MUTHAYAMMAL ENGINEERING COLLEGE

An Autonomous Institution

(Approved by AICTE | Accredited by NBA & NAAC | Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Curriculum/Syllabus

Programme Code : MZ

Programme Name : B.E.-Mechatronics Engineering

Regulation : 2023

MUTHAYAMMAL ENGINEERING COLLEGE

(Approved by AICTE | Accredited by NBA & NAAC | Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Ph. No.: 04287-220837
Email: info@mec.ac.in

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Institution Vision & Mission

Institution Vision

- To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

Institution Mission

- To prepare the students with high professional skills and ethical values.
- To impart knowledge through best practices.
- To instill a spirit of innovation through Training, Research and Development.
- To undertake continuous assessment and remedial measures.
- To achieve academic excellence through intellectual, emotional and social stimulation.

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Department Vision & Mission

Department Vision

- To be a centre of excellence for dissemination of knowledge in Mechatronics Engineering at national and international level.

Department Mission

- Develop knowledge through effective teaching-learning process to meet the global challenges.
- Foster innovation through continuous learning and research activities.
- Promote ethical and entrepreneurial attitude with the students.

Program Educational Objectives

PEO1 : Employ the knowledge of basic sciences and engineering to design and develop Mechatronics systems for real world applications.

PEO2 : Perform as a successful professional in Indian and multinational companies

PEO3 : Exhibit the leadership skills with ethical conduct and have an aptitude for continuous learning.

Program Specific Outcomes

PSO1 : Design and develop sustainable Mechatronics system involving mechanical engineering, electronics and controls systems.

PSO2 : To work as a professional entrepreneur by applying Interdisciplinary and Management practices.

Program Outcomes

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

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

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

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

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

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

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

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

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

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

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

PO12 : **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

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Estd. 2000

B.E.- Mechatronics Engineering
Grouping of Courses

I. Humanities and Social Sciences Courses (HS)

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
1.	23HSS01	Business English	HS	3	2	0	0	2
2.	23HSS02	English Communicative Skills Laboratory	HS	2	0	0	2	1
3.	23HSS03	Life Skills and Workplace Psychology	HS	3	2	0	0	2
4.	23HSS04	Technical English For Engineers	HS	3	2	0	0	2
5.	23HSS05	Communicative English for Engineers	HS	3	2	0	0	2
6.	23HSS06	Basics of Japanese Language	HS	3	2	0	0	2
7.	23HSS07	Basics of French Language	HS	3	2	0	0	2

II. Basic Sciences (BS)

1.	23BSS01	Engineering Physics	BS	4	3	0	0	3
2.	23BSS02	Physics and Chemistry Laboratory	BS	2	0	0	2	1
3.	23BSS03	Bio and Nanomaterials Sciences	BS	4	3	0	0	3
4.	23BSS04	Material Sciences	BS	4	3	0	0	3
5.	23BSS05	Physics for Mechanical Engineers	BS	4	3	0	0	3
6.	23BSS11	Engineering Chemistry	BS	4	3	0	0	3
7.	23BSS12	Environmental Science and Engineering	BS	4	3	0	0	3
8.	23BSS13	Organic Chemistry	BS	4	3	0	0	3
9.	23BSS14	Physical Chemistry	BS	4	3	0	0	3
10.	23BSS15	Applied Chemistry	BS	4	3	0	0	3
11.	23BSS16	Organic Chemistry Laboratory	BS	3	0	0	3	1
12.	23BSS17	Physical Chemistry Laboratory	BS	3	0	0	3	1
13.	23BSS21	Algebra and Calculus	BS	5	3	1	0	4
14.	23BSS22	Advanced Calculus and Complex Analysis	BS	5	3	1	0	4
15.	23BSS23	Differential Equations and Vector Analysis	BS	5	3	1	0	4
16.	23BSS24	Transforms and Boundary Value Problems	BS	5	3	1	0	4
17.	23BSS25	Discrete Mathematics	BS	5	3	1	0	4
18.	23BSS26	Statistics and Queueing Model	BS	5	3	1	0	4

19.	23BSS27	Statistics and Numerical Methods	BS	5	3	1	0	4
20.	23BSS28	Numerical Methods and Analysis	BS	5	3	1	0	4
21.	23BSS29	Probability and Random Processes	BS	5	3	1	0	4

III. General Engineering Science (GES)

1.	23GES01	Programming for Problem Solving Using C	GES	3	3	0	0	3
2.	23GES02	Programming for Problem Solving Technique	GES	3	3	0	0	3
3.	23GES03	Programming in C Laboratory	GES	3	0	0	3	1
4.	23GES04	Programming in C and Python Laboratory	GES	3	0	0	3	1
5.	23GES05	Electrical and Electronic Sciences	GES	3	3	0	0	3
6.	23GES06	Mechanical and Building Sciences	GES	3	3	0	0	3
7.	23GES07	Computer Aided Drafting Laboratory	GES	3	0	0	3	1
8.	23GES08	Python Programming	GES	3	3	0	0	3
9.	23GES09	Programming in Python Laboratory	GES	3	0	0	3	1
10.	23GES10	Soft Skills Laboratory	GES	3	0	0	3	1
11.	23GES11	Electronic Devices	GES	3	3	0	0	3
12.	23GES12	Electronic Simulation Laboratory	GES	3	0	0	3	1
13.	23GES13	Electric Circuits	GES	3	2	1	0	3
14.	23GES14	Electric Circuits Laboratory	GES	3	0	0	3	1
15.	23GES15	Manufacturing Process	GES	3	3	0	0	3
16.	23GES16	Manufacturing Process Laboratory	GES	3	0	0	3	1
17.	23GES17	Mechanical and Building Sciences Laboratory	GES	3	0	0	3	1
18.	23GES18	Construction Materials	GES	3	3	0	0	3
19.	23GES19	Concepts in Product Design	GES	3	3	0	0	3
20.	23GES20	Renewable Energy Sources	GES	3	3	0	0	3
21.	23GES21	Electrical Drives and Control	GES	3	3	0	0	3
22.	23GES22	Electrical Drives and Control Laboratory	GES	3	0	0	3	1
23.	23GES23	Analog and digital communication	GES	3	3	0	0	3
24.	23GES24	Digital Principles and System Design	GES	3	3	0	0	3
25.	23GES25	Digital Principles and System Design Laboratory	GES	3	0	0	3	1
26.	23GES26	Engineering Drawing	GES	4	1	0	3	3
27.	23GES27	Engineering Geology	GES	3	3	0	0	3
28.	23GES28	Engineering Mechanics	GES	4	3	1	0	3

IV. Professional Core (PC)

1.	23MZC01	Applied hydraulics and pneumatics	PC	3	3	0	0	3
2.	23MZC02	Electronics Manufacturing Technology	PC	4	2	2	0	3
3.	23MZC03	Manufacturing Technology	PC	3	3	0	0	3

4.	23MZC04	Digital Electronics	PC	3	3	0	0	3
5.	23MZC05	Fluid mechanics and Machinery Laboratory	PC	2	0	0	2	1
6.	23MZC06	Manufacturing Technology Laboratory	PC	2	0	0	2	1
7.	23MZC07	Digital Electronics Laboratory	PC	2	0	0	2	1
8.	23MZC08	Control System Engineering	PC	3	3	0	0	3
9.	23MZC09	Strength of Materials	PC	4	2	2	0	3
10.	23MZC10	Metrology and Measurements	PC	3	3	0	0	3
11.	23MZC11	Computer Aided Design and Manufacturing	PC	3	3	0	0	3
12.	23MZC12	Microprocessors and Applications	PC	3	3	0	0	3
13.	23MZC13	Strength of Materials Laboratory	PC	2	0	0	2	1
14.	23MZC14	Microcontroller Laboratory	PC	2	0	0	2	1
15.	23MZC15	Dynamics of Machines	PC	2	0	0	2	1
16.	23MZC16	Power Electronics	PC	3	3	0	0	3
17.	23MZC17	Design of Machine Elements	PC	4	2	2	0	3
18.	23MZC18	Medical Mechatronics	PC	3	3	0	0	3
19.	23MZC19	Robotics and Machine Vision System	PC	3	3	0	0	3
20.	23MZC20	Dynamics of Machines Laboratory	PC	2	0	0	2	1
21.	23MZC21	Power Electronics Laboratory	PC	2	0	0	2	1
22.	23MZC22	Micro Controller and PLC	PC	3	3	0	0	3
23.	23MZC23	Sensors and Signal Processing	PC	3	3	0	0	3
24.	23MZC24	Automation System Design	PC	3	3	0	0	3
25.	23MZC25	Assembly Drawing and Modeling Laboratory	PC	4	2	2	0	3
26.	23MZC26	Sensors and Signal Processing Laboratory	PC	2	0	0	2	1
27.	23MZC27	Advanced Robots	PC	2	3	0	0	3

V. Professional Elective (PE)

1.	23MZE01	Advanced Machining Processes	PE	3	3	0	0	3
2.	23MZE02	Total Quality Management	PE	3	3	0	0	3
3.	23MZE03	Principles of Management	PE	3	3	0	0	3
4.	23MZE04	Automotive Mechatronics	PE	3	3	0	0	3
5.	23MZE05	Advanced Microprocessors and Microcontrollers	PE	3	3	0	0	3
6.	23MZE06	System Software	PE	3	3	0	0	3
7.	23MZE07	Automobile Engineering	PE	3	3	0	0	3
8.	23MZE08	Intellectual Property Rights	PE	3	3	0	0	3
9.	23MZE09	Design of Pressure Vessel and Piping	PE	3	3	0	0	3
10.	23MZE10	Lean & Agile Manufacturing	PE	3	3	0	0	3
11.	23MZE11	Industrial Design and Applied Ergonomics	PE	3	3	0	0	3
12.	23MZE12	Process Planning and Cost Estimation	PE	3	3	0	0	3

13.	23MZE13	Operations Research	PE	3	3	0	0	3
14.	23MZE14	VLSI Design	PE	3	3	0	0	3
15.	23MZE15	Virtual instrumentation	PE	3	3	0	0	3
16.	23MZE16	Artificial Intelligence for robotics	PE	3	3	0	0	3
17.	23MZE17	Special Machines and Controllers	PE	3	3	0	0	3
18.	23MZE18	Advanced Control Systems	PE	3	3	0	0	3
19.	23MZE19	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3
20.	23MZE20	Maintenance and Safety Engineering	PE	3	3	0	0	3
21.	23MZE21	Neural Networks and Fuzzy Systems	PE	3	3	0	0	3
22.	23MZE22	Industrial Robotics and Material Handling Systems	PE	3	3	0	0	3
23.	23MZE23	Totally Integrated Automation	PE	3	3	0	0	3
24.	23MZE24	Embedded System Design	PE	3	3	0	0	3
25.	23MZE25	Wireless Sensors Networks for Robotics	PE	3	3	0	0	3
26.	23MZE26	MEMS	PE	3	3	0	0	3
27.	23MZE27	Internet Tools and Java Programming	PE	3	3	0	0	3

VI. Employability Enhancement Courses (EEC)

1.	23MZS01	Project work Phase –I	EEC	6	0	0	6	3
2.	23MZS02	Project work Phase -II	EEC	20	0	0	20	10
3.	23MZS03	Value Added Course / Internship-I	EEC	2	0	0	2	1
4.	23MZS04	Inter Disciplinary Project	EEC	3	0	0	3	1
5.	23MZS05	Constitution of India and Professional Ethics	EEC	3	3	0	0	0
6.	23MZS06	Essence of Indian Traditional Knowledge	EEC	3	3	0	0	0
7.	23MZS07	Value Added Course / Internship-II	EEC	2	0	0	2	1
8.	23MZS08	Presentation Skill and Technical Seminar	EEC	2	0	0	2	1
9.	23MZS09	Internship-III	EEC	2	0	0	2	1

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B.E.- Mechatronics Engineering
Curriculum | UG – R 2023
Semester -I

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23HSS01	Business English	HS	2	2	0	0	2
2.	23BSS21	Algebra & Calculus	BS	4	3	1	0	4
3.	23BSS01	Engineering Physics	BS	3	3	0	0	3
4.	23BSS11	Engineering Chemistry	BS	3	3	0	0	3
5.	23GES02	Programming for Problem Solving Techniques	GE	3	3	0	0	3
6.	23GES05	Electrical and Electronics Sciences	GE	3	3	0	0	3
Practical								
7.	23GES07	Computer Aided Drafting Laboratory	GE	4	0	0	4	1
8.	23GES04	Programming in C & Python Laboratory	GE	3	0	0	3	1
9.	23HSS02	English Communicative Skills Laboratory	HS	3	0	0	3	1
							Total Credit	**21**

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Semester -II

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23HSS03	Life Skill Psychology and Ethics	HS	2	2	0	0	2
2.	23BSS23	Differential Equations and Vector Analysis	BS	5	3	2	0	4
3.	23BSS03	Bio and Nano Material Sciences	BS	3	3	0	0	3
4.	23BSS12	Environmental Science and Engineering	BS	3	3	0	0	3
5.	23GES19	Concepts in Product Design	GE	3	3	0	0	3
6.	23GES15	Manufacturing Processes	GE	3	3	0	0	3
Practical								
7.	23BSS02	Physics and Chemistry Laboratory	BS	2	0	0	2	1
8.	23GES16	Manufacturing Processes Laboratory	GE	3	0	0	3	1
							Total Credit	**20**

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Semester -III

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23BSS24	Transforms and Boundary Value Problems	BS	4	3	1	0	4
2.	23MZC01	Applied hydraulics and pneumatics	PC	3	3	0	0	3
3.	23GES21	Electrical Drives and Control	GE	3	3	0	0	3
4.	23MZC02	Electronics Manufacturing Technology	PC	3	2	1	0	3
5.	23MZC03	Manufacturing Technology	PC	3	3	0	0	3
6.	23MZC04	Digital Electronics	PC	3	3	0	0	3
7.	23GES29	Professional Skill	GE	2	0	0	2	1
Practical								
8.	23MZC05	Fluid mechanics and Machinery Laboratory	PC	2	0	0	2	1
9.	23MZC06	Manufacturing Technology Laboratory	PC	2	0	0	2	1
10.	23MZC07	Digital Electronics Laboratory	PC	2	0	0	2	1
							Total Credit	**23**

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Semester -IV

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23BSS27	Statistics and Numerical Methods	BS	3	3	1	0	4
2.	23MZC08	Control System Engineering	PC	3	3	0	0	3
3.	23MZC09	Strength of Materials	PC	4	2	2	0	3
4.	23MZC10	Metrology and Measurements	PC	3	3	0	0	3
5.	23MZC11	Computer Aided Design and Manufacturing	PC	3	3	0	0	3
6.	23MZC12	Microprocessors and Applications	PC	3	3	0	0	3
Practical								
7.	23MZC13	Strength of Materials Laboratory	PC	2	0	0	2	1
8.	23MZC14	Microcontroller Laboratory	PC	2	0	0	2	1
9.	23MZC25	Assembly Drawing and Modeling Laboratory	PC	2	0	0	2	1
							Total Credit	**22**

