24**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Open Elective-3 (Management Courses)	NEC	3	0	0	3	3
2		Department Elective 5	DEC	3	0	0	3	3
3		Department Elective 6	DEC	3	0	0	3	3
THEORY AND PRACTICALS								
4	23MT711	Machine Vision Systems	PCC	3	0	2	5	4
5	23MT712	Embedded Systems and Programming	PCC	3	0	2	5	4
PRACTICALS								
6	23MT721	Project Work Phase -2	EEC	0	0	6	6	3
7	23MT722	Technical Seminar	ESC	0	0	4	4	1
TOTAL				**15**	**0**	**12**	**2**	**21**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	23MT821/ 23MT822	Capstone Project / Internship cum project	EEC	0	0	20	20	10
TOTAL				**0**	**0**	**20**	**20**	**10**

Total credits: 171

Vertical 1	Vertical 2	Vertical 3	Vertical 4	Vertical 5	Vertical 6
APPLIED ROBOTICS	**DESIGN AND MANUFACTURING**	**SMART MOBILITY SYSTEMS**	**INTELLIGENCE SYSTEMS**	**AUTOMATION**	**DIVERSIFIED GROUP**
Robots and systems in Smart Manufacturing	Fundamentals of Machine Design	Automobile Engineering	Applied Signal Processing	Micro Electro Mechanical Systems	Foundations of Linear Integrated circuits
Drone Technologies	Design for X	Electric and Hybrid Vehicles	Applied Image Processing	Power Electronics	Single Board Computers
Micro robotics	CNC Machine Tools And Programming	Automotive Mechatronics	Machine Learning for Intelligent Systems	Computer Architecture	Reliability and Maintenance Engineering
Agricultural Robotics and Automation	Computer Integrated Manufacturing	Automotive System Modeling and Simulation	Condition Monitoring and Fault Diagnostics	Virtual Instrumentation	Integrated Product Development
Collaborative Robotics	Advanced Manufacturing Systems	Vehicle Dynamics And Controls	Systems Modeling and Simulation Methods	Industrial Network Protocols	Medical Mechatronics
Robot Operating Systems	Additive Manufacturing	Aircraft Mechatronics	Fundamentals of UAV Systems	Motion Control System	Object Oriented Programming in C++ and Java
Medical Robotics	Semiconductor Manufacturing Technology	Smart Mobility and Intelligent Vehicles	Immersive Technologies and Haptics	Total Integrated Automation	Process Planning and Cost Estimation
Humanoid Robotics	Computer Aided Inspection and Testing	Advanced Driver Assistance Systems	Computer vision and Deep learning	Digital Twin and Industry 5.0	VLSI and FPGA

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL1: APPLIED ROBOTICS

SL. NO.	COURSECODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23MT031	Robots and Systems in Smart Manufacturing	DEC	3	0	0	3	3
2	23AE072	Drone Technologies	DEC	3	0	0	3	3
3	23MT032	Microrobotics	DEC	3	0	0	3	3
4	23MT033	Agricultural Robotics and Automation	DEC	3	0	0	3	3
5	23MT034	Collaborative Robotics	DEC	3	0	0	3	3
6	23MT035	Robot Operating Systems	DEC	3	0	0	3	3
7	23MT036	Medical Robotics	DEC	3	0	0	3	3
8	23MT037	Humanoid Robotics	DEC	3	0	0	3	3

VERTICAL2: DESIGN AND MANUFACTURING

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23MT038	Fundamental of Machine Design	DEC	3	0	0	3	3
2	23MT039	Design for X	DEC	3	0	0	3	3
3	23MT040	CNC Machine Tools and Programming	DEC	3	0	0	3	3
4	23MT041	Computer Integrated Manufacturing	DEC	3	0	0	3	3
5	23MT042	Advanced Manufacturing Systems	DEC	3	0	0	3	3
6	23ME031	Additive Manufacturing	DEC	3	0	0	3	3
7	23MT072	Semiconductor Manufacturing Technology	DEC	3	0	0	3	3
8	23MT044	Computer Aided Inspection and Testing	DEC	3	0	0	3	3

VERTICAL 3: SMART MOBILITY SYSTEMS

SL. NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23MT045	Automobile Engineering	DEC	3	0	0	3	3
2	23MT046	Electric and Hybrid Vehicles	DEC	3	0	0	3	3
3	23MT047	Automotive Mechatronics	DEC	3	0	0	3	3
4	23MT048	Automotive System Modeling and Simulation	DEC	3	0	0	3	3
5	23MT049	Vehicle Dynamics and Controls	DEC	3	0	0	3	3
6	23MT050	Aircraft Mechatronics	DEC	3	0	0	3	3
7	23MT051	Smart Mobility and Intelligent Vehicles	DEC	3	0	0	3	3
8	23MT052	Advanced Driver Assistance Systems	DEC	3	0	0	3	3

VERTICAL 4: INTELLIGENCE SYSTEMS

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23MT053	Applied Signal Processing	DEC	3	0	0	3	3
2	23MT054	Applied Image Processing	DEC	3	0	0	3	3
3	23MT055	Machine Learning for Intelligent Systems	DEC	3	0	0	3	3
4	23MT056	Condition Monitoring and Fault Diagnostics	DEC	3	0	0	3	3
5	23MT057	Systems Modelling and Simulation Methods	DEC	3	0	0	3	3
6	23MT058	Fundamentals of UAV systems	DEC	3	0	0	3	3
7	23MT059	Immersive Technologies and Haptics	DEC	3	0	0	3	3
8	23MT060	Computer Vision and Deep Learning	DEC	3	0	0	3	3

VERTICAL 5: AUTOMATION

SL. NO.	COURS CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23MT061	Micro electromechanical Systems	DEC	3	0	0	3	3
2	23EE501	Power Electronics	DEC	3	0	0	3	3
3	23CS404	Computer Architecture	DEC	3	0	0	3	3
4	23MT062	Virtual Instrumentation	DEC	3	0	0	3	3
5	23MT063	Industrial Network Protocols	DEC	3	0	0	3	3

6	23MT064	Motion Control System	DEC	3	0	0	3	3
7	23MT065	Total Integrated Automation	DEC	3	0	0	3	3
8	23ME060	Digital Twin and Industry 5.0	DEC	3	0	0	3	3

VERTICAL 6: DIVERSIFIED GROUP

SL. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PERWEEK			TOTALC ONTACTP ERIODS	CREDITS
				L	T	P		
1	23MT066	Foundations of Linear Integrated Circuits	DEC	3	0	0	3	3
2	23MT067	Single Board Computers	DEC	3	0	0	3	3
3	23MT068	Reliability and Maintenance Engineering	DEC	3	0	0	3	3
4	23MT069	Medical Mechatronics	DEC	3	0	0	3	3
5	23MT070	Integrated Product Development	DEC	3	0	0	3	3
6	23AD301	Object Oriented Programming System in C++ and Java	DEC	3	0	0	3	3
7	23ME035	Process Planning and Cost Estimation	DEC	3	0	0	3	3
8	23MT071	VLSI and FPGA	DEC	3	0	0	3	3

OPEN ELECTIVE – EMERGING TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23OE972	Block Chain Technology	OEC	3	0	0	3	3
2	23OE973	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
3	23OE974	Augmented Reality and Virtual Reality	OEC	3	0	0	3	3
4	23OE975	IoT Concepts and Applications	OEC	3	0	0	3	3
5	23OE976	Introduction to Data Science	OEC	3	0	0	3	3
6	23OE980	Renewable Energy Technologies	OEC	3	0	0	3	3
7	23OE982	Resource Management Techniques	OEC	3	0	0	3	3
8	23OE985	Introduction to Non-Destructive Testing	OEC	3	0	0	3	3

OPEN ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23HS971	Total Quality Management	OEC	3	0	0	3	3
2	23HS972	Engineering Economics and Financial Accounting	OEC	3	0	0	3	3
3	23HS973	Engineering Management and Law	OEC	3	0	0	3	3
4	23HS974	Knowledge Management	OEC	3	0	0	3	3
5	23HS975	Industrial Management	OEC	3	0	0	3	3
6	23HS976	Entrepreneurship and Business Opportunities	OEC	3	0	0	3	3
7	23HS977	Modern Business Administration and Financing	OEC	3	0	0	3	3
8	23HS978	Essentials of Management	OEC	3	0	0	3	3

OPEN ELECTIVE – SAFETY COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23HS979	Disaster Management	OEC	3	0	0	3	3
2	23HS980	Industrial Safety	OEC	3	0	0	3	3
3	23HS981	Automotive Safety	OEC	3	0	0	3	3

Semester-wise Credit Distribution

SEMESTER	HSMC	BSC	ESC	PCC	DEC	OEC	EEC	Total
Semester I	**4**	**11**	**5**				**1**	**21**
Semester II	**4**	**7**	**9**	**3**				**23**
Semester III	**3**	**4**		**18**				**25**
Semester IV		**4**		**14**	**6**		**1**	**25**
Semester V			**2**	**16**		**3**	**1**	**22**
Semester VI			**4**	**8**	**6**	**3**	**3**	**24**
Semester VII			**1**	**8**	**6**	**3**	**3**	**21**
Semester VIII							**10**	**10**
Total curriculum	**11**	**26**	**21**	**67**	**18**	**9**	**19**	**171**

Total credits: 171

23IP101	INDUCTION PROGRAMME	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.
- The induction programme has been introduced by AICTE with the following objectives
- Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.
- One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character
- Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature

  Physical Activity

  This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc

  Life skills

  Every student would choose one skill related to daily needs such as stitching, accounting, finance management, etc

  Universal human values

This is the anchoring activity of the Induction Programme. It gets the student to

explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Club Activity

(i) Students will be introduced to more than 20 Clubs available in the college-both technical and non technical. The student can choose as to which club the student will enrol in .

Value Based Communication

(i) This module will focus on improving the communication skills of students

(ii) Lectures by Alumni

(i) Lectures by alumni are arranged to bring in a sense of belonging to the student towards the institution and also to inspire them to perform better

Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged

Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities

Address by different heads

Heads of Placement, Training, Student affairs, counsellor, etc would be interacting with the students to introduce them to various measures taken in the institution for the betterment of students.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References:

Guide to Induction program from AICTE

23HS101	ESSENTIAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from short and simple correspondence
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, short paragraphs and essays
- To enable learners to use language efficiently while expressing their opinions via various media.

UNIT I FORMATION OF SENTENCES 9

Reading- Read pictures-notices- short comprehension passages and recognize main ideas and specific details. **Writing**- framing simple and compound sentences, completing sentences, developing hints, writing text messages. **Language development**- Parts of Speech, Why- Questions, yes or no questions, direct and indirect questions. **Vocabulary development**– prefixes- suffixes- articles – countable and uncountable nouns.

UNIT II NARRATION AND DESCRIPTION 9

Reading – Read short narratives and descriptions from newspapers, dialogues and conversations. Reading strategies and practices. Language development – Tenses- simple present, present continuous, present perfect, simple past, past continuous, past perfect, simple future, future continuous, past participle, pronouns. Vocabulary development- guessing meanings of words in context. Writing – Write short narrative paragraphs, biographies of friends/relatives - writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures.

UNIT III COMPARING AND CONTRASTING 9

Reading- short texts and long texts -understanding different types of text structures, -coherence-jumbled sentences. Language development- degrees of comparison, concord- Vocabulary development – single word substitutes- discourse markers- use of reference words Writing - comparative and contrast paragraphs writing-

topic sentence- main idea, free writing, compare and contrast using some suggested vocabulary and structures.

UNIT IV SOCIAL MEDIA COMMUNICATION **9**

Reading- Reading blogs, social media reviews, posts, comments, process description, Language development - relative clause, Vocabulary development- social media terms-words, abbreviations and acronyms Writing- -e-mail writing- conventions of personal email, descriptions for simple processes, critical online reviews, blog, website posts, commenting to posts.

UNIT V ESSAY WRITING **9**

Reading- Close reading non-technical longer texts Language development - modal verbs, phrasal verbs- Vocabulary development - collocation. Writing- Writing short essays- brainstorming – developing an outline- identifying main and subordinate ideas.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Summarize simple, level-appropriate texts of around 300 words recognizing main ideas and specific details.

CO2: Demonstrate the understanding of more complex grammatical structures and diction while reading and writing.

CO 3 Use appropriate expressions to describe, compare and contrast people, things, situations etc., in writing.

CO 4 Establish the ability to communicate effectively through emails.

CO 5 Determine the language use appropriate for different social media platforms.

CO 6 Use appropriate expressions for narrative descriptions and process descriptions

TEXTBOOKS:

1. Susan Proctor, Jack C. Richards, Jonathan Hull. “Interchange Level 2”. Cambridge University Press and Assessment
2. Susan Proctor, Jack C. Richards, Jonathan Hull. “Interchange Level 3”. Cambridge University Press and Assessment

REFERENCES:

1. Dutt P. Kiranmai and Rajeevan Geeta. "Basic Communication Skills", Foundation Books: 2013
2. Means, L. Thomas and Elaine Langlois. "English & Communication for Colleges". Cengage Learning , USA: 2007

CO-PO Mapping:															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
CO 2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO 3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO 5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
CO 6	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
Overall Correlation		-	-	-	-	1	1	-	3	3	-	2	-	-	-

23MA101 MATRICES AND CALCULUS

L	**T**	**P**	**C**
3	**1**	**0**	**3**

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practicalapplications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in manybranches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integralsand their applications.

UNIT-I MATRICES **9**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS **9**

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

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9**

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

UNIT IV INTEGRAL CALCULUS **9**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS **9**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the matrix algebra techniques and applications in Engineering Problems.

CO2: Use the concept of limits and rules of differentiation to differentiate functions

CO3: Find the derivative of functions of several variables

CO4: Examine the application of partial derivatives

CO5: Compute integrals by different techniques of Integration.

CO6: Apply the concept of integration to compute multiple integrals.

TEXT BOOKS:

1. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition,New Delhi, 2016.
2. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, NewDelhi, 2015.

REFERENCES:

1. Dr. P Sivaramakrishnadas, Dr.C.Vijayakumari.,"Matrices and Calculus" Pearson Publications.
2. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
3. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Narayanan. S. and Manicavachagom Pillai. T. K.,"Calculus Volume I and II", S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

CO-PO Mapping:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 5	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 6	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
Overall Correlation	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-

23AD101	PROGRAMMING IN PYTHON	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To teach Computational thinking using Python.
- To know the basics of Programming.
- To convert an algorithm into a Python program.
- To construct Python programs with control structures.
- To structure a Python Program as a set of functions.
- To use Python data structures-lists, tuples, dictionaries and files.

UNIT-I COMPUTATIONAL THINKING 9

Introduction to Computing and Problem Solving: Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms (statements, state, control flow, functions), notation (pseudo code, flowchart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration,recursion).

UNIT II INTRODUCTION TO PYTHON 9

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, type() Function and Is Operator, Dynamic and Strongly Typed Language. **Control Flow Statements**: if, if…else, if…elif…else Decision Control Statements, Nested if Statement, while Loop, for Loop, continue and break Statements.

UNIT III FUNCTIONS AND STRINGS 9

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling theFunction, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

UNIT IV LISTS, TUPLES, DICTIONARIES AND FILES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list Parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension. **Files and Exception**: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.

UNIT V OBJECT-ORIENTED AND FUNCTIONAL PROGRAMMING **9**

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, Polymorphism.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs using Control Statements
CO 3: Develop simple Python programs for solving problems using Functions andStrings
CO 4: Structure a Python program into lists, tuples, dictionaries and files**.**
CO 5: Construct a code related to Object-Oriented Programming.
CO 6: Construct a code related to Functional Programming

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition,Updated for Python3, Shroff/O'ReillyPublishers,2016 (http://greenteapress.com/wp/think-python/).
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving andProgramming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Richard L Halterman, " LearningToProgramwithPython".Copyright©2011.
2. Dr. Charles R ,"Python for Everybody, Exploring Data Using Python 3" Severance.2016.
3. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
4. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
5. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MITPress , 2021.
6. Eric Matthes, —Python Crash Course, "A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
7. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	1	1	1	-	-	-	-	-	2	2	1	1	-
CO 2	3	2	1	1	1	-	-	-	-	-	2	2	1	1	-
CO 3	3	2	1	1	1	-	-	-	-	-	2	-	1	1	-
CO 4	2	1	1	1	1	-	-	-	-	-	1	-	1	1	-
CO 5	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO 6	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
Overall Correlation	2	2	1	1	1	-	-	-	-	-	2	1	1	1	-

23HS102	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To explain to students the classical literature of Tamil language and define the contribution of Tamil poets and the development of modern literature
- To Summarize the making of musical instruments related to Tamil heritage.
- To Illustrate to students the sports and games of Tamils.
- To make students Recall the education and literacy during sangam age.
- To make students realize the importance and contribution of Tamils to Indian FreedomStruggle

UNIT-I LANGUAGE AND LITERATURE 9

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 HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 9

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 FOLK AND MARTIAL ARTS 9

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

UNIT IV THINAI CONCEPT OF TAMILS **9**

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 CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE **9**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over theother parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1 Explain the evolution of Tamil language and literature, focusing on its cultural, ethical, and secular themes.

CO 2 Outline the making of musical instruments related to Tamil heritage.

CO 3 Discuss the sports and games of Tamils

CO 4 Explain the education and literacy during Sangam age.

CO 5 Express the importance and contribution of Tamils to Indian Freedom Struggle

CO 6 Outline the print history of books in Tamil Nadu

TEXTBOOKS:

1. தமிழக வரலாறு-மக்களும் பண்பாடும்-கே.கேபிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).

REFERENCES:

1. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
2. பொருனை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

CO-PO Mapping:															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
Overall Correlation		-	-	-	-	2	2	-	-	-	-	-	-	-	-

23PH111 **ENGINEERING PHYSICS**

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

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

UNIT I MECHANICS **9**

Types of stress, Stress-strain diagram and its uses- factors affecting elastic modulus-tensile strength- Bending of beams, bending moment – theory and experiment: Uniform and non-uniform bending, Center of mass (CM) – CM of continuous bodies –rod, motion of the CM. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of rod, disc, solid sphere – M.I of a diatomic molecule - torque -rotational energy state of a rigid diatomic molecule – M.I of disc by torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

Concept of field-introduction to gradient, divergence and curl of field – Stokes theorem (No proof)-Gauss divergence theorem (No proof) - The Maxwell's equations in integral form and differential form - wave equation; Plane electromagnetic waves in vacuum - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Energy and momentum in EM waves-Poynting's vector - Cell-phone reception.

UNIT III OPTICS AND LASERS 9

Reflection and refraction of light waves - total internal reflection – types of optical fiber, Numerical Aperture and acceptance angle - interference –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients(Qualitative) - population inversion - CO2 laser, semiconductor laser (Homo junction) - Applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V ADVANCED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL PERIODS:45

PRACTICAL EXERCISES: (Any Seven Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending- Determination of Young's modulus
4. Uniform bending–Determination of Young's modulus
5. Laser-Determination of the wavelength of the laser using grating

6. Airwedge- Determination of thickness of a thinsheet /wire
7. a) Optical fibre-Determination of Numerical Aperture and acceptance angle b) Compact disc-Determination of width of the groove using laser.
8. Acoustic grating-Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer–determination of the velocity of sound and compressibility of liquids
10. Post office box-Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Determine the mechanical properties of materials.

CO 2 Apply the principles of electromagnetic waves to real world system.

CO 3 Determine the thickness of thin wire and the characteristic parameter of an optical fiber.

CO 4 Apply the principles of lasers to real world application.

CO 5 Organize the quantum mechanical properties of particles and waves.

CO 6 Utilize the quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer Verlag, 201Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
3	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall correlation	3	2	**1**	-	-	-	-	-	-	-	-	1	-	-	-

23CY111 **ENGINEERING CHEMISTRY**

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage batteries.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Sewage treatment primary treatment and disinfection (UV, Ozonation, break-point chlorination). Hardness-Estimation of Hardness of water by EDTA-numerical Problems-Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials (Metal oxide and Metal) Synthesis and Characterization of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, energy, sensor , electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system – water system; CO2 system; Reduced phase rule; Two component system: lead-silver system – Pattinson process. Composites: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites – definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Fossil Fuels, Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – Cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value – higher and lower calorific values,

Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis – ORSAT Method. CO2 emission and carbon sequestration, Green Hydrogen.

UNIT V ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear fission and fusion- light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium-ion battery; Electric vehicles – working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell and its advanced technology, supercapacitor.

TOTAL: 45 PERIODS

TOTAL: 15 PERIODS

LIST OF EXPERIMENTS

1. Determination of hardness causing salts in water sample by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of chloride content of water sample by argentometric method.
4. Determination of strength of given Barium chloride using conductivity meter.
5. Determination of strength of Acid using pH meter.
6. Determination of strength of FAS by potentiometer
7. Determination of strength of acids in a mixture using conductivity meter.
8. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.
9. Estimation of Nickel in steel

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Interpret the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO 2 Illustrate the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO 3 Estimate the knowledge of phase rule and composites for material selection requirements

CO 4 Choose a suitable fuel for engineering processes and applications

CO 5 Relate the different forms of energy resources and apply them for suitable applications in energy sectors.

CO 6 Discuss the different types of batteries, fuel cells and working principles of Electric vehicles

TEXTBOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014New Delhi, 2018.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, "Applied Chemistry-A Text Book for Engineers and Technologists", Springer Science Business Media, New York, 2nd Edition, 2013

CO – PO Mapping:

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
2	2	1	-	-	-	2	2	-	-	-	-	1	2	-	-
3	2	1	-	-	-	2	2	-	-	-	-	1	2	-	-
4	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
5	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
6	2	1	-	-	-	2	2	-	-	-	-	1	2	-	-
Overall correlation	3	2	1	-	-	2	2	-	-	-	-	2	3	-	-

23AD121	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Operators and Conditional Statements
- Control Structures and Functions (both recursive and iterative) and Recursion.
- String functions
- Lists, Sets, Dictionaries, Tuples and Files.
- Object-Oriented Programming

PRACTICAL EXERCISES:

I. Programs to demonstrate the usage of operators and conditional statements.

1. Write a program that takes two integers as command line arguments and prints the sum of two integers.
2. Program to display the information:

   Your name, Full Address, Mobile Number, College Name, Course Subjects
3. Program that reads the URL of a website as input and displays contents of a webpage.

II. Programs to demonstrate usage of control structures.

4. Program to find the sum of all prime numbers between 1 and 1000.
5. Program to find the product of two matrices.
6. Program to find the roots of a quadratic equation.

III. Programs to demonstrate the usage of Functions and Recursion

7. Write both recursive and non-recursive functions for the following:
   a. To find GCD of two integers
   b. To find the factorial of positive integer
   c. To print Fibonacci Sequence up to given number ‗n'
   d. To convert decimal numbers to Binary equivalent
8. Program with a function that accepts two arguments: a list and a number ‗n'. It should display all the numbers in the list that are greater than the given number ‗n'.
9. Program with a function to find how many numbers are divisible by 2, 3,4,5,6 and 7 between 1 to 1000.

IV. Programs to demonstrate the usage of String functions.

10. Program that accepts two strings S1 and S2 and finds whether they are equal are not.
11. Program to count the number of occurrences of characters in each string.
12. Program to find whether a given string is palindrome or not.

V. Programs to demonstrate the usage of lists, sets, dictionaries, tuples and files.

13. Simple sorting, Histogram, Students marks statement, Retail bill preparation
14. Write a program that combines lists L1 and L2 into a dictionary.
15. Program to display a list of all unique words in a text file and word count, copy file, Voter's age validation, Marks range validation (0-100).

VI. Programs to demonstrate the usage of Object-Oriented Programming

16. Program to implement inheritance.
17. Program to implement polymorphism.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 Develop algorithmic solutions to simple computational problems

CO2 Develop and execute simple Python programs

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

CO4 Deploy functions to decompose a Python program

CO5 Process compound data using Python data structures

CO6 Read and write data from/to files in Python Programs

COs.	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	-	2	-	-	-	-	-	-	2	3	2	1
2	3	3	3	-	2	-	-	-	-	-	-	2	3	2	2
3	3	3	3	-	2	-	-	-	-	-	-	2	3	2	1
4	3	2	2	-	2	-	-	-	-	-	-	2	3	2	2
5	3	3	3	-	3	-	-	-	-	-	-	2	3	3	3
6	3	3	3	-	3	-	-	-	-	-	-	2	3	3	3

Overall Correlation	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**2**

23HS121 COMMUNICATION SKILLS LABORATORY

L	**T**	**P**	**C**
0	**0**	**2**	**2**

COURSE OBJECTIVES:

- To enable the students to comprehend the main idea and specific information of the listening passage.
- To help students express themselves clearly and communicate effectively with others.
- To introduce authentic language use and context-specific vocabulary that might not be encountered in textbooks.

Exercise: 1	Listening to conversations set in everyday social context and complete gap-filling exercise
Exercise: 2	Listening to a monologue in everyday social context. Diagram labelling and MCQ
Exercise: 3	Listening to a group conversation in academic setting and answer MCQ
Exercise: 4	Listening to a lecture and answer MCQ or gap filling
Exercise: 5	Listening to Ted Talks, podcasts, documentaries - discussion
Exercise: 6	Listening to a lecture and reading a text on the same subject- compare and contrast
Exercise: 7	Speaking Introducing oneself
Exercise: 8	Answering questions based on the introduction
Exercise: 9	Speaking on a given prompt for 2 mins.
Exercise: 10	Answering questions based on the topic spoken
Exercise: 11	Role play- Engaging in conversation
Exercise: 12	Engaging in Podcast Discussion

TOTAL PERIODS: 25

COURSE OUTCOMES

CO1: Demonstrate fluency in speaking in variety of situations

CO2: Express their knowledge by talking continuously for more than two minutes on a topic

CO3: Develop active listening for more meaningful interactions and conversations

CO4: Use a full range of structures naturally and appropriately

CO5: Identify the specific information in conversations, interviews, talks and lectures

CO6: Develop the ability to compare and analyse different forms of information, identifying key similarities and differences.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	-	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	2	3	-	-	-	-	-
Overall correlation		-	-	-	-	1	1	-	3	3	-	2	-	-	-

SEMESTER – II

23HS201 **PROFESSIONAL ENGLISH** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To help learners extract information from longer, technical and scientific texts
- To familiarize learners with different text structures by engaging them in reading,writing and grammar learning activities
- To help learners write coherent, extensive reports and essays.
- To enable learners to use language efficiently while expressing their opinions inprofessional and business situations.

UNIT I **WORKPLACE COMMUNICATION** **9**

Reading – Reading brochures (technical context), advertisements, telephone

messages, gadgetreviews social media messages, digital communication relevant to technical contexts and business. Writing – Writing emails -emails on professional contexts including introducing oneself, writing checklist, writing single sentence definition, product description- advertising or marketing slogans, Language Development– Tenses, Concord, Question types: Why/ Yes orNo/ and Tags, imperative sentences, complex sentences. Vocabulary One-word substitutes; Abbreviations & Acronyms as used in technical contexts and social media.

UNIT II EXPRESSING CAUSE AND EFFECT 9

Reading - Reading longer technical texts– Cause and Effect Essays, and emails of complaint. Writing - writing complaint emails (raising tickets) and responses to complaints, writing Cause and effect paragraphs and essays. Language Development– Active, Passive and Impersonal Passive Voice transformations, Infinitive and Gerunds Vocabulary – Synonyms- contextual meaning of words, Same word acting as different parts of speech, causal expressions

UNIT III PROVIDING SOLUTIONS TO PROBLEMS 9

Reading - Case Studies, editorials, news reports etc. Writing – Letter to the Editor, Writing instructions and recommendations, Problem solution essay / Argumentative Essay, LanguageDevelopment – Error correction; If conditional sentences Vocabulary - Compound Words, discourse markers.

UNIT-IV INTERPRETATION OF GRAPHICS 9

Reading newspaper articles, nonverbal communication (charts and graphs,) Writing – Transferring information from nonverbal (chart, graph etc, to verbal mode) Process description. Language development–Possessive & Relative pronouns, numerical adjectives Vocabulary Homonyms and Homophones, sequence words

UNIT-V REPORT WRITING AND RESUME WRITING 9

Reading – Company profiles, journal reports. Language Development– Reported Speech Vocabulary-reporting words and phrases. Writing accident reports, survey report and progress report, project proposals, minutes of the meeting, writing statement of purpose, internship application and resume.

TOTAL: 30 PERIODS

LAB COMPONENT **TOTAL: 15 PERIODS**

LIST OF EXPERIMENTS

1. Determination of hardness causing salts in water sample by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of chloride content of water sample by argentometric method.
4. Determination of strength of given Barium chloride using conductivity meter.
5. Determination of strength of Acid using pH meter.
6. Determination of strength of FAS by potentiometer
7. Determination of strength of acids in a mixture using conductivity meter.
8. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.
9. Estimation of Nickel in steel

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Summarize long technical and scientific text of not less than 500 words recognizing main ideas and specific details

CO2: Demonstrate the understanding of more complex grammatical structures and diction while reading and writing

CO 3 Use appropriate expressions to describe process and product, compare and contrast data, analyze problems, provide solutions and prove an argument in writing

CO 4 Establish the ability to communicate effectively in professional environment through emails and reports

CO 5 Determine the language use appropriate for different social media platforms used for digital marketing

CO 6 Convert skills to assets and position themselves in job market through their own professional narratives.

TEXT BOOKS:

1. V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, VeenaSelvam, "English for Science & Technology I", Cambridge University Press and Assessment
2. V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, VeenaSelvam, "English for Science & Technology II", Cambridge University Press and Assessment

REFERENCES:

1. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
2. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
3	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
5	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Overall correlation		-	-	-	-	1	1	-	2	3	-	3	-	-	-

23MA203 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

This course aims at providing

- The necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numericaltechniques of differentiation and integration which plays an important role in engineeringand technology

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions – Standard error - Large sample test for single mean, proportion, difference of means – Small sample Tests– t Test for single mean and difference of means - F test for equality of variance – Chi square test for single variance- Independence of attribute- Goodness of fit (Binomial Distribution, Poisson Distribution).

UNIT II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a square matrix by Power method

UNIT-IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICALINTEGRATION 12

Interpolation - Newton‘s forward and backward difference interpolation - Lagrange‘s and Newton‘s divided difference interpolations –– Approximation of derivative using interpolation polynomials – Numerical single integration and double integrations using Trapezoidal and Simpson‘s1/3rules.

UNIT-V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods: Taylor‘s series method - Euler‘s method - Modified Euler‘s method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne‘s and Adam‘s Bashforth method**.**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

2. Johnson, R.A., Miller, I and Freund J., ―Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition,2015**.**

REFERENCES:

1. Dr.P.Sivaramakrishnadas, Dr. C.Vijykumari, ―Statistics and Numerical Methods‖Pearson Publications.
2. Burden, R.L and Faires,J.D,"Numerical Analysis‖, 9th Edition, Cengage Learning,2016.
3. Devore.J.L.‖Probability and Statistics for Engineering and the Sciences‖, CengageLearning, NewDelhi, 8th Edition,2014.
3. Gerald.C.F. and Wheatley.P.O. "Applied Numerical Analysis‖ Pearson Education,Asia, New Delhi, 7th Edition, 2007.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Examine the given data for large and small samples problems.

CO 2 Examine the problems involving design of experiments.

CO 3 Find the numerical solutions for nonlinear (algebraic or transcendental) equations, large system of linear equations and Eigen value problem of a matrix, when analytical methods fail to give solution.

CO 4 Determine the intermediate values of the experimental data, using Newton's forward, backward, divided difference and Lagrange's methods.

CO 5 Find the solutions for the problems involving numerical differentiation and integration.

CO 6 Solve numerically, ordinary differential equations which is used to solve different kinds of problems occurring in engineering and technology**.**

CO – PO Mapping:															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

23PH202 APPLIED MATERIALS SCIENCE

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying material properties.
- To inculcate the knowledge of phase relationships for the understanding of material properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications.
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures: BCC, FCC and HCP- directions and Planes- linear and planar densities – crystal imperfections- edge and screw dislocations- grain and twin boundaries- Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials – Polymorphism.

UNIT II PHASE DIAGRAMS 9

Phase equilibrium – solubility limit – solid solution (interstitial and substitution) – intermediate phases – intermetallics – electron compound – Gibbs phase rule – Unary phase diagram (iron) – Binary phase diagrams: Isomorphous systems (Cu-Ni) – determination of phase composition and phase amounts – tie line and lever rule – binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) – eutectoid and peritectic reactions – other invariant reactions – microstructural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions.

UNIT III ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory: Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states. Magnetic materials: Dia, para and ferromagnetic effects – Domain theory of ferromagnetism and hysteresis – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

UNIT IV SEMICONDUCTOR AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion (qualitative) – Hall effect and devices – Ohmic contacts – Schottky diode – Introduction to solid state drive (SSD)

UNIT V OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Apply the basics of crystallography and its importance in studying materials properties

CO 2 Develop the knowledge of phase relationships for the understanding of material properties.

CO 3 Apply the electrical properties of materials using classical and quantum free electron theory

CO 4 Analyze the properties of magnetic materials in devices.

CO 5 Develop the knowledge on physics of semiconductors, determination of charge carriers and device applications.

CO 6 Build a sound grasp of knowledge on different optical properties of materials, optical displays and applications.

TEXTBOOKS:

1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. Safa Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)
5. Safa kasap, Optoelectronics & Photonics: Principles and Practices, Pearson, 2013.

REFERENCES:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006.
4. Simon Sze and Ming-kwei Lee, Semiconductor Devices: Physics and Technology, Wiley, 2015.
5. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	-	-	-	2	-	-	-	-	1	1	-	-
2	3	3	2	-	-	-	2	-	-	-	-	1	-	-	-
3	3	3	1	-	-	-	1	-	-	-	-	1		-	-
4	3	2	1	-	-	-	1	-	-	-	-	1	-	-	-
5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall correlation	3	3	2	-	-	-	1	-	-	-	-	1	1	-	-

23ME201	**APPLIED MECHANICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Inculcate the ability to analyze any problem in a simple and logical manner.
- Learn the use of scalar and vector analytical techniques for analysing forces in staticallydeterminate structures.
- Introduce the equilibrium of rigid bodies, vector methods and free body diagram.
- Learn the principles of friction, forces and to determine and apply the concepts offrictional forces at the contact surfaces of various engineering systems.
- To develop basic dynamics concepts such as force, momentum, work and energy.
- To apply the well understood basic principles for the real time.

UNIT-I BASICS AND STATICS OF PARTICLES 9

Introduction – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces - vector representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle – Forces in space – Equilibrium of a particle in space - Equivalent systems of forces, Free body diagram

UNIT-II EQUILIBRIUM OF RIGID BODIES 9

Principle of transmissibility - Varignon's theorem -Types of supports - Action and reaction forces - stable equilibrium - Moment of a force about a point and about an axis – Single equivalent force - Equilibrium of rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions, Analysis of Trusses – Method of Joints and Method of sections.

UNIT-III PROPERTIES OF SURFACES AND SOLIDS 9

Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Theorems of Pappus - Area moments of inertia of plane areas - rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and Perpendicular axis theorem - Principal moments of inertia of plane areas - Principal axes of inertia-Mass

moment of inertia - mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT-IV FRICTION 9

Friction force - Ladder Friction, Wedge friction, Screw friction - Rolling resistance, Square threaded Screws, Journal Bearings, Thrust Bearings, Disc friction, Wheel friction, Rollingresistance.