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Curriculum | UG – R 2023
Semester -V

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MZC15	Dynamics of Machines	PC	3	2	2	0	3
2.	23MZC16	Power Electronics	PC	3	3	0	0	3
3.	23MZC17	Design of Machine Elements	PC	3	2	2	0	3
4.	23MZC18	Medical Mechatronics	PC	3	3	0	0	3
5.	23MZE**	PROFESSIONAL ELECTIVE -I	PE	3	3	0	0	3
6.	23MZE**	OPEN ELECTIVE-I	OE	3	3	0	0	3
7.	23MZS07	Value Added Course / Internship-II	EEC	2	0	0	2	1
Practical								
8.	23MZC20	Dynamics of Machines Laboratory	PC	2	0	0	2	1
9.	23MZC21	Power Electronics Laboratory	PC	2	0	0	2	1
10.		Mandatory Course – I		1	1	0	0	0
							Total Credit	**21**

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B.E.- Mechatronics Engineering
Curriculum | UG – R 2023

Semester -VI

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MZC22	Micro Controller and PLC	PC	3	3	0	0	3
2.	23MZC24	Sensors and Signal Processing	PC	3	3	0	0	3
3.	23MZC25	Automation System Design	PC	3	3	0	0	3
4.	23MZE**	PROFESSIONAL ELECTIVE -II	PE	3	3	0	0	3
5.	23MZE**	PROFESSIONAL ELECTIVE -III	PE	3	3	0	0	3
6.	23*****	OPEN ELECTIVE-II	OE	3	3	0	0	3
Practical								
7.	23MZC26	Sensors and Signal Processing Laboratory	PC	2	0	0	2	1
8.	23MZS04	Interdisciplinary Project	EEC	3	0	0	3	1
							Total Credit	**20**

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Semester -VII

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MZS06	Essence of Indian Traditional Knowledge	EEC	2	2	0	0	0
2.	23MZC27	Advanced Robots	PC	3	3	0	0	3
3.	23MZC19	Robotics and Machine Vision System	PC	3	3	0	0	3
4.	23MZE**	PROFESSIONAL ELECTIVE -IV	PE	3	3	0	0	3
5.	23MZE**	PROFESSIONAL ELECTIVE -V	PE	3	3	0	0	3
6.	23MZE**	PROFESSIONAL ELECTIVE -VI	PE	3	3	0	0	3
7.	23*****	OPEN ELECTIVE-III	OE	3	3	0	0	3
8.	23*****	NPTEL		3	3	0	0	3
Practical								
9.	23MZS01	Project work Phase –I	EEC	6	0	0	6	3
10.	23MZS08	Presentation Skill and Technical Seminar	EEC	2	0	1	0	1
							Total Credit	**25**

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Semester -VIII

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Practical								
1.	23MZS02	Project work Phase -II	EEC	20	0	0	20	10
2.	23MZS09	Internship-III	EEC	2	0	0	2	1
							Total Credit	**11**

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B.E.- Mechatronics Engineering
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Summary of Course Component

Sl.No.	Course Area	Semesters								Total Credits	% of Credits
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	3	2	-	-	-	-	-	-	5	**3.07**
2.	BS	10	11	4	4	-	-	-	-	29	**17.79**
3.	GES	8	7	4	-	-	-	-	-	19	**11.66**
4.	PC	-	-	15	18	14	9	6	-	62	**38.04**
5.	PE	-	-	-	-	3	6	9	-	18	**11.04**
6.	OE	-	-	-	-	-	-	3	-	3	**1.84**
7.	EEC	-	-	-	-	1	2	4	11	18	**11.04**
8.	MC	-	-	-	-	-	-	-	-	-	**0.00**
9.	NPTEL	-	-	-	-	3	3	3	-	9	**5.52**
									Total	**163**	**100.00**

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23BSS24	TRANSFORMS AND BOUNDARY VALUE PROBLEMS	L	T	P	C
		3	1	0	4

Course Objective:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes.
- To introduce Fourier series analysis this is central to many applications in engineering.
- To develop the basic knowledge in solving the boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To develop Z transform techniques for discrete time systems.

Course Outcomes:

23BSS24.CO1	Provides the students to have sound knowledge Fourier series analysis.
23BSS24.CO2	This course enables the students to apply Fourier transform techniques to many engineering problems.
23BSS24.CO3	Using this course, a student develops Z transform techniques for discrete time systems for real world problems.
23BSS24.CO4	It equips students to find the solutions of partial differential equations that model real time processes.
23BSS24.CO5	The students will have the ability to solve boundary value problems

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23BSS24.CO1	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
23BSS24.CO2	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
23BSS24.CO3	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
23BSS24.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
23BSS24.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-

Unit-I FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – odd and even functions – Half range sine series – Half range cosine series – Parseval‟s identity – Harmonic analysis.

Unit-II FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem - Fourier transforms pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Problems.

Unit-III Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z- transforms the relationship of the Z-transforms to the Laplace transform - Elementary properties – Initial and final value theorem – Inverse Z - transforms – Partial fraction method – Residue method – Convolution theorem - Formation of difference equations – Solution of difference equations using Z – transforms.

Unit-IV PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Singular integrals – 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 homogeneous. .

Unit-V BOUNDARY VALUE PROBLEMS 9+3

Classification of PDE - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Fourier series solution in Cartesian coordinates – Steady state solution of two dimensional heat equation (excluding insulated edges) on finite square plates (excluding circular plates).

Total Periods: 45+15

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Erwin Kreyszig	Advanced Engineering Mathematics, 9th Edition	John Wiley and Sons, New Delhi	2014
2.	Grewal. B.S	Higher Engineering Mathematics, 43rd Edition	Khanna Publications, Delhi	2014

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Glyn James	Advanced Modern Engineering Mathematics, 4th Edition	Pearson Education	2016
2.	Bali N. P Manish Goyal	A Text book of Engineering Mathematics, 9th edition	Laxmi Publications Pvt Ltd.	2016
3.	Datta.K.B.	Mathematical Methods of Science and Engineering	Cengage Learning India Pvt Ltd, Delhi	2013
4.	Ray Wylie. C, Barrett.L.C	Advanced Engineering Mathematics, 6th Edition	Tata Mc Graw Hill Education Pvt Ltd, New Delhi	2012

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23BSS27	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

Course Objective:

- To understand concepts of testing of hypothesis.
- To develop design of experiments model for research problems.
- To find the trend information from discrete data set through numerical differentiation and summary information through numerical integration.
- To predict the system dynamic behavior through solution of ODEs modeling the system.
- To introduce numerical tools for the solutions of ordinary differential equations that model several physical processes.

Course Outcomes:

23BSS27.CO1 Determine testing of hypothesis to real life problems.

23BSS27.CO2 Enhance design of experiments model for research.

23BSS27.CO3 Demonstrate the applications of numerical techniques to various engineering fields.

23BSS27.CO4 Equip the knowledge in numerical differentiation and numerical integration.

23BSS27.CO5 Implement the ordinary differential equations to real life problems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23BSS27.CO1	X	X	X	-	-	-	-	-	-	-	-	-	-	X	X
23BSS27.CO2	X	X	X	-	-	-	-	-	-	-	-	-	-	X	X
23BSS27.CO3	X	X	X	-	-	-	-	-	-	-	-	-	-	X	X
23BSS27.CO4	X	X	X	-	-	-	-	-	-	-	-	-	-	X	X
23BSS27.CO5	X	X	X	-	-	-	-	-	-	-	-	-	-	X	X

Unit-I TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, Difference of means (large and small samples) – Tests for single variance and equality of variances – chi-square test for goodness of fit – Independence of attributes.

Unit-II DESIGN OF EXPERIMENTS 9+3

Completely randomized design – Randomized block design – Latin square design – One way- Two way Classification.

Unit-III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Newton-Raphson method- Gauss Elimination method – Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Horner's Method – Eigen values of a matrix by Power method .

Unit-IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolation –Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's 1/3 rules.

Unit-V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations – Adam's and Milne's predictor corrector methods for solving first order equations.

Total Periods: 45+15

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S. K. Gupta	Numerical Methods for Engineers , 3rd Edition	New Age International Pvt Ltd Publishers	2015
2.	Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K.	Probability and Statistics for Engineers and Scientists, 8th Edition	Pearson Education, Asia	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Douglas C. Montgomery and George C. Runger	Applied Statistics and Probability for Engineers (International Student Version)", 6th Edition	John Wiley & Sons, Inc.	2016
2.	Spiegel. M.R., Schiller. J., and Srinivasan.R.A.	Schaum's Outlines on Probability and Statistics, 4th Edition	Tata McGraw Hill Education	2013
3.	Chapra. S.C., and Canale.R.P.	Numerical Methods for Engineers, 6th Edition	Tata McGraw Hill, , New Delhi	2012
4.	Johnson. R.A., and Gupta. C.B.	Miller,Freund's Probability and Statistics for Engineers,11th Edition	Pearson Education, Asia	2011

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23GES21	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the basics of electrical drives.
- To study the drive motor characteristics,
- To study the different methods of starting D.C motors and Induction Motors.
- To study the Conventional and Solid-State DC Drives.
- To study the Speed Control of AC Drives.

Course Outcomes:

23GES21.CO1 Able to explain the basics of electrical drives.

23GES21.CO2 Able to describe drive motor characteristics

23GES21.CO3 Able to demonstrate the methods of starting D.C motors and Induction Motors.

23GES21.CO4 Able to describe speed control of DC drives.

23GES21.CO5 Able to explain the conventional and solid state speed control of AC drives.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23GES21.CO1	x	x	-	-	x	x	-	-	-	-	-	-	-	-	x
23GES21.CO2	x	x	-	-	x	x	-	-	-	-	-	-	-	-	x
23GES21.CO3	x	x	-	-	x	x	-	-	-	-	-	-	-	-	x
23GES21.CO4	x	x	-	-	x	x	-	-	-	-	-	-	-	-	x
23GES21.CO5	x	x	-	-	x	x	-	-	-	-	-	-	-	-	x

Unit-I INTRODUCTION 9

Basic Elements - Types of Electric Drives - Factors are influencing the choice of Electrical Drives -Heating and Cooling Curves - Loading conditions and classes of duty - Selection of power rating for drive motors with regard to thermal over loading and Load variation factors.

Unit-II DRIVE MOTOR CHARACTERISTICS 9

Dynamics of Motor load system –Multi quadrant operation–DC Motor (Types, Torque Equation, Characteristics and Applications)- Single phase induction motor (Types and Applications) - Three phase induction motors(Types, Characteristics)-Braking of Electric motors.

Unit-III STARTING METHODS 9

Necessity of a starters – Types of DC Motor Starters – Types of 3 phase squirrel cage and slip ring Induction Motor Starters.

Unit-IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF DC DRIVES 9

Speed control of DC series and shunt motors - Armature and field control - Ward-Leonard control system using controlled rectifiers and DC choppers.

Unit-V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES 9

Speed control of three phase induction motor- Voltage control, voltage / frequency control and slip power recovery scheme using inverters and AC voltage regulators.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G. K. Dubey	Fundamentals of Electrical Drives	CRC press	2002
2.	Vedam Subrahmaniam	Electric Drives (Concepts and Applications)	Tata McGraw-Hill	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gnanavadivel J, Karthikeyan J and Chitra Selvi S	Electrical Drives and Controls	Anuradha Publishers	2004
2.	Thiyagarajan V	Electrical Drives and Controls	A.R. Publications	2015
3.	Pillai SK	A First Course on Electric Drives	New age international publishers	2013
4.	Jagadeesh Babu V	Electrical Drives and Controls	Scitech Publications	2015
5.	Austin Hughes and Bill Drury	Electric Motors and Drives	Newness Heinemann Publishers	2018

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PROFESSIONAL CORES (PC)
For
Mechatronics

23MZC01	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on the applications of fluid power engineering in power transmission systems.
- To familiarize students with hydraulic systems and their components.
- To design hydraulic circuits for various applications.
- To understand pneumatic systems and the related components used in such systems.
- To design pneumatic system circuits

Course Outcomes:

23MZC01.CO1 Apply the fundamental laws of fluid power systems on real time applications.

23MZC01.CO2 Select the hydraulic pumps and actuators to the various engineering applications.

23MZC01.CO3 Designing hydraulic circuits for engineering applications

23MZC01.CO4 Design the basic pneumatic circuits using various pneumatic components.

23MZC01.CO5 Design the hydro-pneumatic circuits using advanced fluid power techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC01.CO1	X	X	X	X	-	X	X	-	-	X	-	X	X	-	-
23MZC01.CO2	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
23MZC01.CO2	X	X	X	-	-	-	X	-	X	X	-	-	X	-	-
23MZC01.CO4	X	X	X	-	-	X	X	-	-	X	-	-	X	-	-
23MZC01.CO5	X	X	X	-	-	-	X	-	X	X	-	-	X	-	-

Unit-I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids –Fluid power symbols. Basics of Hydraulics-Applications of Pascal's Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

Unit-II HYDRAULIC PUMPS & ACTUATORS 9

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators –Fluid motors, Gear, Vane and Piston motors.

Unit-III CONTROL COMPONENTS &HYDRAULIC CIRCUITS 9

Construction of Control Components: Directional control valve – pressure control valve – Flow control valve –Types, Construction and Operation – Accessories. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit. Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Reciprocation, Fail-Safe, Deceleration circuits and Sizing of hydraulic systems

Unit-IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumatic hydraulic circuit, Sequential circuit design for simple applications using cascade method.

Unit-V ELECTRO PNEUMATIC SYSTEMS **9**

Electro Pneumatic System – Elements– Ladder diagram – timer circuits-Problems. Fluidics – Introduction to fluidic devices, simple circuits. Fluid power circuits; failure and trouble shooting. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Anthony Esposito	Fluid Power with Applications	Pearson Education	2013
2.	Majumdar S.R	Oil Hydraulics Systems-Principles and Maintenance	Tata McGraw-Hill	2001

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Srinivasan.R	Hydraulic and Pneumatic controls	Vijay Nicole	2006
2.	Shanmugasundaram.K	Hydraulic and Pneumatic controls	Chand & Co.	2006
3.	Majumdar S.R	Pneumatic systems– Principles and maintenance	Tata McGraw Hill	2001
4.	Anthony Lal	Oil hydraulics in the service of industry	Allied publishers	1982
5.	Harry L. StevartD.B	Practical guide to fluid power	Taraoeala sons and Port Ltd.	1976

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23MZC02	ELECTRONICS MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on wafer preparation and PCB fabrication
- To introduce Through Hole Technology (THT) and Surface Mount Technology (SMT) with various types of electronic components
- To elaborate various steps in Surface Mount Technology (SMT)
- To be acquainted with various testing and inspection methods of populated PCBS
- To outline repair, rework and quality aspects of Electronic assemblies.

Course Outcomes:

23MZC02.CO1	Perceive wafer preparation and PCB fabrication
23MZC02.CO2	Recognize the importance of Through Hole Technology (THT) and Surface Mount Technology (SMT)
23MZC02.CO3	Demonstrate various steps in Surface Mount Technology (SMT)
23MZC02.CO4	Identify various testing and inspection methods of populated PCBS
23MZC02.CO5	Discuss various techniques in repair, rework, quality and reliability of Electronic Assemblies

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC02.CO1	X	X	X	X	-	X	X	-	-	X	-	X	X	-	-
23MZC02.CO2	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
23MZC02.CO2	X	X	-	-	-	-	X	-	X	-	-	-	X	-	-
23MZC02.CO4	X	X	X	-	-	X	X	-	-	X	-	-	X	-	-
23MZC02.CO5	X	X	X	-	-	-	X	-	X	X	-	-	X	-	-

Unit-I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit board –fabrication, types, single sided, double sided, multi-layer and flexible printed circuit board.

Unit-II COMPONENTS AND PACKAGING 9

Introduction to packaging, – axial, radial, multi leaded, odd form Surface-mount components- active, passive. Interconnections types-Through hole technology(THT) and Surface mount technology (SMT), Through hole components - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi-chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

Unit-III SURFACE MOUNT TECHNOLOGY 9

SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, soldering- wave soldering, reflow process, process parameters, profile generation and control, adhesive, under fill and encapsulation process.

Unit-IV INSPECTION AND TESTING 9

Inspection techniques, equipment and principle- AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.

Unit-V REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES 9

Repair and rework of PCB- Coating removal, base board repair, conductor repair, thermo-mechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, re-workability, testing, reliability, and environment.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Prasad R	Surface Mount Technology – Principles and practice	2nd Edition, Chapman and Hall	1997
2.	Tummala R.R	Fundamentals of micro system packaging	Tata McGraw Hill Co. Ltd., New Delhi	2001

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Harper C.A	Electronic Packaging and Interconnection Handbook	2nd Edition, McGraw Hill Inc., New York, N.Y.,	1997
2.	Zarrow P. and Kopp D	Surface Mount Technology Terms and Concepts	Elsevier	1997

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23MZC03	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on the concepts and basic mechanism of metal cutting.
- To understand the constructional features and working principle of centre lathe, and special purpose lathes.
- To familiarize the working principle of various machining operations such as milling, shaping, planning, slotting, drilling and broaching.
- To understand the various abrasive processes.
- To understand the concepts of computer numerical control (CNC) machine tool and CNC programming

Course Outcomes:

23MZC03.CO1	Analysis the metal cutting tool parameters for various machine tool working conditions.
23MZC03.CO2	Suggest the suitable Lathe machine and its operations for various engineering applications
23MZC03.CO3	Suggest the suitable shaper and milling machines and its operations for making gears
23MZC03.CO4	Select the suitable machine operation in grinding and broaching machine tool for engineering applications.
23MZC03.CO5	Write the various CNC part programming produce the engineering components

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC03.CO1	X	X	X	-	-	X	-	-	-	-	-	X	-	-	X
23MZC03.CO2	X	X	-	X	X	X	-	-	-	-	-	X	-	-	X
23MZC03.CO2	X	-	X	X	X	-	-	-	-	-	-	X	-	-	X
23MZC03.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X
23MZC03.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X

Unit-I THEORY OF METAL CUTTING 9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal 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, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

Unit-III SHAPER, MILLING AND GEAR CUTTING MACHINES 9

Shaper - Types of operations. Drilling, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbling and gear shaping processes – finishing of gears

Unit-IV ABRASIVE PROCESS AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, center less grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machine.

Unit-V CNC MACHINES AND PROGRAMMING 9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining center, Work holding methods in Turning and machining centers. Coolant systems, Safety features. CNC Control systems –

Open/closed, point-to point/continuous. Part programming fundamentals in CNC –Manual part programming, G and M codes.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hajra Choudhury	Elements of Workshop Technology	Media Promoters	2008
2.	Rao. P.N	Manufacturing Technology - Metal Cutting and Machine Tools	Tata McGraw-Hill	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White	Machine Tool Practices	Prentice Hall of India	2010
2.	Jain.R.K	Production Technology: Manufacturing Processes, Technology and Automation	Khanna Publishers	2011
3.	GeofreyBoothroyd	Fundamentals of Metal Machining and Machine Tools	McGraw Hill	2007
4.	Roy. A.Lindberg	Manufacturing Technology -Metal Cutting and Machine Tools	PHI/Pearson Education	2006
5.	Dr. B. Kumar	Manufacturing Technology	Khanna Publishers	2009

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23MZC04	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the basic postulates of Boolean algebra and shows the correlation between Boolean expressions.
- To impart the knowledge on procedures for the analysis and design of combinational circuits
- To understand the procedures for the analysis and design of sequential circuits
- To understand the principles of synchronous and asynchronous sequential circuits
- To understand the concept of VHDL and programmable logic devices.

Course Outcomes:

23MZC04.CO1	Apply Boolean algebra, K-Map and Tabulation method for simplification of Boolean expression.
23MZC04.CO2	Design combinational logic circuits for various applications
23MZC04.CO3	Design shift registers, Modulo-N asynchronous and synchronous counters.
23MZC04.CO4	Design and analyze state machines for the given specifications.
23MZC04.CO5	Design Logic Memories and built VHDL Program.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC04.CO1	X	X	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC04.CO2	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23MZC04.CO2	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23MZC04.CO4	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23MZC04.CO5	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-

Unit-I BASIC CONCEPTS OF DIGITAL SYSTEMS AND LOGIC FAMILIES 9

Review of Number systems, Number Representation, Boolean algebra, Boolean postulates and laws - De-Morgan 's Theorem - Principle of Duality, Simplification using Boolean algebra, Canonical forms - Sum of product and Product of sum - Minimization using Karnaugh map and Tabulation method, Digital Logic Families- TTL, ECL, CMOS

Unit-II COMBINATIONAL CIRCUITS 9

Realization of combinational logic using gates, Design of combinational circuits: Adder, Subtractor, Parallel adder Subtractor, carry look ahead adder, Magnitude Comparator, Parity generator and checker, Encoder, Decoder, Multiplexer, De-Multiplexer - Function realization using Multiplexer, Decoder - Code converter

Unit-III SEQUENTIAL CIRCUITS 9

Flip-flops - SR, JK, D and T- Master-Slave – Triggering - Characteristic table and equation – Application table – Asynchronous and synchronous counters - Shift registers - Types – Universal shift registers – Ring counter – Johnson Counters- Serial adder / Subtractor.

Unit-IV SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Mealy and Moore models – State diagram - State table – State minimization – State assignment - Excitation table - Design of Synchronous sequential circuits: Counters and Sequence generators- Circuit implementation - Asynchronous sequential circuits - Asynchronous sequential circuits, Hazard free combinational circuits

Unit-V PROGRAMMABLE LOGIC DEVICES MEMORY AND VHDL 9

Memories: ROM, PROM, EPROM, PLA, PLD, FPGA – VHDL Programming: RTL Design – Combinational Logic – Types – Operators – Packages – Sequential Circuits – Sub Programs – Test benches. (Examples: adders, counters, flip flops, FSM, Multiplexers / De-Multiplexers)

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Morris Mano M. and Michael D. Ciletti	Digital Design	Pearson Education	2013
2.	Donald D.Givone,	Digital Principles and Design	Tata Mc-Graw Hill Publishing company limited, New Delhi	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Thomas L. Floyd	Digital Fundamentals	Pearson Education Inc	2011
2.	Charles H. Roth Jr,	Fundamentals of Logic Design	Jaico Publishing House	2003
3.	Leach D, Malvino A P &Saha	Digital Principles and Applications	Tata McGraw-Hill Publishing Company	2014
4.	John F. Wakerly,	Digital Design Principles and Practices	Pearson Education	2007
5.	John.M Yarbrough	Digital Logic Applications and Design	Thomson – VikasPublishing House	2002

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23MZC05	FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To train to conduct the experiments using fluid flow measuring instruments.
- To train to conduct fluid flow losses using pipe line instrument.
- To train to conduct centrifugal /submergible pumps experiments.
- To train to conduct Reciprocating / gear pumps experiments.
- To train to conduct Elton/ Francis/ Kaplan turbines experiments.

Course Outcomes:

23MZC05.CO1 Interpret the results observed from the experiments using fluid flow measuring instruments.

23MZC05.CO2 Analysis the results observed from fluid flow losses in pipe lines.

23MZC05.CO3 Analysis the performance characteristics of centrifugal /submergible pumps

23MZC05.CO4 Analysis the performance characteristics of Reciprocating / gear pumps

23MZC05.CO5 Analysis the performance characteristics of Pelton/ Francis/ Kaplan turbines

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC05.CO1	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC05.CO2	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC05.CO2	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC05.CO4	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC05.CO5	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X

Sl.No.	List of Experiments
1.	Determination of the Coefficient of discharge of given Orifice meter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Calculation of the rate of flow using Rota meter.
4.	Determination of friction factor for a given set of pipes.
5.	Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump
6.	Conducting experiments and drawing the characteristic curves of reciprocating pump.
7.	Conducting experiments and drawing the characteristic curves of Gear pump.
8.	Conducting experiments and drawing the characteristic curves of Pelton wheel.
9.	Conducting experiments and drawing the characteristics curves of Francis turbine.
10.	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Total Periods: 30

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23MZC06	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To train to operate the Lathe machine tool.
- To train to make the simple engineering components using Milling machine tool.
- To train to make the gears using Milling/ Gear Hobbing/ Gear Shaping machine tools.
- To train to make the simple engineering components using various grinding machine tools.
- To train to measure the cutting force on the Milling / Turning machine tools

Course Outcomes:

23MZC06.CO1	Make the simple components using Lathe Machine tool
23MZC06.CO2	Make the simple components using Milling machine tool
23MZC06.CO2	Make the various Gear using Milling/ Gear Hobbing/ Gear Shaping machine tools
23MZC06.CO4	Make the simple engineering components using different Grinding machine tools.
23MZC06.CO5	Analysis the various cutting forces in the Milling / Turning machine tools.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC06.CO1	-	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC06.CO2	-	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC06.CO2	-	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC06.CO4	-	-	-	X	-	-	-	-	-	-	-	X	-	-	X
23MZC06.CO5	-	-	-	X	-	-	-	-	-	-	-	X	-	-	X

Sl.No.	List of Experiments
1.	Eccentric Turning, Thread Cutting
2.	Contour milling using vertical milling machine
3.	Spur gear cutting in milling machine
4.	Helical Gear Cutting in hobbing machine
5.	Gear generation in hobbing machine
6.	Gear generation in gear shaping machine
7.	Plain Surface grinding
8.	Cylindrical grinding
9.	Tool angle grinding with tool and Cutter Grinder
10.	Centreless grinding
11.	Measurement of cutting forces in Milling / Turning Process

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Total Periods: 30

23MZC07	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To train to use the different logic gate.
- To train to make the different flip flops circuits.
- To train to construct the various electronic logical circuits using registers
- To train to construct the various electronic logical circuits using counters.

Course Outcomes:

23MZC07.CO1 Demonstrate various Logical Gate and its circuits.

23MZC07.CO2 Demonstrate various flip flops circuits.

23MZC07.CO3 Make the electronic logical circuits using registers for various engineering applications

23MZC07.CO4 Make the electronic logical circuits using counters for various engineering applications

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC07.CO1	X	X	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC07.CO2	X	X	X	X	X	-	-	-	-	-	-	-	X	-	-
23MZC07.CO3	X	X	X	X	X	-	-	-	-	-	-	-	X	-	-
23MZC07.CO4	X	X	X	X	X	-	-	-	-	-	-	-	X	-	-

Sl.No.	List of Experiments
1.	Logic Gates AND, OR, NOT, XOR, XNOR
2.	Flip flops 1.SR 2.JK 3.D-Type Flip flop 4.T- Type Flip Flop
3.	Registers
4.	Counters

Total Periods: 30

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23MZC08	CONTROL SYSTEM ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce the elements of control system and their modeling using various Techniques.
- To impart knowledge for analyzing the time response of control system
- To introduce the frequency response of given system
- To impart the knowledge to analysis of stability of systems
- To introduce the state variable analysis method

Course Outcomes:

23MZC08.CO1	Determine the transfer functions and analogy of control systems
23MZC08.CO2	Analysis the time responses of the controller system using MATLAB program.
23MZC08.CO3	Analysis of frequency responses of control system using various frequency response plots using MATLAB program.
23MZC08.CO4	Analysis the stabilities of control system using MATLAB program.
23MZC08.CO5	Apply the various state variable analysis methods to engineering applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC08.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
23MZC08.CO2	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZC08.CO3	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZC08.CO4	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZC08.CO5	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-

Unit-I CONTROL SYSTEM MODELING 9

Basic Elements of Control System–Open loop and Closed loop systems-Differential equation- Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems- Block diagram reduction Techniques- Signal flow graph

Unit-II TIME RESPONSE ANALYSIS 9

Time response analysis-First Order Systems- Impulse and Step Response analysis of second order systems – Steady state errors–P, PI, PD and PID Compensation, Analysis using MATLAB

Unit-III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response-Bode Plot, Polar Plot, Nyquist Plot-Frequency Domain specifications from the plots-Constant M and N Circles-Nichol's Chart-Use of Nichol's Chart in Control System Analysis. Series, Parallel, series-parallel Compensators -Lead, Lag, and Lead Lag Compensators, Analysis using MATLAB

Unit-IV STABILITY ANALYSIS 9

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability,Dominant Poles, Application of Root Locus Diagram-Nyquist Stability, Criterion-Relative Stability,Analysis using MATLAB

Unit-V STATE VARIABLE ANALYSIS 9

State space representation of Continuous Time systems–State equations–Transfer function from State Variable Representation–Solutions of the state equations-Concepts of Controllability and Observability– State

spacerepresentationforDiscretetimesystems.SampledDatacontrolsystems–SamplingTheorem – Sampler & Hold–Open loop & Closed loop sampled data systems.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	J.Nagrath and M.Gopal	Control System Engineering	New Age International Publishers, 5th Edition	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Thomas L. Floyd	Digital Fundamentals	Pearson Education Inc	2011
2.	Charles H. Roth Jr,	Fundamentals of Logic Design	Jaico Publishing House	2003
3.	Leach D, Malvino A P &Saha	Digital Principles and Applications	Tata McGraw-Hill Publishing Company	2014
4.	John F. Wakerly,	Digital Design Principles and Practices	Pearson Education	2007
5.	John.M Yarbrough	Digital Logic Applications and Design	Thomson – VikasPublishing House	2002

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23MZC09	STRENGTH OF MATERIALS	L	T	P	C
		3	0	3	3

Course Objective:

- To gain knowledge of simple stresses, strains and deformation in components due to external loads, 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 shells, columns

Course Outcomes:

23MZC09.CO1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
23MZC09.CO2	Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
23MZC09.CO3	Apply basic equation of torsion in designing of shafts and helical spring
23MZC09.CO4	Calculate slope and deflection in beams using different methods.
23MZC09.CO5	Analyze stresses and deformation of thin shells and columns.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC09.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
23MZC09.CO2	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZC09.CO2	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZC09.CO4	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZC09.CO5	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-

Unit-I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads-Principal stresses and principal planes – Mohr's circle of stress.