UNIT-V DYNAMICS OF PARTICLES 9

Newton's laws of motion - Principle of Work and Energy, Applications of the Principle of Work and Energy, Power and Efficiency, Conservation of Energy, Principle of Impulse and Momentum, Impacts of bodies - Work Energy Equation - Impulse and Momentum equation

TOTAL: 45 PERIODS

Course outcomes

At the end of the course, students will be able to

CO1: Apply law of forces on particles.

CO2: Calculate forces on rigid bodies.

CO3: Calculate area moment of inertia of planar body and mass moment of inertia ofrigid bodies.

CO4: Determine friction and its effects at the surfaces of contact for ladder, wedge, beltand bearings.

CO5: Calculate dynamic forces on rigid bodies.

CO6: Determine reaction forces at the support

TEXTBOOKS:

1. Beer, F.P and Johnston Jr. E.R., —Vector Mechanics for Engineers (In SI Units): Statics andDynamics‖, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).

2. Bhavikatti, S.S and Rajashekarappa, K.G., —Engineering Mechanics‖, New Age International (P) Limited Publishers, 1998.

REFERENCES:

1. Hibbeller, R.C and Ashok Gupta, —Engineering Mechanics: Statics and Dynamics‖, 11th Edition, Pearson Education 2010.

2. Irving H. Shames and Krishna Mohana Rao. G., —Engineering Mechanics – Statics andDynamics‖, 4th Edition, Pearson Education 2006.

3. Meriam J.L. and Kraige L.G., — Engineering Mechanics- Statics - Volume 1, Dynamics -Volume 2‖, Third Edition, John Wiley & Sons, 1993.

4. Rajasekaran S and Sankarasubramanian G., —Engineering Mechanics Statics andDynamics‖, 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

COs	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	2	-	-	-	-	-	-	2	3	1	1
2	3	2	2	1	2	-	-	-	-	-	-	2	3	1	1
3	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
4	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
5	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
6	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
Overall coordination	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2

23HS203 TAMILS AND TECHNOLOGY

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To summarize the weaving industry and ceramic technology during Sangam Age
- To explain the design and construction of houses during Sangam Age and the sculptures and temples of Chola,Pallava and Pandya period
- To Explain about the water bodies of Sangam age and relate it to the agricultural usage
- To Outline to students the agriculture and irrigation technology during the Chola Period
- To help students Interpret and explain the digitalization of Tamil books and development of Tamil software

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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 MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 Summarize the weaving industry and ceramic technology during Sangam Age .

CO2 Explain the design and construction of houses during Sangam Age.

CO3 Explain the sculptures and temples of Chola,Pallava and Pandya period.

CO4 Explain about the water bodies of Sangam age and relate it to the agricultural Usage.

CO5 Outline the agriculture and irrigation technology during the Chola Period.

CO6 Interpret and explain the digitalization of tamil books and development of Tamil software.

TEXTBOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL

REFERENCES:

1. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
2. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
2	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
3	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
4	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
5	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
6	-	-	-	-	-	1	1	1	1				-		
Overall correlation	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

23ME211 ENGINEERING GRAPHICS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- Gain a solid foundation in the fundamental principles and concepts of engineering graphics, including conic sections, orthographic projection, isometric projection, section views and development of surfaces, perspective projection, and dimensioning.
- Develop graphic skills for communication of concepts, ideas and design of engineering products.
- Gain knowledge on drafting software to construct part models.
- Familiarize with existing national standard practices and conventions related to technical drawings.
- Enhance the ability to visualize objects in three dimensions and translate them into 2D representations.

UNIT I PLANE CURVES 9 + 6

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

LIST OF EXERCISES:

1. Drawing of a title block with necessary text, projection symbol and ettering using drafting software.
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 9 + 6

Orthographic projection - principles - Principal planes - First angle projection - projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (hexagonal and pentagonal planes only) inclined to both the principal planes by rotating object method.

LIST OF EXERCISES:

1. Draw the projection of points when it is placed in different quadrants
2. Draw the projection of lines when it is placed in first quadrant
3. Draw the planes when it is placed in first quadrant

UNIT III PROJECTION OF SOLIDS AND FREE HAND SKETCHING 9 + 6

Projection of simple solids - hexagonal prism, pentagonal pyramid and cone inclined to the horizontal plane by rotating object method. Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views - Free hand sketching of multiple views from pictorial views of objects

LIST OF EXERCISES:

1. Practicing three dimensional modeling of simple objects.
2. Drawing of orthographic views from the given pictorial diagram.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 9 + 6

Sectioning of hexagonal prism, pentagonal pyramid and cone when the cutting plane is inclined to the horizontal plane, Development of lateral surfaces of simple and

sectioned solids – hexagonal prism and cone cut by a plane inclined to horizontal plane only.

LIST OF EXERCISES:

1. Draw the sectioned views of prisms and pyramids
2. Draw the development of hexagonal prism cut by a section plane inclined to the horizontal plane

UNIT V ISOMETRIC PROJECTION 9 + 6

Principles of isometric projection - Isometric scale – Isometric view - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.

LIST OF EXERCISES:

1. Drawing Isometric view and projection of simple solids.
2. Drawing three dimensional modeling of isometric projection of combination of solids.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Construct the conic curves, involutes and cycloids.

CO 2 Draw the orthographic projections of points, lines and plane surfaces.

CO 3 Draw the orthographic projections of simple solids.

CO 4 Draw the projections of sectioned solids and development of the lateral surfaces of solids.

CO 5 Sketch the isometric sections of solids.

CO 6 Sketch the orthographic projection 2D and 3D objects using Auto CAD.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2019.

2. Basant Agarwal and Agarwal C.M.,―Engineering Drawing‖, McGraw Hill, 2nd Edition, 2019

REFERENCES:

1. Natrajan K.V., ―A Text Book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2018.

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

COs	COs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
6	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
Overall correlation	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

23EE283 BASIC ELECTRICAL, ELECTRONICS ENGINEERING AND MEASUREMENTS

L T P C
2 0 2 3

COURSE OBJECTIVES:

The learning objective of this course is to

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of linear integrated circuits
- To introduce the functional elements and working of measuring instruments.

UNIT I ELECTRICAL CIRCUITS 6

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor–Ohm's Law-Kirchhoff's Laws -Nodal Analysis, Mesh analysis within dependent sources only

(Steady state)- Introduction to AC Circuits–Steady state analysis of RL, RC, and RL Circuits(Simple problems only)

UNIT II ELECTRICAL MACHINES 6

Construction and Working principle of DC Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications -Construction, Working principle and Applications of Single- Phase Transformer.

UNIT III ANALOG ELECTRONICS 6

PN Junction Diodes, Zener Diode –characteristics Applications – Bipolar Junction Transistor- JFET, SCR - I-V Characteristics and Applications- Rectifier

UNIT IV LINEAR INTEGRATED CIRCUITS 6

Ideal OP-AMP characteristics, Basic applications of op-amp – Inverting and Non-inverting Amplifiers, D/A converter (R- 2R ladder), A/D converters (Flash type) - ADC using OP-AMPS

UNIT V MEASUREMENTS AND INSTRUMENTATION 6

Functional elements of an instrument, Standards and calibration, Operating Principle, types-Moving Coil and Moving Iron meters, Instrument Transformers- CT and PT,DSO-Block diagram-Data acquisition

30 PERIODS

LAB COMPONENT

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Single phase Transformer
4. Experiment on Operational Amplifier based Inverting and non-inverting amplifier
5. Experiments on ADC and 555 Timer
6. Measurement of Amplitude, Frequency, Time, Phase Measurement using DSO

TOTAL: 30+15 = 45 PERIODS

TEXTBOOKS:

1. D P Kothari and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, Second Edition, 2020.
2. Allan S Moris, "Measurement and Instrumentation Principles", Third Edition, Butterworth Heinemann,2001.
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley,2018

REFERENCES:

1. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
2. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, January 2015.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Build the electric (DC) circuit parameters for simple problems and verify with experiments

CO2: Develop the electric (AC) circuit parameters for simple problems and verify with experiments

CO3: Identify the working principle and applications of electrical machines and correlate with experimental results

CO4: Discuss the characteristics of analog electronic devices

CO5: Explain the basic concepts of linear integrated circuits and model the opamp based amplifier experimentally

CO6: Explain the operating principles of measuring instruments and build the basic measurements using DSO**.**

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
CO2	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
CO3	3	2	1	1	-	1	1	1	1	1	-	1	3	-	1
CO4	2	1	-	-	-	1	1	1	1	1	-	1	2	-	1
CO5	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
CO6	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
Overall correlation	3	2	1	1	-	1	1	1	1	1	-	1	3	-	1

23ME221	ENGINEERING PRACTICES LABORATORY (MECHANICAL & CIVIL)	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- Familiarize students with basic engineering tools and equipment.
- Educate students on the importance of safety practices, including proper handling of equipment, adherence to safety protocols, and understanding potential hazards in the laboratory environment
- Develop basic manufacturing and fabrication skills.
- Provide hands on training to the students in plumbing and woodworking.
- Provide hands on training to the students in welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
- Demonstrate the wiring and measurement methods in common household electrical applications.
- Study the basic electronic components, gates and provide hands on training in soldering.

GROUP A (CIVIL & MECHANICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK

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

WOOD WORK

a) Sawing
b) Planning
c) Making of T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study

a) Study of joints in door panels and wooden furniture

b) Study of common industrial trusses using models.

PART II MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK

a) Study of Welding and its tools.

b) Welding of Butt Joints, Lap Joints and Tee Joints by metal arc welding.

c) Study of Gas Welding.

BASIC MACHINING PRACTICE

a) Facing and Plain Turning

b) Taper Turning

c) Drilling and Tapping

SHEET METAL WORK

a) Forming and Bending

b) Making of a square Tray

MACHINE ASSEMBLY WORK

a) Study of Centrifugal Pump

b) Study of Air Conditioner

FOUNDRY PRACTICE

a) Demonstration on Foundry operations like mould preparation.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO 1	Draw the pipeline plan; lay and connect various pipe fittings used in common household plumbing work.
CO 2	Use welding equipment to join the structures, perform the basic machining operation, make joints in wood materials and make the models using sheet metal works.
CO 3	Demonstrate on centrifugal pump, air conditioner and foundry operations.
CO 4	Demonstrate the electrical wiring connections for household applications and study the working of iron box and fan regulator.
CO5	Identify the basic electronic components and explain the gates and soldering methods.
CO 6	Examine the performance and operation of CRO, LED TV and Smart phone.

CO-PO Mapping:															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO 2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO 3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO 4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO 5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO 6	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
Overall Correlation	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

23HS221 SOFT SKILLS

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To help learners improve their interpersonal skills and critical thinking
- To familiarize learners with the attributes of a leader to enhance team performance
- To prepare students to face job interviews

UNIT I INTERPERSONAL COMMUNICATION 5

Basic communication- verbal and non-verbal communication; passive, assertive and aggressive communication; presentation skills; giving feedback and responding to feedback.

UNIT II TEAMWORK AND LEADERSHIP 5

Vision- setting realistic goals and objectives, collaboration, cooperation, dependability, empathy, sympathy, motivation, delegation of responsibilities, open mindedness, creativity, flexibility, adaptability, cross cultural communication and group dynamicso help learners to know the importance of ethics in workplace.

UNIT III TIME MANAGEMENT AND STRESS MANAGEMENT 5

Effective Planning, Planning activities at macro and micro levels, setting practical deadlines and realistic limits/targets, punctuality, prioritizing activities, spending the right time on the right activity, positive attitude, emotional intelligence, self-

awareness and regulation.

UNIT IV CRITICAL THINKING AND WORK ETHICS 5

Questioning, analysing, inferencing, interpreting, evaluating, solving problems, explaining, self-regulation, open-mindedness, conflict management- ethical dilemmas, appearance, attendance, attitude, character, organizational skills, productivity, respect.

UNIT V INTERVIEW SKILLS AND RESUME BUILDING TECHNIQUES 5

Telephonic interview, online interviews, f2f interviews, FAQ soft skills interview questions, drafting error-free CVs/ Resumes and Cover Letters, selecting the ideal format for resume, content drafting along with sequencing, art of representing one's qualifications and most relevant work history, video resume, website resume**.**

TOTAL: 25 PERIODS

COURSE OUTCOMES:

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

CO1: Express their thoughts, opinions and ideas confidently to one or more people in spoken form

CO2: Develop evolving competences required for professional success

CO3: Demonstrate knowledge and skills in a group as team player and leader

CO4: Compose a comprehensive resume reflecting qualifications, exposure and achievements

CO5: Exhibit knowledge and skills confidently during job interviews

CO6: Demonstrate ethical and professional behaviour at workplace in all situations

TEXTBOOKS:

1. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman & Shalini Upadhyay. Cengage

REFERENCES:

1.English for Job Seekers (Language and Soft Skills for the Aspiring) by Geetha Rajeevan, C.L.N. Prakash) Cambridge University Press pvt,Ltd.

2.Business Benchmark by Norman Whitby. Cambridge University Press pvt,Ltd

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-
2	-	-	1	1	-	2	2	2	3	3	2	2	-	-	2
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
6	-	-	-	-	-	-	-	-	3	3	-	-	-		-
Overall correlation	-	-	1	1	-	1	1	1	2	2	1	1	-	-	1
													3	1	0	4

23MA302 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of second order Quasi Linear PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of Heat conduction – Steady state solution of two dimensional equation of heat conduction (Infinite) (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS **9+3**

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem (Without proof) – Parseval's identity.

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS **9+3**

Z-transforms - Elementary properties – Convergence of Z-transforms – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand how to solve the given standard partial differential equations.

CO 2 Understand Fourier series analysis which plays a vital role in engineering applications.

CO 3 Examine the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.

CO 4 Understand the mathematical principles on Fourier transforms to solve some of the physical problems of engineering.

CO 5 Understand Z transforms, inverse Z transforms and its elementary properties

CO 6 Apply the effective mathematical tools for the solutions of difference equations by using Z transform techniques for discrete time systems.

TEXTBOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

3. P.Sivaramakrishna Das and C.Vijayakumari "A Text Book on TPDE" Pearson Publications.

REFERENCES:

1. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
2. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	-	-	-	-	-	-	-	-	2	2	-	1
2	3	3	3	-	-	-	-	-	-	-	-	2	2	-	1
3	2	2	2	-	-	-	-	-	-	-	-	2	2	-	1
4	3	3	3	-	-	-	-	-	-	-	-	2	2	-	1
5	2	2	2	-	-	-	-	-	-	-	-	2	2	-	1
6	2	2	2	-	-	-	-	-	-	-	-	2	2	-	1
Overall correlation	3	3	2	-	-	-	-	-	-	-	-	2	2	-	1

23MT301 MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concepts and basic mechanics of metal cutting and the factors affecting machinability.
- To learn working of basic and advanced turning machines.
- To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
- To study the basic concepts of CNC of machine tools and constructional features of CNC.
- To learn the basics of CNC programming concepts to develop the part program for Machine centre and turning centre.

UNIT I MECHANICS OF METAL CUTTING 9

Mechanics of chip formation, forces in machining, Types of chips, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi- automatic – single spindle: Swiss type, automatic screw type – multi spindle.

UNIT III RECIPROCATING MACHINE TOOLS 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations- attachments- types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods.

UNIT IV CNC MACHINES 10

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to- point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.

UNIT V PROGRAMMING OF CNC MACHINE TOOLS 8

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centres and Turning centres – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Apply the mechanism of metal removal process and to identify the factors involved in improving machinability.

CO2: Describe the constructional and operational features of centre lathe and other special purpose lathes.

CO3: Describe the constructional and operational features of reciprocating machine tools.

CO4: Describe the constructional and operational features of milling and grinding machines.

CO5: Apply the constructional features and working principles of CNC machine tools

CO6: Demonstrate the Program CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component

TEXTBOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India 8th Edition, 2020.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2019.

REFERENCE BOOKS:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 3rd edition 2015.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 3rd edition 2005.
3. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 4th Edition 2018.
4. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	-	-	-	3	-	1	3	2	2	3	3	2
2	3	3	3	-	-	-	3	-	2	3	1	2	3	2	2
3	2	3	3	-	-	-	3	-	1	2	1	2	3	2	2
4	3	3	2	-	-	-	3	-	1	3	2	2	3	2	2
5	3	3	3	-	-	-	3	-	1	3	1	2	3	2	3
Overall Correlation	3	3	3	-	-	-	3	-	1	3	1	2	3	2	3

23MT311 ELECTRICAL DRIVES AND ACTUATORS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The learning objective of this course is

- To familiarize a relay and power semiconductor devices
- To get a knowledge on drive characteristics
- To obtain the knowledge on DC motors and drives.
- To obtain the knowledge on AC motors and drives.
- To obtain the knowledge on Stepper and Servo motor.

UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9

Study of Switching Devices- Relay and its Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT. Introduction to Triggering, Commutation Driver and snubber circuits.

UNIT II DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.

UNIT III DC MOTORS AND DRIVES 9

DC motor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge (Single Phase) – 4 quadrant operation – Applications

UNIT IV AC MOTORS AND DRIVES 9

Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.

UNIT V STEPPER AND SERVO MOTORS 9

Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation- Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Illustrate the working principle of relays, and the switching Characteristics of Various Power Semiconductor Devices.

CO2: Explain the characteristics of drives & Selection of Motors.

CO3: Explain the various types of DC Motors and Drives.

CO4: Identify the various applications of DC motor drives in single phase 4 quadrant operation.

CO5: Explain the Various types of AC Motors and Drives

CO6: Explain the construction and working principle of Stepper Motor and Servo motor

TEXTBOOKS:

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd.,New Delhi, 2016.

REFERENCE BOOKS:

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House,New Delhi, 2001.
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand&Co. Ltd., New Delhi, 2012.
3. Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007.
4. Andre Veltman , Duco W.J. Pulle , R.W. de Doncker , * Fundamentals of Electrical Drives (Power Systems)",Springer International Publishing AG; Softcover reprint of the original 2nd ed. 2016 edition.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	1	2	1	-	-	-	-	-	-	-	1	-	3
2	3	-	2	2	1	-	-	-	-	-	-	-	1	-	3
3	3	-	2	2	1	-	-	-	-	-	-	-	1	-	3
4	3	-	1	2	2	-	-	-	-	-	-	-	1	-	3
5	3	-	1	2	2	-	-	-	-	-	-	-	1	-	3
Overall Correlation	3	-	1	2	1	-	-	-	-	-	-	-	1	-	3

23HS301	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

The learning objective of this course is to

- Develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understand the harmony in the human being, family, society and nature/existence.
- Strengthen the self-reflection.
- Develop a commitment and courage to act.

UNIT I COURSE INTRODUCTION **9**

Need, Basic Guidelines, Content and Process for Value Education - Understanding the need, basic guidelines, content and process for Value Education -Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations -Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority - Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario -Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING **9**

Harmony in Myself- Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) -Understanding the characteristics and activities of 'I' and harmony in 'I' -Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity.

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY **9**

Harmony in Human-Human Relationship -Understanding Harmony in the family – the basic unit of human interaction -Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure satisfaction; Trust(Vishwas) and Respect as the foundational values of relationship -Understanding the meaning of Vishwas; Difference between intention and

competence -Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship -Understanding the harmony in the society (society being an extension of family)-Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order- from family to world family.

UNIT IV ENGINEERING ETHICS 9

Senses of ‗Engineering Ethics‟ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT V SAFETY, RESPONSIBILITY AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination-Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the need of value education.

CO2: Comprehend the difference between self and body.

CO3: Understand the need to exist as an unit of Family and society.

CO4: Understand Harmony at all levels.

CO5: Apply the values acquired in the professional front.

CO6: Identify appropriate technologies for ecofriendly production systems.

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, by, Excel Books, New Delhi, 2013.
2. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, New Delhi, 2003.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004

REFERENCE BOOKS:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth Autobiography, Good press, 2023 .

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
2	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
3	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
4	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
5	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
6	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
Overall correlation	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3

23MT312 DIGITAL ELECTRONICS AND MICROPROCESSOR **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems.
- To familiarize with the design of various combinational digital circuits using logic gates.
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.
- To explain the various semiconductor memories and related technology.
- To introduce the electronic circuits involved in the making of logic gate.

UNIT I DIGITAL FUNDAMENTALS **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and products of sums, Mini terms and Maxterms, Karnaugh map Minimization and Quine McCluskey method of minimization.

UNIT II COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder - Multiplexer, Demultiplexer, Decoder, Priority Encoder. Flip flops – SR, JK, T, D, design of clocked sequential circuits – Design of Counters- Shift registers, Universal Shift Register.

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUITS AND MEMORY DEVICES 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

UNIT IV 8085 PROCESSOR 9

Hardware Architecture, pin diagram – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT V PROGRAMMING PROCESSOR 9

Instruction - format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions – stack -8255 architecture and operating modes.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Truth Table Verification of Logic gates.
2. Implementation of Boolean expression using K-map and logic gates.
3. Design and implementation of code converters.
4. Design of Full adders using logic gates.
5. Design of Full subtractors using logic gates.
6. Design and Implementation of Shift Registers.
7. Design and implementation of counters using flip-flops.
8. Simple arithmetic operations: Multi precision addition / subtraction /multiplication / division.
9. Programming with control instructions: Increment / Decrement, Ascending / Descending.
10. Program with subroutines.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: State the fundamental operating concepts behind digital logic circuits and microprocessors.

CO 2: Recognize the use of various digital logic circuits and subunits in microprocessors.

CO 3: Sketch the digital logic circuits and the architectures of microprocessors.

CO 4: Design the DLC and Microprocessor for the standard applications.

CO 5: Create the circuits using DLC and Microprocessor for given applications.

TEXTBOOKS:

1. M.Morris Mano and Michael D.Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

REFERENCE BOOKS:

1. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
4. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	2	2	1	2	1	1	1	3	2	2
2	3	3	2	2	1	2	2	1	2	1	1	1	3	2	2
3	3	3	2	2	1	2	2	1	2	1	1	1	3	2	2
4	3	3	2	2	1	2	2	1	2	1	1	1	3	2	2
5	3	3	2	2	1	2	2	1	2	1	1	1	3	2	2
Overall correlation	3	3	2	2	1	2	2	1	2	1	1	1	3	2	2

23MT302	KINEMATICS AND DYNAMICS OF MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system/ machine and also learn about the mechanisms.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
- To learn about the concepts in friction.
- To understand the principles in force analysis.
- To learn about the basic concept of static and dynamic balancing and vibration

UNIT I KINEMATICS OF MACHINES 10

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slider crank chain kinematics analysis in simple mechanisms – velocity and acceleration polygons (Relative velocity method) Coriolis component of Acceleration**.**

UNIT II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains..

UNIT III CAM AND FRICTION DRIVES 9

Cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of follower motion – circular arc and tangent cams. Sliding and Rolling Friction angle – friction in threads – Friction Drives – Belt and rope drives.

UNIT IV FORCE ANALYSIS 8

Static Force analysis in simple machine members – Dynamic Force Analysis Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members**.**

UNIT V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – critical speed of simple shaft.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Coriolis Component of Acceleration
2. Determination of Mass moment of inertia of Fly wheel and Axle system.
3. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
4. Determination of torsional natural frequency of single and Double Rotor systems. - Undamped Natural frequencies.
5. Vibration of Equivalent Spring mass system – undamped vibration.
6. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
7. Transverse vibration of Free-Free beam – with and without concentrated masses.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Recognize the basic terminologies of kinematics and dynamics of machines

CO2: Interpret the various concepts of kinematics and dynamics including forces and frictions

CO 3: Show the motions parameters on the various mechanisms, gears and gear trains.

CO 4: Apply the mechanism, gears and gear train for the design of new machines.

CO 5: Analyze the working of various mechanism, gears and gear train.

TEXT BOOKS:

1. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
2. Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition,2009

REFERENCE BOOKS:

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh. A, and A.K. Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi,1988.
3. Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
4. Ambekar A. G., "Mechanism and Machine Theory" Prentice Hall of India,New Delhi, 2007.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3
2	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3
3	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3
4	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3
5	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3
6	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3
Overall Correlation.	3	2	1	1	2	2	-	-	-	-	-	1	2	1	3

23MT321 MANUFACTURING TECHNOLOGY LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To Selecting appropriate tools, equipment's and machines to complete a given job.
- To Performing various welding process using GMAW and fabricating gears using gear making machines.
- To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analyzing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear Hobbing machine.
10. Generating gears using gear shaping machine.
11. Grinding components using cylindrical and centerless grinding machine.
12. Grinding components using surface grinding machine.
13. Cutting force calculation using dynamometer in milling machine

14. Cutting force calculation using dynamometer in lathe machine

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.
- The students can make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.
- The students make the gears using gear making machines and analyze the defects in the cast and machined components.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	1	-	2	-	-	1	1	1	1
2	3	-	-	-	-	-	1	-	2	-	-	1	1	1	1
3	3	-	-	-	-	-	1	-	2	-	-	1	1	1	1
Overall Correlation	3	-	-	-	-	-	1	-	2	-	-	1	1	1	1

23MT322 ELECTRICAL DRIVES AND ACTUATORS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics To impart industry-oriented learning
- To evaluate the use of computer-based analysis tools to review the major classes ofmachines and their physical basis for operation

LIST OF EXPERIMENTS

1. Load test on DC Motor.
2. Load test on 3-phase Induction Motor.
3. Load test on 3-Phase Synchronous Motor.
4. Rheostat-based Speed control of motors (AC and DC).
5. Switching circuits of MOSFET, IGBT, SCR and TRAIC.
6. Gate pulsation generation using PWM signals.
7. Speed control of DC motor using Power Electronic Drive.
8. Position, Direction, and speed control of stepper Motor.
9. Position and direction control DC servomotor.
10. VFD controls single-phase and three-phase induction motors using Power Electronic Drive.
11. Position, direction, and speed control of BLDC and PMDC motors using Power Electronic drive.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Practice the basic working of AC, DC motor, stepper motor, servo motor, and synchronous motor using power electronic drive

CO2: Demonstrate the control of AC, DC motor, stepper motor, servo Motor and synchronous motor using power electronic drive

CO3: Analyze the performance of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	-	-	-	1	2	2	3
2	3	2	1	1	1	-	-	-	-	-	-	1	2	2	3
3	3	2	1	1	1	-	-	-	-	-	-	1	2	2	3
Overall Correlation	3	2	1	1	1	-	-	-	-	-	-	1	2	2	3

23ES391 PRESENTATION SKILLS

L	T	P	C
0	0	2	1*

COURSE OBJECTIVES:

- To help learners use brainstorming techniques for generating, organizing and outlining ideas.
- To familiarize learners with different speech structures by engaging them in watching speeches with great opening and closing.
- To give practice on voice modulation and use of body language and eye contact for making captivating presentations.
- To give hands on training on preparing presentation slides and using remote presentation tools.
- To train students on responding to question and feedback with confidence.

UNIT I BRAINSTORMING AND OUTLINING **6**

Mind Mapping based on prior knowledge, collecting additional information from external resources, giving prompts to Generative AI tools seeking information, organizing ideas generated, knowing your audience.

UNIT II STRUCTURING THE PRESENTATION **6**

3 Ts of a presentation, writing effective introduction- Beginning the introduction with a hook (question, data, storytelling) and closing the introduction with the objective of the presentation. Structuring the body paragraphs -Choosing key ideas from the list of ideas generated during brainstorming. Substantiating ideas with examples, data, reasons and anecdotes. Summarizing the ideas for conclusion.

UNIT III DELIVERY TECHNIQUES **6**

Vocal variety, intonation, reducing filler words and improving articulation, inflection, engaging the audience. Body language- eye contact, gestures, movement on stage.

UNIT IV USE OF TECHNOLOGICAL AIDS **6**

Use of presentation software like MS Power Point, Google Slides etc, incorporating images, graphs, charts and videos, using interactive tools like quizzes and polls, using remote presentation tools like zoom, MS Teams, WebEx for screen sharing, virtual whiteboards and chat functionalities, incorporating AR/VR for more immersive presentations.

UNIT V HANDLING QUESTIONS AND FEEDBACK 6

Audience engagement through questions, PAR (Point, Answer, Redirect) strategy for structuring responses to questions. Understanding feedback process - Receiving, interpreting and evaluating constructively, active listening techniques for processing feedback, responding to feedback- acknowledging, clarifying and appreciating, Dealing with challenging feedback.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1 construct ideas for presentation through mind mapping techniques.

CO2 organize ideas and structure the presentation with captivating introduction, body paragraphs illustrated with examples and reasons and compelling conclusion.

CO3 apply vocal variety and body language techniques to enhance delivery.

CO4 prepare engaging presentations by integrating multimedia elements.

CO5 demonstrate proficiency in delivering presentations in remote platforms utilizing various technological tools and strategies to engage audience in virtual environments.

CO6 exhibit active listening skills by responding to questions with clarity and confidence and incorporating constructive feedback for professional development.

TEXT BOOKS:

1. "Slide:ology: The Art and Science of Creating Great Presentations" by Nancy Duarte. O'Reilly Media
2. "The Naked Presenter: Delivering Powerful Presentations With or Without Slides" by Garr Reynolds. New Riders

REFERENCE BOOK:

1. Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds" by Carmine Gallo.

23MA401 OPTIMIZATION TECHNIQUES

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- Formulate and solve linear programming problems (LPP)
- Evaluate Transportation and Assignment Problems

- Obtain solution to network problems using CPM and PERT techniques.
- Optimize the function subject to the constraints

UNIT I LINEAR PROGRAMMING MODELS 9+3

Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Big M method, Two phase method.

UNIT II TRANSPORTATION PROBLEMS AND ASSIGNMENT PROBLEMS 9+3

Transportation problem (TP) - finding basic feasible solution of TP using North-West Corner Rule, Least Cost and Vogel's Approximation Method - MODI method for finding optimal solution for TP - Assignment problem - Hungarian method for solving Assignment problem - Travelling salesman problem as assignment problem – Production Scheduling problem – Introduction, Problems in single machine scheduling.

UNIT III INVENTORY CONTROL 9+3

Introduction, Models – Problems in Purchase and Production (Manufacturing) models with and without shortages – Theory on types of inventory control systems: P& Q, ABC, VED, FNS, XYZ, SDE and HML.

UNIT IV PROJECT MANAGEMENT 9+3

Project definition - Gantt chart - Project network - Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM.

UNIT V CLASSICAL OPTIMIZATION THEORY 9+3

Unconstrained problems – necessary and sufficient conditions - Newton-Raphson method, Constrained problems – equality constraints – inequality constraints - Kuhn-Tucker conditions.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Formulate and solve linear programming problems (LPP).

CO 2 Examine Transportation Problems.

CO 3 Examine Assignment Problems.

CO 4 Plan the purchase/ manufacturing policies to meet customer demands.

CO 5 Obtain solution to network problems using CPM and PERT Techniques.
CO 6 Optimize the function subject to the constraints.

TEXT BOOKS:

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.
2. R. Pannerselvan, Operations Research, 2nd Edition, PHI Publications, 2006.

REFERENCE BOOKS:

1. Dontzig G.B, Linear Programming and extensions, Princeton University Press.
2. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4thEdition, 2011.
3. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5thEdition, 2012.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	-	-	-	-	-	-	1	2	1	-	-
2	3	3	2	1	-	-	-	-	-	-	1	2	1	-	-
3	3	3	2	1	-	-	-	-	-	-	1	2	1	-	-
4	3	3	2	1	-	-	-	-	-	-	1	2	1	-	-
5	3	3	2	1	-	-	-	-	-	-	1	2	1	-	-
6	3	3	2	1	-	-	-	-	-	-	1	2	1	-	-
Overall correlation	3	3	2	1	-	-	-	-	-	-	1	2	1		

23MT401 SENSORS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communicationsystems used in mechatronics system development.
- To learn about the optical, pressure and temperature sensor.
- To understand the signal conditioning and DAQ systems.

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **8**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope,Inclinometers**.**

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **10**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi- channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Recognize with various calibration techniques and signal types for sensors.

CO2: Describe the working principle and characteristics of force, magnetic, heading pressure and temperature, smart and other sensors and transducers.

CO3: Apply the various sensors and transducers in various applications.

CO4: Select the appropriate sensor for different applications.

CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill,2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons,Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford SciencePublications, 1999.
4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	2	2	1	-	-	-	-	-	1	2	1	3
2	3	2	1	2	2	1	-	-	-	-	-	1	2	1	3
3	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3
4	3	2	1	3	2	1	-	-	-	-	-	1	2	1	3
5	3	2	1	3	2	1	-	-	-	-	-	1	2	1	3
Overall Correlation	3	2	1	2	2	1	-	-	-	-	-	1	2	1	3

23MT402	FLUID MECHANICS AND THERMAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To knowledge in Fluid Properties and Statics
2. To understand the concept of fluid kinematics and Dynamics.
3. To learn about the flows in fluid, Viscous flows and flow through pipes
4. To understand the basics laws of thermodynamics
5. To understand the second law of thermodynamics and entropy

UNIT I FLUID PROPERTIES AND FLUID STATICS 9

Fluid Definition and Classification – Properties of fluids: Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Bulk Modulus, Capillary and Surface Tension – Fluid statics: Concept of fluid static pressure – Pascal's law –Absolute and Gauge pressures – Manometers: Types and Pressure measurement.

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS **9**

Fluid Kinematics: Types of fluid flow – Continuity equation in two and three dimensions – Velocity and Acceleration of fluid particle – Velocity potential function and Stream function. Fluid dynamics: Euler's equation along a streamline –Bernoulli's equation and applications – Venturi meter, Orifice meter and Pitot tube.

UNIT III BASICS OF THERMODYNAMICS AND FIRST LAW OF THERMODYNAMICS **9**

Thermodynamics – Microscopic and macroscopic point of view – Systems, properties, process, path, cycle. Thermodynamic equilibrium – Zeroth law of Thermodynamics – internal energy, enthalpy. First law of Thermodynamics – Application to closed and open systems – Steady Flow Energy Equation (SFEE) – Simple problems.

UNIT IV SECOND LAW OF THERMODYNAMICS AND ENTROPY **9**

Second Law of thermodynamics – Kelvin Planck and Clausius Statements – Equivalents of Kelvin Planck and Clausius statements. Reversibility – Irreversibility, reversible cycle – Heat engine, heat pump and refrigerator. Carnot cycle and Clausius theorem, the property of entropy, the inequality of Clausius – Entropy principle – General expression for entropy – Simple problems in entropy

UNIT V HEAT TRANSFER **9**

Introduction to heat transfer Modes of Heat Transfer- Conduction, Convection Radiation, Heat exchangers. Introduction to computational heat transfer.

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO1: Recognize the fluid properties, fluid statics
CO2: Interpret the problems related to kinematics and dynamics of fluids
CO3: Recognize basics of thermodynamics and laws of thermodynamics.
CO4: Analyze the thermal process
CO5: Solve the problems related to thermal systems.
CO6: Understand and explain the basic mechanisms of heat transfer**.**

TEXT BOOKS:

1. Bansal R.K., ―Fluid Mechanics and Hydraulic Machines‖, 9th Edition, Laxmi Publications, New Delhi, 2015.
2. Nag P.K., ―Engineering Thermodynamics‖, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.