Unit-II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

. Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

Unit-III TORSION 9

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

Unit-IV DEFLECTION OF BEAMS 9

Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.

Unit-V THIN CYLINDERS, COLUMNS 9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses- Deformation in thin cylinders- Theory of columns – Long column and short column - Euler's formula – Rankine's formula.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rajput R.K	Strength of Materials (Mechanics of Solids)	S.Chand & company Ltd., New Delhi	2018
2.	Rattan S.S	Strength of Materials	Tata McGraw Hill Education Pvt .Ltd., New Delhi	2017

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singh. D.K	Strength of Materials	Ane Books Pvt Ltd., New Delhi	2021
2.	Egor P Popov	Engineering Mechanics of Solids	PHI Learning Pvt. Ltd., New Delhi	2015
3.	Beer. F.P. & Johnston. E.R	Mechanics of Materials	Tata McGraw Hill, New Delhi	2019
4.	Vazirani. V.N, Ratwani. M.M, Duggal .S.K	Analysis of Structures: Analysis, Design and Detailing of Structures- Vol.1	Khanna Publishers, New Delhi	2014

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23MZC10	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	3	3

Course Objective:

- To provide knowledge on various terminologies used in metrology.
- Toprovideknowledgeonthecorrectproceduretobeadoptedtomeasurelinear or angular dimensions.
- To introduce advanced measurement instruments.
- To familiarize students with from various form measuring instruments.
- To introduce the various Power, Flow and Temperature measuring instruments.

Course Outcomes:

23MZC10.CO1	Suggest various terminologies used while using measuring instruments.
23MZC10.CO2	Use the linear or angular instruments to measure linear or angular measurements
23MZC10.CO3	Suggest the suitable advanced measurement instruments for the various engineering applications.
23MZC10.CO4	Analysis the observation results from various form measurements
23MZC10.CO5	Suggest the suitable measuring instruments for Power, Flow and Temperature measurements.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC10.CO1	X	X	-	-	X	X	-	-	-	-	-	-	X	-	-
23MZC10.CO2	X	X	-	-	X	X	-	-	-	-	-	-	-	-	-
23MZC10.CO2	X	X	-	-	X	X	-	-	-	-	-	-	X	X	-
23MZC10.CO4	X	X	-	-	X	X	-	-	-	-	-	-	-	X	-
23MZC10.CO5	X	X	-	-	X	X	-	-	-	-	-	-	X	X	-

Unit-I BASICS OF METROLOGY **5**

Introduction to Metrology–Need–Elements–Workpiece, Instruments–Persons–Environment–their effect on Precision and Accuracy–Errors–Errors in Measurements–Types–Control–Types of standards.

Unit-II LINEAR AND ANGULAR MEASUREMENTS **10**

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

Unit-III ADVANCES IN METROLOGY **12**

Basic concept of lasers Advantages of lasers– laser Interferometers–types–DC and AC Lasers interferometer–Applications–Straightness–Alignment. Basic concept of CMM–Types of CMM – Constructional features–Probes–Accessories – Software – Applications – Basic concepts of Machine Vision System–Element –Applications.

Unit-IV FORM MEASUREMENT **10**

Principles and Methods of straightness–Flatness measurement– Thread measurement, gear measurement, surface finish measurement, Roundness measurement–Applications.

Unit-V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 8

Force, torque, power- mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube– Temperature: bimetallic strip, thermocouples, electrical resistance thermometer–Reliability and Calibration –Readability and Reliability.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	JainR.K	Engineering Metrology	Khanna Publishers	2018
2.	Gupta. I.C.,	Engineering Metrology	Dhanpatrai Publications	2018

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Charles ReginaldShotbolt	Metrology for Engineers	Cengage Learning EMEA	1990
2.	Backwith,Marangoni,L ienhard	Mechanical Measurements	Pearson Education	2006
3.	Jay.L.Bucher	The Metrology Handbook	Measurement Quality Division (ASQ)	2015
4.	L.V. Ragavendra and L.Krishnamoorthy	Engineering Metrology and Measurements	Oxford Higher Education	2013
5.	Anand K. Bewoor Vinay A .Kulgarni	Metrology and Measurements	McGraw Hill Companies	2016

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23MZC11	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objective:

- To provide the basic computer graphics knowledge used in mechanical engineering field.
- To understand the characteristics of geometric curves, surfaces, solids elements
- To impart the knowledge on CAD Standards.
- To understand the fundamental concepts and part programming concepts.
- To learn the principles of cellular manufacturing and flexible manufacturing systems

Course Outcomes:

23MZC11.CO1	Determine the geometric transformations matrix for simple two/ three dimensional objects.
23MZC11.CO2	Apply the various representations of geometric curves, surfaces, solids elements.
23MZC11.CO3	Suggest the geometrical data exchanging formats to transfer CAD Models between various platforms.
23MZC11.CO4	Write the CNC part programming for the making engineering parts in CNC machines
23MZC11.CO5	Demonstrate the cellular manufacturing and flexible manufacturing systems used in industrial processes.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC11.CO1	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC11.CO2	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC11.CO3	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC11.CO4	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC11.CO5	X	-	X	-	X	-	-	-	-	-	-	-	-	X	-

Unit-I INTRODUCTION **9**

Introduction to CAD/CAM –CAD/CAM concept - Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations– Manufacturing Planning, Manufacturing controls –– Types of production.

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 bi-cubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep. Basics of Assembly modeling, Purpose of Assembly modeling & amp; its advantages – Top to Down & amp; Bottom Up modeling approaches.

Unit-III CAD STANDARDS **9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.

Unit-IV FUNDAMENTAL OF CNC AND PART PROGRAMING **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 on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

Unit-V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) 9

Group Technology (GT), Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility – FMS FMS Components – FMS Application & Benefits – FMS Planning and Control–Quantitative analysis in FMS ME8691 Computer Aided Design and Manufacturing

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ibrahim Zeid	CAD CAM	Tata McGraw-Hill	2007
2.	Radhakrishnan P, SubramanyanS.andRaju V.	CAD/CAM/CIM	New Age International (P) Ltd, New Delhi	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chris McMahon and Jimmie Browne	CAD/CAM Principles, Practice and Manufacturingmanagement	Pearson Education	1999
2.	Donald Hearn and M. Pauline Baker	Computer Graphics	Prentice Hall, Inc.	2010
3.	Foley, Wan Dam, Feiner and Hughes	Computer graphics principles & practice	Pearson Education	2003

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23MZC12	MICRO PROCESSORS AND APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objective:

- To provide the basic knowledge on microprocessor and instructions sets.
- To understand the various interfacing techniques with microprocessor circuits.
- To understand the interface devices with microprocessors.
- To provide the various microprocessor circuits using peripheral devices.
- To provide the knowledge micro controller products using case studies.

Course Outcomes:

23MZC12.CO1 Use microprocessor kit to execute the basic 8085 programs.

23MZC12.CO2 Apply the various interfacing techniques to develop the microprocessor circuits.

23MZC12.CO3 Interface the various controllers with microprocessors

23MZC12.CO4 Design the various microprocessor circuits using peripheral devices.

23MZC12.CO5 Demonstrate the various microcontroller applications and case studies

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC12.CO1	X	X	X	-	X	X	-	-	-	-	-	-	X	-	-
23MZC12.CO2	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23MZC12.CO2	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23MZC12.CO4	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23MZC12.CO5	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-

Unit-I INTRODUCTION 9

Organization of 8085: Architecture, Internal Register Organization and Pin Configuration– Instruction Set of 8085–addressing modes–instruction machine cycles with states and timing diagram.-8085 assembly language programming-Examples.

Unit-II INTERFACING TECHNIQUES 9

Need for Interfacing-Memory Interfacing, address space partitioning–address map–Address decoding– Designing decoders circuit. I/O Interfacing: Data transfer schemes–programmed Synchronous and asynchronous– Interrupt driven Transfer–Multiple devices and multiple interrupt levels–enabling disabling and masking of interrupts. DMA transfer: Cycle stealing–Burst mode– Multiple DMA devices–DMA transfer in8085system–serial data transfer.

Unit-III INTERFACING DEVICES 9

Programmable peripheral device (8255)–programmable interval timer(8353)–Programmablecommunication interface (8251)(USART)–Programmable interrupt controller–Programmable DMA Controller (8257)-Programmable Keyboard/display controllers(8279)

Unit-IV DESIGN USING PERIPHERAL DEVICES 9

Interfacing A/D and D/A converters –Matrix Keyboard design using 8255 with 8085 programs. Designing real time clock, detecting power failure, detecting presence of objects using8253-Design of Keyboard and display interfacing using8279–Design of digital transmission with modems and telephone lines using8251A.

Unit-V MICROPROCESSORAPPLICATIONS 9

Temperature monitoring system– Automotive applications – Closed loop process control – Steppermotor control.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rafiquzzaman	Microprocessors and Microcomputer-Based System Design	Taylor& Francis,	2009
2.	Ramesh Gonakar	Microprocessor Architect. Programming and Applications With the8085	Penram International Publishing(India)Private Limited	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Aditya P Mathur	Electronic Packaging and Interconnection Handbook	3rdEdition, Tata Mc Grw Hill Publishing, Co Ltd., New Delhi	2003
2.	Douglas V.Hall	Surface Mount Technology Terms and Concepts	Tata McGraw–Hill Publishing Company Ltd. New Delhi	1997
3.	Rafiq uzzaman	Microprocessors and Micro computer-Based System Design	Taylor & Francis,	2009

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23MZC13	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To impart knowledge on the concepts and basic methods of material testing process.
- To understand the procedure of Tension test, Shear test, torsion test impact test of Steel material.
- To familiarize the testing procedure of hardness test of Rockwell and Brinell Hardness Testing Apparatus.
- To understand the various deflection tests on metal beam using given apparatus.
- To impart the knowledge of compression and deflection tests procedure of helical and carriage springs.

Course Outcomes:

23MZC13.CO1	To impart knowledge on the concepts and basic methods of material testing process.
23MZC13.CO2	To understand the procedure of Tension test, Shear test, torsion test impact test of Steel material.
23MZC13.CO3	To familiarize the testing procedure of hardness test of Rockwell and Brinell Hardness Testing Apparatus.
23MZC13.CO4	To understand the various deflection tests on metal beam using given apparatus.
23MZC13.CO5	To impart the knowledge of compression and deflection tests procedure of helical and carriage springs.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC13.CO1	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
23MZC13.CO2	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-
23MZC13.CO2	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
23MZC13.CO4	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
23MZC13.CO5	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-

Sl.No.	List of Experiments
1.	Tension test on mild steel rod
2.	Double shear test on metal
3.	Torsion test on mild steel rod
4.	Impact test on metal specimen (Izod and Charpy)
5.	Hardness test on metals (Rockwell and Brinell Hardness Tests)
6.	Deflection test on metal beam
7.	Compression test on helical spring
8.	Deflection test on carriage spring

Total Periods: 30

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23MZC14	MICRO CONTROLLER LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To demonstrate microcontroller kit to execute the various programs.
- To provide skill to interface stepper and DC motors with microcontrollers kit.
- To provide the training on the microcontroller program using instructions set.
- To impart the knowledge to develop the micro controller system.
- To impart the knowledge to develop the micro controller system Programmable Logic controller system.

Course Outcomes:

23MZC14.CO1	Use the microcontroller kit to execute the various programs.
23MZC14.CO2	Interface stepper and DC motors with micro controller kit.
23MZC14.CO3	Write the microcontroller program using instructions set to perform the various tasks.
23MZC14.CO4	Develop the various micro controller systems with interfacing of various actuators and sensors.
23MZC14.CO5	Develop the various real time control system using Programmable Logic controller.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC14.CO1	X	-	-	X	-	X	-	X	-	-	-	-	X	X	X
23MZC14.CO2	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-
23MZC14.CO2	X	-	-	X	-	-	-	X	-	-	-	-	X	X	X
23MZC14.CO4	X	-	-	X	-	-	-	X	-	-	-	-	X	X	X
23MZC14.CO5	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-

Sl.No.	List of Experiments
1.	Study of Microcontroller Kits.
2.	8051/ 031ProgrammingExercises.
3.	Stepper Motor interface.
4.	D.C. motor controller interface.
5.	Study of interrupt structureof8051.
6.	Interfacing high power devices to microcomputer port lines, LED relays and LCD displays.
7.	Linear actuation of hydraulic cylinder with counter and speed control.
8.	Hydraulic rotation with timer and speed control.
9.	Sequential operation of pneumatic cylinders.
10.	Traffic light controller.
11.	Speed control of DC motor using PLC.
12.	Testing of Relays using PLC.

Total Periods: 30

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23MZC15	DYNAMICS OF MACHINES	L	T	P	C
		3	0	0	3

Course Objective:

- To learn about the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To impart knowledge on static and dynamic balancing.
- To understand the concept of single degree of freedom of vibrations and its damping mechanism.
- To gain knowledge on the basic vibrations on the constrained body and its critical position of vibrations.
- To understand principles in mechanisms used for governing of machines.

Course Outcomes:

23MZC15.CO1	Gain knowledge on forces like static, dynamic forces and Inertia force and inertia torque on the reciprocating engines
23MZC15.CO2	Acquire knowledge on turning moment diagrams of flywheels and follower mechanisms
23MZC15.CO3	Know the concepts of balancing mechanisms of different types of engines and machines.
23MZC15.CO4	Understand different types of vibration occurring in the moving system.
23MZC15.CO5	Understand the effect of Dynamics of undesirable vibrations

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC15.CO1	X	X	X	X	-	X	-	-	-	X	-	-	X	-	-
23MZC15.CO2	X	X	-	X	-	X	-	-	-	X	-	X	X	-	-
23MZC15.CO3	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-
23MZC15.CO4	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-
23MZC15.CO5	X	X	-	X	-	X	-	-	X	X	-	X	X	-	X

Unit-I FORCE ANALYSIS **9**

Applied and constraint forces – Free body diagrams – Static equilibrium conditions – Static force analysis of simple mechanisms – Dynamic force analysis – Inertia force and Inertia torque – D Alembert's principle – Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams – Fly Wheels – Flywheels of punching presses- Dynamics of Cam-follower mechanism.