REFERENCES:

1. Cengel Yunus A. and Boles Michael A., ―Thermodynamics: An Engineering Approach,b7th Edition, McGraw-Hill, New York, 2011.
2. Frank M. White., ―Fluid Mechanics‖, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.
3. Heat Transfer by J.P. Holman
4. Fundamentals of Heat and Mass Transfer by Frank P. Incropera and David P. DeWitt

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	1	2					1	1	2	2	1
CO2	3	3	2	2	1	2					1	1	2	2	1
CO3	2	2	3	2	2	3					1	1	3	3	1
CO4	2	2	3	2	1	2					1	1	3	3	1
CO5	3	3	2	2	2	2					1	1	2	2	1
CO6	3	3	2	2	1	2					1	1	2	2	1
Overall correlation	3	3	2	2	1	2					1	1	2	2	1

23CE412 STRENGTH OF MATERIALS

L	**T**	**P**	**C**
3	**0**	**2**	**4**

COURSE OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants, Poisson's ratio – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle for plane stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAMS 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections– Shear stress distribution.

UNIT III DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method- Conjugate beam method for computation of slopes and deflections in determinate beams.

UNIT IV TORSION, SPRINGS AND COLUMNS 9

Theory of Torsion - Stresses and deformations in solid and hollow circular shafts – Stepped shafts – Power transmitted by a shaft. Helical springs – Differences between closely coiled and open coiled helical springs – Closely coiled helical springs – Calculation of shear stress, deflection and stiffness. Columns – Euler's theory – Calculation of crippling load for different end conditions for a long column.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin and thick cylindrical shell, deformation in thin and thick cylinders – spherical shells subjected to internal pressure –Deformation in spherical shells.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Double shear test on mild steel rod
3. Torsion test on mild steel rod
4. Izod Impact test on metal specimen
5. Charpy Impact test on metal specimen
6. Rockwell Hardness test on metals
7. Brinell Hardness test on metals
8. Compression test on helical spring.
9. Heat Treatment Processes- Annealing, Normalizing, Quenching and Tempering
10. Jominy End Quench Test

TOTAL: 45 + 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Calculate the different stresses developed in the solids when subjected to different loading conditions.

CO2: Interpret the shear force and bending moment diagrams of the beams under the various loading conditions.

CO3: Examine the bending stress and shear stress distribution of various sections of the beam.

CO4: Calculate the slope and deflection of beams using different methods.

CO5: Apply the basic equations to design shafts, springs and columns.

CO6: Calculate the stresses developed in the thin cylinder, thick cylinder, and spherical shells.

TEXTBOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Rattan S.S., “Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.

REFERENCE BOOKS:

1. Rajput R.K. “Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th edition, 2018.
2. Egor P Popov, “Engineering Mechanics of Solids”, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.

3. Beer. F.P. & Johnston. E.R. “Mechanics of Materials”, Tata McGraw Hill, 8th Edition, New Delhi 2019.
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
2	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
3	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
4	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
5	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
6	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
Overall correlation	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-

23MT421 FLUID MECHANICS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

List of Experiments

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of Gear pump.
7. Conducting experiments and drawing the characteristic curves of Pelton wheel.

Content Beyond Syllabus

1. *Heat transfer – pin fin apparatus*
2. *Thermal conductivity – composite wall apparatus.*
3. *Thermal conductivity - Lagged pipe apparatus.*
4. *Heat exchanger – parallel and counter flow.*
5 *Refrigeration – Determination of COP*

COURSE OUTCOMES:

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

- Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
- Use the measurement equipment for flow measurement.
- Perform test on different fluid machinery.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	1	1	-	-	-	-	1	1	2	2	1
2	3	3	2	1	1	1	-	-	-	-	1	1	2	2	1
3	2	2	3	2	2	3	-	-	-	-	1	1	3	3	1
4	2	2	3	2	1	2	-	-	-	-	1	1	3	3	1
5	3	3	2	2	2	2	-	-	-	-	1	1	2	2	1
Overall Correlation	3	3	2	2	1	2	-	-	-	-	1	1	2	2	1

23MT422 SENSORS AND INSTRUMENTATION LABORATORY

L	**T**	**P**	**C**
0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To learn about various force, pressure and vibration measuring sensors.
- To learn about various Temperature, light and magnetic field measuring sensors.
- To learn about various displacement and speed measuring sensors.

LIST OF EXPERIMENTS:

1. Determination of Load, Torque and Force using Strain Gauge.
2. Determination of the characteristics of Pressure Sensor and Piezoelectric Force Sensor.
3. Determination of Displacement using LVDT.
4. Determine the Characteristics of Various Temperature Sensors.
5. Determine the Characteristics of Various Light Detectors (Optical Sensors).
6. Distance Measurement using Ultrasonic and Laser Sensor.
7. Determine angular velocity of gyroscope.
8. Vibration measurement using Accelerometer.
9. Direction measurement using Magnetometer.

10. Speed, Position and Direction Measurement Using Encoders.
11. Force measurement using 3 axis force sensor.
12. Force Measurement using tactile sensors.
13. Data acquisition, visualization and analysis of signals.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Demonstrate the various contact and non-contact sensors.
CO2: Analyse and Identify appropriate sensors for given applications.
CO3: Create a sensor system for given requirements.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3
2	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3
3	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3
Overall Correlation	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3

23ES491 APTITUDE AND LOGICAL REASONING –I

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint student with frequently asked questions and patterns in quantitative aptitude and logical reasoning.

UNIT I **3**

Numbers, LCM, HCF, Averages, Ratio & Proportion, Mixtures & Allegation.

UNIT II **3**

Percentages, Time and work, Pipes and Cistern, coding and decoding.

UNIT III **3**

Time Speed Distance, Train, Boats and Streams, Analogy.

UNIT IV **3**

Data Interpretation (BAR, PIE, LINE), Seating arrangement.

UNIT V **3**

Simple Interest and Compound Interest, Profit loss and Discount, Partnership.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand the basic concepts of quantitative ability.

CO 2 Understand the basic concepts of logical reasoning Skills.

CO 3 Increase in critical thinking skills.

CO 4 Able to solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning Ability.

TEXT BOOK:

APTIPEDIA, 2nd edition, Wiley Publishers.

REFERENCE BOOKS:

1. Quantitative Aptitude – R.S. Agarwal.
2. A Modern Approach To Verbal & Non-Verbal Reasoning By R S Agarwal.

23RE501	RESEARCH METHODOLOGY AND INELLECTUAL PROPERTY RIGHTS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To provide an overview on selection of research problem based on the Literature review
- To enhance knowledge on the Data collection and Analysis
- To outline the importance of ethical principles to be followed in Research work and IPR

UNIT - I INTRODUCTION TO RESEARCH FORMULATION **6**

Meaning of research problem, Sources of research problem, Criteria- good research problem, and selecting a research problem, Scope and objectives of research

problem. Defining and formulating the research problem - Necessity of defining the problem - Importance of literature review in defining a problem

UNIT - II LITERATURE REVIEW 6

Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis

UNIT – III DATA ANALYSIS 6

Execution of the research - Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Generalization and Interpretation

UNIT-IV REPORT, THESIS PAPER, AND RESEARCH PROPOSAL WRITING 6

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, types of referencing, citations- index and footnotes, how to write report- Paper Developing,- Plagiarism- Research Proposal- Format of research proposal- a presentation - assessment by a review committee

UNIT - V INTELLECTUAL PROPERTY AND PATENT RIGHTS 6

Ethical principles- Plagiarism, Nature of Intellectual Property - Patents, Designs, Trade and Copyright- patent search, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of Patent Rights – Scope of Patent Rights, Geographical Indications

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO 1	Analyse and identify the research gap in the given area of research.
CO 2	Identify and formulate the research Problem
CO 3	Analyse and synthesize the data using research methods and knowledge to provide scientific interpretation and conclusion.
CO 4	Prepare research reports and proposals
CO5	Conduct patent database search for the research problem identified.
CO 6	Apply ethical principles in research to promote healthy scientific practice

TEXT BOOKS:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, Trade Marks, Copy right designs and Geographical indications. Universal Law Publishing

REFERENCES:

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7. Satarkar, S.V., 2000. Intellectual property rights and copy right. ESS Publications.

COs	Pos												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	1	-	1	-	-	1	1		-	1	1	1	1
CO 2	3	2	1	-	1	-	-	1	1		-	1	1	1	1
CO 3	3	2	1	-	1	-	-	1	1		-	1	1	1	1
CO 4	3	2	1	-	1	-	-	1	1		-	1	1	1	1
CO 5	3	2	1	-	1	-	-	1	1		-	1	1	1	1
CO 6	2	2	1	-	1	-	-	1	1		-	1	1	1	1
Overall Correlation	3	2	**1**	**-**	**1**	**-**	**-**	**1**	**1**		**-**	**1**	**1**	**1**	**1**

23MT501 ROBOTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To learn about basics of robots and their classifications
2. To understand the robot kinematics and dynamics in various planar mechanisms
3. To learn about the robot operating systems
4. To understand the concepts in trajectory planning and programming
5. To know about the basics of image processing

UNIT – I BASICS OF ROBOTICS **10**

Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, workspace-accuracy-resolution –repeatability of robot. Robot end effectors & Grippers: types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers

UNIT – II ROBOT KINEMATICS AND DYNAMICS **11**

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms. Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT – III ROBOT OPERATING SYSTEM **8**

ROS Concepts, Writing ROS Nodes, ROS Tools; Messages, Classes and Servers in ROS; Simulation and Visualization in ROS

UNIT–IV TRAJECTORY, PATH PLANNING AND PROGRAMMING **8**

Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages

UNIT– V ROBOT CASE STUDY **8**

Robot Applications – Welding, Palletizing, Deburring, Assembly- material handling and processing applications, recent trends in industrial robots- Building of grippers

TOTAL: 45 PERIODS

TEXTBOOKS:

1. John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.

2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

REFERENCES:

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010
3. S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800
4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.
5. Lentin Joseph, "Mastering ROS for Robotic Programming", Packt Publishing, 2015.
6. Francisco Martín Rico, "A Concise Introduction to Robot Programming with ROS2", 1st Edition, CRC Press, 2023.

COURSE OUTCOMES

Upon completion of this course, the students can be able to

CO1: Explain the basic concepts and terminologies of robots

CO2: Apply the Procedures for Forward and Inverse Kinematics of Robots.

CO3: Apply the procedures for Dynamics for Various Robots

CO4: Construct the different concepts of robots using ROS

CO5: Apply the various programming techniques in industrial applications

CO6: Explain the use of Machine vision systems

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	1	2	-	-	1	-	-	-	1	2	1	3
CO2	3	2	2	1	2	-	-	1	-	-	-	1	2	1	3
CO3	3	2	3	2	2	-	-	1	-	-	-	1	2	1	2
CO4	3	2	3	1	2	-	-	1	-	-	-	1	2	1	3
CO5	3	2	3	1	2	-	-	1	-	-	-	1	2	2	3
CO6	3	2	3	1	2	-	-	1	-	-	-	1	2	2	3
Overall correlation	3	2	3	1	1	-	-	1	-	-	-	1	2	1	3

23MT502 MECHATRONICS SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To learn about Mechatronics system design and simulation, ergonomics and safety
2. To understand theoretical and practical aspects of interfacing, real time data acquisitionand control
3. Design of motion converter, Pneumatic and Hydraulic Controller and temperature control.
4. To learn the real time interfacing software and man machine interface
5. To know about the various applications in this system

UNIT – I INTRODUCTION TO DESIGN OF MECHATRONICS SYSTEM 9

Key elements – Mechatronics design process – design parameters – mechatronics and traditional design – Advanced approaches in mechatronics design – Introduction to industrial design, modelling, simulation and analysis.

UNIT – II BASIC SYSTEM MODELLING 9

Introduction – model categories – model development – Simulation using software's – verification and validation – Mathematical modelling: Basic system modelling.

UNIT – III MECHATRONIC SYSTEM MODELLING 9

Engineering systems: Rotational – translational, electro-mechanical, pneumatic-mechanical, hydraulic-mechanical – Performance measures and control systems.

UNIT – IV REAL TIME INTERFACING 9

Introduction – Selection of interfacing standards- elements of data acquisition and control systems. – Overview of I/O process – general purpose I/O cards and its installation – Data conversion process – Application software – Man machine interface

UNIT – V CASE STUDIES ON DESIGN OF MECHATRONICS SYSTEM 9

Motion control using DC Motor, AC Motor and Servomotor - Temperature control of hot/cold reservoir – Pick and place robot – Car parking barriers – Motion and temperature control of washing machine.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the basic concepts of Integration and familiar the elements of mechatronics
CO2: Develop the system models and familiar the Mechatronics design process
CO3: Apply Real-Time Mechatronics system integration.
CO4: Develop the data acquisition for Real Time application.
CO5: Explain the various Mechatronics drives and controls of mechatronics systems
CO6: Explain he various applications of design of mechatronics systems.

TEXT BOOKS:

1. Devdas Shetty, Richard A. Kolk, "Mechatronics System Design", 2nd Edition, Cengage Learning 2012.
2. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL's, John wiley and sons Ltd, 2003.

REFERENCES:

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.
3. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	-	2	1	-	1	-	-	-	2	3	2	3
CO2	3	2	3	-	2	1	-	1	-	-	-	2	3	2	3
CO3	3	2	3	-	2	2	-	1	-	-	-	2	3	2	3
CO4	3	2	3	-	2	2	-	1	-	-	-	2	3	2	3
CO5	3	2	3	-	2	3	-	1	-	-	-	2	3	2	3
CO6	3	2	3	-	2	3	-	1	-	-	-	2	3	2	3
Overall correlation	3	2	3	-	2	2	-	1	-	-	-	2	3	2	3

23EE511 CONTROL SYSTEM ENGINEERING L T P C
3 0 2 4

COURSE OBJECTIVES:

1. To introduce the components and their representation of control systems
2. To learn various methods for analyzing the time response, frequency response and stabilityof the systems.
3. To learn the various approach for the system frequency analysis
4. To understand the concept of stability analysis
5. To know about the state variable methods of control system analysis

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Mođels-Block diagram Models-Signal flow graphs

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system- Steady-state error constant - type number-Introduction to P, PI, PID controllers.

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot-Design of compensators using Bode plots- Introduction to Lag, Lead, Lag-Lead compensators.

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversionof transfer functions to state variable models-Concepts of Controllability and Observability.

TOTAL: 45 PERIODS

List of Experiments

1. Mathematical Modelling and Simulation of a Physical Systems and Simulation and Reduction of Cascade and Parallel, and Closed Loop Sub-System.
2. Simulation and Analysis of First and Second Order System Equations in

Time andFrequency Domain.

3. Simulation and Analysis of System using Root-Locus and Bode Plot.
4. Simulation and Implementation of PID Combination for First Order Systems.
5. Simulation and Implementation of PID Combination Second Order Systems.
6. Auto tuning of PID parameters and analysis of PID Control.

TOTAL: 15 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the various control terminologies and concepts.

CO2: Apply the procedure to evaluate the performance of Time domain analysis and basic concepts of Controllers

CO3: Apply the procedure to evaluate the performance of Frequency domain analysis and basic concepts of compensators

CO4: Explain the concept of stability analysis

CO5: Explain the concepts of state variable representation and methods.

CO6: Construct various mathematical modeling and simulation analysis of control system.

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
2. K.Ogata, "Modern Control Engineering", PHI, 5 th Edition, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers,5th Edition, 2007.
2. S.K.Bhattacharya, "Control System Engineering", Pearson, 3 rd Edition, 2013.
3. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.
4. Nagoor Kani, "Control Systems", RBA Publications, 2017.
5. Norman. S. Nise, "Control Systems Engineering", Wiley India edition, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-
CO2	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-
CO3	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-
CO4	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-
CO5	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-

CO6	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-
Overall correlation	2	2	2	2	2	2	-	-	-	-	-	-	2	1	-

23MT511 COMPUTER AIDED DESIGN AND MANUFACTURING L T P C
3 0 2 4

COURSE OBJECTIVES:

- To Educate students by covering different aspects of computer Aided Design and Manufacturing.
- To Interpret geometric modelling of curves surfaces and solids
- To create strong skills of writing CNC programs.
- To Educate students to understand different advances in manufacturing systems like: GT, CAPP and FMS.
- To Educate students by covering different integrated production management systems.

UNIT I INTRODUCTION 9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing –Clipping viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM –CAD/CAM concepts ––Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance.

UNIT II GEOMETRIC MODELING 9

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.

UNIT III: NC AND CNC PART PROGRAMMING 9

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming (FANUC) on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

UNIT IV: COMPUTER INTEGRATED MANUFACTURING SYSTEM 9

Computer Integrated manufacturing system, Group Technology, Flexible Manufacturing System, Computer aided process Planning-Retrieval and Generative System. Manufacturing Execution System; Overview, Components and Functionality, Relationship between MES and ERP, Benefits of MES.

UNIT V: SMART MANUFACTURING **9**

Introduction to additive manufacturing, IoT, Smart Sensing, Smart Machines, Data Visualization and Analysis, Augmented Reality, Automated material handling and Cobots. Overview of 3D printing Technology, Materials used in 3D printing, Cybersecurity for manufacturing.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Modelling of a part using any CAD package.
2. Modelling and assembling of the mechanical assembly using any CAD package.
3. Structural analysis using FEA software – any analysis package.
4. Beam deflection analysis using FEA software – any analysis package.
5. Modelling and tool path simulation – turning using any CAM package.
6. Modelling and tool path simulation – milling using any CAM package.
7. NC code generation for milling using any CAM package.
8. NC code generation for turning using any CAM package.

TOTAL: 15 PERIODS

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TOTAL: 60 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics

CO2 Explain the fundamentals of parametric curves, surfaces and Solids

CO3 Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines

CO5 Explain the concepts of smart manufacturing.

CO6 Construct the design and analysis of structural components and construct the part programming for basic industrial components using CAD/CAM software.

TEXTBOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007
2. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.

REFERENCES:

1. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.
2. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management "Second Edition, Pearson Education, 1999.
3. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc,1992.
4. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education -2003
5. William M Neumann and Robert F. Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	1	-	-	-	1	2	1	1
CO2	2	2	1	1	1	-	-	1	-	-	-	1	2	1	1
CO3	3	2	1	1	1	-	-	2	-	-	-	2	2	1	2
CO4	3	2	1	1	1	-	-	1	-	-	-	1	2	1	1
CO5	3	2	3	3	3	-	-	2	-	-	-	2	2	1	2
CO6	3	2	1	1	1	-	-	3	-	-	-	3	2	1	3
Overall correlation	3	2	1	1	1	-	-	2	-	-	-	2	2	1	2

23MT521 **ROBOTICS LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES

1. To introduce different types of robotics and demonstrate them to identify different parts and components.
2. To write programming for simple operations.
3. To gather the practical exposure on machine vision elements, lighting technique, processing software and algorithms

LIST OF EXPERIMENTS
ROBOTICS LABORATORY

1. Robot programming and simulation for pick and place with conveyor motion

2. Robot programming and simulation for pick and place with conveyor motion and linear rail.
3. Robot programming and simulation for Colour identification
4. Robot programming and simulation for Shape identification
5. Robot programming and simulation for writing practice
6. Robot programming and simulation for welding
7. Modelling and simulation of vehicle body
8. Modelling and simulation of vehicle engine
9. Modelling and simulation of a 2 DOF robot - Forward and inverse kinematics.
10. Modelling and simulation of a 2 DOF robot - Polynomial and Trapezoidal functions.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of this course, the students will be able to;

CO1: Construct the Programme for robots in pick and place operation
CO2: Construct the Programme for robots in colour and shape identification.
CO3: Construct the Programme to perform the robots in writing operation
CO4: Create a machine vision setup for various industrial tasks.
CO5: construct the programs for robot simulation
CO6: construct programs for robot kinematics.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3
CO2	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3
CO3	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3
CO4	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3
CO5	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3
CO6	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3
Overall correlation	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3

23MT522 **MINI PROJECT – 2** **L T P C**

0 0 4 2

COURSE OBJECTIVES:

- To help students improve their ability to deal with a specific problem, from its identification and literature research to its successful solution, as well as to train them in creating project reports and dealing with reviews and viva voce examinations.
- To develop interactive, communication, organization, time management, and presentation skills.
- To support independent learning and innovative attitude and train students to present the topic of project work without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

METHOD OF EVALUATION

- The project work should preferably be an industrial real time problem or solution t societal problem, a micro issue on performance in the manufacturing industry a should involve scientific research, design, generation/collection and analysis of da use of software's, determining solution and must preferably bring out the individ contribution.
- The students as a group have to prepare a comprehensive project report a completing the work on a topic approved by the head of the department under guidance of a faculty member and to the satisfaction of the supervisor.
- The progress of the project work should be evaluated in three reviews.
- The Project Review Committee (PRC) members may be constituted by the Head of Department. Each student is requested to develop a working model/ proce software package /system on the chosen work and demonstrate before the P members. The dissertation should be presented in standard format.
- The mini project report should undergo plagiarism check as per the Anti-Plagiarism policy of the institute.
- The viva-voce shall be conducted in the presence of external examiner. A project report is required at the end of the semester and is evaluated based on oral

presentation and the project report by external and internal examiner.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO 1 Identify and establish solution for challenging problems.

CO 2 Develop critical thinking and problem-solving skills.

CO 3 Utilize tools, software, or techniques relevant to their field.

CO 4 Develop project management and time management skills.

CO5 Build independent learning, motivating students.

CO 6 Examine the project's outcomes in written reports, oral presentations.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	1	-	1	1	1	1	-	1	1	1	1	1	1
CO 2	3	2	1	-	1	1	1	1	-	1	1	1	1	1	1
CO 3	3	2	1	-	1	1	1	1	-	1	1	1	1	1	1
CO 4	3	2	1	-	1	1	1	1	-	1	1	1	1	1	1
CO 5	3	2	1	-	1	1	1	1	-	1	1	1	1	1	1
CO 6	3	3	2	-	1	1	1	1	-	1	1	1	1	1	1
Overall Correlation	3	3	2	-	1	1	2	1	-	1	1	1	1	1	1

23CE611 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To provide basic knowledge on environment impact assessment
- To create an awareness on the pollutants in the environment
- To familiarize the student with the technology for restoring the environment.
- To Apply the technology for producing ECO safe products
- To develop simple climate models and evaluate climate changes using models

UNIT – I INTRODUCTION TO ENVIRONMENT IMPACT ASSESSMENT 9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework.

UNIT–II MOVEMENT OF POLLUTANTS IN ENVIRONMENT 9

Concepts of diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, hydraulic potential, Darcy's equation, types of flow, turbulence. Concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); mixing heights, laws of thermodynamics; concept of heat and work, Carnot engine, transmission of electrical power, efficiency of turbines, windmills and hydroelectric power plants.

UNIT-III ECOLOGICAL RESTORATION 9

Wastewater treatment: anaerobic, aerobic process, methanogenesis, treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste treatment: sources and management (composting, vermiculture and methane production, landfill. hazardous waste treatment).

UNIT - IVECOLOGICALLY SAFE PRODUCTS AND PROCESSES 9

Biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation.

UNIT–V CLIMATE CHANGE MODELS 9

Constructing a climate model – climate system modeling – climate simulation and drift– Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming –climate change observed to date.

TOTAL:45 PERIODS

LAB COMPONENT

LIST OF EXPERIMENTS

1. Determination of Bio fuel parameters such as flash point and fire point.
2. Determination of density of biofuels.
3. Determination of BOD/COD in water.
4. Simulating the RCM and GCM model for different geographic conditions.
5. Measurement of Pollutant in environment by Gaussian Plume model.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Explain the importance of the process of environmental impact assessment and its types

CO 2 Illustrate the chemical processes and pollutant chemistry

CO 3 Identify the methods to solve environmental problems

CO 4 Apply the knowledge to develop eco-friendly products

CO 5 Construct the various simple climate models for simulation

CO 6 Apply the climate model simulation to monitor climate change

TEXTBOOKS:

1. David .E Neelin"Climate Change and Modelling",Cambridge University Press,California2012.
2. Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications.
3. Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House
4. N.S. Raman , A.R. Gajbhiye& S.R. Khandeshwar, Environmental Impact Assessment, 2014,IK International Pvt Ltd.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
2	3	2	1	-	-	2	2	-	-	-	-	1	2	-	-
3	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
4	3	2	1	-	-	3	3	-	-	-		2	3	-	-
5	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
6	3	2	1	-	-	3	3	-	-	-	-	2	3	-	-
Overall correlation	**3**	**2**	1	-	-	3	3	-	-	-	-	2	3	-	-

23MT611 INDUSTRIAL AUTOMATION L T P C

3 0 2 4

OBJECTIVES:

- Abstract the importance of Automation and PLC Programming
- Detail the architecture components of production plants using DCS
- To understand the working of SCADA elements

- Compare the working of SCADA, DCS and PLC
- Teach the working of networking in industries

UNIT I INDUSTRIAL AUTOMATION AND PLC 9

Introduction to Industrial Process Automation-Definition, Necessity, Evolution, Types, Challenges of Automation Architecture of Industrial Automation Network- Process Automation with Smart and Intelligent Instruments- Industry 1.0 to Industry 4.0. PLC Program Structure and Execution - Programming Devices for PLC - PLC Programming Tools-Timer – Counters - Registers- Advanced PLC Functions - PLC Protocols- Selection and Commissioning of PLC

UNIT II DISTRIBUTED CONTROL SYSTTEM 9

Computers in Process Automation-Architecture of Computer-Based Industrial Automation System-Hardware and Software Configuration-Process Automation Network-PC-Based Control Loop-Sampling of Process Data- Distributed Control System-Hardware Units of DCS-Communications in DCS Architecture-Software Packages of DCS-Operation, Monitoring, Control, and Data Acquisition in DCS-Integration of DCS with PLC and SCADA DCS based Process Control Simulations.

UNIT III SCADA SYSTEM & ARCHITECTURE 9

Introduction-SCADA Basics-Different SCADA System Topologies-Evolution of SCADASCADA Architecture-Functions of SCADA-Elements of SCADA-SCADA, DCS, and PLC: A Comparison-SCADA Security: Threats, Vulnerabilities, and Consequences-SCADA Standards Organizations-Application Areas of SCADA-SCADA and IIoT SCADA Implementations for Automation Industries

UNIT IV INDUSTRIAL NETWORKING &M2M COMMUNICATION 9

Introduction to industrial Networking-Network Devices- Fieldbus-Types- Topology-Benefits- Foundation Fieldbus-Comparison with OSI Model-Medium Access Control (MAC)- PROFIBUS-Communication via PROFIBUS, PROFINET, DP Bus Access-HART: Highway Addressable Remote Transducer-Wireless field bus-WHART-M2M Communication and Technologies-M2M Communication Protocols

UNIT V INDUSTRIAL INTERNET OF THINGS (IIOT) 9

Introduction: IoT and IIoT - Evolution of IIoT – Architecture of IoT and IIoT – IIoT Protocols – Layout of a Smart Factory – Benefits, Challenges, Technological components of IIOT – Difference between IoT and IIoT – Application areas of IIoT

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS

1. Design a Ladder Logic Program for various Logic Gates AND, OR, NOT, NOR, NAND, EX-OR and EX-NOR.

2. Develop Ladder Diagram Programming to set Timer and Counter in PLC.
3. Develop PLC Program to Control Traffic Light.
4. Develop PLC Program to Maintain the Pressure and Level in a Bottle Filling System.
5. Develop Ladder Diagram Program in PLC For Material Filling, Object Shorting, Orientation Check and Material Property Check.
6. Develop the Ladder Diagram Program in PLC for Material Handling, Delaying Conveyor, Feeding, Pick and Place Operation.
7. Sensor and Actuator Interfacing in PLC and PLC to PLC Communication.

TOTAL: 15 PERIODS

OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Discuss Industrial Automation Process

CO2: Discuss PLC program

CO2: Explain the architecture layout for Automation Production Plant

CO3: Analyze the components and implementation of SCADA in process industries

CO4: Determine the types of Networking in Industries

CO5: Justify the difference in IoT and IIoT

TEXTBOOKS:

1. Dey, Chanchal, and Sunit Kumar Sen, Industrial automation technologies, 2020, CRC Press.
2 Gilchrist, Alasdair, Industrial Internet use-cases. Industry 4.0., 2016, Apress, Berkeley, CA.

REFERENCES

1. Johnson, David. Programmable Controllers for Factory Automation, 2020, CRC Press.
2. Sharma, K. L. S. Overview of industrial process automation, 2016, Elsevier.
3. Mikell P Groover, Automation, Production Systems and Computer Integrated Manufacturing, 2016, Pearson.
4. Frank D. Petruzzella, Programmable Logic Controllers, 2019, Mc-Graw Hill.
5. Veena S. Chakravarthi, Internet of Things and M2M Communication Technologies Architecture and Practical Design Approach to IoT in Industry 4.0, Springer 2021

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO2	3	2	1	1	-	-	-	3	-	-	-	3	3	3	3

CO3	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO4	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO5	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO6	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
Overall correlation	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2

23MT612 **FLUID POWER SYSTEMS** **L T P C**

3 0 2 4

OBJECTIVE:

1. To recognize the standard symbols and to understand the functions of basic fluid power generation and actuation elements.
2. To realize the functions of hydraulic regulation and control elements and its typical uses in fluid power circuit and to acquire the practice on assembling the various types of hydraulic circuits.
3. To familiarize and exercise the design procedure of various types of hydraulic fluid power circuits and to provide a training to create the various types of hydraulic circuits.
4. .To recognize the functions of pneumatic elements and design pneumatic circuits and understand logic functions and circuits
5. To realize problems in installation and selection of hydraulic and pneumatic components and applications of hydraulics and pneumatics

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS **9**

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids – Basics of Hydraulics – Pascal's Law- Principles of flow – Friction loss- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps-Problems

UNIT II HYDRAULIC ACTUATORS AND VALVES **9**

Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning – Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves-Types, Construction and Operation- Servo and Proportional valves - Applications – Types of actuators. Accessories: Reservoirs, Pressure Switches- Applications- Fluid Power ANSI Symbols – Problems

UNIT III HYDRAULIC SYSTEMS **9**

Accumulators, Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT IV PNEUMATIC SYSTEMS **9**

Properties of air– Perfect Gas Laws - Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics, Pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS **9**

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems. Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for a Pick and Place application and tool handling in a CNC machine. - Low cost Automation – Hydraulic and Pneumatic power packs- case studies.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design and testing of hydraulic circuits such as

Pressure control

Flow control

Direction control

Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electrohydraulic Trainer.

2. Design and testing of pneumatic circuits such as

Pressure control

Flow control

Direction control

Circuits with logic controls

Circuits with timers

Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.

Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using

MATLAB/LABVIEW software.

3. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.

TOTAL: 15 PERIODS

OUTCOMES:

CO 1: Explain the various concepts of hydraulic and pneumatic systems

CO 2: Explain the concepts of various actuators and valve for Hydraulic systems.

CO 3: Construct the various basic hydraulic circuit systems.

CO 4: Construct the fluid power circuits-based automation system

CO 5: Explain the trouble shooting and applications of PLC

C O 6 : Demonstrate the standard fluid power circuits using trainer kit and simulation software

TEXTBOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. Shanmuga Sundaram. K, "Hydraulic and Pneumatic Controls", Chand & Co, 2006

REFERENCES:

1.. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata Mc Graw Hill, 2001

2. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata Mc Graw Hill, 2007.

3. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

4. Srinivasan.R, "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 2008.

5. Joji.P, "Pneumatic Controls", John Wiley & Sons India, 2008

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	1	-	-	-	1	3	2	3
CO2	2	2	1	1	1	-	-	1	-	-	-	1	3	2	3
CO3	3	2	2	2	2	-	-	2	-	-	-	1	3	2	3
CO4	3	2	2	2	2	-	-	2	-	-	-	1	3	2	3
CO5	2	2	1	1	1	-	-	1	-	-	-	1	3	2	3
CO6	3	3	3	3	3	-	-	3	-	-	-	1	3	2	3
Overall correlation	3	2	2	2	2	-	-	2	-	-	-	1	3	2	3

23MT621	Project Work Phase-1	L	T	P	C
		0	0	4	2

COURSE DESCRIPTION:

This course provides an opportunity for students to apply their engineering knowledge to solve real-world problems through project-based learning. Students, working in groups with maximum of 4 under faculty supervision, undertake a comprehensive project addressing an approved topic. The course focuses on fostering collaboration, research, and practical skills, culminating in a detailed Phase 1 project report and oral presentations. Regular reviews ensure consistent progress and adherence to academic standards.

COURSE OBJECTIVES:

- Encourage students to apply theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork.
- Train students in research methodology, technical documentation, and presentation skills.
- Enhance students' ability to design, analyze, and evaluate solutions systematically.
- Prepare students for real-world engineering challenges and multidisciplinary teamwork

Project Outline:

Week 1 – Orientation and course overview. Formation of project teams and approval of topics by HoD.

Week 2 – Initial meeting with supervisors. Define problem statement and objectives

Week 3 – Literature review: Research methodologies and topic-specific studies.

Week 4 – Zeroth Review.

Week 5 – Refinement of literature review and identification of research gaps.

Week 6 – Identification of Base Paper.

Week 7 – First Review.

Week 8 – Conceptual design discussions and brainstorming solutions.

Week 9 – Narrowing done on the exact work.

Week 10 – Completion of first stage of the Project.

Week 11 – development of detailed conceptual design and methodology.

Week 12 – Incorporation of feedback and refinement of design and methodology.

Week 13 – Third Review.

Week 14 – Compilation of Phase 1 results, report writing, and presentation preparation.

Week 15 – Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work

EVALUATION:

- Evaluate how effectively the project is structured and communicated in both oral presentations and written texts, emphasizing logical flow and coherence.
- Assess the depth of understanding demonstrated in the project's conceptualization and the ability to answer questions during public presentations.
- Analyze the application of a well-defined investigative approach to guide the project and its alignment with Sustainable Development Goals (SDGs).
- Examine the inquiry-driven arguments presented to justify the project's direction and its potential contribution to global SDGs such as such as industry innovation (SDG 9), clean energy (SDG 7), and partnerships for goals (SDG 17) climate action (SDG 13), sustainable communities (SDG 11), and responsible consumption (SDG 12).
- Evaluate the relevance and innovation of practical resources or prototypes developed, focusing on their potential to support sustainability, innovation, and SDG-aligned goals.
- Ability to convey clear conceptualization of project and answer questions in public presentation.
- Review the accuracy of English usage, including grammar, clarity, and coherence in oral and written communication, ensuring effective delivery of technical content.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Formulate a well-defined problem statement and research objectives.

CO 2 Conduct a literature review to identify gaps and establish the project's relevance.

CO 3 Design and analyze conceptual solutions addressing the project goals

CO 4 Demonstrate effective teamwork, communication, and project management skills.

CO 5 Present technical concepts and results through professional oral and written communication.

CO 6 Develop innovative and sustainable engineering solutions that contribute to achieving Sustainable Development Goals (SDGs), such as climate action, sustainable communities, and responsible consumption and production

COs	PROGRAMME OUTCOMES (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	2	3	3	2	3	2	3	2	3	2	3
CO 3	2	3	3	3	3	3	3	3	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	2	2	2	2
CO 5	2	3	3	3	3	3	3	3	3	3	3	3
CO 6	2	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	3	3	3	3	3	3	3	3	3	3	3

23MT622 **TECHNICAL TRAINING** **L T P C**

0 0 2 1

Preamble:

The course 'Technical Training' is intended to enable a B.E./B.Tech. graduate to practice, learn,apply and prepare report about the training undergone. The learner shall be involved in the training of latest technology in relevant Industry preferably in computer-oriented platform. This course can help the learner to experience training and learn practical skills for the relevant domain. Learner should also be able to

present his learning through PPT and report articulating his level of learning about the specific training.