Unit-II BALANCING **9**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing Multi- cylinder engines – Partial balancing in locomotive engines – Balancing of linkages – Balancing machines.

Unit-III SINGLE DEGREE FREE VIBRATION **9**

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration – Tensional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

Unit-IV FORCED VIBRATION **9**

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –

Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

Unit-V MECHANISM FOR CONTROL 9

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force. Gyroscopes- Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Shigley	Theory of Machines and Mechanisms	Oxford University Press	2016
2.	Sadhu Singh	Theory of Machines	Pearson Education	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rattan. S.S	Theory of Machines	Tata McGraw-Hill	2009
2.	Thomas Bevan	Theory of Machines	CBS Publishers and Distributors	2005
3.	Cleghorn. W. L,	Mechanisms of Machines	Oxford University Press	2005
4.	Benson H. Tongue	Principles of Vibrations	Oxford University Press	2007
5.	Ballaney.P.L	Theory of Machines	Khanna Publishers	2001

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23MZC16	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objective:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand by harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

Course Outcomes:

23MZC16.CO1 Explain the working principles of various Power-semi-Conductor Devices

23MZC16.CO2 Understand the various Phase-Controlled Convertors

23MZC16.CO3 Understand the various principles on DC to DC Converter.

23MZC16.CO4 Understand the various phase changing inverters

23MZC16.CO5 Understand the various principles on AC to AC Converter.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC16.CO1	X	X	-	X	X	X	-	-	-	-	-	-	X	-	-
23MZC16.CO2	X	X	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC16.CO2	X	X	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC16.CO4	X	X	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC16.CO5	X	X	-	X	X	-	-	-	-	-	-	-	X	-	-

Unit-I POWER SEMI-CONDUCTOR DEVICES 9

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit.

Unit-II PHASE-CONTROLLED CONVERTERS 9

2-pulse,3-pulse and 6-pulse converters–performance parameters–Effect of source inductance–- Gate Circuit Schemes for Phase Control–Dual converters.

Unit-III DC TO DC CONVERTER 9

Step-down and step-up chopper-control strategy–Forced commutated chopper–Voltage commutated, Current commutated,load commutated, Switched mode regulators-Buck, boost, buck- boost converter, Introduction to Resonant Converters.

Unit-IV INVERTERS 9

Single phase and three phase voltage source inverters(both 120^0 mode and 180^0 mode)–Voltage& harmonic control—PWM techniques: Sinusoidal PWM, modified sinusoidal PWM- multiple PWM– Introduction to space vector modulation– Current source inverter.

Unit-V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control Strategy-Power Factor Control– Multi stage sequence control-single phase and three phase cyclo converters–Introduction to Matrix converters

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.H.Rashid	Power Electronics: Circuits, Devices And Applications	Pearson Education, 3rdEdition NewDelhi,	2004
2.	P.S.Bimbra	Power Electronics	Khanna Publishers	2003

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Daniel.W.Hart	Power Electronics	Indian Edition Mc Graw Hill	2013
2.	M.D.Singhand K.B. Khanchandani	Power Electronics	Mc Graw Hill India	2013
3.	Joseph Vithayathil	Power Electronics, Principles and Applications	Mc Graw Hill Series	2013

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23MZC17	DESIGN OF MACHINE ELEMENTS (Use of approved Design Data book is permitted)	L	T	P	C
		3	0	0	3

Course Objective:

- To select the materials based on mechanical properties, different types of loading, simple, steady and variable stresses.
- To know the design procedure for various types of shafts, keys and couplings.
- To design the threaded fasteners, bolted joints including eccentric loading and welded joints for pressure vessels and structures.
- To design the various types of springs like helical, leaf, disc and torsional springs.
- To state the design procedure for various types of bearings and flywheel

Course Outcomes:

23MZC17.CO1	Select the materials based on mechanical properties, different types of loading and introduction aboutsimple, steady and variable stresses.
23MZC17.CO2	Know the design procedure for various types of shafts, keys and couplings.
23MZC17.CO3	Design the threaded fasteners, bolted joints including eccentric loading and welded joints for pressurevessels and structures.
23MZC17.CO4	Design the various types of springs like helical, leaf, disc and torsional springs.
23MZC17.CO5	Design various types of bearings like sliding contact, rolling contact bearing and flywheels.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC17.CO1	X	X	-	-	-	X	-	-	-	-	-	-	X	-	-
23MZC17.CO2	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-
23MZC17.CO3	X	-	X	-	-	X	-	-	-	-	-	-	X	-	-
23MZC17.CO4	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-
23MZC17.CO5	X	-	X	-	-	X	-	-	-	-	-	-	X	-	-

Unit-I STEADY AND VARIABLE STRESSES 9

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties, preferred numbers – direct, bending and torsional stress equations – calculation of principle stresses for various load combinations, eccentric loading – design of curved beams – crane hook and 'c' frame - factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

Unit-II DESIGN OF SHAFTS AND COUPLINGS 9

Design of Solid And Hollow Shafts Based on Strength And Rigidity – Design Of Keys - Design Of Rigid And Flexible Couplings

Unit-III DESIGN OF FASTNERS AND WELDED JOINTS 9

Threaded fasteners - design of bolted joints including eccentric loading – design of welded joints for structures

Unit-IV DESIGN OF SPRINGS 9

Design of helical, leaf and torsional springs under constant loads and varying loads – concentric torsion springs - Belleville springs introduction to modern spring like wave spring, constant force spring (theory only).

Unit-V DESIGN OF BEARINGS AND FLYWHEELS 9

Design of bearings – sliding contact and rolling contact types. – cubic mean load – design of journal bearings – mckees equation – lubrication in journal bearings – calculation of bearing dimensions – design of flywheels involving stresses in rim and arm.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Richard G Budynas J.Keith Nisbett	Shigley's Mechanical Engineering Design	Mc Graw Hill	2011
2.	Khurmi R.S, Gupta J.K	Machine Design	Eurasia publishing house	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Norton R.L	Design of Machinery	Tata McGraw-hill book co	2002
2.	Orthwein W	Machine Component Design	Jaico Publishing co	2003
3.	Ugural A.C	Mechanical Design – An Integral Approach	Mcgraw-hill book co	2004
4.	Spotts M.F., ShoupT.E	Design and Machine Elements	Pearson Education	2004
5.	V B Bhandari	Design of Machine Elements	Tata Mcgraw-hill.	2007

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23MZC18	MEDICAL MECHATRONICS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand how to measure biochemical parameters and various physiological information.
- To study the need and technique of electrical safety in Hospitals.
- To study the use of radiation for diagnostic and therapy.
- To study about recorders and advanced equipment in medicine

Course Outcomes:

23MZC18.CO1 Explain different measurement techniques used in physiological Parameters measurement

23MZC18.CO2 Describe the sensors and signal conditioning circuits used in biomedical Engineering.

23MZC18.CO3 Understand about various amplifiers, recording and display devices.

23MZC18.CO4 Differentiate the working of recorders and explain the advanced systems used in medicine

23MZC18.CO5 Understand about various Bio- medical diagnostics instrumentation

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC18.CO1	X	X	X	-	-	X	-	-	-	-	-	X	-	-	X
23MZC18.CO2	X	X	-	X	X	X	-	-	-	-	-	X	-	-	X
23MZC18.CO3	X	-	X	X	X	-	-	-	-	-	-	X	-	-	X
23MZC18.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X
23MZC18.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X

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 and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

Unit-III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp- Electrometer amplifier, carrier Amplifier – instrument power supply. Oscillographic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems –Telemetry principles – Bio telemetry.

Unit-IV MEDICAL SUPPORT 9

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – Plethysmography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC– defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

Unit-V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION 9

Introduction – computers in medicine – basis of signal conversion and digital filtering data Reduction technique – time and frequency domain technique – ECG Analysis.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
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

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
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

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23MZC19	ROBOTICS AND MACHINE VISION SYSTEM	L	T	P	C
		3	0	0	3

Course Objective:

- To learn about basics of robots, programming and Machine vision applications in robots.
- To learn the working principles of varies robots end effectors.
- To learn robot mechanics
- To understand the mission vision concepts.
- To learn the robotics programmes.

Course Outcomes:

23MZC19.CO1 Understand the basics of robots, programming and Machine vision applications in robots

23MZC19.CO2 Explain working principles of varies robots end effectors.

23MZC19.CO3 Explain the various robot mechanics

23MZC19.CO4 Explain the various applications using mission vision concepts

23MZC19.CO5 Write the various robotics programmes

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC19.CO1	X	-	-	X	X	X	X	-	-	-	-	X	X	X	X
23MZC19.CO2	X	-	-	X	X	-	X	-	-	-	-	X	X	X	X
23MZC19.CO3	X	-	-	X	X	-	X	-	-	-	-	X	X	X	X
23MZC19.CO4	X	-	-	X	X	-	X	-	-	-	-	X	X	X	X
23MZC19.CO5	X	-	-	X	X	-	X	-	-	-	-	X	X	X	X

Unit-I BASICS OF ROBOTICS **9**

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space- accuracy-resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drive

Unit-II ROBOT END EFFECTORS **9**

Robot End effectors: Introduction-types of End effectors-Mechanical gripper-types of gripper mechanism-gripper force analysis-other types of gripper-special purpose grippers.

Unit-III ROBOT MECHANICS **9**

Robot kinematics: Introduction-Matrix representation-rigid motion & homogeneous transformation- forward & inverse kinematics-trajectory planning. Robot Dynamics: Introduction-Manipulator dynamics–Lagrange-Euler formulation- Newton- Euler formulation

Unit-IV MACHINE VISION FUNDAMENTALS **9**

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique-segmentation-Thresholding-edge detection-binary morphology-grey morphology

Unit-V ROBOTPROGRAMMING **9**

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Valsystem and Languages- application of robots.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.P.Groover,M.Weiss,R.N.Nagal, N.G.Odrey	Industrial Robotics-Technology, Programming and Applications	Tata McGraw-Hill Education Pvt Limited	2008

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sathya RanjanDeb	Robotics Technology & flexible Automation	Sixth edition, Tata McGraw-Hill Publication	2003
2.	K.S.Fu,R.C.Gonzalez,C .S.G.Lee	Robotics: Sensing, Vision & Intelligence	Tata McGraw-Hill Publication	1987
3.	John.J.Craig	Introduction to Robotics: Mechanics& control	Tata McGraw-Hill Second edition	2002
4.	Jazar	Theory of Applied Robotics: Kinematics, Dynamics and Control	Springer Indian Reprint	2010

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23MZC20	DYNAMICS OF MACHINES LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To learn about basics of various links and mechanisms.
- To learn the working principles of gyroscopes and cams
- To learn various governors.
- To understand the mission vibrating instruments.
- To learn the balancing of rotating and reciprocating masses.

Course Outcomes:

23MZC20.CO1	Understand the basics of various links and mechanisms
23MZC20.CO2	Use gyroscopes and cams.
23MZC20.CO3	Operate the various governors.
23MZC20.CO4	Measure the various parameters using vibrating instruments.
23MZC20.CO5	Analysis the balancing of rotating and reciprocating masses.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC20.CO1	X	X	X	X	-	X	-	-	-	X	-	-	X	-	-
23MZC20.CO2	X	X	-	X	-	X	-	-	-	X	-	X	X	-	-
23MZC20.CO2	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-
23MZC20.CO4	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-
23MZC20.CO5	X	X	-	X	-	X	-	-	X	X	-	X	X	-	X

Sl.No.	List of Experiments
1.	Study of gear parameters.
2.	Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
3.	Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
4.	Kinematics of single and double universal joints.
5.	Determination of Mass moment of inertia of Fly wheel and Axle system.
6.	Determination of Mass Moment of Inertia of axi-symmetric bodies using Turn Table apparatus.
7.	Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
8.	Motorized gyroscope – Study of gyroscopic effect and couple.
9.	Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
10.	Cams – Cam profile drawing, Motion curves and study of jump phenomenon
11.	Single degree of freedom Spring Mass System – Determination of natural frequency and verification 1.of Laws of springs – Damping coefficient determination.
12.	Multi degree freedom suspension system – Determination of influence coefficient.
13.	Determination of torsional natural frequency of single and Double Rotor systems. - Undamped and .Damped Natural frequencies.

14. b) Vibration Absorber – Tuned vibration absorber.

15. Vibration of Equivalent Spring mass system – undamped and damped vibration.

16. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
    a) Balancing of rotating masses
    b) Balancing of reciprocating masses.

17. Transverse vibration of Free-Free beam – with and without concentrated masses.

18. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.

19. Determination of transmissibility ratio using vibrating table

Total Periods: 30

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23MZC21	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	2

Course Objective:

- To train for using the SCR, MOSFET & IGBT characteristics.
- To understand the electronics components.
- To train for using the Controller circuits
- To train for using the Control the AC and DC motors
- To train for using the Chopper and Invertors

Course Outcomes:

23MZC21.CO1	Use SCR,MOSFET, TRIAC in electronic circuit
23MZC21.CO2	Perform characteristic study on the electronics components.
23MZC21.CO3	Make the varies Controller circuits
23MZC21.CO4	Control the AC and DC motors
23MZC21.CO5	Use the Chopper and Invertors

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC21.CO1	X	-	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC21.CO2	X	-	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC21.CO2	X	-	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC21.CO4	X	-	-	X	X	-	-	-	-	-	-	-	X	X	-
23MZC21.CO5	X	-	-	X	X	-	-	-	-	-	-	-	X	X	-

Sl.No.	List of Experiments
1.	Study of SCR, MOSFET & IGBT characteristics
2.	UJT,R, RC firing circuits for SCR
3.	Voltage& current commutated chopper
4.	SCR phase control circuit
5.	TRIAC phase control circuit
6.	Study of half controlled &fully controller converters
7.	Study of three phase AC regulator
8.	Speed control of DC shunts motor using three phase fully controlled converter.
9.	SCR single-phase cyclo-converterSCR series and parallel inverters
10.	IGBT Chopper
11.	IGBT based PWM inverter (single phase)
12.	Speed control of DC shunts motor using three phase fully controlled converter.

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Total Periods: 30

23MZC22	MICRO CONTROLLER AND PLC	L	T	P	C
		3	0	0	3

Course Objective:

- To impart basics of varies microcontrollers.
- To impart the knowledge on 8051 microcontrollers Programme.
- To impart the knowledge on interfacing various microcontrollers.
- To impart the knowledge on PLC.
- To impart the knowledge on Applications of various PLC.

Course Outcomes:

23MZC22.CO1 Familiarize varies microcontrollers.

23MZC22.CO2 Write the 8051 microcontrollers Programme.

23MZC22.CO3 Interface various microcontrollers.

23MZC22.CO4 Explain various PLC systems.

23MZC22.CO5 Illustrate the various applications of PLC.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC22.CO1	X	-	-	X	X	X	-	-	-	-	-	X	X	-	-
23MZC22.CO2	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZC22.CO2	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZC22.CO4	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZC22.CO5	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-

Unit-I INTRODUCTION TO MICROCONTROLLER 9

8051Architecture: –Memory map-Addressing modes, I/O Ports–Counters and Timers –Serial data- I/O– Interrupts– Instruction set, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, Assembly Language Programming tools

Unit-II MICROCONTROLLER PROGRAMMING 9

Fundamentals of Assembly language Programming - C Programming for Microcontrollers – Compiler and IDE Assembler -8051AssemblyLanguageProgramming Block transfer, arithmetic cooperation's, Code conversion, Time delay generation, Interrupt programming, Look up table techniques.

Unit-III MICROCONTROLLER APPLICATIONS 9

Interfacing of Keyboards–Interfacing of Display Devices–Pulse measurement–Analog to Digital and Digital to Analog Converter –Interfacing Hardware Circuit– Serial Data Communication– Network Configuration.

Unit-IV PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction––Principles of operation–PLC Architecture and specifications –PLC hardware components Analog & digital I/O modules, CPU & memory module–Programming devices–PLC ladder diagram, Converting simpler lay ladder diagram into PLC relay ladder diagram.PLC programming Simple instructions–Manually operated switches–Mechanically operated a Proximity switches-Latching relay.

Unit-V APPLICATIONS OF PROGRAMMABLE LOGIC CONTROLLERS. 9

Timer instructions-On delay, Off delay, Cyclic and Retentive timers, Up/Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications, Automaticcontrol of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muhammad Ali Mazdi,J.G.Mazdi & R.D.Mc Kinlay	The 8051Microcontroller& Embedded Systems Using assembly & C	2nd Edition Pearson Education	2006
2.	Udayasankara.v & Mallikarjunaswamy.M.S	8051 Microcontroller, Hardware, Software & Applications	Tata McGraw Hill Educati on Pvt Limited. New Delhi	2009
3.	Gary Dunning	Introduction To Programmable Logic Controllers	Thomson Learning	2001

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singh. B.P	Microprocessors and Microcontrollers	Galcotia Publications (P) Ltd, First edition, New Delhi	1997
2.	Parr	Programmable Controllers: An Engineers Guide	3rd Edition, Elsevier, Indian Reprint	2013
3.	Valdes-Perez	Microcontrollers: Fundamentals and Applications with PIC	Taylor & Francis, Indian Reprint	2013
4.	Bolton	Programmable Logic Controllers	5th Edition News	2009

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23MZC23	SENSORS AND SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objective:

- To impart basics of sensors and the methods of processing their signals.
- To impart the knowledge on instruments for mechanical measurements.
- To impart the knowledge on instruments for Electrical Measurement.
- To impart the knowledge on smart sensors.
- To impart the knowledge on signal conditioning and data acquisition.

Course Outcomes:

23MZC23.CO1 Familiarize sensors and the methods of processing their signals.

23MZC23.CO2 Explain the working principle of mechanical measurements.

23MZC23.CO3 Explain the working principle of instruments for Electrical Measurement.

23MZC23.CO4 Illustrate the working principle of smart sensors.

23MZC23.CO5 Illustrate the working principle of signal conditioning and data acquisition.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC23.CO1	X	X	X	-	X	-	-	-	-	-	-	X	X	-	-
23MZC23.CO2	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZC23.CO2	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZC23.CO4	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZC23.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	-	-

Unit-I SCIENCE OF MEASUREMENT **9**

Units and Standards–Calibration techniques– Errors in Measurements–Generalized Measurement System– Static and dynamic characteristics of transducers– Generalized Performance of Zero Order and First Order Systems- Response of transducers to different time varying inputs–Classification of transducers

Unit-II MECHANICAL MEASUREMENTS **9**

Temperature: Filled thermometer–Bimetallic thermometer–monometers–elastic transducers–bourdon gauge–bellows–Diaphragm . Vacuum :Mc Leod gauge , thermal conductivity gauge–Ionization gauge, flow measurement: orifice, venture, nozzle, pitot tube, turbine flow meter, hotwire anemometer.

Unit-III ELECTRICAL MEASUREMENTS **9**

Electrical measuring instruments: Resistive transducers–Potentiometer–RTD–Thermistor–Thermocouple–Straingauges–use in displacement, temperature, phase measurements – Inductive transducer–LVDT–RVDT–Capacitive transducer–Piezo electric transducer–Digital displacement transducers.

Unit-IV SMART SENSORS **9**

Radiation Sensors-Smart Sensors and communication-Film sensor, MEMS & Nano Sensors–applications- Automobile, Aerospace,Home appliances and automation, Manufacturing, Medical diagnostics, Environmental monitoring.

Unit-V SIGNAL CONDITIONING AND DATA ACQUISITION **9**

Amplification–Filtering–Sample and Hold circuits–Data Acquisition: Single channel and multichannel data acquisition– Data logging, Data acquisition hardware – sensing system.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Doebelin.E.O	Measurement Systems– Applications and Design	Tata Mc Graw Hill	1992
2	Patranabis.D	Sensors and Transducers	2ndEdition PHI, New Delhi	2003

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Ian Sincla Ir.R	Sensors and transducers	Newnes ,Elaiver Indian print	2011
2	Beck with, Marangonian d Lienhard	Mechanical Measurements	Addison Wesley	2000
3	Venkatesan.S.P	Mechanical Measurements	Ane Books Pvt Ltd, India	2008

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23MZC24	AUTOMATION SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objective:

- To know about the basic concepts in industrial automation
- To design automated systems.
- To know about transfer lines and automated assembly
- To expose to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
- To know about the advancement in hydraulics and pneumatics

Course Outcomes:

23MZC24.CO1 Familiarize the industrial automation by transfer lines and automated assembly lines.

23MZC24.CO2 Design an automated system

23MZC24.CO3 Understanding of automated controls using pneumatic and hydraulic systems

23MZC24.CO4 Understand the electronic control systems in metal machining and other manufacturing processes.

23MZC24.CO5 Understand advancement in hydraulics and pneumatics systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC24.CO1	X	-	-	-	X	X	X	-	-	-	-	X	X	-	-
23MZC24.CO2	X	-	-	X	X	-	X	-	-	-	-	X	X	X	X
23MZC24 CO2	X	-	-	X	X	-	X	-	-	-	-	X	X	X	X
23MZC24.CO4	X	-	-	X	X	-	X	-	-	-	-	X	X	-	-
23MZC24 CO5	X	-	-	X	X	-	X	-	-	-	-	X	X	-	-

Unit-I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types ofproduction and types of automation, automation strategies, levels of automation-PLC Architecture and specifications.

Unit-II TRANSFER LINES AND AUTOMATED ASSEMBLY 10

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines withstorage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

Unit-III DESIGN OF MECHATRONIC SYSTEMS 8

Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, enginemanagement system.

Unit-IV PROGRAMMABLE AUTOMATION 9

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machinetools. Programming devices – PLC ladder diagram, Converting simple relay ladder diagram into ladder diagram.

Unit-V DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY 9

Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of anassembly. General rules for product design for automation.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Mikell P Groover	Automation Production Systems and Computer- Integrated Manufacturing	Pearson Education, New Delhi	2001
2	Bolton W	Mechatronics	Pearson Education	1999

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Mikell P Groover	Industrial Robots – Technology Programmes and Applications	McGraw Hill, New York, USA	2000
2	Steve F Krar	Computer Numerical Control Simplified	Industrial Press	2001
3	Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight	Product Design for manufacture and Assembly	CRC Press	2011

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23MZC25	ASSEMBLY DRAWING AND MODELING LABORATORY	L	T	P	C
		0	0	3	1

Course Objective:

- To develop skill to use software for creating 2 Dimensional models.
- To provide an overview of how computers are being used in mechanical component design.
- To make the students understand the computer graphics fundamentals.
- To build the students to identify with the various file types used in the CAD software.
- To provide an overview of how computers are being used in component manufacturing.

Course Outcomes:

23MZC25.CO1	Ability to use the software packers for drafting and modeling.
23MZC25.CO2	Demonstrate proficiency in CAD skills by creating complex 2D drawings from 3D solid modeling techniques.
23MZC25.CO3	Plan critically and use creativity in the design of mechanical components and systems.
23MZC25.CO4	Ability to export / import CAD drawings for different applications.
23MZC25.CO5	Ability to generate CNC part programming using CAM package

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC25.CO1	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC25.CO2	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC25.CO3	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC25.CO4	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
23MZC25.CO5	X	-	X	-	X	-	-	-	-	-	-	-	-	X	-

Sl.No.	List of Experiments
1.	**CAD** Drawing of Parts and assembly drawings of following components using any CAD package. 1. Fasteners (Square and Hexagonal headed bolt and nut) 2. Flange coupling (Unprotected), 3. Footstep Journal Bearing 4. Screw Jack 5. Plummer block. 6. Gib and cotter joint 7. Cotter joint with sleeve.
2.	**CAM** 1. COMPUTER AIDED PART PROGRAMMING Generate CL Data and Post process data using CAM packages for Machining and Turning Centre. 2. STUDY OF CNC EDM 3. STUDY OF ADDITIVE MANUFACTURING PROCESS: FDM or SLA or SLS or LOM

Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

Total Periods: 30

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23MZC26	SENSORS AND SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To provide knowledge in thermal and displacement sensors.
- To provide knowledge in Torque and strain sensors.
- To provide knowledge Servomotor position control and wave Shaping sensors.
- To provide knowledge comparators and controllers.
- To provide hands-on experience on encoders and data acquisition system.

Course Outcomes:

23MZC26.CO1 Use thermal and displacement sensors.

23MZC26.CO2 Measure Torque and strain using sensors.

23MZC26.CO3 Use Servomotor position control and wave Shaping sensors

23MZC26.CO4 Use comparators and controllers.

23MZC26.CO5 Operate encoders and data acquisition system.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC26.CO1	X	-	-	X	X	X	-	-	-	-	-	X	X	X	-
23MZC26.CO2	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZC26.CO2	X	-	-	X	X	-	-	-	-	-	-	X	X	X	X
23MZC26.CO4	X	-	-	X	X	-	-	-	-	-	-	X	X	X	X
23MZC26.CO5	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-

Sl.No.	List of Experiments
1.	Measurement of temperature using thermo couple, thermistor and RTD
2.	Measurement of displacement using POT, LVDT& Capacitive transducer
3.	Torque measurement using torque measuring devices
4.	Strain Measurement using strain gauge
5.	Servo motor position control using photo electric pickup
6.	Wave Shaping circuit
7.	Analog to Digital Converters
8.	Digital Comparator
9.	Voltage to frequency converter
10.	Frequency to Voltage Converter
11.	Position and velocity measurement using encoders
12.	Study on the application of data acquisition system for industrial purposes.

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Total Periods: 30

23MZC27	ADVANCED ROBOTS	L	T	P	C
		3	0	0	3

Course Objective:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study about the localization, planning and navigation.
- To study the control of robots for some specific applications.
- To study about the humanoid robots.

Course Outcomes:

23MZC27.CO1 Explain the basic concepts of working of robot

23MZC27.CO2 Analyze the function of sensors in the robot

23MZC27.CO3 Write program to use a robot for a typical application

23MZC27.CO4 Use Robots in different applications

23MZC27.CO5 Know about the humanoid robots

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZC27.CO1	-	-	-	X	-	-	X	-	-	-	-	X	X	X	X
23MZC27.CO2	-	-	-	X	-	-	X	-	-	-	-	X	X	X	X
23MZC27.CO2	-	-	-	X	-	-	X	-	-	-	-	X	X	X	X
23MZC27.CO4	-	-	-	X	-	-	X	-	-	-	-	X	X	X	X
23MZC27.CO5	-	-	-	X	-	-	X	-	-	-	-	X	X	X	X

Unit-I INTRODUCTION 9

History of service robotics – Present status and future trends – Need for service robots – applications examples and Specifications of service and field Robots. Non-conventional Industrial robots.

Unit-II SURGICAL ROBOTICS 9

Minimally invasive surgery and robotic integration - surgical robotic sub systems – synergistic control - Control Modes – Radio surgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies

Unit-III MICRO ROBOTICS 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-IV FIELD ROBOTS 9

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

Unit-V HUMANOIDS 9

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Humanactivity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance,Interaction, Safety and robustness, Applications, Case studies.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza	Introduction to Autonomous Mobile Robots	Bradford Company Scituate, USA	2004
2	RiadhSiaer	The future of Humanoid Robots- Research and applications	Intech Publications	2012

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Richard D Klafter, Thomas A, Chmielewski, Michael Negin	Robotics Engineering – An Integrated Approach	Eastern Economy Edition, Prentice Hall of India P Ltd	2006
2	Kelly, Alonzo; Iagnemma, Karl Howard, Andrew	Field and Service Robotics	Springer,	2011

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PROFESSIONAL ELECTIVES (PE)
For
Mechatronics

23MZE01	ADVANCED MACHINING PROCESSES	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the surface treatment techniques.
- To understand the non-traditional machining
- To familiarize the laser beam machining and electron beam machining.
- To understand the manufacturing processes of ceramic composites.
- To understand the various Processing of Composites.

Course Outcomes:

23MZE01.CO1 Understand the fundamentals of Surface treatment

23MZE01.CO2 Illustrate the concepts of non-traditional machining processes

23MZE01.CO3 Explain the working principle of laser beam machining and electron beam machining.

23MZE01.CO4 Summarize the fabrication techniques of microelectronic devices.

23MZE01.CO5 Comprehend the fabrication and processing of ceramic composites

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE01.CO1	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE01.CO2	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE01.CO3	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE01.CO4	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE01.CO5	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-

Unit-I SURFACE TREATMENT 9

Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

Unit-II NON-TRADITIONAL MACHINING 9

Introduction, need, AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment, process characteristics, performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.

Unit-III BEAM, ARC AND CHEMICAL MACHINING 9

Laser beam, electron beam, plasma arc & electro chemical machining-Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Unit-IV FABRICATION OF MICROELECTRONIC DEVICES 9

Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology

Unit-V PROCESSING OF CERAMICS AND COMPOSITES 9

Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, drying, sintering, Hot compaction, Area of application, finishing of ceramics. Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	V. K. Jain	Advanced Machining Processes	Allied Publishers	2009
2.	J. A. McGeough	Advanced Methods of Machining	Springer	2011

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kalpakijian	Manufacturing Engineering and Technology	Adisson Wesley	2010
2.	R. A. Lindburg	Process and Materials of Manufacturing	PHI	2003
3.	Chang Liu	Foundation of MEMS	Pearson	2012
4.	Hassan El- Hofy,	Advanced Machining Processes: Nontraditional and Hybrid Machining Processes	McGraw-Hill	2005
5.	V. K. Jain	Introduction to Micromachining	Alpha Science International Limited	2010

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23MZE02	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management
- To understand the application of statistical approach for quality control
- To create an awareness about the ISO and QS certification process and its need for the industries.
- To apply the quality concepts in product design, manufacturing etc in order to maximize customer Satisfaction.
- Human involvement to improve quality and the development and transformation.