Course Objectives:

- To equip students with practical skills and real-world experience in technical domains, enabling them to effectively apply theoretical knowledge to hands-on applications.
- To develop competencies in working with industry-relevant tools and software technologies.
- To foster teamwork, problem-solving, and technical skills through innovative technologies

COURSE OUTCOMES:

After successful completion of the course, the students will be ableto

CO1	Identify specific domain from the enrolled branch and to get training preferable in computer-oriented platform.
CO2	Survey and apprehend the learning modules in the training program and to become expert in the specific domain.
CO3	Apply theoretical learning in the practical environment and enhance the skillset of learner.
CO4	Estimate the learning using available literature.
CO5	Defend a presentation about the learning done in the specified skillset.
CO6	Construct a technical report about the training.

Guidelines:

- More than one training program may be given depending on availability and interest of the students. One training coordinator may be appointed for the same.
- Training coordinator shall provide required input to their students regarding the selection of training topic.
- Choosing a Training topic: The topic for a Technical Training should be current and broad based rather than very specific area of interest. It should also be outside the present syllabus. It's advisable to choose a training topic to be

computer oriented as the resources for the same may be readily available. Every student of the program should be involved and assessed.

- Head of Department shall approve the selected training topic by the second week of the semester. Training may be assessed based on the ability to apply the skillset in a practical domain.

Evaluation pattern:

Training Coordinator:

50 marks (Training Manual – 40 (Each student shall maintain a Training Manual and the Coordinator shall monitor the progress of the training work on a weekly basis and shall approve the entries in the Training Manual during the weekly meeting with the student), Attendance – 10,).

Presentation of Application:

Candidate should apply the skillset attained in training. 20 marks to be awarded by the External and Internal Examiner (Clarity of presentation – 10, Interactions – 10, Quality of the slides – 10).

Report about Application:

30 marks to be awarded by the Examiner (check for technical content, overall quality, templates followed, adequacy of application of the skillset etc.).

Training duration – 30 Hours

Total – 100 Marks

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	-	2	1	-	-	-	-	3
CO2	3	3	2	1	-	2	1	-	-	-	-	3
CO3	3	3	3	3	3	-	-	1		2	-	3
CO4	3	3	3	2	2	-	-	1		3	-	3
CO5	3	3	3	2	1	2	-	2		2	-	2
CO6	3	3	3	3	2	2	-	2		3	-	3
Overall correlation	-	-	-	-	-	-	-	-	-	-	-	-

23MT711 MACHINE VISION SYSTEMS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

1. To introduce the various concepts in machine vision
2. To understand the concepts in image acquisition
3. To learn about a various basics in image processing
4. To knowledge about the feature extraction and vision techniques
5. To understand the various applications in machine vision

UNIT – I INTRODUCTION **9**

Human vision – Machine vision and Computer vision – Benefits of machine vision – Block diagram and function of machine vision system implementation of industrial machine vision system – Physics of Light – Interactions of light – Refraction at a spherical surface – Thin Lens Equation.

UNIT – II IMAGE ACQUISITION **9**

Scene constraints – Lighting parameters – Lighting sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection– Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras – Digital Camera Interfaces – Camera Computer Interfaces, Specifications and Selection – Geometrical Image formation models – Camera Calibration

UNIT – III IMAGE PROCESSING **9**

Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Grayscale Stretching – Neighborhood Operations, Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Colour image processing.

UNIT – IV FEATURE EXTRACTION **9**

Feature extraction – Region Features, Shape and size features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.

UNIT – V MACHINE VISION APPLICATIONS **9**

Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile, applications in non-visible spectrum, metrology and gauging, OCR and OCV, vision guided robotics – Field and Service Applications – Agricultural, and

Bio medical field, augmented reality, surveillance, biometrics.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Study of lighting techniques for machine vision
2. Study of design of machine vision system
3. Image processing reading, video playback Display
4. Image Processing, Dilation and Erosion
5. Counting similarly - shaped objects from an image.
6. Classifying similar objects
7. Detecting cells, angles and lines Colour and line segmentation

TOTAL: 15 PERIODS

COURSE OUTCOMES:

Upon completion of this course the student will be able to

CO 1: Know the various types of sensors, lightings, hardware and concept of machine vision

CO 2: Acquire the image by the appropriate use of sensors, lightings and hardware

CO 3:Apply the various techniques of image processing in real time applications

CO 4: Select the suitable sensors, lightings and hardware for machine vision system

CO 5: Apply the machine vision techniques in machine vision system

CO6: Create a machine vision setup for various industrial tasks and write the programs for robot and machine vision applications

TEXTBOOKS

1. Eugene Hecht, A. R. Ganesan "Optics", Fourth Edition, 2008
2. Alexander Hornberg, "Handbook of Machine Vision", First Edition, 2006

REFERENCES

1. Emanuele Trucco, Alessandro Verri, "Introductory Techniques For 3D Computer Vision", First Edition, 1998
2. Rafael C. Gonzales, Richard. E. Woods, "Digital Image Processing Publishers", Fourth Edition, 2007

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3
CO2	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3
CO3	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3

CO4	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3
CO5	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3
CO6	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3
Overall correlation	3	2	-	3	-	2	-	-	-	-	-	2	3	2	3

23MT712 EMBEDDED SYSTEMS AND PROGRAMMING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

1. To familiarize the architecture and fundamental units of microcontroller.
2. To know the microcontroller programming methodology and to acquire the interfacing skillsand data exchange methods using various communication protocols.
3. To design the interface circuit and programming of I/O devices, sensors and actuators.
4. To understand ARM processor architecture and its functions to meet out the computationaland interface needs of growing mechatronic systems.
5. To acquaint the knowledge of real time embedded operating system for advanced systemdevelopments.

UNIT I INTRODUCTION TO MICROCONTROLLER 9

Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization – Addressing Modes.

UNIT II PROGRAMMING AND COMMUNICATION 9

Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller-Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I^2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

UNIT III PERIPHERAL INTERFACING 9

I/O Programming – Interfacing of Memory, Keyboard and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT IV ARM PROCESSOR 9

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining –

basic programming of ARM 7 - Applications.

UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING 9

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Python for Embedded Systems- GPIO Programming – Interfacing

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051.
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with8051.
7. UART Serial and Parallel Port Programming of 8051.
8. I^2C, SPI and CAN Programming of 8051.
9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
10. Programming of ARM Processor for Sensor Interface.
11. Stepper Motor and Servo Motor Control Using ARM Processor.
12. Serial Communication of ARM Processor with Computation Platform.
13. Wireless Communication of ARM Processor with Computation Platform.
14. GPIO Programming of Real Time Embedded Operating Systems.
15. IOT application using SBC.

(any 7 experiments) **TOTAL:15 PERIODS**

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the various functional units of microcontrollers, processors, and system-on-chip based on their features and specifications.

CO2: Analyse the role of each functional unit in microcontrollers, processors, and system-on-chip based on their features and specifications.

CO3: Explain the Integrate sensors, actuators, and other I/O devices with microcontrollers, processors, and system-on-chip-based systems.

CO4: Construct circuits using microcontrollers, processors, and system-on-chip for specific applications.

CO5: Develop programs for microcontrollers, processors, and system-on-chip to meet desired functionalities.

CO6: Create embedded system applications to solve real-world problems.

TEXT BOOKS:

1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and ProgrammingApplications", 2003.

REFERENCES:

1. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and EmbeddedSystems", Pearson Education, 2006.
2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with PythonMcGraw Hill TAB; 2nd edition,2015
3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", RegentsPrentice Hall, 2003.
4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3
CO2	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3
CO3	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3
CO4	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3
CO5	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3
CO6	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3
Overall correlation	3	2	1	1	2	2	-	1	-	-	-	1	3	1	3

23MT721 **PROJECT WORK PHASE-2**

L	T	P	C
0	0	6	3

COURSE DESCRIPTION:

Project Phase 2 is a continuation of Project Phase 1, focusing on implementing the proposed methodology through fabrication, simulation, or experimental validation. Students will refine their designs, validate test problems, and commission setups for final testing. This phase emphasizes hands-on application, calibration, and

demonstration of results, culminating in a final presentation and report submission.

COURSE OBJECTIVES:

- Implement the proposed methodology to address engineering problems identified in Phase 1.
- Develop and fabricate prototypes or simulate solutions for the selected project.
- Validate solutions through testing, calibration, and commissioning of setups.
- Enhance problem-solving and critical thinking skills by troubleshooting and optimizing results.
- Present technical findings effectively through oral presentations and comprehensive documentation.

Project Outline:

Week 1 – Review of Phase 1 outcomes and refinement of proposed methodology.
Week 2 – Material procurement, software setup for simulation, and initiation of fabrication/simulation work.
Week 3 – Progress on fabrication or simulation work; troubleshooting initial challenges.
Week 4 – Third Review.
Week 5 – Intermediate fabrication/simulation work and initial testing or calibration.
Week 6 – Validation of test problem or refinement of prototype/simulation.
Week 7 – Commissioning of the test setup and initial trials.
Week 8 – Troubleshooting and optimization of setup or simulation results.
Week 9 – Final testing of setup or simulation outcomes.
Week 10 – Calibration and benchmarking of the setup against expected results.
Week 11 – Demonstration of the working prototype or simulated solution.
Week 12 – Fourth Review.
Week13– Compilation of Phase 2 results, report writing, and presentation preparation.
Week 14 - Preparing research article.
Week 15 – Final Viva Voce Presentations.
Individual meetings will be set up on a need's basis in conjunction with developing work

EVALUATION:

- Evaluate how effectively the project is structured and communicated in both oral presentations and written texts, emphasizing logical flow and coherence.

- Assess the depth of understanding demonstrated in the project's conceptualization and the ability to answer questions during public presentations.
- Analyze the application of a well-defined investigative approach to guide the project and its alignment with Sustainable Development Goals (SDGs).
- Examine the inquiry-driven arguments presented to justify the project's direction and its potential contribution to global SDGs such as such as industry innovation (SDG 9), clean energy (SDG 7), and partnerships for goals (SDG 17) climate action (SDG 13), sustainable communities (SDG 11), and responsible consumption (SDG 12).
- Examine the inquiry-driven arguments presented to justify the project's direction. Evaluate how effectively the project contributes to SDGs and addresses real-world challenges in line with global sustainability goals.
- Ability to convey clear conceptualization of project and answer questions in public presentation.
- Review the accuracy of English usage, including grammar, clarity, and coherence in oral and written communication, ensuring effective delivery of technical content.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Fabricate or simulate engineering solutions based on a validated methodology.

CO 2 Calibrate and commission test setups to achieve reliable and accurate results.

CO 3 Demonstrate and validate solutions through testing and analysis

CO 4 Effectively present technical findings using oral and written communication..

CO 5 Evaluate the effectiveness of the oral presentation, focusing on the ability to engage the audience, clearly convey complex ideas, and answer questions with confidence

CO 6 Apply sustainable and innovative practices in engineering problem-solving.

COs	**PROGRAMME OUTCOMES (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	2	3	3	2	3	2	3	2	3	2	3
CO 3	2	3	3	3	3	3	3	3	3	3	3	3

CO 4	2	2	2	2	2	2	2	2	2	2	2	2
CO 5	2	3	3	3	3	3	3	3	3	3	3	3
CO 6	2	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	3	3	3	3	3	3	3	3	3	3	3

23MT722 **TECHNICAL SEMINAR** **L T P C**

0 0 2 1

Preamble:

The course 'Technical Seminar' is intended to enable a B.E graduate to read, understand,present and prepare a report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and empower her/him to prepare a technical report

Course Objectives:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literate and to give a presentationabout it
- To prepare a technical report.

Guidelines:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with an academic coordinator for that program as the Chairperson and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work. It's advisable to choose a

topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern:

Seminar Guide:

20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

Seminar Coordinator:

20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

Total – 100 Marks

COURSE OUTCOMES:

After successful completion of the course, the students will be able to

CO1 Identify academic documents from the literature which are related to her/his areas of interest.

CO2 Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.

CO3 Compile a presentation about an academic document.

CO4 Estimate the Contents using available literature.

CO5 Defend a presentation about an academic document.

CO6 Construct a technical report.

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	1	1		2	1					3
2	3	3	2	1		2	1					3
3	3	3	3	3	3			1		2		3
4	3	3	3	2	2			1		3		3
5	3	3	3	2	1	2		2		2		2
6	3	3	3	3	2	2		2		3		3
Overall correlation	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

23MT821 **CAPSTONE PROJECT** **L T P C**

0 0 20 10

COURSE DESCRIPTION:

The *Capstone Project* ***(CP)*** provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the engineering field. Capstone projects will be investigative, practice centered. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students.

The aim of the course is to facilitate the development of your *Capstone Projects.* Students are encouraged to apply and expend knowledge gained on teaching and learning throughout the Bachelor of Engineering Education program as part of this process

COURSE OBJECTIVES:

The Capstone Project should demonstrate the depth and extent of knowledge of students

During this course, students will

- Investigate and evaluate prominent literature connected to your CP.
- Develop an outline for thinking and practice that illuminates and brings insight

to an area of the particular branch of engineering field.

- Develop and create practical resources (either computational or experimental) for the concerned area of interest in engineering field.
- Present a clearly articulated investigative framework, while situating projects within established academic practices and/ or ideas.
- Offer inquiry-based argumentation for development in the concerned area within engineering field.

Project Outline:

Week 1 – Team segregation and Identification of Project Guide

Week 2 – Identification of Area of Interest.

Week 3 – Literature Review on the chosen area of interest.

Week 4 – Literature Review on the chosen area of interest.

Week 5 – Zeroth Review.

Week 6 – Identification of Base Paper.

Week 7 – Preliminary Work.

Week 8 – First Review.

Week 9 – Narrowing done on the exact work.

Week 10 – Completion of first stage of the Project.

Week 11 – Second Review.

Week 12 – Extending work for more parameters and Validation

Week 13 – Finalizing second stage of Project.

Week 14 – Third Review.

Week 15 – Improvement of the obtained results and final corrections. Testing & Validation

Week 16 - Preparing Journal and Report Generation.

Week 17 – Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology (K4).

CO 2 On Completion of the project work students will be able to identify research

methodology to tackle a specific problem (K4).

CO 3 On Completion of the project work students will be able to conduct extensive study on particular research projects (K3).

CO 4 On Completion of the project work students will be able to perform experimental and computational studies on innovative research projects (K6).

CO 5 On Completion of the project work students will be able to execute incremental study on existing research projects (K3).

CO 6 On Completion of the project work students will be in a position to take up real life engineering challenges and provide appropriate solutions (K6).

EVALUATION:

- Evidence of application of clearly articulated investigative framework to inform the capstone project.
- Offer of an inquiry-based argumentation for development in the concerned area within engineering field.
- Synthesis and evaluation of a relevant body of literature to contextualize the topic.
- Development of appropriate and relevant practical resources for identified area of interest in engineering field.
- Ability to organize and illustrate project in oral presentation and written texts.
- Ability to convey clear conceptualization of project and answer questions in public presentation.
- Accurate use of English.
- Accurate use of referencing.

COs	**PROGRAMME OUTCOMES (POs)**											
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	2	3	3	2	3	2	3	2	3	2	3
CO 3	2	3	3	3	3	3	3	3	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	2	2	2	2
CO 5	2	3	3	3	3	3	3	3	3	3	3	3
CO 6	2	2	2	2	2	2	2	2	2	2	2	2
Overall	3	3	3	3	3	3	3	3	3	3	3	3

Correlation												

23MT031	**ROBOTS AND SYSTEMS IN SMART MANUFACTURING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To get a knowledge of working on Industrial robots and their load handling capacity
2. To enlist with an application of robots in various operation
3. To familiar with a material handling system
4. To impart the knowledge on robotic welding
5. To obtain the knowledge on various type of robot welding operation

UNIT – I INTRODUCTION **7**

Types of industrial robots - Load handling capacity - general considerations in Robotic material handling-material transfer - machine loading and unloading - CNC machine tool loading - Robot centered cell

UNIT – II SELECTION OF ROBOTS AND OTHER APPLICATIONS **9**

Factors influencing the choice of a robot - robot performance testing - economics of robotization - Impact of robot on industry and society. Application of Robots in continuous arc welding - Spot welding - Spray painting -assembly operation - cleaning - robot for underwater applications.

UNIT – III MATERIAL HANDLING **13**

concepts of material handling - principles and considerations in material handling systems design - conventional material handling systems - industrial trucks - monorails - rail guided vehicles - conveyor systems -cranes and hoists - advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems (ASRS) - bar code technology - radio frequency identification technology -Introduction to Automation Plant design software.

UNIT – IV ROBOTIC WELDING **8**

Robotic welding system, Programmable and flexible control facility –Introduction-Types- Flex Pendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic welding, Welding simulation, Welding

sequences, Profile welding

UNIT – V APPLICATIONS OF ROBOTS IN WELDING AND ALLIED PROCESSES **8**

Application of robot in manufacturing: Exploration of practical application of robots in welding: Robots for car body's welding, robots for box fabrication, robots for microelectronic welding and soldering – Applications in nuclear, aerospace and ship building, case studies for simple and complex applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The Student must be able to

CO 1: Explain the various concepts of Industrial Robot.
CO 2: Apply the appropriate manufacturing procedure for Robots
CO3: Explain the various industrial applications of robots
CO 4: Explain the applications of robots in material handling.
CO 5: Explain the concepts of robots for the Welding operation.
CO 6: Construct the procedure of a manufacturing plan for developing a robot

TEXTBOOKS:

1. Richard D Klafter, Thomas Achmielewski, MickaelNegin , "Robotic Engineering – An integrated Approach", Prentice Hall India, New Delhi, 2006.
2. Mikell P Groover , "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, New York, 2019.

REFERENCES:

1. Pires J N, Loureiro A, Bolson G, "Welding Robots: Technology, System Issues and Application", Springer, London, 2010.
2. Parmar R S , "Welding Processes and Technology", Khanna Publishers, New Delhi, 2nd Edition, 2013.
3. John A. Piotrowski, William T. Randolph , "Robotic welding: A Guide to Selection and Application, Welding Division, Robotics International of SME", Publications Development Dept., Marketing Division, 1987.
4. Mikell P Groover, Mitchel Weiss, Roger N Nagel, N.G.Odrey, Ashish Dutta "Industrial Robotics (SIE): Technology, Programming and Applications", 2nd Edition, McGraw Hill Education India Pvt Ltd, 2012.
5. Yoram Koren , "Robotics for Engineers", McGraw-Hill, 1987.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO2	3	2	2	2	-	-	-	3	-	-	-	3	3	2	3
CO3	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO4	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO5	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2
CO6	3	2	2	2	-	-	-	3	-	-	-	3	3	2	3
Overall correlation	2	2	1	1	-	-	-	2	-	-	-	2	2	2	2

23AE072 **DRONE TECHNOLOGIES** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To understand the basics of drone concepts
2. To learn and understand the fundaments of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT – II DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi **rotor** stabilization- Flight modes -Wi-Fi connection.

UNIT – III DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled

environment- Drone controls Flight operations –management tool –Sensors- Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.

UNIT – IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT – V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain various types of drone technology and, drone fabrication
CO2: Construct the programming for various types of drones.
CO3: Apply the suitable operating procedures for functioning a drone.
CO4: Explain various sensors and actuators for Drones.
CO5: Develop a drone mechanism for specific applications.
CO6: Explain the safety and future development of drones

TEXTBOOKS

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social

Implications for Security and Surveillance", Springer, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	1	-	-	2	-	-	-	2	2	1	2
CO2	3	2	2	2	2	-	-	3	-	-	-	3	3	1	3
CO3	3	2	2	2	2	-	-	3	-	-	-	3	3	1	3
CO4	2	2	1	1	1	-	-	2	-	-	-	2	2	1	2
CO5	3	2	2	2	2	-	-	3	-	-	-	3	3	1	3
CO6	2	2	1	1	1	-	-	2	-	-	-	2	2	1	2
Overall correlation	3	2	1	1	1	-	-	3	-	-	-	3	3	1	3

23MT032 MICROROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To expose students to the fundamental aspects of the emerging field of micro robotics.
2. To expose students to micro scale, technologies for fabricating small devices, bio- inspired design, and applications of the field.
3. To expose students to various Mathematical formalism for flexures, Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuators and other sensors.
4. To apply micro robotics to various applications
5. To engage students in implementation of microrobotics

UNIT – I INTRODUCTION TO MICROROBOTICS 9

Introduction - MST (Micro System Technology) - Micromachining - Working principles of Microsystems Applications of Microsystems - Micro-fabrication principles-Design selection criteria for micromachining - Packaging and Integration aspects - Micro-assembly platforms and manipulators

UNIT – II SCALING LAWS AND MATERIALS FOR MEMS 9

Introduction - Scaling laws - Scaling effect on physical properties scaling effects on Electrical properties - scaling effect on physical forces - Physics of Adhesion - Silicon - compatible material system - Shape memory alloys - Material properties - Piezo resistivity, Piezoelectricity and Thermoelectricity

UNIT – III FLEXURES, ACTUATORS AND SENSORS 9

Elemental flexures - Flexure systems - Mathematical formalism for flexures - Electrostatic actuators - Piezo-electric actuators - Magneto-strictive actuators - Electromagnetic sensors - Optical-based displacement sensors - Motion tracking with microscopes

UNIT – IV MICROROBOTICS 9

Introduction - Task specific definition of micro robots - Size and Fabrication Technology based definition of micro- robots - Mobility and Functional-based definition of micro-robots - Applications for MEMS based micro-robots.

UNIT – V IMPLEMENTATION OF MICROROBOTS 9

Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators- Design of locomotive micro-robot devices based on arrayed actuators - Micro-robotics devices - Micro grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots - multi-robot system: Micro-robot powering, Micro-robot communication.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of the course the Student will be able to

CO1: Explain and apply the concepts of mass, energy, and momentum balance in micro robotics.

CO2: Apply adapt and synthesize learned engineering skills to create microrobot.

CO3: Design of microrobots for different robotics applications

CO4: Explain he various sensors and actuators used in microrobots

CO5: Illustrate the specifications and design of mechatronic Systems.

CO6: Explain the Microrobot for different robotics applications

TEXTBOOKS:

1. Mohamed Gad-el-Hak , "The MEMS Handbook", 2nd Edition, CRC Press, New York, 2019.
2. Yves Bellouard, "Microrobotics Methods and Applications", CRC Press, Massachusetts, 2019.

REFERENCES:

1. Nadim Maluf and Kirt Williams, "An Introduction to

Microelectromechanical systems Engineering", 2nd edition, Artech House, 2004.
2. Julian W Gardner, "Microsensors: Principles and Applications", 2nd edition, Wiley, 2007.
3. Metin Sitti, "Mobile Microrobotics", MIT Press, 2017.
4. Nicolas Chaillet, Stephane Rangier, "Microrobotics for Micromanipulation", John Wiley & Sons, 2013.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3
CO2	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3
CO3	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3
CO4	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3
CO5	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3
CO6	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3
Overall correlation	3	2	1	1	2	-	-	-	-	-	-	1	2	2	3

23MT033 AGRICULTURAL ROBOTICS AND AUTOMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To learn about Farming-related Machines.
2. To understand the global position and information system in machines.
3. To know about traction and testing
4. To familiarize the concept on weed management
5. To learn about machinery selection.

UNIT – I INTRODUCTION **9**

History of Mechanized Agriculture - Farming Operations and Related Machines - Tillage, Planting Cultivation, and Harvesting, Agricultural Automation - Agricultural Vehicle Robot.

UNIT – II PRECISION AGRICULTURE **9**

Sensors – types and agricultural applications, Global Positioning System (GPS) - GPS for civilian use, Differential GPS, Carrier-phase GPS, Real-time kinematic GPS, Military GPS, Geographic Information System, Variable Rate Applications and Controller Area Networks

UNIT – III TRACTION **9**

Hitching- Principles of hitching, Types of hitches, Hitching and weight transfer, Control of hitches, Tires and Traction models, Traction predictor spread sheet, Soil Compaction, Traction Aids, Tractor Testing.

UNIT – IV SOIL TILLAGE AND WEED MANAGEMENT **9**

Tillage Methods and Equipment, Mechanics of Tillage Tools, Performance of Tillage Implements, Hitching of Tillage Implements, Weed Management - Conventional Cropping Systems, Tools, Crop Rotation, Mechanical Cultivation

UNIT – V MACHINERY SELECTION **9**

Screw Conveyors, Pneumatic Conveyors, Bucket Elevators, Forage Blowers and Miscellaneous Conveyors, Machinery Selection - Field Capacity and Efficiency, Draft and Power Requirements, Machinery Costs.

TOTAL: 45 PERIODS

COURSE OUTCOMES

The student will be able to

CO 1: Identify the areas in agricultural process where robotics can be applied.

CO 2: Illustrate sensor and system for a required specific process in agricultural applications.

CO 3: Apply Mechanics to the design various robot parameters.

CO 4: Explain various mechanisms into robot by providing actuation at specific links and joints of the mechanism.

CO5: Explain he various machinery used in agriculture robots

CO 6: Develop suitable robotic system for specific agricultural tasks.

TEXT BOOKS:

1. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buckmaster, "Engineering Principles of Agricultural Machines", ASABE Publication, 2012.
2. Myer Kutz , "Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2019.

REFERNCE BOOKS:

1. Qin Zhang, Francis J. Pierce, "Agricultural Automation Fundamentals and Practices", CRC Press, 2016.
2. Stephen L Young, Francis J. Pierce, "Automation: The Future of Weed Control in Cropping Systems", Springer, Dordrecht Heidelberg New York London, 2014.

3. R.A. Kepner, Roy Bainer, E.L. Barger, "Principles of Farm Machinery", 3rd Edition, CBS Publishers, New Delhi, 2005.
4. Guangnan Chen, "Advances in Agricultural Machinery and Technologies", 1st Edition, CRC Press, 2021.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	1	2	1	-	-	-	-	-	2	-	-	3
CO2	1	2	3	1	3	1	-	-	-	-	-	2	-	-	3
CO3	1	2	3	1	2	1	-	-	-	-	-	2	-	-	3
CO4	1	2	3	1	2	3	-	-	-	-	-	2	-	-	3
CO5	1	2	3	1	2	1	-	-	-	-	-	2	-	-	3
CO6	1	2	3	1	2	1	-	-	-	-	-	2	-	-	3
Overall correlation	1	2	3	1	2	1	-	-	-	-	-	2	-	-	3

23MT034 COLLABORATIVE ROBOTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To know the fundamentals of Collaborative Robotics
2. To introduce Swarm robot and trajectory planning for Swarm
3. To introduce Modular Robotics and its Mechanics
4. To learn about various Natural models of robot collaboration
5. To introduce the concept of Reconfigurable robot

UNIT – I INTRODUCTION TO COBOTICS **9**

Collaborative Robotics- Properties - Introduction to Modern Mobile Robots: Swarm Robots, Cooperative and Collaborative Robots, Mobile Robot Manipulators-Current Challenges.

UNIT – II SWARM ROBOTICS **9**

Introduction, mapping, kinematics and trajectory error compensation, state transitions, collective decision making and methodologies, swarm robot scenarios-aggregation, clustering dispersion, pattern formation, sorting, flocking and collective motion, shepherding, heterogeneous swarms, Error Detection and Security.

UNIT – III MODULAR ROBOTICS **9**

Module Designs - Modular Robot Representation -Modular Serial Robot Kinematics - Kinematic Calibration for Modular Serial Robots- Modular Serial Robot Dynamics -

Modular Parallel Robot Kinematics

UNIT – IV NATURALLY INSPIRED COLLABORATION 9

Collective Decision-Making. Group Decision Making in Animals, Collective Motion as Decision Process, Models for Collective Decision-Making Processes, Urn Models, Voter Model ,Majority Rule , Hegselmann and Krause , Kuramoto Model , Axelrod Model, Ising Model, Fiber Bundle Model, Sznajd Model, Bass Diffusion Model, Socio physics and Contrarians.

UNIT – V RECONFIGURABLE ROBOTS 9

V-Shaped Formation Control for Robotic Swarms Constrained by Field of View – formation of reconfigurable virtual linkage - Reconfigurable Formation Control of Multi-Agents - Self- Assembly Modular Robot Platform Based on Sambot - Swarm Dynamics Emerging from Asymmetry.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the fundamentals of Collaborative Robotics.
CO2: Apply Swarm robots technology in real time applications.
CO3: Analyze and select the suitable concept of Modular Robotics
CO4:Analyze the concept of Robot Mechanics for modelling a collaborative robot
CO5: construct the various Natural models for robot collaboration.
CO6: Develop collaborative robots for various requirements in industrial tasks.

TEXTBOOKS

1. Guilin Yang, I-Ming Chen, "Modular Robots: Theory and Practice", Springer, 2022.
2. Giandomenico Spezzano, "Swarm Robotics", Applied Sciences, MDPI, 2019.

REFERENCE

1. Heiko Hamann, "Collective Decision-Making in Swarm Robotics: A Formal Approach", Springer, 2019.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO2	1	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO3	1	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO4	1	2	1	1	-	-	-	-	-	-	2	2	1	1	2

CO5	1	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO6	1	2	1	1	-	-	-	-	-	-	2	2	1	1	1
Overall correlation	1	2	1	1	-	-	-	-	-	-	2	2	1	1	1

23MT035 ROBOT OPERATING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce ROS and programming
2. To develop the Robot environment
3. To obtain the simulation robots in ROS with GAZEBO
4. To simulate robots with V-Rep
5. To understand mapping, navigation and motion planning ROS with Move-it

UNIT – I ROS ESSENTIALS 9

Introduction to ROS- Advantages and Disadvantages of ROS - ROS Framework- ROS package C++, Python – ROS computation Graph – nodes, Messages, topics, services, bags, ROS Master- ROS Community- Basic programming and Syntax overview in C++ and Python – start with ROS programming - Creating Environment - Services-Actions and Nodes- Simple Interaction with the Simulation environment.

UNIT – II BUILD YOUR OWN ROBOT ENVIRONMENT 9

CAD Tools for Robot Modelling – ROS Packages for robot modelling – Unified Robot Description Format and Tags- Kinematics and Dynamics Library – Create URDF Model - Robot Modelling using Unified Robot Description Format (URDF),- ROS parameter server and adding real-world object representations to the simulation environment _ Create Robot description using 7 DOF: joint number, name, type and angle limits – Xacro – Rviz – viewing of 7 DOF arm – creation of wheeled robot

UNIT – III SIMULATION ROBOTS IN ROS WITH GAZEBO 9

Robot simulation - Gazebo –create simulation model at Gazebo- Adding colors, textures, transmission tags, 3D vision sensor to Gazebo- Moving robot joints using ROS controllers- ROS controller interacts with Gazebo, interfacing state controller, simulation of moving the robot joints – simulation of differential wheeled robot in Gazebo.

UNIT – IV ROS WITH V-REP **9**

V-REP is a multi-platform robotic simulator - Simulating the robotic arm using V-REP - Adding the ROS interface to V-REP joint - Simulating a differential wheeled robot, Adding a laser sensor , 3D vision sensor.

UNIT – V ROS WITH MOVEIT **9**

Moveit Installation - Generating the Self-Collision matrix .virtual joints, planning groups, robot poses, robot end effector - Moveit Architecture Diagram - Trajectory from RViz GUI executing in Gazebo - Planning scene overview diagram- Collision Checking - Motion Planning, Pick and Place Behaviors using Industrial Robots with ROS Moveit – ROS with MATLAB - ROS with Industrial applications.

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:
CO1: Explain the concept of ROS and programming.
CO2: Evaluate various robot algorithms in ROS programming.
CO3: Explain the mapping, navigation and motion planning ROS with Move-it.
CO4: Identify the suitable robots in ROS with GAZEBO
CO5: Identify the suitable Robots in ROS with V-REP
CO6: Develop the program a Robot using ROS and its toolboxes

TOTAL: 45 PERIODS

TEXT BOOK

1. Lentin Joseph, Jonathan Cacace, "Mastering ROS for Robotics Programming", Second Edition, Packt Publishing, 2018.

REFERENCES

1. Lentin Joseph, Aleena Johny, "Robot Operating System (ROS) for Absolute Beginners Robotics Programming Made Easy", Second Edition, Apress, 2022.
2. Lentin Joseph, "ROS Robotics Projects", Packt publishing, 2017

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2
CO2	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2
CO3	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2

CO4	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2
CO5	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2
CO6	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2
Overall correlation	2	1	1	2	-	-	-	-	-	-	1	1	2	1	2

23MT036 MEDICAL ROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Identify and describe different types of medical robots and their potential applications.
2. Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
3. Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image guided interventions.
4. Be familiar with the state of the art in applied medical robotics and medical robotics research.
5. Understand the various roles that robotics can play in healthcare.

UNIT – I INTRODUCTION 9

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics – State of art of robotics in the field of healthcare-DICOM

UNIT – II LOCALIZATION AND TRACKING 9

Position sensors requirements - Tracking - Mechanical linkages - Optical – Sound based - Electromagnetic - Impedance-based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems.

UNIT – III DESIGN OF MEDICAL ROBOTS 9

Characterization of gestures to the design of robots - Design methodologies - Technological choices - Security.

UNIT – IV SURGICAL ROBOTICS 9

Minimally invasive surgery and robotic integration - surgical robotic sub systems - synergistic control - Control Modes - Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies.

UNIT – V ROBOTS IN REHABILITATION AND MEDICAL CARE 9

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - Assistive robots - Robots in Physiotherapy - case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Identify various medical robots and their potential applications.

CO 2: Explain the position tracking and hybrid systems.

CO 3: Apply Robotics and its concepts in medical field.

CO 4: Apply the Simulate a MIS procedure and be aware of the state of art in surgical robots

CO5: Explain the Oncology surgical robotics.

CO 6: Develop the medical robotic system for Rehabilitation and Medical care.

TEXT BOOKS:

1. Achim Ernst Floris Schweikard, "Medical Robotics", Springer, 2016.
2. Paula Gomes, "Medical robotics Minimally invasive surgery", Wood head, 2013.

REFERENCES:

1. Jaydev P Desai, Rajni V Patel, Antoine Ferreira; Sunil Kumar Agrawal, "The Encyclopedia of Medical Robotics", World Scientific Publishing Co. Pvt. Ltd, 2019.
2. Jocelyne Troccaz , "Medical Robotics", John Wiley & Sons Incorporated, 2013.
3. Vanja Bonzovic , "Medical Robotics", I-tech Education publishing, Austria, 2008.
4. Farid Gharagozloo "Robotic Surgery", Springer, 2022.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3
CO3	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3
CO4	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3
CO5	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3
CO6	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3
Overall correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	2	3

23MT037	HUMANOID ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn the basic knowledge about Humanoid robots.
2. To impart knowledge in kinematics of humanoids.
3. To learn about the dynamics in humanoid robots.
4. To understand the basics of biped walking.
5. To know about the different walking patterns.

UNIT – I INTRODUCTION **9**

Historical development of Humanoids, Human Likeness of a Humanoid Robot, Trade-Offs in Humanoid Robot Design, Human-Friendly Humanoid Robot Design, characteristics of humanoid robots.

UNIT – II KINEMATICS **9**

Kinematic structure, forward and inverse kinematic problems, differential kinematics, Twist, Spatial Velocity, and Spatial Transform, Inverse Differential Kinematic Relations. Differential kinematics at singular configurations- Gait Analysis.

UNIT – III ZMP AND DYNAMICS **9**

ZMP Overview,2D Analysis,3D Analysis, Measurement of ZMP, General Discussion- ZMP of Each Foot, ZMP for Both Feet Contact, Dynamics of Humanoid Robots, Humanoid Robot Motion and Ground Reaction Force, Momentum, Angular Momentum, Angular Momentum and Inertia Tensor of Rigid Body, Calculation of Robot's Center of Mass, Link Speed and Angular Velocity, Calculation of Robot's Momentum and Angular Momentum

UNIT – IV BIPED WALKING **9**

Two-Dimensional Walking Pattern Generation, Two Dimensional Inverted Pendulum, Behavior of Linear Inverted Pendulum, Orbital Ener y Sup rt Le Exchange, Planning a Simple Biped Gait, Extension to a Walk on Uneven Terrain.

UNIT – V WALKING PATTERN GENERATION **9**

ZMP Based Walking Pattern Generation, Cart-Table Model, Off-Line Walking Pattern Generation, Stabilizer, Principles of Stabilizing Control, Stabilizing Control of Honda Humanoid Robot, Advanced Stabilizers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the evolution of Humanoid robots.

CO 2: Explain the basic knowledge in kinematics of humanoids.

CO3: Explain the dynamics of humanoid robots

CO 4: Explain the Humanoid Robot Motion and Ground Reaction Force.

CO 5: Identify Two-Dimensional Walking pattern on different terrain.

CO 6: Develop the Walking Pattern models.

TEXTBOOKS:

1. Dragomir N. Nenchev, Atsushi Konno, "Humanoid Robots Modeling and Control", Butterworth Heinemann, 2019
2. Shuuji K, Hirohisa H, Kensuke H, Kazuhito, Springer-Verlag GmbH "Introduction to Humanoid Robotics", Springer, London, 2014.
3. Goswami Ambarish, Vadakkepat Prahlad, "Humanoid Robotics: A Reference", Springer, 2019.
4. J. Craig, "Introduction to Robotics: Mechanics and Control", Fourth Edition, Pearson, 2022.

REFERNCES:

1. A. Goswami, P. Vadakkepat (Eds.), "Humanoid Robotics: A Reference", Springer, Netherlands, Dordrecht, 2018
2. J K. Harada, E. Yoshida, K. Yokoi (Eds.), "Motion Planning for Humanoid Robots", Springer, London, 2010.
3. Lorenzo Sciavicco and Bruno Siciliano, "Modelling and Control of Robot Manipulators", second edition, Springer, 2000.
4. Jean-Claude Latombe, "Robot Motion Planning", Kluwer.

COs	POs											PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO2	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO3	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO4	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO5	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO6	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3
Overall correlation	3	2	1	1	-	-	-	-	-	-	-	1	1	2	3

23MT038 FUNDAMENTALS OF MACHINE DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Designing machine members subjected to static and variable loads.
2. Designing flexible elements like belts, ropes, and chain drives for engineering applications.
3. Designing shafts and threaded fasteners for various applications.
4. Designing and selecting bearings and robot grippers.
5. Designing gears and gearbox for machine tools and applications.

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to design - factors influencing design, selection of materials based on mechanical properties - Modes of failure -Factor of safety – stresses due to bending and torsion moment - Eccentric loading, Design against fluctuating loads - theories of failures.

UNIT II DESIGN OF FLEXIBLE ELEMENTS AND JOINTS 9

Introduction to flexible elements, Design of belt drives – Flat, Vee Belts and Timing belt, Design of cotter and knuckle joints.

UNIT III DESIGN OF SHAFTS AND COPULINGS 9

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity, and critical speed- Keys and splines, Rigid and Flexible couplings

UNIT IV DESIGN OF GEARS 9

Design of Spur, Helical, Bevel and Worm gears –using gear life method only.

UNIT V DESIGN OF BEARINGS 9

- Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Somerfield Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course, students should be able to:

CO1: Construct machine elements subjected to various types of loadings.

CO2: Analyze machine elements subjected to variable loading

CO3: Analyse the various parameters in flexible elements and Joints.

CO4: Construct the shafts and Couplings.

CO5: Analyze the design of Spur, Helical Bevel and Worm gears .

CO6: Analyze the design and selection of bearings.

TEXT BOOKS:

1. Bhandari. V.B, "Design of Machine Elements", Tata McGraw-Hill Education, 5th edition, 2020.
2. Joseph Edward Shigley, Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill, 11th edition, 2020.

REFERENCES:

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, 2015.
2. Robert L.Norton, "Machine Design – An Integrated Approach", Prentice HallInternational Edition, 5th edition, 2018.
3. Sharma. C.S, Purohit. K. "Design of Machine Elements", Prentice-Hall of India, 2003.
4. Prabhu T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
5. "P.S.G.Design Data Hand Book", PSG College of Tech Coimbatore.
6. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	1	-	-	2	-	-	-	2	2	2	2
CO2	3	3	3	2	2	-	-	3	-	-	-	3	2	2	3
CO3	3	3	3	2	2	-	-	3	-	-	-	3	2	2	3
CO4	3	3	3	2	2	-	-	3	-	-	-	3	2	2	3
CO5	3	3	3	2	2	-	-	3	-	-	-	3	2	2	3
CO6	2	2	2	1	1	-	-	2	-	-	-	2	2	2	2
Overall correlation	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3

23MT039 **DESIGN FOR X** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
2. To learn the design consideration principles of forming in the design of extruded, stamped, and forged products T
3. To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
4. To learn design consideration principles of welding in the design of welded products.
5. To learn design consideration principles in additive manufacturing

UNIT – I INTRODUCTION **9**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

UNIT - II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT - III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws – Reduction of machined area - simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly - Product design for manual assembly - Product design for automatic assembly - Robotic assembly.

UNIT IV COMPONENT DESIGN – CASTING 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined. holes, redesign of cast members to obviate cores.

Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA.

UNIT – V DESIGN FOR ADDITIVE MANUFACTURING 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

OUTCOMES:

At the end of the course the students would be able to

1. Explain the various design principles for manufacturability.
2. Explain the various factors influencing in form design.
3. Apply the component design features of various machines.
4. Apply the component design factor consideration for casting
5. Explain the design consideration principles of welding in the design of welded products.
6. Explain the design consideration principles of additive manufacturing.

TOTAL:45 PERIODS

TEXT BOOKS:

1. James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Professional, 1998.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCES:

1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel

Dekker, 1994

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	1	-	-	2	-	-	-	2	2	3	2
CO2	2	2	1	1	1	-	-	2	-	-	-	2	2	3	2
CO3	3	2	2	2	2	-	-	3	-	-	-	3	2	3	3
CO4	3	2	2	2	2	-	-	3	-	-	-	3	2	3	3
CO5	2	2	1	1	1	-	-	2	-	-	-	2	2	3	2
CO6	2	2	1	1	1	-	-	2	-	-	-	2	2	3	2
Overall correlation	2	2	1	1	1	-	-	2	-	-	-	2	2	3	2

23MT040 CNC MACHINE TOOLS AND PROGRAMMING L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To explain the mechanics of metal cutting and the factors affecting machinability.
2. To explain the working of basic and advanced turning machines.
3. To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
4. To explain the constructional features of CNC machine tools.
5. To explain the basics of CNC programming and the machine tools through planning, writing codes and ,setting up CNC machine tools

UNIT I MECHANICS OF METAL CUTTING 9

Mechanics of chip formation, forces in machining, types of chip, cutting tools – Single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes - tool layout – automatic lathes: semi- automatic – single spindle: Swiss type, automatic screw type – multi spindle

UNIT III RECIPROCATING MACHINE TOOLS 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments-types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centerless grinding, internal grinding - micro finishing methods.

UNIT IV CNC MACHINES 9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed point-to- point/continuous - Turning and machining centers - Work holding methods in Turning and machining centers, Coolant systems, Safety features.

UNIT V PROGRAMMING OF CNC MACHINE TOOLS 9

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1 Explain the mechanism of metal removal process and to identify the factors involved in improving machinability

CO2 Explain the constructional and operational features of centre lathe and other special purpose lathes.

CO3 Explain the working and operational features of reciprocating machine tools.

CO4 Explain the constructional features and working principles of CNC machine tools

CO5 Construct CNC manual part program for turning center.

CO6: Construct CNC manual part program for machining center.

TEXT BOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education 8th Edition, 2022.
2. Michael Fitzpatrick, "Machining and CNC Technology", McGraw-Hill Education;4thedition, 2019.

REFERENCES:

1. Roy. A. Lindberg, "Processes and materials of manufacture", Pearson India Education Services Pvt. Ltd, 4th edition, 2015.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1985
3. Rao. P.N, "Manufacturing Technology Volume 2, Metal Cutting and Machine Tools", McGraw- Hill, New Delhi, 3rd edition, 2013.
4. Peter Smid, "CNC Programming Handbook", Industrial Press Inc., 3rd edition, 2007.
5. A. B. Chattopadhyay, "Machining and Machine Tools", Wiley, 2nd edition, 2017.

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	2	-	-	-	2	-	3	2
CO2	2	2	1	1	-	-	-	2	-	-	-	2	-	3	2
CO3	2	2	1	1	-	-	-	2	-	-	-	2	-	3	2
CO4	2	2	1	1	-	-	-	2	-	-	-	2	-	3	2
CO5	3	2	2	2	-	-	-	3	-	-	-	3	-	3	3
CO6	3	2	2	2	-	-	-	3	-	-	-	3	-	3	3
Overall correlation	2	2	1	1	-	-	-	2	-	-	-	2	-	3	2

23MT041 COMPUTER INTEGRATED MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES

1 To provide the overview of evolution of automation, CIM and its principles.
2 To learn various automation tools, including material handling systems.
3 To train students to apply group technology and FMS.
4 To familiarize the computer aided process planning in manufacturing.
5 To introduce to basics of data transaction, information integration and control of CIM.

UNIT – I INTRODUCTION 9

Introduction to CAD, CAM, and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety

aspects of CIM– advances in CIM

UNIT – II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipment – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety.

UNIT III AUTOMATED STORAGE SYSTEMS 9

Storage system performance – storage location strategies – Conventional storage methods and equipment – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing

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UNIT – IV PROCESS PLANNING 9

Process planning – Activities in process planning, Information required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriority's – various examples – forming of Matrix of A nteriority – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

UNIT – V PROCESS CONTROL AND DATA ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology – Automatic data capture technologies.- Quality management (SPC) and automated inspection

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

CO1: Explain the concepts and fundamentals for computer integrated manufacturing.
CO2: Apply the principle and concepts of advanced manufacturing systems.
CO3: Explain fundamentals of group technology.
CO4: Explain concepts of flexible manufacturing systems
CO5: Explain the functions and operations of process planning.
CO6: Illustrate the concepts of process control and data analysis.

TEXTBOOKS:

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August- Wilhelm Scheer.

REFERENCES:

1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi and Ronald D. Weill, Principles of Process Planning‖, Chapman Hall, 1995.
3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing‖, Pearson Education, Asia,3rd Edition,2004.
4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.
5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO2	3	2	2	-	-	-	-	2	-	-	-	2	-	3	3
CO3	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO4	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO5	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO6	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
Overall correlation	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2

23MT042 ADVANCED MANUFACTURING SYSTEMS **L T P C**

3 0 0 3

COURSE OBJECTIVES:

The objective of this course is to

1. Teach the lean tools to attain optimum level in quality.
2. Enhance the ability to make decisions for new product development.
3. Develop the students to conserve energy and natural resources, and to ensure that they have minimal impact on the environment and society.
4. Give students an introduction to an advanced information process technique.
5. Learn about the various smart manufacturing techniques and applications.

UNIT – I INTRODUCTION TO LEAN MANUFACTURING 9

Objectives of lean manufacturing-key principles and implications of lean manufacturing - traditional Vs lean manufacturing- flow-continuous improvement/Kaizen –worker involvement- 5S principles elements of JIT - uniform production rate - Kanban system - Lean implementation, Reconciling lean with other systems - lean six sigma- lean and ERP - lean with ISO 9001:2000.

UNIT – II AGILE MANUFACTURING 9

Agile Manufacturing Vs Mass Manufacturing - Agile practice for product development - Manufacturing agile practices - Implementing new technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. - Costing for Agile Manufacturing practices.

UNIT – III SUSTAINABLE MANUFACTURING 9

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement Programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – IV INTELLIGENT MANUFACTURING 9

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement Programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – V SMART MANUFACTURING 9

Introduction to various Smart Manufacturing Techniques-Supply chain management-Block chain of inventory management-Plant digitization-Predictive maintenance-Supply chain visibility-Warehouse-Cost reduction-Waste management-Automated systems-Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain basic concept of lean manufacturing.

CO2: Explain various development and technology involved in agile manufacturing.

CO3: Explain concepts of sustainable manufacturing.

CO4: Apply concept of modern intelligent manufacturing.

CO5: Explain smart manufacturing and its various techniques.

CO6: Explain the basic concepts of predictive and waste management.

TEXT BOOKS:

1. Lonnie Wilson, "How to Implement Lean manufacturing", McGraw-Hill Professional; 2nd edition, 2015.
2. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.

REFERENCES:

1. Kusiak, Andrew, "Intelligent Manufacturing Systems", Prentice Hall, 1st edition, 1990.
2. Black .J.T. and Kohser R.A, "DeGarmo's Materials and Processes in Manufacturing", Published by Wiley, 11th edition, 2011.
3. Christian N. Madu, "Handbook of environmentally conscious manufacturing", Springer, US Publishers, 1st edition, 2001.
4. John Schey, "Introduction to Manufacturing Processes", Tata McGraw-Hill Education,3rd edition,1999
5. Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer, United States, 2012, ISBN 978-3-642-27289-9.
6. Rao R. V, "Advanced Modeling and Optimization of Manufacturing Processes", 2nd edition, 2006.

7. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
8. Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO2	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO3	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO4	3	2	2	-	-	-	-	2	-	-	-	2	-	3	3
CO5	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO6	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
Overall correlation	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2

23ME031 ADDITIVE MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications.
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes.
- To be familiar with powder bed fusion and material extrusion processes.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes.

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DFAM) 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL- Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM**.**

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSIT 9

Photo polymerization: Stereolithography Apparatus (SLA) - Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP) Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery - Materials -Benefits - Applications.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Explain the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO 2 Explain the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO 3 Explain the vat polymerization processes and its applications.

CO 4 Explain direct energy deposition processes and its applications.

CO 5 Explain the process and applications of powder bed fusion and material extrusion.

CO 6 Explain the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0.
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN: 9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1

2	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1
3	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1
4	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1
5	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1
6	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1
Overall correlation	2	1	-	-	1	2	-	-	-	-	2	1	3	-	1

23MT072 SEMICONDUCTOR MANUFACTURING TECHNOLOGY

L T P C
3 0 0 3

Objectives:

- Provide comprehensive knowledge of semiconductor manufacturing processes.
- Develop the ability to analyse and design semiconductor manufacturing systems.
- Impart knowledge on the application of semiconductor principles in various industries.
- Enhance problem-solving skills in semiconductor fabrication and process control.
- Integrate theoretical concepts with practical applications through theoretical studies and simulations

UNIT-I INTRODUCTION TO SEMICONDUCTOR MANUFACTURING 9

Overview of Semiconductor Manufacturing: History and significance, Major industry players; Semiconductor Materials: Types, properties, and applications, Silicon, Gallium Arsenide, other materials; Crystal Growth and Wafer Preparation: **Electronic Grade Silicon**, Czochralski process, Float-zone process, Silicon Shaping - Wafer slicing, cleaning, and polishing.

UNIT-II LITHOGRAPHY AND ETCHING PROCESSES 9

Photolithography: Principles, Mask design, Photoresist application, Exposure, development; Advanced Lithography Techniques: Electron-beam lithography, X-Ray lithography, Ion lithography, Extreme ultraviolet lithography; Etching Processes: Wet etching, Dry etching, Plasma etching, Selectivity, anisotropy in etching.

UNIT-III DEPOSITION TECHNIQUES 09

Chemical Vapor Deposition (CVD): Principles, Types (LPCVD, PECVD), Applications, limitations; Physical Vapor Deposition (PVD): Sputtering, Evaporation, Molecular beam epitaxy (MBE); Atomic Layer Deposition (ALD): Process fundamentals, Advantages, applications in semiconductor manufacturing.

UNIT-IV DOPING AND THERMAL PROCESSES 09

Doping Techniques: Diffusion, Ion implantation, Control of doping profiles and concentrations; Thermal Processes: Oxidation, Annealing, Rapid thermal processing (RTP), Furnace types, operation; Defect Control and Yield Enhancement: Sources of defects, Techniques for defect reduction, Yield analysis and improvement strategies.

UNIT-V PACKAGING, TESTING AND CHARACTERIZATION 09

Semiconductor Packaging: Types of packages, Packaging materials, Techniques (wire bonding, flip-chip); Reliability and Failure Analysis: Thermal management, Stress testing, Failure modes, mechanisms; Testing and Characterization: Electrical testing, Optical testing; Advanced characterization techniques: AFM, SEM, TEM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

Course Outcomes: At the end of this course students be able to:

CO1 Analyse the fundamentals of semiconductor materials and their properties.

CO2 Apply lithography and etching processes in semiconductor fabrication.

CO3 Utilize various deposition techniques for thin film formation.

CO4 Implement doping and thermal processes in semiconductor device manufacturing.

CO5 Evaluate packaging methods for semiconductor devices.

CO6 Evaluate testing methods for semiconductor devices

TEXT BOOKS:

1 May, Gary S., Spanos, Costas J. Fundamentals of Semiconductor Manufacturing and Process Control. Germany: Wiley, 2006.

2 Yoo, Chue San. Semiconductor Manufacturing Technology. Singapore: World Scientific, 2008.

3 Handbook of Semiconductor Manufacturing Technology. United States: CRC Press, 2017.

REFERENCES:

1 Gary S. May, Simon M. Sze, "Fundamentals of Semiconductor Fabrication," Wiley, 2004.

2 Michael Quirk, Julian Serda, "Semiconductor Manufacturing Technology," Prentice Hall, 2nd Edition, 2001.

3 Yuan Taur, Tak H. Ning, "Fundamentals of Modern VLSI Devices," Cambridge University Press, 2nd Edition, 2009.

4 Swayam-NPTEL course on Semiconductor Devices and Circuits
5 Swayam-NPTEL course e: Introduction to Semiconductor Devices
6 S. M. Sze, "VLSI Technology" Tata McGraw Hill, 2003. (Kindly refer to this book)

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	-	-	2	-	-	-	2	2	2	2
CO2	2	2	1	-	-	-	-	2	-	-	-	2	2	2	2
CO3	2	2	1	-	-	-	-	2	-	-	-	1	2	2	2
CO4	2	2	2	-	-	-	-	3	-	-	-	2	3	3	3
CO5	2	2	1	-	-	-	-	2	-	-	-	1	2	2	2
CO6	2	2	2	-	-	-	-	3	-	-	-	1	3	3	3
Overall correlation	2	2	1	-	-	-	-	2	-	-	-	2	2	2	2

23MT044 COMPUTER AIDED INSPECTION AND TESTING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To familiar the measurement standards and to know the instruments used and various errors in measurements
2. To recognize the use of basic and advanced instruments for measurements.
3. To learn the applications of opto-electronics device for measurements.
4. To describe the various measurement techniques using laser metrology.
5. To gain knowledge on computer aided inspection and advances in metrology.

UNIT – I FUNDAMENTALS AND CONCEPTS IN METROLOGY **9**

Standards of Measurement – Analog and Digital Measuring Instruments - Comparators – Limits, Fits and Tolerances – Gauge Design –Surface Roughness – Form Errors and Measurements.

UNIT – II INSPECTION AND GENERAL MEASUREMENTS **9**

Linear Measuring Instruments – Evolution – Types – Classification – Limit Gauges – Gauge Design – Terminology – Procedure – Concepts of Interchange Ability and Selective Assembly – Angular Measuring Instruments – Types – Bevel Protractor Clinometers Angle Gauges, Spirit Levels Sine Bar – Angle Alignment Telescope – Autocollimator – Applications - Inspection of Gears And Threads – Tool Makers' Microscope – Universal Measuring Machine.

UNIT – III OPTO ELECTRONICS IN ENGINEERING INSPECTION 9

Use of Optoelectronics in Tool Wear Measurements – Microhole Measurement and Surface Roughness – Applications in In-Process Measurement and On-Line Inspection.

UNIT – IV LASER METROLOGY 9

Precision instrument based on Laser - Use of Lasers - Principle –Interferometers, Interference microscope -Optical flats - Laser Interferomter - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer. Use of Laser Interferometer in Machine Tool Inspection – Uses of Laser in On-Line Inspection – Laser Micrometer – Laser Alignment Telescope.

UNIT – V COMPUTER AIDED INSPECTION AND ADVANCES IN METROLOGY 9

Co-ordinate Measuring Machines - Constructional features - Types - Applications of CMM - CNC CMM applications - Measurement arms, Laser tracker - Fundamentals of Computer Aided Inspection - Introduction to Nano metrology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain fundamental concepts of metrology.

CO2: Illustrate the various inspection measurements.

CO3: Explain the fundamental concepts and principle of various general measurements.

CO4: Apply the concepts of opto electronics in inspection

CO5: Explain the various measurements using laser interferometry

CO6: Explain the fundamentals of computer aided inspection and advances in metrology.

TEXT BOOKS

1. Anil. K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India Pvt. Ltd.,2006
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 2002.
3. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2014.

REFERENCES

1. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA,5th edition, 1996.
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2012.
3. Robert G. Seippel, "Opto-Electronics for Technology and Engineering", Prentice Hall, 1989.
4. Robert J. Hocken, Paulo H. "Coordinate Measuring Machines and Systems", CRC Press, 2nd edition, 2016.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO2	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO3	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO4	3	2	2	-	-	-	-	2	-	-	-	2	-	3	3
CO5	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
CO6	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2
Overall correlation	2	2	1	-	-	-	-	1	-	-	-	1	-	2	2

23MT045 AUTOMOBILE ENGINEERING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES

1 To study the construction and working principle of various parts of an automobile.
2 To study the practice for assembling and dismantling of engine parts and transmission system
3 To study various transmission systems of automobile.
4 To study about steering, brakes and suspension systems
5 To study alternative energy sources

UNIT – I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT – II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically

controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three- w a y catalytic converter system, Emission norms (Euro and BS).

UNIT – III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT – IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT – V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Electric and Hybrid Vehicles, Fuel Cell

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Identify the various parts of automobile, their functions, materials and analyze aerodynamics forces
2. Explain the working principle of engine auxiliary system and engine emission control system
3. Explain the different types of transmission systems and its working
4. Explain the working mechanism of steering and steering gear boxes
5. Explain the working principle of braking and suspension systems
6. Explain the various alternate sources of energy and drives for automobiles

TEXT BOOKS:

1 Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

2 Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.

REFERENCES:

1 Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2 Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3 Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4 Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The
Good heart - Will Cox Company Inc, USA ,1978.
5 Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

	POs												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	-	-	2	2	3	-	-	-	3	3	-	1
2	3	2	-	-	-	3	3	2	-	-	-	3	2	-	1
3	3	2	-	-	-	2	2	2	-	-	-	3	2	-	1
4	3	2	-	-	-	2	2	2	-	-	-	3	2	-	1
5	3	2	-	-	-	2	2	2	-	-	-	3	2	-	1
6	3	2	-	-	-	3	3	2	-	-	-	3	2	-	1
Overall correlation	3	2	-	-	-	2	3	2	-	-	-	3	2		1

23MT046 ELECTRIC AND HYBRID VEHICLES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know about the general aspects of Electric and hybrid vehicles
- To learn about the architecture of electric and hybrid vehicles.
- To learn to model the electric and hybrid vehicles
- To study the sizing, sub system design and hybrid vehicle control of electric and hybrid vehicles.

UNIT I DESIGN OF ELECTRIC VEHICLES 9

Need - Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design.

.UNIT II ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types- Half reactions of fuel cell. Ultra capacitors. Battery Management System.

.

UNIT III ELECTRIC MOTORS FOR EV 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics and Applications

UNIT IV HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation Modes - Control Strategies for Hybrid Vehicles - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

.UNIT V EMERGING TECHNOLOGIES 9

Electric Vehicle Supply Equipment's ,Need of Charging Station Selection (CSS) server ,Smart grid technologies: Applications, Benefits, Smart meter, Smart charger: Purpose and benefits. Electric Vehicle Recharging and Refuelling Systems.

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COURSE OUTCOMES:

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

CO1:Explain the operation and architecture of electric and hybrid vehicle

CO2:Explain the various energy source options like battery and fuel cell.

CO3:Identify the suitable electric motors for applications in hybrid and electric vehicles.

CO4 Explain the Switching Characteristics of Power Converters and motor drives.

CO5 Explain the working principle of Electric and Hybrid vehicles

CO6: Explain the operating modes, control strategies of Hybrid vehicles and study the specifications of electric and hybrid vehicles.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003
2. Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRCPress,2005.

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003
2. Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005
3. Ron HodKinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005.

COs	POs												PSOs		
	1	2	3	4		6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3
CO2	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3
CO3	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3
CO4	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3
CO5	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3
CO6	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3
Overall correlation	2	2	2	2	-	3	2	2	-	-	-	2	1	1	3

23MT047 AUTOMOTIVE MECHATRONICS L T P C

3 0 0 3

COURSE OBJECTIVES:

The intention and purpose of this course is

1. To study the basics of electronics, emission controls and its Importance in automobiles.
2. To study the Ignition and Injection system in Automobiles
3. To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
4. To study the various blocks of mechatronic control units used for control of fuel, ignition and exhaust systems.

5. To learn about different types of chassis and mechatronics safety systems in automobile

UNIT – I INTRODUCTION 8

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT – II IGNITION AND INJECTION SYSTEMS 10

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fueling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT – III SENSOR AND ACTUATORS IN AUTOMOTIVES 7

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT – IV ENGINE CONTROL SYSTEMS 10

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECUs used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT – V CHASSIS AND SAFETY SYSTEMS 10

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the importance of emission standards in automobiles.

CO2: Analyze the electronic fuel injection and ignition components.

CO3: Explain the use of sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.

CO4: Analyze issues in electronic engine control systems

CO5: Analyze the chassis safe system

CO6: Analyze and vehicle safety system.

TEXT BOOKS

1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2017.
2. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 7th edition, 2019

REFERENCES

1. Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication,4th edition, 2000.
2. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.
3. Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers,2000.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1
CO2	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1
CO3	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1
CO4	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1
CO5	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1
CO6	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1
Overall correlation	3	2	1	1	1	-	-	1	-	-	-	1	1	2	1

23MT048 AUTOMOTIVE SYSTEM MODELING AND SIMULATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the various steps involved in the design of automotive components
2. To show their knowledge in designing engine components.
3. To complete design exercise and arrive at important dimensions

of chassis components.

4. To learn the use of standard practices in design.
5. To determine the dimensions of front and rear axles

UNIT – I DESIGN OF CYLINDER, PISTON AND CONNECTING ROD 9

Choice of material for cylinder and piston, design of cylinder, design of piston, piston pin, piston rings and piston assembly. Material for connecting rod, design of connecting rod assembly. Case study on piston for car with Modelling and simulation.

UNIT – II DESIGN OF CRANK SHAFT AND VALVES 9

Material for crankshaft, design of crankshaft under bending and twisting. Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam& camshaft. Design of rocker arm. Cam profile generation. 3D Engine simulation: Introduction to thermal and flow analysis in engine cylinder, modeling of cylinder and piston for combustion analysis

UNIT – III DESIGN OF CLUTCHES AND GEARS 9

Design of single plate clutch, multiplate clutch and cone clutch assembly. Torque capacity of clutch. Design of clutch components. Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes. Modelling and simulation: braking system

UNIT – IV DESIGN OF VEHICLE FRAME AND SUSPENSION 9

Study of loads-moments and stresses on frame members. Design Of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs. Case study on development of frame for ATV. Modelling and simulation of suspension system.

UNIT – V DESIGN OF FRONT AND REAR AXLE 9

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings. Analysis of loads- moments and stresses at different sections of front axle. Determination of optimum dimensions and proportions for steering linkages, Design of front axle beam. Modelling and simulation of steering system, transmission system.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Analyze the stress and strain imparted on automotive components.

CO2: Analyze the design and dimension requirements of the vehicle components.
CO3: Identify optimal design solutions to real-world problems in Compliance with industry standards.
CO4: Analyze the design skill by creating new design strategy with the application of the knowledge.
CO5: Explain the modern system in vehicle and would help in developing the system with less impact on the environment.
CO6: Construct the design procedure of front and rear axle .

TEXT BOOKS:

1. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Volume 1, Components Design", Springer International Edition, 2nd edition,2020
2. Khurmi. R.S. & Gupta. J.K., "A textbook of Machine Design", Eurasia Publishing House (Pvt) Ltd, 25th edition, 2022.
3. Alec Stokes, "Manual gearbox design", Butterworth-Heinemann 1992.

REFERENCES:

1. "Design Data Hand Book", PSG College of Technology, 2013- Coimbatore.
2. Dean Averns, "Automobile Chassis Design", Il life Book Co., 2001.
3. Kolchin-Demidov , "Design of Automotive Engines"-Mir Publishers (1984)
4. Lukin P G G and Rodionov V, "Automobile Chassis Design and Calculations", MirPu blishers, Moscow, 1989.
5. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3
CO2	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3
CO3	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3
CO4	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3
CO5	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3
CO6	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3
Overall correlation	3	2	1	1	-	-	-	1	-	-	-	1	2	2	3

23MT049 VEHICLE DYNAMICS AND CONTROLS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To Develop physical and mathematical models to predict the dynamic

response of vehicles

2. To Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response
3. To Use dynamic analyses in the design of vehicles.
4. To understand the principle behind the lateral dynamics.
5. To Evaluate the longitudinal dynamics and control in an automobile

UNIT – I INTRODUCTION **9**

History of road and off-road vehicle system dynamics - dynamics of the motor vehicle, coordinate systems- vehicle fixed coordinates system, , details of vehicle systems, wheel angles, typical data of vehicles. Fundamental approaches to vehicle dynamics modeling lumped mass, vehicle fixed coordinate system, motion variables, earth fixed coordinate system, Definitions- modeling and simulation of dynamic behavior of vehicle., motion analysis, force analysis, and energy analysis.

UNIT – II LONGITUDINAL DYNAMICS **9**

Introduction to longitudinal dynamics - Performance of road vehicles: forces and moments on vehicle, equation of motion, tire forces, rolling resistance, weight distribution, tractive effort/tractive resistance and power available from the engine/ power required for propulsion, road performance curves- acceleration, grade ability, drawbar pull, and the problems related to these terms. Calculation of maximum acceleration braking torque, braking force, brake proportioning, braking efficiency, stopping distance, load distribution (three wheeled and four wheeled vehicles), calculation of acceleration, tractive effort and reactions for different drives, Stability of a vehicle on slope, (Problems related to these). Steer-By-Wire Systems.

UNIT – III LATERAL DYNAMICS **9**

Introduction to lateral dynamics Steering geometry, types of steering systems, fundamental condition for true rolling, development of lateral forces. slip angle, cornering force, cornering stiffness, pneumatic trail, self-aligning torque, power consumed by tire, tire stiffness, hysteresis effect in tires, steady state handling characteristics. yaw velocity, lateral acceleration, curvature response & directional stability. Stability of a vehicle on a curved track and a banked road. Gyroscopic effects, weight transfer during acceleration, cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling, the problems related to these terms.

UNIT – IV VERTICAL DYNAMICS **9**

Introduction to vertical dynamics - Human response to vibrations, classification of vibration, specification and vibration , sources of vibration, suspension systems, Modal Analysis, One DOF, two DOF, free and forced vibration, damped vibration,

magnification and transmissibility, vibration absorber, functions of suspension system. body vibrations: bouncing and pitching. Doubly conjugate points (only basic idea). body rolling. roll center and roll axis, roll axis and the vehicle under the action of side forces, stability against body rolling. Vehicle dynamics and suspension design for stability, choice of suspension spring rate, chassis springs and theory of chassis springs, gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system. Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car mode- Hydraulic Actuators for Active Suspensions.

UNIT – V VEHICLE AERODYNAMIC AND DYNAMIC CONTROL SYSTEM **9**

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, dynamic Control, modelling of actuators, sensors for automobile control, sensors for detecting vehicle environment, central tire inflation system. Prediction of vehicle performance. ABS, stability control, traction control. Dynamic Model for Simulation of a Parallel Gas-Electric Hybrid Vehicle Dynamic Model for Simulation of a Power-Split Hybrid Vehicle.

Background on Control Design Techniques for Energy Management – steer by wire controller Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the concepts of vehicle system dynamics.

CO 2: Evaluate the driving/ braking resistances and their influences on vehicle dynamics

CO 3: Analyze the dynamics systems such as suspension systems, body vibrations, steering mechanisms.

CO 4: Analyze and solve engineering problems related to vehicle dynamics.

CO 5: Identify the different types of control systems in automobiles.

CO6: Explain he dynamic model for simulation of hybrid vehicle

TEXT BOOKS

1. Rajesh Rajamani, “Vehicle Dynamics and Control”, 2nd edition, Springer, 2021.
2. Singiresu S. Rao, “Mechanical Vibrations”, 8th Edition, Prentice Hall, 2018.
3. Thomas D. Gillespie, “Fundamentals of Vehicle Dynamics”, Society of Automotive Engineers Inc., 2021.

4. Wong. J. Y., "Theory of Ground Vehicles", 5th Edition, Wiley-Interscience, 2022 .
5. N.K. Giri, "Automotive Mechanics", Kanna Publishers, 2007.

REFERENCES

1. J. Y. Woung - John Willey & Sons "Theory of Ground Vehicles ", NY ,5th Edition,2022
2. J. G. Giles," Steering, Suspension &Tyres", Ilete Books Ltd., London,1968
3. W. Steed "Mechanics of Road Vehicles ", Ilete Books Ltd. London,1960
4. P. M. Heldt, "Automotive Chassis", Chilton Co. NK
5. Gillespie.T.D., "Fundamental of vehicle dynamic society of Automotive Engineers ", USA, 2021 Revised Edition.
6. Rajesh Rajamani, "Vehicle dynamics and control", Springer publication,2014
7. Reza N Jazar, "Vehicle Dynamics: Theory and Application", Springer publication,3rd Edition,2018

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	2	-	-	2	-	-	-	2	2	2	2
CO2	3	3	2	2	2	-	-	3	-	-	-	3	2	2	3
CO3	3	3	2	2	2	-	-	3	-	-	-	3	2	2	3
CO4	3	3	2	2	2	-	-	3	-	-	-	3	2	2	3
CO5	3	3	2	2	2	-	-	3	-	-	-	3	2	2	3
CO6	2	2	2	2	2	-	-	2	-	-	-	2	2	2	2
Overall correlation	3	2	2	2	2	-	-	3	-	-	-	3	2	2	3

23MT050 AIRCRAFT MECHATRONICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To introduce the basic of avionics and its need for civil and military aircrafts
2. To impart knowledge about the avionic architecture and various avionics data bases
3. To gain more knowledge on various avionics subsystems
4. To impart knowledge on aircraft materials.
5. To analyze the application of Mechatronics in aircraft.