Course Outcomes:

23MZE02.CO1 Understand the concept of total quality management

23MZE02.CO2 Comprehend and illustrate the TQM principles

23MZE02.CO3 Solve quality related problems using statistical process control

23MZE02.CO4 Understand proven methodologies to enhance management processes

23MZE02.CO5 Illustrate the salient features of quality systems

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE02.CO1	-	-	-	-	-	X	X	X	X	X	-	X	-	X	-
23MZE02.CO2	-	-	-	-	-	X	X	X	X	X	-	X	X	X	-
23MZE02.CO3	-	X	X	X	-	X	X	X	X	X	-	X	X	X	-
23MZE02.CO4	-	X	X	X	-	X	X	X	X	X	-	X	X	X	-
23MZE02.CO5	-	X	-	-	X	X	X	X	X	X	X	X	-	X	-

Unit-I INTRODUCTION **9**

Definition of Quality – Dimensions of Quality – Quality Planning – Quality costs – Analysis Techniques for Quality Costs – Basic concepts of Total Quality Management – Historical Review – Quality Statements – Strategic Planning, Deming Philosophy – Crosby philosophy – Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen – Obstacles to TQM Implementation

Unit-II TQM PRINCIPLES **9**

Principles of TQM, Leadership – Concepts – Role of Senior Management – Quality Council, Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits– Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure

Unit-III STATISTICAL PROCESS CONTROL (SPC) **9**

The seven tools of quality – Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma – New seven Management tools

Unit-IV TQM TOOLS **9**

Benchmarking – Reasons to Benchmark – Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, and Benefits – Taguchi Quality Loss Function – Total Productive Maintenance (TPM) – Concept, Improvement Needs, and FMEA – Stages of FMEA- Case studies

Unit-V QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems – ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 (definitions), ISO 9001:2008 (requirements) and ISO 9004:2009 (continuous improvement), TS 16949, ISO 14000, AS9100

– Concept, Requirements and Benefits- Case studies

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dale H. Besterfiled	Total Quality Management	Pearson Education Inc, New Delhi	2011
2.	James R. Evans and William M. Lidsay,	The Management and Control of Quality	South-Western	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	N.Gupta and B. Valarmathi,	Total Quality Management	Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi	2009
2.	Dr S. Kumar	Total Quality Management,	Laxmi Publications Ltd., New Delhi	2006
3.	P. N. Muherjee	Total Quality Management	Prentice Hall of India, New Delhi	2006
4.	James R. Evans and William M. Lindsay	The Management and Control of Quality	8thEdition, First Indian Edition, Cengage Learning	2012
5.	Suganthi.L and Anand Samuel	Total Quality Management	Prentice Hall (India) Pvt. Ltd	2006

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23MZE03	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objective:

- To analyze the historic development of Management thoughts
- To learn the nature and purpose of planning, forecasting and decision making
- To expose the knowledge on concepts of organizing
- To analyze the concepts of delegation of authority and Organization culture.
- To familiarize the students to the basic concepts of management in order to aid in understanding how an organization functions.

Course Outcomes:

23MZE03.CO1 Understand the evolution of management thought and role of managers

23MZE03.CO2 Discuss the phases of planning process and types of plans

23MZE03.CO3 Comprehend the different types of organization structure and illustrate the HR tasks

23MZE03.CO4 Describe the communication and directing process

23MZE03.CO5 Summarize the different controlling techniques in management

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE03.CO1	X	-	-	-	X	X	X	X	-	-	-	X	X	X	-
23MZE03.CO2	X	-	-	-	X	X	X	X	-	-	-	X	X	X	X
23MZE03.CO3	X	-	-	-	X	X	X	X	-	-	-	X	X	X	X
23MZE03.CO4	X	-	-	-	X	X	X	X	-	-	-	X	X	X	X
23MZE03.CO5	X	-	-	-	X	X	X	X	-	-	X	X	-	X	-

Unit-I INTRODUCTION TO MANAGEMENT 9

Organization- Management- Role of managers- Evolution of management thought- Organization and the environmental factors- Managing globally- Strategies for International business

Unit-II PLANNING 9

Nature and purpose of planning- Planning process- Types of plans- objectives- Managing by Objective (MBO) strategies- Types of strategies – Policies – Decision Making- Types of decision making process- Rational decision-making process- Decision making under different conditions.

Unit-III ORGANISING 9

Nature and purpose of organizing- Organization structure- Formal and informal groups/ organization- Line and staff authority- Departmentation- Span of control- Centralization and decentralization- Delegation of authority- Staffing- Selection and Recruitment- Orientation- Career development- Career stages- Training- Performance appraisal

Unit-IV DIRECTING 9

Managing people- Communication- Hurdles to effective communication- Organization Culture Elements and types of culture- Managing cultural diversity.

Unit-V CONTROLLING 9

Process of controlling- Types of control- Budgetary and non-budgetary control techniques Managing productivity- Cost control- Purchase control- Maintenance control- Quality control Planning operations.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Harold Koontz and Heinz Weihrich	Essentials of management: An International & Leadership Perspective	Tata McGraw-Hill Education	2015
2.	Charles W.L Hill and Steven L McShane	Principles of Management	McGraw Hill Education	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Samuel C. Certo and Tervis Certo	Modern management: concepts and skills	Pearson education	2014
2.	Heinz Weihrich, Mark V Cannice and Harold Koontz,	Management a global entrepreneurial perspective	Tata McGraw Hill	2013
3.	Stephen P. Robbins, David A.De Cenzo and Mary Coulter	Fundamentals of management	Prentice Hall of India	2012
4.	Don Hellriegel, Susan E. Jackson and John W. Slocum,	Management a competency-based approach	Thompson South Western	2008
5.	Joseph L.Massie	Essentials of Management	Pearson Education	2003

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23MZE04	AUTOMOTIVE MECHATRONICS	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on emission standards in automobiles.
- To impart knowledge on electronic fuel injection/ignition components and their function.
- To study the basics of electronics, emission controls and its Importance in automobiles.
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems.

Course Outcomes:

23MZE04.CO1	Know the importance of emission standards in automobiles
23MZE04.CO2	Understand the electronic fuel injection/ignition components and their function
23MZE04.CO3	Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators
23MZE04.CO4	Diagnose electronic engine control systems problems with appropriate diagnostic tools
23MZE04.CO5	Analyses the chassis and vehicle safety system.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE04.CO1	-	-	X	X	X	-	X	-	-	X	-	X	-	X	-
23MZE04.CO2	-	-	X	X	X	-	X	X	-	X	-	X	X	X	-
23MZE04.CO3	-	-	X	X	X	-	X	-	-	X	-	X	X	X	-
23MZE04.CO4	-	-	X	X	X	-	X	-	-	X	-	X	X	X	-
23MZE04.CO5	-	-	X	X	X	X	X	-	-	X	-	X	-	X	-

Unit-I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES 8

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Power train Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

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 9

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, vacuum operated actuator.

Unit-IV ENGINE CONTROL SYSTEMS 9

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's 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 9

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 Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ribbens	Understanding	Elsevier, Indian	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Barry Hollembeak	Automotive Electricity, Electronics & Computer Controls	Delmar Publishers	2001
2.	Richard K. Dupuy	Fuel System and Emission controls	Check Chart Publication	2000
3.	Ronald. K. Jurgon	Automotive Electronics Handbook	McGraw-Hill	1999
4.	Tom Denton	Automobile Electrical and Electronics Systems	Edward Arnold Publishers	2000

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23MZE05	ADVANCED MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

Course Objective:

- To study the Architecture of 8085 microprocessor.
- To study the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To study about communication and bus interfacing.
- To study the Architecture of 8051 microcontroller.

Course Outcomes:

23MZE05.CO1 Design and implement programs on 8085 microprocessors.

23MZE05.CO2 Design and implement programs on 8086 microprocessors.

23MZE05.CO3 Design I/O circuits.

23MZE05.CO4 Design Memory Interfacing circuits.

23MZE05.CO5 Design and implement 8051 microcontroller-based systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE05.CO1	-	-	X	-	X	X	X	X	-	-	-	X	X	-	-
23MZE05.CO2	-	-	X	X	X	-	X	X	-	-	-	X	X	X	-
23MZE05.CO3	-	-	X	X	X	-	X	X	-	-	-	X	X	X	X
23MZE05.CO4	-	-	X	X	X	-	X	X	-	-	-	X	X	X	-
23MZE05.CO5	-	-	X	X	X	-	X	X	-	-	-	X	X	-	-

Unit-I 8086 MICROPROCESSOR 8

Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

Unit-II 80286 MICROPROCESSOR 8

Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

Unit-III 80386, 80486 PROCESSORS 8

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors

Unit-IV PENTIUM MICROPROCESSOR 6

Introduction – Architecture – Special Pentium registers – Memory management

Unit-V PIC MICROCONTROLLER 15

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES: PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I2C Bus operation

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Barry B Brey	The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II,III,4	Prentice Hall of India New Delhi	2005
2.	Douglas V Hall	Microprocessors and Interfacing: Programming and Hardware	McGraw Hill, New Delhi	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mohammed Rafiquzzaman	Microprocessors and microcomputer- based system design	CRC Press	2005
2.	Walter A Triebel, Avtar Singh	The 8088 and 8086 microprocessors Programming Interfacing Software Hardware and Applications	Pearson Education	2009
3.	Myke Pred ko	Programming and Customizing the PIC Microcontroller	McGraw Hill	1998
4.	John B Peatman	Design with PIC Microcontroller	McGraw Hill	2001

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23MZE06	SYSTEM SOFTWARE	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the phases in a software project.
- To understand fundamental concepts of requirements engineering and Analysis Modelling.
- To understand the major considerations for enterprise integration and deployment.
- To learn various testing and maintenance measures.
- To learn about various parsing techniques.

Course Outcomes:

23MZE06.CO1 Identify the key activities in managing a software project.

23MZE06.CO2 Compare different process models.

23MZE06.CO3 Concepts of requirements engineering and Analysis Modeling

23MZE06.CO4 Apply systematic procedure for software design and deployment

23MZE06.CO5 Compare and contrast the various testing and maintenance.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE06.CO1	X	-	-	X	X	X	-	-	-	-	-	X	X	X	-
23MZE06.CO2	X	-	-	X	X	X	-	-	-	-	-	X	X	X	-
23MZE06.CO3	X	-	-	X	X	X	-	-	-	-	-	X	X	X	-
23MZE06.CO4	X	-	-	X	X	X	-	-	-	-	-	X	X	X	-
23MZE06.CO5	X	-	-	X	X	X	-	-	-	-	-	X	X	X	-

Unit-I ASSEMBLERS 16

General Design procedures – Design of an Assembler – data structures – format of databases – algorithm – flow chart – PASS structures – modular functions. MACRO LANGUAGE AND MACRO PROCESSORS**:** Macro instructions, features of a macro facility –implementation.

Unit-II LOADERS 8

Loader schemes – compile and go loaders, general load scheme – absolute loaders – direct linking loaders and their design. Other loading schemes: linking loaders, overlays, dynamic binders.

Unit-III COMPILERS 10

Introduction – Structure of a compiler – phases of a compiler - compiler writing tools. LEXICAL ANALYSIS: Role of a lexical analyzer – finite automata –regular expressions to finite automata – minimizing the number of states of a deterministic finite automaton – implementation of a lexical analyzer.

Unit-IV PARSING TECHNIQUES 6

Context free grammars – derivations and parse trees – ambiguity – capabilities of context free grammars. Top down and bottom up parsing – handles – shift reduce parsing – operator precedence parsing – recursive descent parsing – predictive parsing

Unit-V INTERMEDIATE CODE GENERATION 5

Postfix notation, Quadruples, triples, indirect triples – Representing information in a symbol table – introduction to code optimization – basic blocks – DAG representation – error detection and recovery - code generation.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Leland Beck	System Software – An Introduction to Systems Programming	Third Edition, Pearson Education, Inc	2008
2.	Srimanta Pal	Systems Programming	Oxford University Press	2011

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John J Donovan	Systems Programming	McGraw Hill	1999
2.	Dhamdhere D M	Systems Programming	Tata McGraw Hill	2001
3.	Aho A V, Sethi R and Ullman J D	Compilers: Principles, Techniques and Tools	Addison Wesley, ongman	1999
4.	Holub Allen I	Compiler Design in C	Prentice Hall	2001

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23MZE07	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To identify the different structures in automobile engineering.
- To realize the engine auxiliary systems such as fuel injection system, electrical system and ignition system.
- To understand the working principles of transmission systems.
- To scrutinize the working principle of different types of steering and brake systems.
- To Familiarize about alternative fuels and hybrid vehicles.