UNIT – I AIRCRAFT AERODYNAMICS **9**

Nomenclature used in Aerodynamics, different parts of airplane- Wing as lifting surface, Types of wing plan forms, Aerodynamic features like Aerofoil pressure

distribution- Aerodynamic forces and moments Lift and Drag- Drag polar, L/D ratio, high lift devices, Airplane performance like Thrust/Power available, climb and glide - maximum range and endurance, take off and landings.

UNIT – II AIRCRAFT PROPULSION 9

Requirement of power- various means of producing power - Brief description of thermodynamics of engines - Piston engines, Jet engines - Airplane Structure, Materials and Production - Structural arrangement of earlier airplane-developments leading to all metal aircraft - Strength to weight ratio choice of aircraft materials for different parts.

UNIT – III AIRCRAFT MATERIALS 9

Detailed description of wing - tail and fuselage joints - Stress-Strain diagrams, Plane and Space, Mechanical properties of materials - Materials for different components - use of composites - Aircraft production methods and equipment.

UNIT – IV PRIMARY FLIGHT CONTROLS 9

Ailerons - Aileron Control System of a Commercial Aircraft - Elevators - Elevator control system of a commercial aircraft – Rudders- Rudder Control System

UNIT – V APPLICATIONS OF MECHATRONICS IN AVIATION 9

Aileron-Flaps and Actuator drive unit-Pilot Static system-Fly by wire control system-Yaw damper-Primary flight control system-Internal navigation system-Under carriage-Measurement of motor rpm-Measurement of air flow velocity-Altitude measurement sensor-Air speed.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the Basics in aerodynamics, aircraft propulsion, materials and controls

CO 2: Explain about the various concepts used in aerodynamics.

CO 3: Apply the techniques to develop the aero system.

CO 4: Apply the aircraft concepts used in aerodynamics

CO5: Develop the aircraft design with concepts in aircraft propulsion, materials and controls.

CO 6: Apply this aircraft system in various applications.

TEXTBOOKS

1. Fundamentals of Flight; By Dr. O. P. Sharma and Lalit Gupta.2006.

2. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004.

REFERENCES

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Pallet. E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
4. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO2	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO3	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO4	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO5	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO6	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
Overall correlation	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-

23MT051 SMART MOBILITY AND INTELLIGENT VEHICLES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are:

1. To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
2. To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
3. To learn Basic Control System Theory applied to Autonomous Automobiles.
4. To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
5. To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

UNIT – I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES **9**

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles.

UNIT – II SENSOR TECHNOLOGY FOR SMART MOBILITY **9**

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT – III CONNECTED AUTONOMOUS VEHICLE **9**

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks d Autonomy.

UNIT – IV VEHICLE WIRELESS TECHNOLOGY AND NETWORKING **9**

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

UNIT – V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY **9**

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1:Explain the operation and architecture of electric and hybrid vehicles.

CO2:Explain the types of sensor technology needed to implement remote sensing

CO3:Explain the basic control system theory applied for Automobiles & operation of ECU's.

CO4:Explain the concept of cyber-physical control systems and their application to

collision avoidance and autonomous vehicles

CO5:Explain the basic concepts of wireless communications and wireless data networks

CO6:Determine the concept of the connected vehicle and its role in automated vehicles

TOTAL: 45 PERIODS

TEXTBOOKS

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019,Springer

REFERENCE

1. Tom Denton, "Automobile Electrical and Electronic systems, Roult edge", Taylor & Francis Group, 5th Edition, 2018.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO2	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO3	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO4	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO5	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
CO6	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-
Overall correlation	2	3	1	2	2	-	-	-	-	-	-	-	3	2	-

23MT052 ADVANCED DRIVER ASSISTANCE SYSTEMS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

The objectives of the course are:

1. To introduce students with various fundamentals related to advanced driver assistance technologies.
2. To impart knowledge on sensors, control and actuation methodologies and create impact of automating vehicles.
3. To acquire skills on vehicle prognostics and impaired driver technology
4. To learn about various commonly available Advanced Driver Assistance

Systems.

5. To study about Center Console Technology and other display technology

UNIT – I AUTOMOTIVE FUNDAMENTALS 9

Power System-Running System-Comfort System– Engine Components – Drive train – suspension system, ABS, Steering System.

UNIT – II AUTOMOTIVE SENSORS 9

Knock sensors, oxygen sensors, crankshaft angular position sensor, temperature sensor, speed sensor, Pressure sensor, Mass air flow sensor, Manifold Absolute Pressure Sensors, crash sensor, Coolant level sensors, Brake fluid level sensors – operation, types, characteristics, advantage and their applications. Radar, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera.

UNIT – III OVERVIEW OF DRIVER ASSISTIVE TECHNOLOGY 9

Basics of Theory of Operation, Applications, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion. Vehicle Prognostics Technology.

UNIT – IV ADVANCED DRIVER ASSISTANCE SYSTEMS 9

Advanced Driver Assistance Systems - Lane Departure (LDW), Active Cruise Control (ACC), Blind Spot Detection, Parking Assist, Autonomous Emergency Braking (AEB), Night Vision, Traffic Sign Recognition (TSR), Intelligent High beam Assistant (IHC), Tire Pressure Monitoring (TPMS), Front Collision Warning System (FCWS), Front Vehicle Departure Warning (FVDW), Adaptive Lighting, Driver Drowsiness Detection, Hill Decent Control, Rear Cross Traffic.

UNIT-V ADAS DISPLAY AND IMPAIRED DRIVER TECHNOLOGY 9

Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, and Warning Technology – Driver Notification. Impaired Driver Technology -Driver Impairment Sensor Technology, Sensor Technology for Driver Impairment Detection, Transfer of Control Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Explain the fundamentals of automotive system

CO2: Explain the various automotive functions, sensors Technology

CO3: Explain the concept of driver assistance systems.

CO4: Explain the proposed autonomous vehicle systems

CO5: Explain the concept of sensor data fusion as it relates to ADAS.
CO6: Apply possible evolution of vehicle prognostics and impaired driver technology.

TEXTBOOKS

1. Tom Denton, "Automobile Electrical and Electronic systems, Roultedge", Taylor & Francis Group, 5th Edition,2018.
2. William B Ribbens, "Understanding Automotive Electronic: An Engineering Perspective", Elsevier Science,8th Edition,2017.

REFERENCES

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", Transportation Research Board, 2016.
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", Springer, 2019.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
CO2	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
CO3	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
CO4	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
CO5	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
CO6	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
Overall correlation	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3

23MT053 APPLIED SIGNAL PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the characteristics of various types of signals.
2. To carry out the preprocessing of continuous time signals and systems
3. To learn DTFT, FFT and Z-Transform methods in signals processing.
4. To design digital IIR, FIR filters for signal processing
5. To learn about various signal processors and its applications of signals.

UNIT – I INTRODUCTION TO SIGNALS AND SYSTEMS **9**

Elementary signals in continuous and discrete time - graphical and mathematical representation - Elementary operations and classification of continuous and discrete time signals — CT systems and DT systems - Properties of CT systems and DT systems Classification of systems.

UNIT – II ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS **9**

The continuous time Fourier series - Fourier Transform properties - Laplace transform and properties - Impulse response - convolution integrals - Fourier and Laplace transforms in Analysis of CT systems - Frequency response of systems characterized by differential Equations.

UNIT – III ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS 9

Fourier Transform of discrete time signals (DTFT) Properties of DTFT - Discrete Fourier Transform - Fast Fourier Transform (FFT) - Z Transform and Properties — Impulse response -Convolution sum - System analysis from difference equation model - Stability of systems.

UNIT – IV DESIGN OF DIGITAL FILTERS 9

Review of design techniques for analog low pass filters - Frequency transformation – IIR filters Properties - Design of IIR digital filters using bilinear transformation - FIR filters - Characteristics of FIR filters with linear phase - Design of FIR filters using Window functions.

UNIT – V DIGITAL SIGNAL PROCESSORS AND APPLCATIONS 9

Architecture of TMS320C54xx DSP - Addressing Modes - Instructions and Programming - Applications: Signal Compression - Sine wave generators - Noise generators — DTMF Tone Detection - Echo cancellation - Speech enhancement and recognition

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the characteristics of various types of signals.

CO2: Analyze continuous time signals and systems

CO3: Compare DTFT, FFT and Z-Transform methods in signals processing.

CO4: Design digital IIR, FIR filters for signal processing

CO5: Analyze and apply various signal processors.

CO6: Apply signal processing techniques to practical applications.

TEXTBOOKS:

1. Alan V Oppenheim, Alan S Willsky, Hamid Nawab S , "Signals and Systems", 2nd edition, Learning, New Delhi, 2015.
2. John G. Proakis, Dimitris K Manolakis , "Digital Signal Processing,

5th edition, Hoboken,NJ : Pearson Education, New Delhi, 2021

REFERENCES:

1. Lonnie C Ludeman, "Fundamentals of Digital Signal Processing", Wiley & Sons, New Delhi, 2014.
2. Emmanuel C Ifeachor, Barrie W Jervis, "Digital Signal Processing", Pearson Education, New Delhi, 2013.
3. Haykin S, Barry Van Veen, "Signals and Systems", John Wiley and sons, New Delhi, 2016.
4. Vinay K Ingle, John G Proakis , "Digital Signal Processing using MATLAB", Cengage Learning, New Delhi, 2012.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3
CO2	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3
CO3	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3
CO4	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3
CO5	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3
CO6	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3
Overall correlation	3	2	2	2	-	-	-	2	-	-	-	2	1	1	3

23MT054 APPLIED IMAGE PROCESSING L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To introduce various image processing and preprocessing techniques.
2. To learn about feature detection and matching using Image processing
3. To learn about segmentation using Image processing techniques.
4. To learn about computational photography.
5. To learn about image recognition using Image processing techniques.

UNIT – I IMAGE FORMATION AND PROCESSING 9

Introduction - Geometric primitives and Transformations - Photometric Image formation - The digital camera. Introduction to image processing - point - spatial - Fourier Transform - Pyramids and wavelets - Geometric transformations - global optimization

UNIT – II FEATURE DETECTION AND MATCHING 9

Introduction - Points and patches - Feature detectors - Feature Descriptors - SIFT - PCA SIFT - Gradient location orientation histogram

UNIT – III SEGMENTATION 9

Introduction - Active contours - Snakes - Scissors - Level sets - Split and merge - Watershed — Region splitting - region merging - and graph based segmentation - mean shift and mode finding - Normalized cuts — graph cuts and energy based methods — application

UNIT – IV COMPUTATIONAL PHOTOGRAPHY 9

Photometric calibration - Radiometric response function - Noise level estimation - Vignetting - Optical blur - High dynamic range imaging - Super resolution and blur removal - Color image demos icing — application

UNIT – V IMAGE RECOGNITION 9

Object detection - Face recognition - Instance recognition - category recognition - Bag of words- Part based models - context and scene understanding- Application: Image search.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Illustrate various image formation techniques.

CO2:Explain the various image processing techniques.

CO3: Illustrate various preprocessing techniques.

CO4: construct the feature detection algorithm for the given application.

CO5: Explain the various computational photography techniques.

CO6: Explain the concept of an image recognition techniques for given application.

TEXTBOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
2. Hartley R, Zisserman A, "Multiple View Geometry in Computer Vision", Cambridge University Press, 2004.

REFERENCES:

1. Forsyth D A, Ponce J, “Computer Vision: A Modern Approach”, 2nd Edition Bostan Pearson, 2015
2. Duda R O, Hart P E, Stork D G, "Pattern Classification", Wiley, 2001.
3. Richard Sc "Computer Vision: Algorithms and Applications", Springer, 2010.
4. Simon J.D.Prince "Computer Vision: Models, Learning and Inference",

Cambridge University Press, New York, 2014.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO2	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO3	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO4	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO5	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO6	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
Overall correlation	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2

23MT055 MACHINE LEARNING FOR INTELLIGENT SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES

1 To introduce basic machine learning techniques such as regression, classification
2 To learn about introduction of clustering, types and segmentation methods
3 To learn about fuzzy logic, fuzzification and defuzzification
4 To learn about basics of neural networks and neuro fuzzy networks.
5 To learn about Recurrent neural networks and Reinforcement learning.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal

component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III FUZZY LOGIC **9**

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application.

UNIT IV NEURAL NETWORKS **9**

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptron's, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics.

UNIT – V RNN AND REINFORCEMENT LEARNING **9**

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

CO1: Explain basic concepts of machine learning techniques.

CO2: Illustrate about clustering and segmentation.

CO3: Construct the Model fuzzy logic system with fuzzification and defuzzification.

CO4: Develop the concepts of neural networks.

CO5: Develop the concepts of neuro fuzzy networks.

CO6: Explain the concepts on Reinforcement learning.

TEXT BOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, hester, 2011, Sussex Wiley

REFERENCES:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer
2. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, Delhi 2016.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO2	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO3	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO4	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO5	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
CO6	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2
Overall correlation	2	2	2	2	-	-	2	2	-	-	-	2	1	3	2

23MT056 CONDITION MONITORING AND FAULT DIAGNOSTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To Understand the basics of various condition monitoring methods.
2. To Identify the selection of condition monitoring sensors for various applications.
3. To study various signal processing for condition monitoring applications.
4. To Know about various failure analysis, maintenance and machine learning.
5. To provide a basic understanding with case studies on different fault diagnosis methods.

UNIT – I CONDITION MONITORING TECHNIQUES AND MACHINE CONDITION MONITORING 9

Condition Monitoring in manufacturing industries; Noise monitoring, Wear and debris Analysis, Thermography, Cracks monitoring, Ultrasonic techniques - Case studies. Vibration, Acoustic emission and vibro-acoustics signal analysis; intelligent fault detection system, Case studies.

UNIT – II SENSORS FOR FAULT DIAGNOSTICS 9

Introduction - Contaminant monitoring sensors- Corrosion monitoring sensors -

Force monitoring sensors - Gas leakage monitoring - sensors Air pollution monitoring sensors - Liquid contamination monitoring sensors - Non-destructive testing techniques - Optical examination -Temperature sensing.

UNIT – III SIGNAL PROCESSING AND ANALYSIS 9

Study of periodic and random signals, probability distribution, statistical properties, auto and cross correlation and power spectral density functions. Time domain and Frequency domain and Time- frequency domain analysis.

UNIT – IV FAILURE ANALYSIS, MAINTENANCE AND MACHINE LEARNING 9

Maintenance Principles, Failure mode analysis - Equipment down time analysis — Breakdown analysis - condition based maintenance, Vibration, Acoustic emission and vibrio-acoustics signal analysis; intelligent fault detection system, Case studies.

UNIT – V MONITORING SYSTEMS CASE STUDEIS 9

Introduction - Marine monitoring systems - Marine turbine monitoring systems - Shipboard vibration monitoring - Monitoring integrity verification - Aircraft condition monitoring - Condition monitoring - generating plant - Automotive diagnostic equipment - Systematic fault monitor selection

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the basics of various condition monitoring methods.

CO2: Apply the suitable condition monitoring sensors for various applications.

CO3: Analyze various signals processing methods for condition monitoring.

CO4: Identify various failure analysis methods and maintenance.

CO5: Apply different fault diagnosis method for Marine monitoring.

TEXTBOOK

1. "Mechanical Fault Diagnosis and condition monitoring" by R. A. Collacott, Chapman and Hall London A Halstead Press Book John Wiley & Sons, New York.

REFERENCE

1. "Condition Monitoring and Assessment of Power Transformers Using Computational Intelligence", W.H. Tang, Q.H. Wu, Springer-Verlag London

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3
CO2	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3
CO3	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3
CO4	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3
CO5	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3
CO6	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3
Overall correlation	3	2	1	2	1	-	-	1	-	-	1	3	3	2	3

23MT057 SYSTEMS MODELLING AND SIMULATION METHODS L T P C

3 0 0 3

COURSE OBJECTIVES

1. To introduce the characteristics of system modelling and the importance of simulation.
2. To study the various approaches of modelling.
3. To model the solutions using queuing theory.
4. To teach the generation of data for simulation.
5. To study the various system models and familiarize the simulation tools

UNIT – I INTRODUCTION TO SIMULATION 9

System definition - Types and characteristics - Need for modelling and simulation -Types of Simulation - Introduction to discrete event simulation - Single server — Multi server Exercises — System modelling - Simple Petrinets

UNIT – II MODELLING APPROACHES 9

Modelling concurrent systems - Analysis of Petrinets - Finite state Automata and Regular Expressions - Relationship - FSA with silent transitions - Pumping lemma for regular sets — Analysis using DFS and model checking.

UNIT – III QUEUING MODELS 9

Characteristics of queuing systems - Notations - Types of Queues - Markovian model — non- Markovian model - Queuing Networks - Applications of queuing systems.

UNIT – IV SIMULATION DATA **9**

Methods for generating random numbers - Testing of random numbers - Methods of generating random variants - Problem formulation - input modelling -Verification and Validation - Output1ZX Analysis.

UNIT – V CASE STUDY **9**

NS2 - Simulation of Computer Systems - Simulation of Computer Networks - Simulation of Mobile Networks -Simulation of Manufacturing and Material Handling Systems

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course students able to

CO1: Explain the characteristics of system modelling

CO2: Analyze the importance of simulation.

CO3: Develop system model using various approaches.

CO4: Apply queuing theory to various systems.

CO5: Develop appropriate data for simulation.

CO6: Construct the Model and analyze a given system using simulation tools.

TEXT BOOKS:

1. Jerry Banks "Discrete-event system simulation", 5th edition Pearson Education, Harlow,2009.
2. Fitzgerald, John, Larsen, PeterGorm, "Modeling Systems; Practical Tools and Techniques in software development", Cambridge University Press, 2009.

REFERENCES:

1. Hopcroft, John E, Motwani, Rajeev, Ullman, Seffrey D, "Introduction to automata theory, languages and computation",3rd edition, Pearson/Dorling Kindersley, New Delhi, 2002.
2. Hamdy A Taha, "Operations Research an Introduction", 9th edition, Pearson/Prentice Hall, New jersey, 2007.
3. Donald Gross and Carl M. Harris, "Fundamentals of Queuing theory", 5th Edition, John Wiley and Sons, New York 2018

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO2	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1

CO3	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO4	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO5	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO6	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
Overall correlation	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1

23MT060 **FUNDAMENTALS OF UAV SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To expose students to concepts needed in modelling and analysing an unmanned system.
2. To expose students to the design and development of UAV.
3. To expose students to the type of payloads used in UAV.
4. To study path planning
5. To understand the avionics hardware used in the UAV.

UNIT I INTRODUCTION TO UAV **9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications.

UNIT II THE DESIGN OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe- Design for Stealth--control surfaces-specifications.

UNIT III AVIONICS HARDWARE **9**

Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing.

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting.

UNIT V THE DEVELOPMENT OF UAV SYSTEMS **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1: Explain the design concepts of UAV system

CO2: Explain preliminary design requirements for an unmanned aerial vehicle.

CO3: Identify different hardware for UAV.

CO4: Apply system testing for unmanned aerial vehicles.

CO5: Identify Communication Payloads and Controls.

CO6: Explain the micro aerial vehicle systems by considering practical limitations.

TEXT BOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998
2. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.

REFERENCES:

1. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
2. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO2	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO3	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO4	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO5	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
CO6	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1
Overall correlation	1	2	3	1	-	2	-	1	-	-	1	1	3	2	1

23MT059 IMMERSIVE TECHNOLOGIES AND HAPTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To identify the terminologies of haptic devices.
2. To understand the structure of haptic system and to aware the tele-operation for various applications.
3. To acquire the knowledge on modelling for haptic system development relevant to the human.
4. To emphasize the significance of knowledge in virtual and augmented reality.
5. To know the concepts and hardware of mixed reality.

UNIT – I INTRODUCTION TO HAPTICS **8**

Definition - Importance of Touch - Tactile Proprioception - Tactual Stereo Genesis - Kinesthetic Interfaces - Tactile Interfaces - Human Haptics - Overview of Existing applications - Basics of Force Feedback Devices - Kinesthetic Vs. Tactile Haptic Devices - Configurations of Kinesthetic Devices -Types of Kinesthetic Devices

UNIT – II KINESTHETIC HAPTIC DEVICES AND TELEOPERATION **10**

Mechatronics in Haptics System - Haptic Kinematics - Haptic Dynamics - Existing Kinesthetic Devices - Haptic Device Static Rendering - Haptic Device Dynamic Rendering - Control of Haptic Devices - Stability Analysis of Haptic Devices - Stability Analysis of the Rendered Model -Passivity of the Rendered Model. Types of Sensors - Measurement of Haptic Parameters - Types of Actuators - Types of Transmission - Admittance Type Kinesthetic Device - Admittance Control - Comparison of Impedance and Admittance Type Devices - Genesis of Tele-Operation - Tele-Operation Controllers -Tele-Operator Transparency - Stability Analysis of Tele-operator - Tracking and Transparency - Surface Haptic - Exogenous Force inputs.

UNIT – III HUMAN HAPTICS ITS PLATFORM **9**

Introduction - Types of Haptic Sensing - Active vs. Passive Touch - Mechanoreception- Mechanoreceptive Afferents - Kinesthetic Sensing - Force Sensing and Proprioception- Introduction to Psychophysics - Measurement Thresholds - Laws of Psychophysics - Weber's Law - Fechner's Law - Fitt's Law - Psychophysical Methods of Limit, Constant Stimuli and Adjustment - Introduction to Virtual Reality Modelling Language (VRML) — Open Haptic Platform - OpenGL-Virtual Environment Manager - Modelling of Simple Haptic System.

UNIT – IV VIRTUAL AND AUGMENTED REALITY **9**

The Reality — Virtuality Continuum - Virtual Reality Definitions - Software, Hardware, Sensation and Perception - Multi-Modal Interaction Challenges - System Architecture of Virtual Reality. Aspects of Geometrical Modelling and Environmental Modelling General Solution for Calculating Geometric & Illumination Consistency in the Augmented Environment. Usability Guidelines - Design and Implementation of an Immersive User Experience - Case Study for VR and AR.

UNIT – V MIXED REALITY **9**

System Architecture of a Mixed Reality System - Common Interaction Techniques for Mixed Reality Environments - Common Navigation Techniques - Common Interface for MR - Menu Design Directions - Haptic Control Panel - Performance of an Interaction Techniques, Advanced Interaction Techniques, Design and Implementation of an Immersive User Experience - Case Study forMR.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the haptic technology and its concepts in various haptic systems.

CO2: Classify the elements of haptics system and tele-operation in detail.

CO3: Design and use the devices in human haptic applications.

CO4: Develop the virtual and augmented reality-based models.

CO5: Develop the build the virtual reality-based models.

CO6: Develop the design and model the hardware of mixed reality.

TEXT BOOKS

1. Burdea, G. C. and P. Coffet. "Virtual Reality Technology", 3rd edition, Wiley-Interscience, Hoboken New Jersey, 2012.
2. Eckehard Steinbach et al, "Haptic Communications", Vol. 100, 4:937-956, 2012
3. Hannaford B and Okamura A. M "Haptics: Handbook of Robotics", Springer, pp. 718735, 2008.

REFERENCES

1. Kenneth Salisbury, Francois Conti and Federico Barbagli, "Haptic Rendering: IEEE Computer Graphics and Applications, v24 n2 (200403): 24-32, 2004.
2. Jean-Pierre Bresciani, Knut Drewing and Marc O. Ernst. "Human Haptic Perception and the Design of Haptic-Enhanced Virtual Environments: The Sense of Touch and Its Rendering",STAR 45, pp. 61–106, 2008.

3. MacLean K. E, "Haptic Interaction Design for Everyday Interfaces: Reviews of Human Factors and Ergonomics", 4:149194, 2008.
4. Weir D. W and Colgate J. E "Stability of Haptic Display: Haptic Rendering: Foundations, Algorithms, and Applications". AK Peters, 2008.
5. Sherman, William R. and Alan B. Craig. "Understanding Virtual Reality — Interface, Application, and Design" 2nd edition, Morgan Kaufmann, Cambridge U.S 2019.
6. Yuichi Ohta, Hideyuki Tamura, "Mixed Reality: Merging Real and Virtual Worlds", Springer Verlag, Berlin, 2014.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO2	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO3	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO4	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO5	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO6	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
Overall correlation	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1

23MT060 COMPUTER VISION AND DEEP LEARNING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To familiarize the fundamentals of image processing and functioning of camera.
2. To appreciate three dimensional structure and motions.
3. To learn the visual servicing for robotic applications
4. To understand the fundamentals of Neural network
5. To appreciate and develop the deep learning networks for image processing

UNIT – I IMAGE FORMATION AND CAMERA CALIBRATION **9**

Basics: Sampling Theorem — Numerical Differentiation — Singular Value Decomposition Introduction to Vision, Terminologies of Fields, Comparison of Biological and Computer Vision, Projective Geometry Basics, Modelling of Geometric Image Formation, Modelling of Camera Distortion, Camera Calibration, Methods of Camera Calibration, Estimation of Projection Matrix, Experimental Performance Assessment in Computer Vision.

UNIT – II 3-D STRUCTURE AND MOTION 9

Computational Stereopsis – Geometry, Parameters – Correspondence Problem, Epipolar Geometry, Essential Matrix And Fundamental Matrix, Eight Point Algorithm – Reconstruction by Triangulation, Visual Motion – Motion Field of Rigid Objects – Optical Flow – Estimation of Motion Field – 3D Structure and Motion from Sparse and Dense Motion Fields – Motion Based Segmentation – Image Processing.

UNIT – III ACTIVE AND ROBOT VISION 8

LIDAR - Construction, Working Principle, Specifications and Selection Criteria. Point Cloud Data Processing. Visual Tracking – Kalman Filtering – Visual SLAM, Solutions, Visual Serving, Types and Architecture.

UNIT – IV INTRODUCTION TO NEURAL NETWORKS 8

Introduction to Neural Networks, Philosophy and Types of Networks, Back propagation, Numerical Problems for Back Propagation, Multi-Layer Perceptrons, Numerical Problems Based on Perceptron, Conventional Neural Networks vs. Deep Learning in the Context of Computer Vision, Loss Function, Optimization, Higher-Level Representations, Image Features, Stochastic Gradient Descent.

UNIT – V DEEP LEARNING 10

Convolutional Neural Networks - Convolution, Pooling, Activation Functions, Initialization, Dropout, Batch Normalization, Deep Learning Hardware - CPU, GPU and TPU -Tuning Neural Networks, Best Practices, Training Neural Networks, Update Rules, Ensembles, Data Augmentation, Transfer Learning, Popular CNN Architectures for Image Classification – Alexnet, VGG, Resnet, , Inception, CNN Architectures for Object Detection – RCNN and Types – Yolo - Semantic Segmentation - FCN, Instance Segmentation - Mask RCNN – Deep Learning frameworks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Analyze and Apply Fundamentals of Image Formation.

CO2: Evaluate 3D Structure and Motion Estimation Techniques.

CO3: Design Active Vision Systems for Robotic applications.

CO4: Develop Neural Network Models for Basic Image Processing Tasks.

CO5: Construct Deep Learning Networks for Advanced Image Analysis.

CO6: Evaluate and Implement Deep Learning Frameworks.

TEXTBOOKS:

1. Boguslaw Cyganek, J. Paul Siebert, "An Introduction to 3D Computer Vision Techniques and Algorithms", 2nd edition, John Willey, 2017.
2. Davies E.R, "Computer and Machine Vision: Theory, Algorithm, Practicalities", 4th edition Academic Press, Elsevier, Waltham 2012.
3. Emanuele Trucco, Alessandro Verri, "Introductory Techniques for 3D Computer Vision", Prentice Hall, South Asia, 2006.

REFERENCES

1. Rafael C. Gonzales, Richard. E. Woods, "Digital Image Processing", 3rd edition, Gates mark Publishing, Tennessee 2020.
2. Emanuele Trucco, Alessandro Verri, "Introductory Techniques for 3D Computer Vision", Prentice Hall, 1998.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", First Edition, MIT Press, 2018.
4. Forsyth and Ponce, "Computer Vision: A Modern Approach", 2nd edition Pearson, Harlow Uk 2015.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO2	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO3	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO4	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO5	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
CO6	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1
Overall correlation	2	1	2	-	1	-	-	-	-	-	-	2	2	3	1

23MT061	MICRO ELECTROMECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. To educate on the rudiments of Micro fabrication techniques.
3. To introduce various sensors and actuators
4. To introduce different materials used for MEMS.
5. To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering

UNIT – I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS — Semiconductor devices –Polymers in MEMS– Polyamide - SU-8 - Liquid Crystal Polymer (LCP) — PDMS — PMMA — Parylene — Fluorocarbon.

UNIT – II SENSORS 9

Characteristics of sensors - Electrostatic sensors – Parallel plate capacitors – Piezoresistive sensors – Piezoresistive sensor materials - Stress and strain analysis – Flexural beam bending- Torsional deflection– Applications to Inertia, Pressure, Tactile and Flow sensors Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials.

UNIT – III ACTUATORS 9

Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications –Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators - Actuation using Shape Memory Alloys.

UNIT – IV MICROMACHINING 9

Silicon Anisotropic Etching — Anisotropic Wet Etching — Dry Etching of Silicon — Plasma Etching– Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch — Striction and Ant restriction methods — LIGA Process - Assembly of 3D MEMS – Foundry process

UNIT – V APPLICATIONS OF MEMS INERTIAL SENSORS 9

Application to Acceleration, Inertia, Acoustic, Tactile, Pressure, Flow and Tactile sensors- Optical MEMS –Lenses and Mirrors -Actuators for Active Optical MEMS.– RF MEMS and Microfluidics.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain MEMS Energy Domains and Transducers, Sensors and Actuators.

CO 2: Select the Various MEMS sensors and its Stress and strain

CO 3: Apply various MEMS actuators in Real time system.

CO 4: Explain various micro machining processes.

CO5: Analyze the various MEMS inertial, tactile, pressure sensors

CO6: Analyze the various flow sensors in real time system

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2014, 2nd edition
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2001.

REFERENCES:

1. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2008.
2. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002.
4. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
5. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
6. Thomas M.Adams and Richard A.Layton, "IntroductionMEMS, Fabrication and Application," Springer 2010.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1
CO2	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1
CO3	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1

CO4	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1
CO5	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1
CO6	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1
Overall correlation	2	1	1	1	1	-	-	1	-	-	1	1	2	1	1

23EE501 POWER ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I SWITCHING POWER SUPPLIES 9

MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters — Isolated topologies — resonant converters - switching loss calculations and thermal design.

UNIT II INVERTERS 9

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI:(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI

UNIT III UNCONTROLLED RECTIFIERS 9

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge.

UNIT IV CONTROLLED RECTIFIERS 9

SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

UNIT V AC PHASE CONTROLLERS 9

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the Characteristics of MOSFET, operation of DC-DC converter, Resonant Converters

CO2: Analyze the Static and dynamic behavior IGBT and VSI(1phase and three phase inverters square wave operation)

CO3: Explain the Voltage control of inverters different types of Space vector modulation and various harmonic elimination techniques

CO4: Explain the operation of Power Diode (1Phase & 3 Phase Rectifier)

CO5: Explain the characteristics of SCR-Two transistor analogy & thermal protection, controlled Converter, and Effect of source inductance.

TEXT BOOKS:

1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.

REFERENCES:

1. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
3. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.

COs	PO'S												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	-	-	2	1	-	-	3	3	3	3	3
CO2	3	3	3	3	-	-		1	-	-	1	1	3	3	3
CO3	3	3	3	3	-	-	2	1	-	-	2	1	3	3	3
CO4	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
CO5	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
CO6	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
Overall correlation	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3

23CS404 **COMPUTER ARCHITECTURE** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating-point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand the memory hierarchies, cache memories and virtual memories.
- To introduce the parallel processing technique.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM **9**

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS **9**

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations.

UNIT III PROCESSOR AND CONTROL UNIT **9**

Basic MIPS implementation – Building a Datapath – Control Implementation Scheme –Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards Exceptions.

UNIT IV MEMORY AND I/O ORGANIZATION **9**

Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.

UNIT V ADVANCED COMPUTER ARCHITECTURE **9**

Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers , Introduction to Multiprocessor network topologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Construct the basics structure of computers, operations and instructions.
CO2: Construct the arithmetic and logic unit.
CO3: Explain pipelined execution and control unit.
CO4: Explain the various memory systems and I/O communication.
CO5: Design the parallel processing architectures.
CO6: Construct the hardware interface for real time applications.

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
3. Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	1	1	1	2	3	1	-
2	3	2	1	1	2	-	-	-	2	2	2	2	3	2	-
3	3	2	1	1	2	-	-	-	2	2	1	2	3	2	-
4	3	2	1	1	2	-	-	-	2	2	2	2	3	2	-
5	3	3	2	2	2	-	-	-	2	1	1	2	3	2	-
6	2	1	1	1	2	-	-	-	1	1	1	2	2	2	-
Overall correlation	3	3	2	2	2	-	-	-	2	2	2	2	3	2	-

23MT062 VIRTUAL INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES

1. To introduce virtual instrumentation concepts and applications.
2. To train to program virtual instrumentation software for biomedical applications
3. To understand the data acquisition and control in VI
4. To obtain the knowledge in instrument interfaces
5. To analyze the applications of VI in Bio Medical Engineering

UNIT – I INTRODUCTION 9

History of Virtual Instrumentation (VI), advantages, block diagram and architecture of a v instrument, Programming paradigms – Virtual Instrumentation – Lab VIEW software – Lab V basics – Lab VIEW environment.

UNIT – II VI USING LABVIEW 9

Creating, Editing and debugging a VI in Lab VIEW – Creating a sub VI – Loops and charts – Case and sequence structures – File I/O – VI customization.

UNIT – III DATA ACQUISITION AND CONTROL IN VI 9

Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems

UNIT – IV INSTRUMENT INTERFACES 9

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

UNIT – V APPLICATION OF VI IN BIOMEDICAL ENGINEERING 9

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Noninvasive Blood Pressure Measurement, Biofeedback, Virtual Reality & 3D graphical modeling, Virtual Prototyping.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course students able to

CO1 Explain virtual instrumentation concepts and applications

CO2 Explain the virtual instrumentation software examples

CO3 Explain the data acquisition and control in VI

CO4 Explain the technologies involved in instrument interfaces

CO5 Identify the applications of VI in Bio Medical Engineering

CO6 Identify the applications of VI in Virtual Reality & 3D Graphical Modeling

TEXT BOOKS:

1. Gary Johnson, "LABVIEW Graphical Programming", McGraw Hill, 4th edition, 2006.
2. Lisa K. Wells and Jeffrey Travis, "LABVIEW for Everyone", PHI, 1997.
3. Skolkoff, "Basic concepts of LABVIEW 4", PHI, 1998.
4. Jerome, Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2010.
5. Sanjay Gupta and Joseph John, "Virtual Instrumentation using Lab VIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2010.

REFERENCES:

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2003.
2. S. Gupta, J.P. Gupta, "PC Interfacing for Data Acquisition and Process Control", ISA, 2nd Edition, 1994.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.

4. Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in Lab VIEW" Pearson Education, 2001.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1
CO2	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1
CO3	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1
CO4	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1
CO5	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1
CO6	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1
Overall correlation	1	2	1	1	-	2	-	1	-	-	1	1	3	2	1

23MT063 INDUSTRIAL NETWORK PROTOCOLS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To study the various types of wired protocols for electronic systems.
2. To know the various types of wireless protocols for electronic systems.
3. To know the various industrial wired protocols in automation.
4. To study the various types of wireless protocols for industrial automation.
5. To develop the wired and wireless functions of various protocols.

UNIT – I WIRED BUSES AND PROTOCOLS **9**

Wireless - Wired Networks Comparison - Serial Communication Protocols - RS232-UART-SPI - I2C –UNI/O Bus -1 Wire -Camera Link - Parallel Communication -PPI - Wishbone Bus – AMBA – JTAG - Firmware IEEE 1394 Bus - Ethernet Overview - RS485

UNIT – II WIRELESS PROTOCOLS **9**

Antenna Technology- Network Topologies - Wireless Local Area Networks (WLAN) - Wireless Personal Area Networks (WPAN) - Wimedia – Wimax - RF – Bluetooth- Wi-Fi – Zigbee – Wireless Industrial Automation Protocols.

UNIT – III INDUSTRIAL AND AUTONOMOUS SYSTEMS WIRED NETWORKS **9**

Overview of Industrial Wired Networks – Terminal Bus- Modbus - HART Network - Mechatrolink-II – EtherCAT- Sercos II/III – CAN- Canopen - Modbus

IDA-PROFINET- PROFIBUS-Ethernet/IP- Ethernet Powerlink- AG Automation and Drives (AS-I) - Device Net

UNIT – IV INDUSTRIAL WIRELESS NETWORKS 9

Overview of Industrial Wireless Networks - IWLAN - ISA100 Standards – Remote Networks- Controller-Based Networks - Wireless HART Technology - 3G/4G for Automation – RFID Data Tags.

UNIT – V APPLICATION OF COMMUNICATION PROTOCALS 9

Wired Machine Networking of Sub-elements and Machines - Wireless Machine Networking of Sub-elements and Machines – Networking of Industry - Communication Network Layout Design - Networking for TIA- Cloud Computing – IOT - Case Studies in Automation Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the wired protocols for electronic systems.

CO2: Explain the wireless protocols for electronic systems.

CO3: Explain the industrial wired protocols in automation.

CO4: Explain wireless protocols for industrial automation.

CO5: Explain the wired functions of various protocols in application, development.

CO6: Apply the wireless functions of various protocols in applications.

TEXT BOOKS

1. Borko Furht, "Encyclopaedia of Wireless and Mobile Communications - Three Volume Set", CRC Press, 2012.
2. Dick Caro, "Wireless Networks for Industrial Automation", 2014.

REFERENCES

1. MMC-SD SERCOS Drive, "G&L Motion Control", Hardware Manual, 2005.
2. Olaf Pfeiffer, Andrew Ayre and Christian Keydel, "Embedded networking with CAN and CANopen", Copperhill Technologies Corporation, 2016.
3. Richard Zurawski, "Industrial Communication Technology", CRC Press, 2017.
4. Siemens IK, "Industrial Ethernet: IEEE 802.3", 2005.
5. Wolfram Behardt and Jorg Wollert, "The wireless B: Evolution and Communication", Stetue Germany, 2016.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	1	-	-	-	-	-	-	1	1		3
CO2	3	2	1	1	1	-	-	-	-	-	-	1	1		3
CO3	3	2	1	1	1	-	-	-	-	-	-	1	1		3
CO4	3	2	1	1	1	-	-	-	-	-	-	1	1		3
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1		3
CO6	3	2	1	1	1	-	-	-	-	-	-	1	1		3
Overall correlation	3	2	1	1	1	-	-	-	-	-	-	1	1		3

23MT064 MOTION CONTROL SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To introduce the basics in motion control system
2. To knowledge about on architecture of motion control system
3. To understand the features and specifications in motion control drives
4. To learn about intelligent motors and integrated drive
5. To ability to know about the programming of motion controller

UNIT – I INTRODUCTION MOTION CONTROL SYSTEMS 9

Introduction to Motion Control System - Dynamic System Modeling - Control System Design Fundamentals – Parameters in Control – Actuators and Measurement in Motion Control Systems -Multi-Body Dynamics – Need for Motion Controller – Specification of Motion Control

UNIT – II ARCHITECTURE OF MOTION CONTROL SYSTEM 9

Introduction to Motion Controller – Programmable Automation Controllers – Features & Specification of Motion Controllers – Digital I/O – Analog I/O – Standards in I/O – I/O Specific to Sensors – Modular and Expansion Concepts – Drives

UNIT – III MOTION CONTROL DRIVES 9

Programmable Automation Controllers – Features & Specification of Motion Controllers – Digital I/O – Analog I/O – Standards in I/O – I/O Specific to Sensors – Modular and Expansion Concepts - Drives

UNIT – IV INTELLIGENT MOTORS WITH INTEGRATED DRIVE 9

Intelligent motors – intelligent drives – features of drives – programmable I/Os-

communication protocols – features – Software - Programming – current, position and speed loops – Application in robots and portable systems.

UNIT – V PROGRAMMING OF MOTION CONTROLLER 9

IEC 61131 standards and Its Programming Languages overview- CoDeSys Platform - status Diagram – PLC Open - Motion Planer - PID - Servo Tuning – Position-velocity, Acceleration and Torque Profiling – CAM Profiling – Multi- Axis Motion Controllers – CNC Machines – Robot case study

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the basics concepts in motion control system.

CO 2: Explain the architecture of motion control system.

CO 3: Analyze the features and specifications in motion control drives.

CO 4: Explain the concepts about on intelligent motors and integrated drive.

CO 5: Explain the various application of robots and portable systems.

CO 6: Explain the programming of motion controller.

TEXT BOOKS:

1. M. Nakamura .S. Gata & N. Kyura, Mechatronic Servo System Control, Springer, 2004.
2. Sabanovic Asif, Motion Control Systems, John Wiley & Sons Inc, 2011

REFERENCES

1. Model 4000 indexer user Guide, Parker Hannifin Corporation, 1994.
2. 2-Axis Motion Controller User Guide, Parker Hannifin Corporation, 1995.
3. Operating instructions Compax3 T30 Programmable motion control according to IEC61131- 3, Parker Hannifin Corporation, 2008.
4. Programming with Easy Motion Studio – User's Manual, online, technosoftmotion.com.
5. Technical Reference, IPOS4808 BX-CAT-STO Intelligent Servo Drive for Step, DC, Brushless DC and AC Motors, Techno soft, 2022.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
CO2	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
CO3	3	2	2	2	-	-	-	3	-	-	-	3	3	1	3
CO4	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2

CO5	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
CO6	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
Overall correlation	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2

23MT065 TOTAL INTEGRATED AUTOMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To gain knowledge in automation in industries.
2. To gain knowledge in various electrical and electronic programmable automations and their applications.
3. To know about the basic in SCADA and DCS systems.
4. To gain knowledge in communication protocols in an integrated system
5. To know about the advanced in automation industries

UNIT – I TOTALLY INTEGRATED AUTOMATION 9

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT – II HUMAN MACHINE INTERFACE (HMI) 9

Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI-Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI).

UNIT – III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

Overview – Dev eloper and runtime packages – architecture – Tools – Tag – Internal &External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT – IV COMMUNICATION PROTOCOLS OF SCADA 9

Proprietary and open Protocols – OLE/OPC- UPC UA/DA – DDE – server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field device

UNIT – V DISTRIBUTED CONTROL SYSTEMS (DCS) 9

DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces. APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the concepts of **totally integrated system**

CO 2: Explain Human Machine Interface systems.

CO 3: Apply concepts of SCADA and C programming for report generation

CO 4: Explain the information's on communication protocols in automation systems

CO 5: Develop the automatic control system using distributed control systems.

CO6 : Explain the Distributed Control System.

TEXTBOOKS:

1. John. W. Webb& Ronald A. Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2009.
2. Michael P. Lukas, "Distributed Control systems", "Van Nostrand Reinfold Company"1995 .

REFERENCES:

1. Win C C Software Manual, Siemens, 2003
2. RS VIEW 32 Software Manual, Allen Bradly, 2005
3. CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
CO2	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
CO3	3	2	2	2	-	-	-	3	-	-	-	3	3	1	3
CO4	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
CO5	3	2	2	2	-	-	-	3	-	-	-	3	3	1	3
CO6	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2
Overall correlation	2	2	1	1	-	-	-	2	-	-	-	2	2	1	2

23ME060 DIGITAL TWIN AND INDUSTRY 5.0

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To understand the basics concepts in digital twin
2. To Introduce the concepts in digital twin in a discrete Industry

3. To Introduce the concepts in digital twin in a process Industry
4. To obtain the knowledge in industry 5.0
5. To know about the advantages in industry 5.0

UNIT – I INTRODUCTION 9

Digital twin – Definition, types of Industry and its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin – Virtual CAD Models – control Parameters- Real time systems – control Parameters – Handshaking Through Internet – cyber physical systems

UNIT – II DIGITAL TWIN IN A DISCRETE INDUSTRY 9

Basics of Discrete Industry, Trends in the discrete industry, control system requirements in a discrete industry, Digital Twin of a Product, Digital Thread in Discrete Industry, Data collection & analysis for product & production improvements, Automation simulation, Digital Enterprise

UNIT – III DIGITAL TWIN IN A PROCESS INDUSTRY 9

Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise.

UNIT – IV INDUSTRY 5.0 9

Industrial Revolutions, Industry 5.0 – Definition, principles, Application of Industry 5.0 in process & discrete industries, Benefits of Industry 5.0, challenges in Industry 5.0, Smart manufacturing, Internet of Things 5.0, Industrial Gateways, Basics of Communication requirements – cognitive systems 5.0

UNIT – V ADVANTAGES OF DIGITAL TWIN 9

Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the basics concepts in digital twin.

CO 2: Explain the concepts in digital twin in a discrete Industry.

CO 3: Explain the concepts in digital twin in a process Industry.

CO 4: Explain recent development of industry 5.0.
CO 5: Apply the concepts of smart manufacturing in various industries
CO 6: Explain process, productivity improved using digital twins.

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2018
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019

REFERENCES:

1. Uthayan Elangovan, Industry 5.0: The Future of the Industrial Economy, CRC Press, 2022.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress., United States ,2015.
3. Christoph Jan Bartodziej, "The Concept Industry 4.0 an Empirical Analysis of Technologies and Applications in Production Logistics", Springer Gambler., Germany, 2017.
4. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0", Springer., Switzerland, 2016.
5. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	2	-	-	-	2	1	2	2
CO2	2	2	1	1	-	-	-	2	-	-	-	2	1	2	2
CO3	2	2	1	1	-	-	-	2	-	-	-	2	1	2	2
CO4	2	2	1	1	-	-	-	2	-	-	-	2	1	2	2
CO5	3	2	2	2	-	-	-	3	-	-	-	3	1	3	3
CO6	2	2	1	1	-	-	-	2	-	-	-	2	1	2	2
Overall correlation	2	2	1	1	-	-	-	2	-	-	-	2	1	2	2

23MT0066 **FOUNDATIONS OF LINEAR INTEGRATED CIRCUITS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To introduce the basic building blocks of Linear integrated circuits
2. To learn the linear and non-linear applications of operational amplifiers

3. To introduce the theory and applications of analog multipliers and PLL
4. To learn the theory of ADC and DAC
5. To introduce the concepts of waveform generation and introduce some special function IC's.

UNIT – I BASICS OF OPERATIONAL AMPLIFIERS 9

Introduction to Operational Amplifier(OPAMP) – Ideal Operational Amplifier – General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT – II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, Peak detector, Clipper and Clamper.

UNIT – III ANALOG MULTIPLIER AND PLL 9

Introduction Analog multiplier ,Analog MultiplierICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565.

UNIT – IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2 Ladder type, Voltage Mode and Current-Mode R – 2R Ladder types – switches for D/A converters high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type.

UNIT–V WAVEFORM GENRATORS AND SPECIALFUNCTION ICs 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator,ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator – Monolithic switching regulator.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain the basic concepts of OPAMP .

CO2: Explain the basic application of OPAMP.

CO 3: Explain the basic concepts and applications of analog multiplier and basic

operation of PLL.

CO 4: Explain the various types A/D & D/A converters

CO 5: Apply the various waveforms generators using OPAMP.

CO6: Explain the basic concepts of special function ICs.

TEXTBOOKS:

1. D.Roy Choudhry, Shail Jain, ―Linear Integrated Circuits‖, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Sergio Franco, ―Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata Mc Graw-Hill, 2016

REFERENCES:

1. Ramakant A. Gayakwad, ―OP-AMP and Linear ICs‖, 4th Edition, Prentice Hall / Pearson Education, 2015.
2. Robert F.Coughlin, Frederick F.Driscoll, ―Operational Amplifiers and Linear Integrated Circuits‖, Sixth Edition, PHI, 2014.
3. B.S.Sonde, ―System design using Integrated Circuits‖ , 2nd Edition, New Age Pub, 2001.
4. Gray and Meyer, ― Analysis and Design of Analog Integrated Circuits‖, Wiley International, 5th Edition, 2011.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3
CO6	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3
Overall correlation	3	2	1	-	-	-	-	-	-	-	-	1	1	2	3

23MT067 SINGLE BOARD COMPUTERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To know the architecture Single board computers
2. To understand the function and uses of Real time operating system
3. To familiar the python programming
4. To develop the embedded based python programming
5. To experiment the application development in SBC using python programming.

UNIT – I INTRODUCTION TO SINGLE BOARD COMPUTERS **9**

On-Board System Architecture - Processor- Architecture – Features - SPI-I2C- UART-USB - Ethernet- CAN Protocol - Wi-Fi – Bluetooth - HDMI- GPIO- Memory- Input Devices – Camera Interfacing.

UNIT – II REAL TIME OPERATING SYSTEM **8**

Operating System Architecture – File Systems- Resource Management – Process Scheduling – Applications.

UNIT – III PYTHON PROGRAMMING 10

Python Language – Using the Interpreter – Python Data Types And Functions – Working With Data – List, Dictionary And Set – Processing Primitives – List Comprehensions – File Handling – Object Model Including Variables, Reference Counting, Copying, and Type Checking – Error Handling Iterative Statement-Conditional Statement – Operators – Arrays Libraries- Library - GUI Development

UNIT – IV EMBEDDED PYTHON PROGRAMMING **9**

GPIO Programming – Numerical Library- Communication Library- Image Processing – Machine Learning.

UNIT – V APPLICATIONS **9**

Automotive – Mobile Robotics - IOT- Factory Automation - Home Automation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the Single board computers and its components

CO2 : Select single board computers for mechatronics system development

CO3: Access the library and functions for Real time operating system

CO4: Write the python programming for various applications

CO5: Use the GPIO and peripherals using embedded based python programming

CO6: Develop the application in SBC using python programming.

REFERENCES:

1. David Beazley and Brian K. Jones, "Python Cookbook", O'Reilly Media, 2014
2. Gabriele Manduchi and Ivan CibrarioBertolotti, "Real-Time Embedded Systems: Open- Source Operating Systems", CRC Press, 2017.
3. Guttag, John. "Introduction to Computation and Programming Using Python", MIT Press, 2021.
4. NinadSathaye, "Learning Python Application Development", Packt Publishing, 2016
5. Sai Yamanoor, Srihari Yamanoor, "Raspberry-Pi Mechatronics Projects", Packt Publishing, 2016.
6. Warren Gay, "Mastering the Raspberry Pi", A press, 2017

COs/POs & PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1								1	1	2	3
CO2	3	2	1	1								1	1	2	3
CO3	3	2	1	1								1	1	2	3
CO4	3	2	1	1								1	1	2	3
CO5	3	2	1	1								1	1	2	3
CO6	3	2	1	1								1	1	2	3
Overall correlation	3	2	1	1								1	1	2	3

23MT068 RELIABILITY AND MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge about basic concepts of reliability
2. To learn about various models of reliability
3. To know about maintenance functions and objectives, maintenance planning and scheduling, maintenance organization.
4. To impart knowledge about Principles of CBM, pillars of condition monitoring, CBM implementation and benefits
5. To learn about reliability centered maintenance, TPM and FMECA

UNIT – I BASIC CONCEPTS OF RELIABILITY 9

Probability distributions used in maintenance engineering- Binomial, Poisson, Exponential, Normal, Log-normal, Gamma and Weibull distribution; failure rate, hazard rate, failure modes, MTTR, MTBF, MTTF

UNIT – II SYSTEM RELIABILITY MODELS 9

System reliability–n-component series systems, m-component parallel systems and combined system; standby systems; K-out-of-m systems; redundancy techniques. in system design; event space, decomposition (Key Stone), cut and tie sets, Markov analysis, reliability and quality, unreliability, maintainability, availability

UNIT – III MAINTENANCE CONCEPTS AND STRATEGIES 9

Introduction, maintenance functions and objectives, maintenance planning and scheduling, maintenance organization. General Introduction to Maintenance Types: Breakdown, emergency, corrective, predictive, and preventive; maintenance prevention; design-out maintenance, productive maintenance, shutdown maintenance and scheduled maintenance.

UNIT – IV CONDITION BASED MAINTENANCE 9

Principles of CBM, pillars of condition monitoring, CBM implementation and benefits; condition monitoring techniques- visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring

UNIT – V RELIABILITY CENTERED MAINTENANCE (RCM) 9

Concept, methodology, benefits; Total Productive Maintenance: Evolution of TPM, TPM objectives, concept, pillars of TPM. Failure Modes and Effects Analysis (FMEA)/ Failure Modes, Effects and Criticality Analysis (FMECA): Overview, elements of FMECA, applications and benefits, risk evaluation, risk priority numbers, criticality analysis, process FMEA, qualitative and quantitative approach to FMECA; design

FMEA and steps for carrying out design FMEA

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course the students can able to

CO1: Explain the basic concepts of reliability

CO2: Explain the various models of reliability

CO3: Apply the various maintenance functions and objectives, maintenance planning and scheduling, maintenance organization.

CO4: Explain the Principles of CBM, pillars of condition monitoring, CBM implementation

CO5: Apply the reliability centered maintenance, TPM

CO6: Apply the FMECA process.

TEXTBOOKS:

1. Ebeling CE, An Introduction To Reliability & Maintainability Engg McGraw Hill Education; 12th edition , 2017
2. Srinath L.S, Reliability Engineering; East West Press, 2005

REFERENCES:

1. Naikan, V.N.A., Reliability engineering and life testing; PHI,2008
2. Kapur KC and Lamberson LR; Reliability in Engineering Design; Wiley India 1997
3. Telang AD and Telang A; Comprehensive Maintenance Management; PHI
4. Mishra R.C; Reliability and Maintenance Engineering; New age International publisher 2006.
5. Balaguruswamy .E., Reliability Engg; TMH,2017
6. Dhillon; Engg Maintainability- How to design for Reliability and easy maintenance; PHI, 1999.
7. Davidson John; The Reliability of mechanical system; Institution of Mech. Engineers, London 1994
8. Patrick D.T and O.'Connor; Practical Reliability Engineering; John Wiley and Sons,1991
9. Terje Aven; Reliability and Risk Analysis, Springer Netherlands, 2000

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3
CO2	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3

CO3	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3
CO4	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3
CO5	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3
CO6	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3
Overall correlation	1	2	1	1	-	-	-	-	-	-	-	1	2	1	3

23MT069 MEDICAL MECHATRONICS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To understand how to measure biochemical parameters and various physiological information.
2. To study the need and technique of electrical safety in Hospitals.
3. To study the use of radiation for diagnostic and therapy.
4. To study about recorders and advanced equipment in medicine

UNIT – I INTRODUCTION 9

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential –electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting

UNIT – II TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION 9

Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fiber-optic, photoelectric, Bio sensor– their description and feature applicable for biomedical instrumentation.

UNIT – III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation, DC amplifier, power amplifier and differential amplifier – feedback, op-Amp- Electrometer amplifier, carrier Amplifier Oscillographic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems

UNIT – IV MEDICAL SUPPORT 9

Blood pressure measurement: by ultrasonic method– Plethysmography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vectorcardiography Heart lung machine Basic ideas of CT scanner – MRI and ultrasonic scanner– cardiac pacemaker – DC– defibrillator patient safety -electrical shock hazards. Centralized patent monitoring system.

UNIT – V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION, BIO TELEMETRY 9

Introduction – computers in medicine – basis of signal conversion, Data Reduction technique– ECG Analysis. –Telemetry principles – Bio telemetry Applications

OTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Explain different measurement techniques used in physiological parameters measurement.

CO2: Explain the sensors and signal conditioning circuits used in biomedical engineering.

CO3: Analyze various amplifiers, recording and display devices.

CO4: Explain the concepts and working of recorders in Real time applications

CO5: Explain the advanced systems used in medicine

CO6: Explain about various Bio- medical diagnostics instrumentation & Bio Telemetry applications.

TEXT BOOKS:

1. Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Pub., 2003

2. Cromwell, Weibell and Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, Printice Hall of india , 2014.

3. Siamak Najarian" Mechatronics in Medicine – A Bio medical engg approach" , McGraw – Hill Education , 2011.

REFERENCES:

1. Geddes L.A., and Baker, L.E., "Principles of Applied Bio-medical Instrumentation", 3rd Edition, John Wiley and Sons, 2010

2. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 2009.

3. Tompkins W.J., "Biomedical Digital Signal Processing", Prentice Hall of India, 1998.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	3	2	-	-	-	-	1	-	-	-	1	2	1	1
CO2	1	3	2	-	-	-	-	1	-	-	-	1	1	1	1
CO3	1	3	2	-	-	-	-	1	-	-	-	1	2	1	1
CO4	1	3	2	-	-	-	-	1	-	-	-	1	1	1	1
CO5	1	3	1	-	-	-	-	1	-	-	-	1	2	1	1
CO6	1	3	1	-	-	-	-	1	-	-	-	1	2	1	1
Overall correlation	1	3	2	-	-	-	-	1	-	-	-	1	2	1	1

23MT070 INTEGRATED PRODUCT DEVELOPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To understand the global trends and development methodologies of various types of products and services
2. To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them into design specification
4. To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

.UNIT – I FUNDAMENTALS OF PRODUCT DEVELOPMENT **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economic Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and services - Types of Product Development - Overview of Product Development methodologies- Product Life Cycle – Product Development Planning and Management.

UNIT – II REQUIREMENTS AND SYSTEM DESIGN **9**

Requirement Engineering - Types of Requirements - Requirement Engineering -traceability Matrix and Analysis - Requirement Management - System Design & Modeling -Introduction to System Modeling - System Optimization - System Specification - Sub-System design - Interface Design

UNIT – III DESIGN AND TESTING **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines – Concept Screening & Evaluation - Detailed Design - Component Design and Verification –Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing

– Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT – IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EOL – Obsolescence Management – Configuration Management - EOL Disposal

UNIT – V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1:Explain the fundamentals of product development

CO2:Explain the various types of Requirement Engineering & concept of system modelling.

CO3:Explain the concept of system design and testing

CO4:Explain the concept of sustenance engineering and product EOL

CO5: Explain the concept of Business dynamic in engineering service industry

CO 6:Explain the concept of IPR and confidentiality & management.

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", TMH, Fifth Edition, 2020.
2. John W Newstorm and Keith Davis, "Organizational Behavior", TMHl, Eleventh Edition.

REFERENCES:

1. Hiriyappa B, "Corporate Strategy – Managing the Business", Author House,

2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 20131. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2015.
5. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2016.
6. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
7. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3
CO2	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3
CO3	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3
CO4	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3
CO5	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3
CO6	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3
Overall correlation	2	2	1	1	-	-	-	-	-	-	-	1	1	1	3

23AD301 OBJECT ORIENTED PROGRAMMING SYSTEM IN C++ AND JAVA

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COUSE OBJECTIVES:

- To understand the concepts of Object-oriented Programming and discuss the important elements of C++.
- To understand and apply the concepts of classes, Inheritance, and exception handling.
- To understand and apply the concepts of packages, interfaces, and Multithread.
- To develop applications using Event Driven Programming
- To develop applications using Swing Programming

UNIT I OBJECT ORIENTED PROGRAMMING AND C++ **12**

Basic Concepts of Objects Oriented Programming - Operators - Control Structures Functions in C++ - Function Overloading - Class - Member Function - Nesting of Member function - Constructors - Destructors - Array with Class - Static Data Member - Friend functions - Returning Objects - Operator Overloading - Type Conversion - Basic type to Class – Class to Basic - Class to Class.

UNIT II OVERVIEW OF JAVA AND EXCEPTION HANDLING 9

An overview of Java, data types, variables and arrays, operators, control statements, classes, objects, methods – Inheritance. Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions.

UNIT III JAVA PROGRAMMING 6

Packages and Interfaces, Multithreaded programming, Strings, Input /Output, Generic Programming – Generic classes – generic methods.

UNIT IV EVENT DRIVEN PROGRAMMING 9

Graphics programming – Frame – Components – working with 2D shapes – Using colour, fonts, and images – Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy.

UNIT V JAVA PROGRAMMING USING SWING 9

Introduction to Swing – layout management – Swing Components – Text Fields, Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Develop C++ programs using OOP principles.

CO2: Develop Java programs with the concepts of inheritance and interfaces.

CO3: Construct the Java applications using exceptions, threads and generics classes

CO5: Develop the Java applications with event driven program.

CO6: Develop interactive Java programs using swings.

TEXTBOOKS:

1. K.R. Venugopal, Rajkumar Buyya, T.Ravishankar, “Mastering C++”, TMH, 2017 (Unit I)
2. Herbert Schildt, “The Java 2: Complete Reference”, Eighth Edition, TMH, 2018. (Unit II, Unit III, Unit IV, and Unit-V)

REFERENCES:

1. Ira Pohl, "Object oriented programming using C++", Pearson Education Asia, 2003
2. Bjarne Stroustrup, "The C++ programming language" Addison Wesley, 2000
3. John R.Hubbard, "Programming with C++", Schaums outline series, TMH, 2003
4. H.M.Deitel, P.J.Deitel, "Java : how to program", Fifthe edition, Prentice Hall of India private limited.
5. E.Balagurusamy " Object Oriented Programming with C++", TMH 2/e
6. James Rumbaugh ,"Object Oriented Modelling and Design" , Pearson publication,1991
7. Robert Lafore ,"Object-oriented programming in Turbo C++", Galgotia Publication,2004.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1	1	1	1	-	-	-	-	1	1	2	-
CO2	3	2	1	1	1	1	1	-	-	-	-	1	1	2	-
CO3	3	2	1	1	1	1	1	-	-	-	-	1	1	2	-
CO4	3	2	1	1	1	1	1	-	-	-	-	1	1	2	-
CO5	3	2	1	1	1	1	1	-	-	-	-	1	1	2	-
CO6	3	2	1	1	1	1	1	-	-	-	-	1	1	2	-
Overall correlation	1	1	1	1	1	1	1	-	-	-	-	1	1	2	-

23ME035 PROCESS PLANNING AND COST ESTIMATION **L T P C**
3 0 0 3

COURSE OBJECTIVES

1 To introduce the process planning concepts to make cost estimation for various products after process planning
2 To Learn the various Process Planning Activities
3 To provide the knowledge of importance of costing and estimation.
4 To provide the knowledge of estimation of production costing.
5 To learn the knowledge of various Machining time calculations

UNIT – I INTRODUCTION TO PROCESS PLANNING **9**

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling

selection.

UNIT – II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies.

UNIT – III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost.

UNIT – IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT – V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

CO1: Explain the process, equipment and tools for various industrial products
CO2: Explain the prepare process planning activity chart.
CO3 : Explain the concept of cost estimation.
CO4 : Apply the job order cost for different type of shop floor.
CO5 : Solve the machining time for various lathe operations.
CO6: Apply the machining time for various milling, shaping and planning operations

TEXTBOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCES:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	2	-	-	-	2	-	2	2
CO2	2	2	1	1	-	-	-	2	-	-	-	2	-	2	2
CO3	2	2	1	1	-	-	-	2	-	-	-	2	-	2	2
CO4	3	2	2	2	-	-	-	3	-	-	-	3	-	3	3
CO5	3	2	2	2	-	-	-	3	-	-	-	3	-	3	3
CO6	3	2	2	2	-	-	-	3	-	-	-	3	-	3	3
Overall correlation	3	2	2	2	-	-	-	3	-	-	-	3	-	3	3

23MT071 VLSI AND FPGA L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the features of programmable logic devices
- To learn the features of various FPGAs and FPAA
- To understand the concepts of synchronous and asynchronous FSMs
- To provide the system design experience with FSMs using PLDs
- To introduce pulse mode approach to asynchronous FSM

UNIT – I PROGRAMMABLE LOGIC DEVICES 9

Logic implementation options - Technology trends - Design with Field programmable devices - ROM, PLA, PAL - CPLD - XC9500 family - Erasable Programmable Logic Devices - MAX5000, MAX7000 families.

UNIT – II FPGA AND FPAA 9

Programming Technology, Logic blocks, routing architectures of SRAM-Programmable FPGA Architectures - XC2000, XC3000, XC4000 — Anti-fuse Programmed FPGAs - Routing Architecture of the Actel FPGAs - ProASIC plus - Design Applications - Current FPGA Technologies - FPAA architecture and its reconfiguration.

UNIT – III SYNCHRONOUS FSM DESIGN **9**

Choice of Components to be Considered - Architecture Centered around Nonregistered PLDs - State Machine Designs - Centered around a Shift Register, Centered around a Parallel Loadable Up/Down Counter - One hot design method - Use of Algorithmic State Machine, Application of one hot design to serial 2's complementer, parallel to serial adder/subtractor controller- System-level design: controller, data path, and functional partition.

UNIT – IV ASYNCHRONOUS STATE MACHINE DESIGN **9**

Features and need for Asynchronous FSMs - Lumped path delay models for asynchronous FSMs - Excitation table, state diagrams, K-maps, and state tables - Design of the basic cells by using the LPD model - design examples - Hazards in Asynchronous FSMs - One-hot design of asynchronous state machines - Design of fundamental mode FSMs by using PLDs.

UNIT – V PULSE MODE APPROACH TO ASYNCHRONOUS FSM DESIGN **9**

Pulse Mode Models and System Requirements - Choice of Memory Elements - Other Characteristics of Pulse Mode FSMs - Design Examples - Analysis of Pulse Mode FSMs - One-Hot Programmable Asynchronous Sequencers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Explain the basic concepts of programmable logic devices.

CO2: Explain the architectural features of FPGA and FPAA

CO3: Explain the concept of synchronous FSMs design.

CO4 : Explain the concept of feature Asynchronous state machine design.

CO5: Explain the various design examples of FSM.

CO6: Explain the Pulse mode approach of asynchronous FSMs design.

TEXT BOOKS:

1. Stephen M. Trimberger, Edr.,"Field Programmable Gate Array Technology", Springer Science Business media, LLC, 2012.

2. Richard F. Tinder, "Engineering Digital Design, Revised Second Edition", Academic Press, 2000.

REFERENCES:

1. Roger Woods, John McAllister, Gaye Light body and Ying Yi, "FPGA-based implementation of Signal Processing Systems", A John Wiley and Sons, Ltd., Publication, 2008.
2. John V. Oldfield, Richard C.Dorf, "Field Programmable Gate Arrays – Reconfigurable logic for rapid prototyping and implementation of digital systems", John Wiley & Sons, Reprint, 2008.
3. P. K .Chan& S. Mourad, "Digital Design Using Field Programmable Gate Array", Prentice Hall, 1994.
4. Thomas L. Floyd, "Electronic Devices", Pearson Education Ltd., 8th Edition, 2008.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO2	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO3	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO4	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO5	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3
CO6	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3
Overall correlation	2	2	1	1	-	-	-	-	-	-	-	1	1	2	3

OPEN ELECTIVES – EMERGING TECHNOLOGY

23OE972 BLACK CHAIN TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To decompose a blockchain system's fundamental components, how they fit together and examine a decentralization using blockchain.
- To explain how Cryptocurrency works, from when a transaction is created to when it is considered part of the blockchain.
- To explain the components of Ethereum and programming languages for Ethereum.

- To study the basics Hyperledger and Web3.
- To provide details of alternative blockchain and blockchain projects in different perspectives.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Types of Blockchain – Pillars of Block chain- Government Initiatives of BlockChain- Bitcoin – SmartContracts - Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT IV *WEB3* AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 Understand the technology components of Blockchain and how it works behind – the scenes.

CO2 Be aware of different approaches to developing decentralized applications.

CO3 Understand Bitcoin and its limitations by comparing with other alternative coins.

CO4 Establish deep understanding of the Ethereum model, its consensus model and code execution.

CO5 Explain the architectural components of a Hyperledger and its development framework.

CO6: Aware of the Alternative blockchains and emerging trends in blockchain.

TEXT BOOKS:

1. Imran Bashir. "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained.", Packet Publishing Second Edition, 2018.
2. Arshdeep Bahga, Vijay Madisetti. "Blockchain Applications: A Hands On Approach", Ventus Publishing ApS, 2017.

REFERENCES:

1. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.
2. Roger Wattenhofer, "The Science of the Blockchain" CreateSpace Independent Publishing, 2016.
3. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly, 2014.

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	-	-	-	1	1	1	2	2	2	2
2	2	1	-	-	1	-	-	-	2	1	1	2	2	3	-
3	3	2	1	1	2	1	1	-	1	2	1	3	2	2	-
4	2	1	-	-	2	-	-	-	1	1	2	2	3	3	-
5	2	1	-	-	2	-	-	-	1	1	1	2	2	2	-
6	2	1	-	-	2	-	-	-	1	1	1	2	2	2	-
Overall Correlation	3	**2**	1	1	2	1	1	-	1	1	1	2	2	2	-

23OE973	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study about uninformed and Heuristic search techniques.
- To learn techniques for reasoning under uncertainty.
- To introduce Machine Learning and supervised learning algorithms.
- To study about ensembling and unsupervised learning algorithms.
- To learn the basics of deep learning using neural networks.

UNIT I PROBLEM SOLVING **9**

Introduction to AI - AI Applications - Problem solving agents and its types – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – Constraint Satisfaction Problems (CSP)

UNIT II PROBABILISTIC REASONING 9

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

UNIT III SUPERVISED LEARNING 9

Introduction to machine learning – Linear Regression Models: Least squares, 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 ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

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 NEURAL NETWORKS 9

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

Total: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 Explain the concepts and applications of AI
CO2 Infer appropriate search algorithms for problem solving
CO3 Apply reasoning under uncertainty
CO4 Build supervised learning models
CO5 Build ensembling and unsupervised models
CO6 Analyze deep learning neural network models

TEXTBOOKS:

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.

REFERENCE BOOKS:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013, (http://nptel.ac.in/)
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016
6. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
7. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.
8. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
9. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	1	1	-	-	1	1	2	-	1
2	2	1	-	-	-	1	1	1	-	-	1	1	2	-	1
3	3	2	1	1	3	1	1	1	-	-	1	1	3	3	1
4	3	2	1	1	3	1	1	1	-	-	1	1	3	3	1
5	3	2	1	1	3	1	1	2	-	-	1	1	3	3	2
6	3	3	2	1	2	1	1	3	-	-	1	1	3	3	3
Overall Correlation	**3**	**2**	**1**	**1**	**3**	1	1	**2**	-	-	1	1	**3**	3	**2**

23OE974 AUGMENTED REALITY AND VIRTUAL REALITY

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide a comprehensive understanding of the fundamental aspects and principles of AR/VR technologies.
- To gain an in-depth understanding of VR modeling techniques.
- To acquire knowledge about different AR/VR applications.
- To grasp the essentials of AR.
- To gain insight into the game engines used to develop AR/VR based applications.

UNIT I INTRODUCTION 9

Introduction to virtual reality and augmented reality – Definition – Introduction to trajectories and hybrid space – Three I's of VR – VR Vs 3D computer graphics – Benefits of VR – Components of VR system – Introduction to AR – AR technologies – Input devices – 3D position trackers – Types of trackers – Navigation and manipulation interfaces – Gesture interfaces – Types of gesture input devices – Output devices – Graphics display – Personal graphics displays – Large volume displays.

UNIT II VR MODELING 9

Modeling – Geometric modeling – Virtual object shape – Object visual appearance – Kinematics modeling – Transformation matrices – Object position – Transformation invariants – Object hierarchies – Viewing the 3D world – Physical modeling – Collision detection – Surface deformation – Force computation – Force smoothing and mapping – Behavior modeling – Model management.

UNIT III APPLICATIONS 9

Human factors in VR – VR health and safety issues – VR and society – Medical applications of VR – VR in education, arts, and entertainment – Military VR applications – Emerging applications of VR – VR applications in manufacturing – Applications of VR in robotics – Information visualization – VR in business.

UNIT IV AUGMENTED REALITY 9

Introduction to augmented reality – Interaction – Modeling and annotation – Navigation – Wearable devices.

UNIT V AR/VR SOFTWARE TOOLS AND GAME ENGINE 9

Fundamentals of Unity – Introduction to Vuforia – Overview of Blender.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Summarize the basic concepts of AR and VR.

CO2: Identify different gesture interfaces used in AR/VR.

CO3: Explain the concepts of VR modeling.
CO4: Identify VR applications in different domains.
CO5: Develop AR applications in different domains.
CO6: Analyze the different types of game engines.

TEXTBOOKS:

1. John Vince, "Introduction to Virtual Reality", Springer London, 1st Edition, India, 2011.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 1st Edition, India, 2016.

REFERENCES:

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publishing, 1st Edition, India, 2018.
2. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality – Interface, Application, and Design", Morgan Kaufmann Publishers, 2nd Edition, New Delhi, 2018.
3. Justin Plowman, "3D Game Design with Unreal Engine 4 and Blender", Packt Publishing, 1st Edition, New Delhi, 2016.
4. Jonathan Linowes, Krystian Babilinski, "Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit and Vuforia", Packt Publishing, 1st Edition, New Delhi, 2017.

	POs												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	-	-	-	2	2	1	2	2	2	-
2	3	2	1	1	2	-	-	-	2	2	1	2	2	2	-
3	2	1	-	-	3	1	1	1	3	2	2	3	3	3	1
4	3	2	1	1	3	-	-	-	2	2	3	3	3	3	-
5	3	2	1	1	3	1	1	1	3	3	3	3	3	3	1
6	3	3	2	2	3	1	1	1	3	3	3	3	3	3	1
Overall correlation	3	2	1	1	3	1	1	1	3	2	3	3	3	3	1

23OE975 IOT CONCEPTS AND APPLICATIONS

L	**T**	**P**	**C**
2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things (IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform

UNIT I INTRODUCTION TO INTERNET OF THINGS 9 + 3

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT II COMPONENTS IN INTERNET OF THINGS 9 + 3

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wi-Fi, GPS, GSM Modules)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IoT 9 + 3

IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems

UNIT IV OPEN PLATFORMS AND PROGRAMMING 9 + 3

IoT deployment for Raspberry Pi /Arduino platform-Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud

UNIT V IoT APPLICATIONS 9 + 3

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

TOTAL: 45 PERIODS

LAB COMPONENT PERIODS TOTAL: 15 PERIODS

LAB EXPERIMENTS

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming

6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Interfacing Arduino to Basic Sensors
9. Design an IOT based system

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Explain the Architectures of IoT
CO 2 Summarize the communication models for IoT system
CO 3 Summarize the various protocols in IoT
CO 4 Design portable IoT using Arduino/Raspberry Pi using open platform
CO 5 Design the Business Models for the IoT system
CO 6 Analyze applications of IoT in real time scenario

TEXTBOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015.

REFERENCES:

1. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. IoT (Internet of Things) Programming: A Simple and Fast Way of Learning, IoT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

	POs												**PSOs**		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	-	-	-	-	-	3	2	-
2	2	1	-	-	2	-	-	-	-	-	-	-	3	2	-
3	2	1	-	-	2	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	2	-	-	-	-	-	-	-	3	3	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	3	-
6	3	3	2	2	3	-	-	-	-	-	-	-	3	3	-

Overall correlation	3	2	1	1	3	-	-	-	-	-	-	-	3	3	-

23OE976 INTRODUCTION TO DATA SCIENCE

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To define key concepts and terminologies in data science.
- To describe the methods used in data munging.
- To use distribution properties of data using statistical concepts.
- To explore types of data Visualization techniques
- To assess regression techniques for solving Data science applications.

UNIT I INTRODUCTION **9**

Introduction To Data Science: Definition, Big Data and Data Science Hype, Datafication, Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modeling, Philosophy of Exploratory Data Analysis, The Data Science Process , A Data Scientist's Role in this Process

UNIT II MATHEMATICAL PRELIMINARIES **9**

Mathematical Preliminaries: Probability, Descriptive Statistics, Correlation Analysis: Data Munging: Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data, Crowdsourcing.

UNIT III SCORES AND RANKINGS **9**

Scores and Rankings: Developing Scoring Systems, Z-scores and Normalization, Advanced Ranking Techniques Statistical Analysis: Sampling from Distributions, Statistical Distributions, Statistical Significance, Permutation Tests and P-values.

UNIT IV VISUALIZING DATA **9**

Visualizing Data: Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations Mathematical Models: Philosophies of Modeling, A Taxonomy of Models, Baseline Models, Evaluating Models, Evaluation Environment.

UNIT V SUPERVISED LEARNING 9

Supervised Learning: Linear Regression, Better Regression Models, Regression as Parameter Fitting, Simplifying Models through Regularization Classification and Logistic Regression, Issues in Logistic Classification, Naive Bayes, Decision Trees Classifiers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Describe the significance of data science and understand the Data Science process.

CO2: Explain how data is collected, managed and stored for data science.

CO3: Build, and prepare data for use with a variety of statistical methods and models

CO4: Analyze Data using various Visualization techniques.

CO5: Utilize contemporary models using machine learning.

CO6: Utilize AI techniques to solve practical problems.

TEXT BOOKS:

1. Steven S. Skiena, "The Data Science Design Manual", Springer 2017.
2. Rachel Schutt & O'neil, "Doing Data Science, Straight Talk from The Frontline", O'REILLY, 1st Edition, October 2013.

REFERENCES:

1. Joel Grus," Data Science from Scratch" O'Reilly Media; 1st Edition,30 April 2015.
2. Gareth James, Daniela Witten, Trevor Hatie, RoberstTibhirani , "An Introduction to Statistical Learning-with Applications in R",Springer; 1st ed. 2013, Corr. 7th printing 2017 edition
3. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, "Mining of Massive Datasets. v2.1", Cambridge University Press. 2 Edition 30 September 2014.
4. Roger D. Peng "R Programming for Data Science", LeanPub, 2015.

	POs												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	1		-	1	2	-	-
2	2	1	-	-	-	-	-	-	-	1	-		2	-	-
3	3	2	1	1	1	-	-	1	1		-		3	1	1
4	3	2	1	1	1	-	-	1	1		-	1	3	1	1
5	3	2	1	1	1	-	-	1	1	1	-	1	3	1	1

6	3	2	1	1	1	-	-	1	1	1	-	1	3	1	1
Overall correlation	2	1	1	1	1	-	-	1	1	1	-	1	2	1-	-1

23OE980 RENEWABLE ENERGY TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES

1 To know the Indian and global energy scenario
2 To learn the various solar energy technologies and its applications.
3 To educate the various wind energy technologies.
4 To explore the various bio-energy technologies.
5 To study the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers – Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations –Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

CO1 Summarize the Indian and global energy scenario.

CO2 Make use of various solar energy technologies for design of renewable energy systems.

CO3 Apply various wind energy technologies for design of renewable energy systems.

CO4 Illustrate the various bio-energy technologies.

CO5 Discuss the different types of ocean energy technologies.

CO6 Elaborate the types of geothermal power plants and its applications.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 :9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

	POs	PSOs

COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	1	-	-	2	1	1	-	1	-	2	3	-	1
2	3	3	1	-	-	2	-	1	-	1	-	2	3	-	1
3	3	2	1	-	-	2	-	1	-	1	-	2	3	-	1
4	2	2	1	1	-	2	-	-	-	1	-	2	2	-	-
5	2	2	1	-	-	2	-	-	-	1	-	2	2	-	-
6	2	2	1	1	-	2	1	1	-	1	-	2	2	-	1
Overall correlation	3	3	1	1	-	2	1	1	-	1	-	2	3	-	1

23OE982 RESOURCE MANAGEMENT TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Learn to formulate linear programming problems and solve LPP using simple algorithm
- Learn to solve networking problems
- Learn to formulate and solve integer programming problems
- Learn to solve Non-Linear programming problems
- Learn to understand and solve project management problems
- Learn to solve networking problems

UNIT I LINEAR PROGRAMMING **9**

Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.

UNIT II DUALITY AND NETWORKS **9**

Definition of dual problems – primal – Dual relationships – Dual simplex method –post optimality analysis – Transportation and assignment model – Shortest route problem.

UNIT III INTEGER PROGRAMMING **9**

Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV CLASSICAL OPTIMISATION THEORY **9**

Unconstrained external problems, Newton – Ralphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

UNIT V OBJECT SCHEDULOING **9**

Network diagram representation – Critical path method – Time charts and resource leveling – PERT

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1 Solve optimization problems using Graphical solution and Simplex methods.
CO 2 Solve the applications of dual relationships by dual simplex method.
CO 3 Find the optimal solution for transportation and assignment problems.
CO 4 Apply integer linear programming to solve real-life applications.
CO 5 Find the solutions for non-linear programming problems.
CO 6 Apply PERT and CPM for problems in project management.

TEXTBOOKS:

1. H.A. Taha, "Operation Research", Prentice Hall of India, 2002.
2. Paneer Selvam, 'Operations Research' Prentice Hall of India, 2002.

REFERENCES:

1. Anderson 'Quantitative Methods for Business', 8th Edition, Thomson Learning, 2002.
2. Winston 'Operations Research for Business', Thomson Learning, 2003.
3. Vohra, 'Quantitative Techniques in Management', Tata Mc Graw Hill, 2002.
4. Anand Sarma, 'Operation Research' Himalaya Publishing House, 2003.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1									1	3		
CO2	3	2	1									1	3		
CO3	3	2	1									1	3		
CO4	3	2	1									1	3		

CO5	3	2	1									1	3		
CO6	3	2	1									1	3		
Overall Correlation	3	2	1									1	3		

23OE985 INTRODUCTION TO NON-DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic importance of NDT in quality assurance.
- To imbibe the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- To equip the students to locate a flaw in various materials, products
- To apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- To acquire the knowledge on the selection of the suitable NDT technique for a given application

UNIT - I INTRODUCTION TO NDT & VISUAL TESTING 9

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT - II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9

Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT – III EDDY CURRENT TESTING & THERMOGRAPHY 9

Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography-approaches, IR detectors, Instrumentation and methods, applications.

UNIT-IV ULTRASONIC TESTING & AET 9

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT - V RADIOGRAPHY TESTING 9

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1. Realize the importance of NDT in various engineering fields.

CO2. Inspect the surface the objects using surface NDE techniques.

CO3. Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.

CO4. Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.

CO5. Interpret the results of Radiography testing.

CO6. Analyze the influence of various parameters on the testing.

TEXTBOOKS:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGrawHill Education, 2nd edition, 2011.
3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCES:

1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.
3. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2012.
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

CO-PO Mapping:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1
CO 2	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1
CO 3	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1
CO 4	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1
CO 5	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1
CO 6	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1
Overall correlation	3	2	1	-	1	1	-	1	-	-	-	-	1	1	1

OPEN ELECTIVES – MANAGEMENT COURSES

23HS971 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM frame work, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.

- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM – Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Ability to apply TQM concepts in a selected enterprise.

CO 2 Ability to apply TQM principles in a selected enterprise.

CO 3 Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO 4 Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO 5 Ability to apply QMS in any organization.

CO 6 Ability to apply EMS in any organization**.**

TEXTBOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, RevisedThird Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
2	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
3	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
4	2	3	2	2	2	2	3	-	-	-	-	-	-	-	-
5	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
6	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-

Overall correlation	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-

23HS972 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Understanding the concept of Engineering Economics.
- Implement various micro economics concept in real life.
- Gaining knowledge in the field of macroeconomics to enable the students to have better
- Understanding of various components of macro economics
- Understanding the different procedures of pricing and cost related functions

UNIT I DEMAND & SUPPLY ANALYSIS 9

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - short run and long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT III PRICING 9

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT 9

Investments - Risks and return evaluation of investment decision - Average rate return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Acquires the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO 2 Evaluate the economic theories, cost concepts and pricing policies

CO 3 Understand the market structures and integration concepts.

CO 4 Understand the measures of national income, the functions of banks and concepts of globalization.

CO 5 Apply the concepts of financial management for project appraisal

CO 6 Understand the financial statements of the business organizations.

TEXT BOOKS:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi,2001.
2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007

REFERENCES:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	1	1	2	2	-	-	-	-	-	-	-	-
2	2	1	-	1	2	2	2	-	-	-	-	-	-	-	-

3	2	1	-	2	2	2	2	-	-	-	-	-	-	-	-
4	2	3	-	1	2	2	2	-	-	-	-	-	-	-	-
5	2	1	-	0	2	2	2	-	-	-	-	-	-	-	-
6	2	1	-	2	2	2	2	-	-	-	-	-	-	-	-
Overall correlation	**2**	**1**	-	**2**	**2**	**2**	**2**	-	-	-	-	-	-	-	-

23HS973 ENGINEERING MANAGEMENT AND LAW L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide students with foundational knowledge of engineering management principles and practices, including planning, organizing, and leading engineering projects.
- To familiarize students with the structure, behavior, and human resource strategies of organizations to effectively manage engineering teams and projects.
- To equip students with essential tools and techniques for project planning, financial decision - making, and quality assurance in engineering practices.
- To educate students about the legal frameworks, intellectual property rights, environmental laws, and contract management necessary for ethical and compliant engineering practices.
- To develop problem-solving skills and ethical awareness in addressing challenges in engineering management and law.

UNIT I INTRODUCTION TO ENGINEERING MANAGEMENT 9

Role of engineering management in organizations-Evolution of management theories (Classical, Behavioral, and Modern)-Decision-making process in engineering management-Project lifecycle and stages-Basics of leadership and motivation.

UNIT II ORGANIZATIONAL BEHAVIOR AND HUMAN RESOURCE MANAGEMENT 9

Organizational structure and culture-Communication in engineering teams-Team dynamics and conflict management-Recruitment, training, and performance evaluation-Ethics and professionalism in engineering.

UNIT III PROJECT MANAGEMENT AND FINANCIAL PRINCIPLES 9

Introduction to project planning, scheduling, and budgeting-Tools and techniques:

Gantt charts, CPM, PERT-Cost estimation and financial risk management-Quality assurance and control in engineering-Case studies in project management.

UNIT IV LEGAL FRAMEWORK FOR ENGINEERS 9

Introduction to engineering laws and regulations-Intellectual property rights (IPR): Patents, trademarks, copyrights-Environmental laws and compliance in engineering-Contract laws and dispute resolution-Case studies on legal challenges in engineering.

UNIT V ENGINEERING LAW 9

Legal responsibilities and liabilities of engineers-Regulatory frameworks governing engineering practices -Public procurement laws and tendering processes-Engineering contracts: Types, clauses, and enforceability-Case studies on legal disputes in engineering projects**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand fundamental principles of engineering management and apply decision-making frameworks in projects.

CO 2 Analyze organizational behavior.

CO 3 Apply and implement effective HR strategies for engineering projects.

CO 4 Apply project management tools and financial principles to plan and execute engineering projects effectively.

CO 5 Demonstrate knowledge of legal frameworks and ensure compliance in engineering practices.

CO 6 Understand and apply engineering laws, sustainability principles, and risk management strategies to ensure legal and ethical compliance in engineering projects.

TEXTBOOK:

1. A S Chauhan, R S Vaishwanar, Niyati Jain, Engineering Management, 14th Edition, Jain Brothers.

REFERENCE:

1. Haring Alexander ,Engineering Law, 2013..

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

1	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
2	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
3	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
4	-	2	-	-	-	2	3	3	-	-	-	3	-	-	-
5	-	2	-	-	-	2	3	3	-	-	-	3	-	-	-
6	-	3	-	-	-	3	3	3	-	-	-	3			
Overall correlation	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-

23HS974 KNOWLEDGE MANAGEMENT

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide students with foundational knowledge of knowledge management principles and practices.
- To familiarize students with the organizational metrics of knowledge management
- To equip students with knowledge management ideas related to societal issues
- To educate students about knowledge management tools
- To learn about ethics of knowledge management.

UNIT I INTRODUCTION TO KNOWLEDGE MANAGEMENT **9**

Introduction to KM- History of KM- Importance of KM- Information Management to Knowledge Management-K M Cycle- Industrial Economy to Knowledge Economy.

UNIT II KNOWLEDGE PROCESSES **9**

Mechanics of Knowledge Management–Tools and Technologies, Communities of Practice and Knowledge conversion, The knowledge Management Matrix.

UNIT III KNOWLEDGE ORGANIZATION LEVELS **9**

Social Nature of Knowledge- Social Network Analysis- Obstacles to knowledge sharing- Organizational learning and Social Capital- Knowledge Application – Individual level, Group level and Organization Level.

UNIT IV KNOWLWDGE FRAMEWORK **9**

KM Strategy- Knowledge audit- GAP Analysis- Road Map-KM Metrics- Balance Score Card-KM Tools – Knowledge Capture and Creation tools- Knowledge sharing and Dissemination Tools- Knowledge Acquisition and Application tools.

UNIT V ENGINEERING LAW **9**

KM Team–Roles & Responsibilities, Ethics in KM, Strategies issues in Knowledge Management, Future of Knowledge Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand fundamental principles of knowledge management
CO 2 Understand organizational metrics of knowledge management .
CO 3 Apply knowledge management principles to societal issues.
CO 4 Understand the roadmap of Knowledge Management
CO 5 Apply knowledge management tools appropriately.
CO 6 Understand ethical aspects of knowledge management**.**

TEXTBOOK:

1. Ganesh Natarajan and Sandhya Shekhar, "Knowledge management - Enabling business growth", Tata McGraw Hill, New Delhi,2000.

REFERENCE:

1. Elias M Award, Knowledge Management, First Edition, Pearson,2003.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	1	1	2	2	-	-	-	-	-	-	-	-
2	2	1	-	1	2	2	2	-	-	-	-	-	-	-	-
3	2	1	-	2	2	2	2	-	-	-	-	-	-	-	-
4	2	3	-	1	2	2	2	-	-	-	-	-	-	-	-
5	2	1	-	1	2	2	2	-	-	-	-	-	-	-	-
6	2	1	-	2	2	2	2	-	-	-	-	-	-	-	-
Overall correlation	**2**	**1**	**2**	**2**	**2**	**2**	**2**	-	-	-	-	-	-	-	-

23HS975 INDUSTRIAL MANAGEMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of Management.
- To understand the different types of company registrations.
- To be able to difference between Industrial Management & Production Management
- To understand the basic knowledge of production management and make decisions proficiently
- To learn the knowledge in maintaining better human relations in the organizations

UNIT I INDUSTRIAL MANAGEMENT 9

Functions of management – Planning, Organizing, Staffing, Directing Controlling and Coordinating- Levels of management-Role of Manager- Skills of manager, – F.W. Taylor's scientific management and Henry Fayol's principles of management.

UNIT II PRODUCTION AND COST ANALYSIS 9

Meaning of Organization- Principles of organization- Departmentalization, Communication- Importance, purpose and forms of communication- Barriers to communication.

UNIT III PRICING 9

Salient features of Sole proprietorship- Partnership, Joint Stock Company- Private limited company and Public limited company-Government enterprises and Co-operative societies.

UNIT IV PRODUCTION OPERATIONS MANAGEMENT 9

Production planning and control-Plant location and factors affecting plant location-Plant layout and types of layout (in brief).

UNIT V HUMAN RESOURCE MANAGEMENT 9

Basic functions of human resource management. Manpower planning, Recruitment, Selection, Training and Development, Placement, Compensation and Performance appraisal.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand fundamental principles of industrial management.
CO 2 Apply the knowledge of industrial management to industrial organization.
CO 3 Understand the importance of communication.
CO 4 Understand forms of Business Organization.

CO 5 Understand how to plan production management.

CO 6 Apply the gained knowledge to Human Resource Management.

TEXTBOOKS:

1. P.C. Tripathi, P.N.Reddy, "Principles of Management" , Fourth Edition, Tata Mc Graw Hill Companies, New Delhi ,2008.
2. A.R. AryaSri, "Managerial Economics and Financial Analysis", TMH Publications, new Delhi, 2014.

REFERENCES:

1. Khanna, 'Industrial Engineering and Management', Dhanpat Raj and Sons.
2. S.C. Sharma and Banga T. R., "Industrial Organization & Engineering Economics", Khanna Publications, Delhi,2006

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
2	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
3	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
4	-	2	-	-	-	2	**3**	**3**	-	-	-	**3**	-	-	-
5	-	2	-	-	-	2	**3**	**3**	-	-	-	**3**	-	-	-
6	**-**	3	**-**	**-**	**-**	3	3	3	-	-	-	3			
Overall correlation	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-

23HS976 ENTREPRENEURSHIP AND BUSINESS OPPORTUNITIES

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Understand the role of entrepreneur in economic growth of the nation
- To enable the students to know the major motivation factors for becoming an entrepreneur
- To enable students to Classify, compare and analyze for setting up of a good business opportunity
- To assess the various souces sources of finance and method of acounting
- To know how to plan for establishing business opportunity with the knowledge on government norms
- To Understand the role of entrepreneur in economic growth of the nation

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

UNIT-II MOTIVATION 9

Major Motives Influencing an entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objective

UNIT-III BUSINESS Entrepreneurship Development Program 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies

UNIT-IV FINANCING AND ACCOUNTING 10

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty - Sales Tax.

UNIT-V SUPPORT TO ENTREPRENEURS 8

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Subcontracting

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand and explain the role of entrepreneur in economic growth of the nation

CO 2 Outline the major motivation factors for becoming an entrepreneur

CO 3 Classify, compare and analyse for setting up of a good business opportunity

CO 4 Summarize the various sources sources of finance and method of accounting

CO 5 Plan for establishing business opportunity with the knowledge on government norms

CO 6 Apply the knowledge of different aspects involved in expanding business

TEXT BOOKS:

1. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Lear
2. 2. Khanka. S.S., "Entrepreneurial Development" S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

REFERENCES:

1. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986
2. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
3. 3. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" 2nd Edition
4. 4. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 20114.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**2**	**1**	**0**			**2**	**2**								
2	2	1	0			2	2								
3	2	1	0			2	2								

4	2	3	2			2	2									
5	2	1	0			2	2									
6	2	1	0			2	2									
Overall correlation	2	2	1			2	2									

23HS977 MODERN BUSINESS ADMINISTRATION AND FINANCING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the concepts of Modern Business Administration.
- To gain knowledge on Innovative practices in management.
- To understand the different leadership styles and frameworks
- To learn to maintain good Financial basics.
- To learn to budget the tasks.
- To understand the concepts of Modern Business Administration.

UNIT I FOUNDATIONS OF MODERN BUSINESS MANAGEMENT 9

Evolution of management thought: From classical to contemporary approaches-Core functions of management: Planning, organizing, leading, and controlling-Decision-making in modern businesses-Business models and competitive strategies-Role of technology in business management (e.g., digital transformation, AI, and automation).

UNIT-II STATERGIC MANAGEMENT AND INNOVATION 9

Fundamentals of strategic management and goal setting-SWOT analysis, PESTLE analysis, and Porter's Five Forces-Managing innovation: Strategies for fostering creativity and disruptive innovation-Global business strategies and cultural diversity-Sustainability and corporate social responsibility (CSR) in strategy.

UNIT-III CHANGE MANAGEMENT AND FUTURE TRENDS 9

Contemporary leadership styles: Transformational, transactional, and servant leadership-Emotional intelligence (EI) in leadership-Change management frameworks (ADKAR model)-Managing workforce diversity and remote teams-Emerging trends: green business practices, and digital ecosystems.

UNIT-IV FUNDAMENTALS OF FINANCIAL MANAGEMENT 9

Introduction to financial management and its role in business-Financial statements: Analysis and interpretation (balance sheet, income statement, cash flow statement)

UNIT-V BUDGETING MANAGEMENT **9**

Budgeting and forecasting: Techniques for modern business environments-Working capital management: Liquidity, inventory, and receivables management-Capital structure: Equity, debt, and cost of capital.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand the foundational concepts of modern business management and the influence of technology on management practices.

CO 2 Analyze and apply strategic management tools to foster innovation

CO 3 Use the knowledge to achieve business sustainability in a global context.

CO 4 Understand Leadership and change management skills while understanding future trends that shape modern business environments

CO 5 Understand fundamental financial concepts.

CO 6 Apply the tools to evaluate a company's financial performance and manage resources efficiently.

TEXTBOOKS:

1. Doug Dockery, Laureen Knuden, Modern Business Management: Creating a Built-to-Change Organization , Apress
2. Jonathan Yen, HBR guide to Finance Basics for Managers, Ascent Audio.

REFERENCE:

1. Anil Lamba, Timeless Wisdom on Finance

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
2	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-
3	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-

4	-	2	-	-	-	2	**3**	**3**	-	-	-	**3**	-	-	-
5	-	2	-	-	-	2	**3**	**3**	-	-	-	**3**	-	-	-
6	**-**	3	**-**	**-**	**-**	3	3	3	-	-	-	3			
Overall correlation	-	3	-	-	-	3	3	3	-	-	-	3	-	-	-

23HS978 ESSENTIALS OF MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATION 9

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 PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Decision making steps and process.

UNIT III ORGANISING 9

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.

UNIT IV DIRECTING 9

Foundations of individual and group behavior – 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 CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in M System and process of controlling – budgetary and non-budgetary control technique 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 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Have clear understanding of managerial functions and different types of business structures and recent trends in management.

CO 2 Ability to understand management concept of planning.

CO 3 Ability to understand management concept of organizing.

CO 4 Ability to understand management concept of directing.

CO 5 Ability to understand management concept of controlling.

CO 6 Ability to understand management concept of productivity.

TEXTBOOKS:

1. Stephen P. Robbins & Mary Coulter, "Management", 10th Edition, Prentice Hall (India) Pvt. Ltd., 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6 th Edition, Pearson Education, 2004.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill, 1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
2	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-

3	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
4	2	3	2	2	2	2	3	-	-	-	-	-	-	-	-
5	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
6	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
Overall correlation	2	2	1	2	2	2	2	-	-	-	-	-	-	-	-

OPEN ELECTIVES – SAFETY COURSES

23HS979 DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on exposure to disasters, their significance and types.
- To understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To acquire knowledge on hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INTRODUCTION 9

Definition: Hazard, Disaster, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment and Management, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Understand various natural and man-made disasters, their causes and their impacts on the environment and society.

CO 2 Analyse factors contributing to vulnerability, including development projects, land-use changes and climate change and their differential impacts on communities and ecosystems.

CO 3 Evaluate risk reduction methods, disaster mitigation strategies and climate change adaptation for their effectiveness in reducing disaster impacts.

CO 4 Illustrate hazard and vulnerability profiles of different regions in India, focusing on coastal flooding, landslides, floods, forest fires and man-made disasters.

CO 5 Apply disaster damage assessment and propose mitigation strategies through case study analysis for improving resilience in India.

CO 6 Examine infrastructure vulnerability and design mitigation measures to enhance resilience against disasters.

TEXTBOOKS:

1. R.K Singhal J.P, "Disaster Management‖", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 99380386423.
2. Tushar Bhattacharya, "Disaster Science and Management‖", McGraw Hill India Education Pvt. Ltd., ISBN-10: 1259007367, ISBN-13: 978-1259007361], 2012.

REFERENCES:

1. Gupta Anil K, Sreeja S. Nair, " Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011.
2. Kapur Anu, "Vulnerable India: A Geographical Study of Disasters", IIAS and Sage Publishers, New Delhi,2010.
3. Govt. of India: "Disaster Management Act", Government of India, New Delhi, 2005.
4. Government of India, "National Disaster Management Policy", 2009.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	-	-	1	-	2	2	-	-
2	2	1	-	-	1	1	1	1	-	1	-	2	2	1	1
3	2	1	-	-	1	1	-	1	2	1	-	2	2	1	1
4	2	1	-	-	1	1	-	-	2	1	1	2	2	1	-
5	2	1	-	-	1	1	-	-	2	1	1	2	2	1	-
6	2	1	-	-	1	1	-	-	2	1	1	2	2	1	-
Overall correlation	2	1	-	-	1	1	1	1	2	1	1	2	2	1	1

23HS980 **INDUSTRIAL SAFETY** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the introduction and basic Safety Terminologies.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.
- To have knowledge about Workplace Exposures and Hazards.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS.

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES \ 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic gas Release.

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis-Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Interpret the basic concept of safety.

CO 2 Explain the Statutory Regulations and standards.

CO 3 Summarize the safety Activities of the Working Place.

CO 4 Analyze on the impact of Occupational Exposures and their Remedies.

CO 5 Outline the effects of job safety analysis.

CO 6 Discuss the Risk Assessment Techniques.

TEXTBOOKS:

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER.
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education.

REFERENCES:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring(1996).Safety management system: Chapman &Hall, England.
5. Society of Safety Engineers, USA.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
2	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-

3	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
4	2	3	2	2	2	2	3	-	-	-	-	-	-	-	-
5	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
6	2	1	-	2	2	2	1	-	-	-	-	-	-	-	-
Overall correlation	2	2	1	2	2	2	2	-	-	-	-	-	-	-	-

23HS981 **AUTOMOTIVE SAFETY** **L T P C**

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COURSE OBJECTIVES:

- Understand automotive safety in the broader context of transportation safety.
- To evaluate the effects of collision of vehicles on human body.
- To acquire knowledge on the importance and use of safety systems in road vehicles.

UNIT I INTRODUCTION **9**

Active and passive safety, driver assistance systems in automobiles. Vehicle structures - balance of stiffness and toughness characteristics and energy absorption characteristics, speed and acceleration characteristics of passenger compartment on impact, optimization of vehicle structures for crash worthiness.

UNIT II CRASH TESTING **9**

Introduction - types of crash and roll over, Tests - types of impacts and impact with rebound, movable barrier tests, analysis of vehicle in barrier impacts, roll over crash tests, behavior of specific body structures in crash testing and photographic analysis of impact tests.

UNIT III VEHICLE SAFETY SYSTEMS **9**

Survival space requirements, restraint systems used in automobiles, head restraints, safety belts - regulations, types, automatic seat belt tightener system. Air bags - electronic system for activating air bags, use of energy absorbing systems, impact protection from steering controls. Design of seats for safety and types of seats. Importance of bumpers, and damageability criteria in bumper designs.

UNIT IV ERGONOMICS AND HUMAN RESPONSE TO IMPACT 9

Importance of ergonomics in automotive safety, locations of controls, anthropometry and human impact tolerance. Determination of injury thresholds - severity index, study of comparative tolerance, application of Trauma for analysis of crash injuries, injury criteria and relation with crash study of crash dummies

UNIT V COLLISION WARNING AND AVOIDANCE 9

Causes of rear end collision. Collision warning system - frontal object detection, rear vehicle object detection system and objects detection system with braking system interactions. Vehicle connectivity to assist drivers to prevent accidents and driver fitness detection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO 1 Analyze the different types of active and passive safety system used in automobiles.

CO 2 Examine the crash testing and evaluation of vehicle safety using crash test.

CO 3 Analyze the different types of vehicle safety systems used in automobiles.

CO 4 Examine the crash injuries and human safety using crash test.

CO 5 Classify the different types of advanced safety systems used in automobiles.

CO 6 Compare different detection systems

TEXTBOOKS:

1. D.Vivek, Ergonomics in the Automotive Design Process, Boca Raton: CRC press, Taylor and Francis group, 2011.
2. R.K.Jurgen, Automotive Electronics Handbook, Second edition, London: McGraw-Hill Inc., 2006.

REFERENCES:

1. Bosch, Automotive Handbook, Warren dale PA: SAE International, 2004.
2. J.Powloski, Vehicle Body Engineering, London: Business books limited, 2014.
3. W.Johnson and A.G.Mamalis, Crashworthiness of Vehicles, London: MEP Publishers, 2005.
4. R.Bishop, Intelligent Vehicle Technology and Trends, London: Artech House

Publishers, 2005.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3
2	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3
3	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3
4	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3
5	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3
6	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3
Overall correlation	3	3	2	2	-	3	2	2	-	-	-	1	3	2	3

23OED971 DESIGN THINKING **Category** **L** **T** **P** **C**

3 **0** **0** **3**

Pre-requisite

Students are expected to have an empathetic mindset to help them understand users, a curious mindset to explore and questions assumptions, a collaborative mindset for interdisciplinary teamwork, an iterative approach for refining ideas and creativity to generate innovative solutions

Objectives

- Learn Design Thinking concepts and principles
- Understand the importance of the Design Mind
- Use Design Thinking methods in every stage of problem solving
- Learn the different phases of Design Thinking
- Learn and apply various Design Thinking tools

UNIT 1 FUNDAMENTALS OF DESIGN THINKING **9**

Introduction to Design Thinking: Definition, relevance, and applications - Contexts and situations where Design Thinking is most effective - Core process of implementing Design Thinking - Stakeholders involved in a Design Thinking approach - Design The Thinking® - Personal Visualization, The Wheel of Life, and Balancing Priorities - Understanding and appreciating the concept of 'Design' - The 3 Laws of Design Thinking®

UNIT 2 STEP 1: THE 'FEEL' STAGE 9

Understanding Stakeholders – Role of Empathy in Design Thinking – Tools: Persona, Journey Mapping, Stakeholder Mapping, CATWOE, Cartographic Perspective (L0)®, Empathy Map – Case Study

UNIT 3 STEP 2: THE 'DEFINE' STAGE 9

Problem Framing and Reframing – Role of a Design Thinker – Tools: Five Whys, Anti-Pattern, Problem Paraphrasing, Challenge Mapping – Introduction to LORD Skillset – Case Study

UNIT 4 STEP 3: THE 'DIVERGENCE' & A 'CONVERGENCE' STAGE 9

Ideation through Divergent and Convergent Thinking – Tools: Brainstorming, Metaphor, Random Association, End-State Visualization, 10gm–100gm–1000gm – Prototyping Basics – Wire framing – Case Study - Communicating for Effective Outcome

UNIT 5 Step 5: The 'Communication' Stage 9

Presenting and Packaging Design Outcomes – Tools: 4Cs Framework, Naming, Packaging, Storyboarding, Presentation Techniques, Distribution Methods

Recommended Reading

1. UnMukt – The Science & Art of Design Thinking, Arun Jain
2. The Design of Everyday Things, Don Norman
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Tim Brown

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