Course Outcomes:

23MZE07.CO1	Describe the vehicle construction and function of different parts.
23MZE07.CO2	Realize the engine auxiliary systems such as fuel injection system, electrical system and ignition system.
23MZE07.CO3	Identify the working principle of different types of transmission system.
23MZE07.CO4	Scrutinize the working principle of different types of steering and brake systems
23MZE07.CO5	Familiarize alternative fuels

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE07.CO1	X	X	-	X	X	-	X	-	-	-	-	X	-	X	-
23MZE07.CO2	X	X	-	X	X	-	X	X	-	-	-	X	X	X	-
23MZE07.CO3	X	X	-	X	X	-	X	-	-	-	-	X	X	X	-
23MZE07.CO4	X	X	-	X	X	-	X	-	-	-	-	X	X	X	-
23MZE07.CO5	X	X	-	X	X	X	X	-	-	-	-	X	-	X	-

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-way 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, over drive, 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 –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kirpal Singh	Automobile Engineering Vol 1 & 2, 13th Edition	Standard Publishers, New Delhi	2012
2.	Jain K.K. and Asthana. R. B	Automobile Engineering	Tata McGraw Hill Publishers, New Delhi	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Newton , Steeds and Garet	Motor Vehicles	Butterworth Publishers	2010
2.	Joseph Heitner	Automotive Mechanics, Second Edition	Second Edition, East-West Press	2004
3.	Martin W, Stockel and Martin T Stockle	Automotive Mechanics Fundamentals	The Good heart Will Cox Company Inc, USA	2014
4.	Heinz Heisler	Advanced Engine Technology	SAE International Publications USA	2016
5.	Ganesan V	Internal Combustion Engines, Third Edition	Tata McGraw-Hill.	2007

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23MZE08	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

Course Objective:

- To give an idea about IPR, registration and its enforcement.
- To learn steps for registration of IPRs.
- To learn various agreements and legislations
- To learn digital Products and Law
- To learn the Enforcement of IPRs

Course Outcomes:

23MZE08.CO1 Give an idea about IPR, registration and its enforcement

23MZE08.CO2 Demonstrate steps for registration of IPRs

23MZE08.CO3 Understand various agreements and legislations

23MZE08.CO4 Apply the IPR concepts to digital Products and Law

23MZE08.CO5 Explain the enforcement of IPRs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE08.CO1	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE08.CO2	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE08.CO3	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE08.CO4	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE08.CO5	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-

Unit-I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

Unit-II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

Unit-III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

Unit-IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

Unit-V ENFORCEMENT OF IPRs 7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	V. Scople Vinod	Managing Intellectual Property	Prentice Hall of India	2012
2.	S.V. Satarkar	Intellectual Property Rights and Copy Rights	Ess Publications, New Delhi	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Deborah E. Bouchoux	Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets	Cengage Learning, Third Edition	2012
2.	Edited by Derek Bosworth and Elizabeth Webster	The Management of Intellectual Property	Edward Elgar Publishing Ltd	2013
3.	Prabuddha Ganguli	Intellectual Property Rights: Unleashing the Knowledge Economy	McGraw Hill Education	2011

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23MZE09	DESIGN OF PRESSURE VESSEL AND PIPING	L	T	P	C
		3	0	0	3

(*Usage of Pressure Vessels, Design Hand Book is allowed for the students for examination*)

Course Objective:

- To obtain an understanding of the fundamental methods and Terminology and its application.
- To understand the membrane stress analysis and industrial related problems in vessels.
- To design principles for pressure vessels and enhance the understanding of reinforcement.
- To obtain the buckling of pressure vessels and tubes, cylinders etc.
- To design procedure of pressure vessel and Design of piping layout.

Course Outcomes:

23MZE09.CO1 Develop the stresses and terminology, efficiency and its applications

23MZE09.CO2 Analysis the vessels shells components such as cylindrical, spherical, conical and Thermal.

23MZE09.CO3 Design the pressure vessels and ASME vessels codes.

23MZE09.CO4 Estimate the design procedure of pressure vessel and Design of piping layout

23MZE09.CO5 Design and analysis the pipe stress.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE09.CO1	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE09.CO2	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE09.CO3	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE09.CO4	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
23MZE09.CO5	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-

Unit-I INTRODUCTION 9

Methods for determining stresses – Terminology and Ligament Efficiency– Applications

Unit-II STRESS IN PRESSURE VESSELS 9

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

Unit-III DESIGN OF VESSELS 9

Design of Tall cylindrical self-supporting process columns –Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular Hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes

Unit-IV BUCKLING OF VESSELS 9

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

Unit-V PIPING 9

Introduction – Flow diagram – piping layout and piping stress Analysis

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John F. Harvey	Theory and Design of Pressure Vessels	CBS Publishers and Distributors	2001
2.	Donatello Annaratone	Pressure Vessel Design	Springer	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Henry H. Bedner	Pressure Vessels, Design Hand Book	CBS publishers and Distributors	2001
2.	Stanley, M. Wales	Chemical process equipment, selection and Design	Buterworths series in Chemical Engineering	1988
3.	John F. Harvey	Pressure Vessel Design: Nuclear and Chemical Applications	Priceton Inc.	1963
4.	William. J., Bees	Approximate Methods in the Design and Analysis of Pressure Vessels and Piping	Pre ASME-Pressure Vessels and Piping Conference	1997
5.	Sam Kannapan	Introduction to Pipe Stress Analysis	John Wiley and Sons	1985

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23MZE10	LEAN & AGILE MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objective:

- To acquire the general knowledge to deliver consistently high quality and value-added products and services to the customer in a lean environment
- To understand the terminology relating to lean operations in both service and manufacturing organizations
- To understand various controlling and manufacturing techniques that effect lean manufacturing
- To comprehend the implementation process of lean manufacturing.
- To familiarize with the lean accounting system

Course Outcomes:

23MZE10.CO1 Understand and apply the concept of lean thinking to the processes

23MZE10.CO2 Understand the work place organization process

23MZE10.CO3 Comprehend the various work flow and control techniques

23MZE10.CO4 Illustrate various lean manufacturing techniques

23MZE10.CO5 Understand and analyze the manufacturing time and implementation of lean manufacturing

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE10.CO1	X	-	-	-	X	X	-	-	-	-	-	X	X	-	X
23MZE10.CO2	X	-	-	-	X	X	-	-	-	-	-	X	X	-	X
23MZE10.CO3	X	-	-	-	X	X	-	-	-	-	-	X	X	-	X
23MZE10.CO4	X	-	-	-	X	X	-	-	-	-	-	X	X	-	X
23MZE10.CO5	X	-	-	-	X	X	-	-	-	-	-	X	X	-	X

Unit-I INTRODUCTION 9

History – Evolution - Toyota production system - Lean manufacturing overview.

Unit-II ORGANIZATION OF WORK PLACE 9

Work place organization - Visual controls - Pull production and cellular manufacturing - Value flow pull - Value and perfection lean

Unit-III WORK FLOW AND CONTROL TECHNIQUES 9

Mapping the present – Mapping the future - Product and process development – Value stream analysis - Over production - Waiting - Work In Progress - Transportation - Inappropriate processing - Excess motion or ergonomic problems - Defected products - Underutilization of employees.

Unit-IV LEAN MANUFACTURING TECHNIQUES 9

Just in Time - Kanban tooling - Total Productive Maintenance – 5S - Single Minute Die Exchange - Lean six sigma.

Unit-V 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.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dennis P Hobbs	Lean Manufacturing Implementation	J.Ross Publications	2009
2	Jay Arthur	Lean Six-Sigma Demystified	Tata McGraw-Hill Company, New Delhi	2009

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jeffrey K Liker	The Toyota Way-14 Management Principles	Tata McGraw-Hill Company, New Delhi	2015
2.	Pascal Dennis	Lean Production Simplified,	Productivity Press, USA	2002
3.	Martin W, Stockel and Martin T Stockle	Automotive Mechanics Fundamentals	The Good heart Will Cox Company Inc, USA	2014
4.	Richard J Schonberger	World Class Manufacturing	Sp Free Press	2003
5.	Carreira B	Lean Manufacturing that Works	PHI	2007

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23MZE11	INDUSTRIAL DESIGN AND APPLIED ERGONOMICS	L	T	P	C
		3	0	0	3

Course Objective:

- To explain the general principles that governs the interaction of humans in their working environment.
- To improve improving worker performance and safety.
- To know about the environmental conditions in the industry.
- To know about bio thermodynamics and bioenergetics.
- To know about the human factors in industrial aspects.

Course Outcomes:

23MZE11.CO1 Know about ergonomic principles to design workplaces

23MZE11.CO2 Improve human performance

23MZE11.CO3 Judge the environmental conditions in the work place.

23MZE11.CO4 Know about bio-thermodynamics and bioenergetics

23MZE11.CO5 Implement latest occupational health and safety to the work place.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE11.CO1	X	-	-	-	-	X	X	X	X	X	X	X	X	-	X
23MZE11.CO2	X	-	-	-	-	-	X	X	X	X	X	X	X	-	X
23MZE11.CO3	X	-	-	-	-	-	X	X	X	X	X	X	X	-	X
23MZE11.CO4	X	-	-	-	-	-	X	X	X	X	X	X	X	-	X
23MZE11.CO5	X	-	-	-	-	-	X	X	X	X	X	X	X	-	X

Unit-I INTRODUCTION 9

Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development.

Unit-II HUMAN OUTPUT AND CONTROL 9

Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

Unit-III ENVIRONMENTAL CONDITIONS 9

Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts. BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

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 HUMAN FACTORS APPLICATIONS 9

Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA‟s approach, virtual environments

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chandler Allen Phillips	Human Factors Engineering	John Wiley and Sons New York	2000

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bridger R S	Introduction to Ergonomics	Taylor and Francis, London	2003
2.	Mayall W H	Indus trial Design for Engineers	London ILIFFEE Books Ltd., UK	1998
3.	Mark S Sanders	Human Factors in Engineering and Design	McGraw Hill, New York	1993

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23MZE12	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

Course Objective:

- To impart the knowledge on process, equipment and tools for various industrial products
- To impart the knowledge on process planning activity chart.
- To understand the concept of cost estimation.
- To impart the knowledge on different type of shop floor.
- To understand machining time for various machining operations.

Course Outcomes:

23MZE12.CO1 Select the process, equipment and tools for various industrial products.

23MZE12.CO2 Prepare process planning activity chart.

23MZE12.CO3 Explain the concept of cost estimation.

23MZE12.CO4 Compute the job order cost for different type of shop floor

23MZE12.CO5 Calculate the machining time for various machining operations.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE12.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-
23MZE12.CO2	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZE12.CO3	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZE12.CO4	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
23MZE12.CO5	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-

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 fixtures election 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 Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Peter Scalon	Process planning, Design/Manufacture Interface	Elsevier science technology	2002
2.	Sinha B.P	Mechanical Estimating and Costing	Tata-McGraw Hill publishing	1995

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chitale A.V. and Gupta R.C	Product Design and Manufacturing	PHI	2002
2.	Ostwalal P.F. and Munez J.,	Manufacturing Processes and systems	John Wiley	1998
3.	Russell R.S and Tailor B.W	Operations Management	PHI	2003
4.	Mikell P. Groover	Automation, Production, Systems and Computer Integrated Manufacturing	Pearson	2001
5.	C. Jain & L.N. Aggarwal	K, "Production Planning Control and Industrial Management	Khanna Publishers	1990

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23MZE13	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course Objective:

- To provide knowledge to solve the linear models problems
- To provide knowledge to solve transportation and network problems.
- To understand the Inventory models' problems
- To understand the queueing models' problems
- To understand the decision models' problems

Course Outcomes:

23MZE13.CO1 Solve the linear models problems

23MZE13.CO2 Explain transportation and network problems

23MZE13.CO3 Solve the inventory models' problems

23MZE13.CO4 Solve the queueing models' problems

23MZE13.CO5 Solve the decision models' problems

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE13.CO1	X	-	-	X	-	X	-	-	-	-	-	X	-	X	X
23MZE13.CO2	X	-	-	X	-	X	-	-	-	-	-	X	X	X	X
23MZE13.CO3	X	-	-	X	-	X	-	-	-	-	X	X	X	X	X
23MZE13.CO4	X	-	-	X	-	X	-	-	-	-	-	X	X	X	X
23MZE13.CO5	X	-	-	X	-	X	-	-	-	-	X	X	-	X	X

Unit-I LINEAR MODELS **9**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

Unit-II HUMAN OUTPUT AND CONTROL **9**

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

Unit-III ENVIRONMENTAL CONDITIONS **9**

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

Unit-IV WORKPLACE HEALTH AND SAFETY **9**

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

Unit-V HUMAN FACTORS APPLICATIONS **9**

Decision models – Game theory – Two-person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life –

Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hillier and Libeberman	Operations Research	Holden Day	2005
2.	Taha H.A	Operations Research	Prentice Hall of India	2003

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bazara M.J., Jarvis and Sherali H	Linear Programming and Network Flows	John Wiley	2009
2.	Budnick F.S	Principles of Operations Research for Management	Richard D Irwin	1990
3.	Philip D.T. and Ravindran A	Operations Research	John Wiley	1992
4.	Shennoy G.V. and Srivastava U.K	Operation Research for Management	Wiley Eastern	1994
5.	Tulsian and Pasdey V	Quantitative Techniques	Pearson Asia	2002

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23MZE14	VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Objective:

- To study the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational & sequential digital circuits.
- To learn the architectural choices and performance tradeoffs involved in designing
- To design the circuits in CMOS technology are discussed
- To learn the different FPGA architectures and testability of VLSI circuits.

Course Outcomes:

23MZE14.CO1 Realize the concepts of digital building blocks using MOS transistor.

23MZE14.CO2 Design combinational MOS circuits and power strategies.

23MZE14.CO3 Design and construct Sequential Circuits and Timing systems

23MZE14.CO4 Design arithmetic building blocks and memory subsystems.

23MZE14.CO5 Apply and implement FPGA design flow and testing.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE14.CO1	X	-	-	-	X	X	X	X	-	X	-	X	X	-	-
23MZE14.CO2	X	-	-	X	X	-	X	X	-	X	-	X	X	X	-
23MZE14.CO3	X	-	-	X	X	-	X	X	-	X	-	X	X	X	-
23MZE14.CO4	X	-	-	X	X	-	X	X	-	X	-	X	X	X	-
23MZE14.CO5	X	-	-	X	X	-	X	X	-	X	-	X	X	-	-

Unit-I MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non-Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics, small signal analysis of MOSFET

Unit-II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation.

Unit-III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.

Unit-IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

Unit-V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Neil H.E. Weste, David Money Harris	CMOS VLSI Design: A Circuits and Systems Perspective	Pearson	2017
2.	Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic	Digital Integrated Circuits: A Design perspective	Pearson	2016

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.J. Smith	Application Specific Integrated Circuits	Addisson Wesley	1997
2.	Sung-Mo kang, Yusuf leblebici, Chulwoo Kim	CMOS Digital Integrated Circuits:Analysis & Design	McGraw Hill Education	2013
3.	Wayne Wolf	Modern VLSI Design: System On Chip	Pearson Education	2007
4.	R.Jacob Baker, Harry W.LI., David E.Boyee	CMOS Circuit Design, Layout and Simulation	Prentice Hall	2005

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23MZE15	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce the principle, programming technique with instrument interfaces
- To learn applications of virtual instruments and
- To understand the basics of data acquisition
- To understand the instrument interfaces
- To learn the tools for various applications

Course Outcomes:

23MZE15.CO1	Understand the evolution, advantages, techniques, architecture and applications of visualinstrumentation
23MZE15.CO2	Acquiring knowledge on VI programming techniques
23MZE15.CO3	Study about the basics of data acquisition
23MZE15.CO4	Understanding the concept of common instrument interfaces with industrial applications
23MZE15.CO5	Study about the use of analysis tools with various applications

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE15.CO1	X	-	-	-	X	X	X	-	-	X	-	X	X	X	-
23MZE15.CO2	X	-	-	X	X	-	X	-	-	X	-	X	X	X	X
23MZE15.CO3	X	-	-	X	X	-	X	-	-	X	-	X	X	X	X
23MZE15.CO4	X	-	-	X	X	-	X	-	-	X	-	X	X	X	X
23MZE15.CO5	X	-	-	X	X	-	X	-	-	X	-	X	X	-	X

Unit-I REVIEW OF VIRTUAL INSTRUMENTATION 9

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data - flow techniques, graphical programming in data flow, comparison with conventional programming.

Unit-II VI PROGRAMMING TECHNIQUES 9

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

Unit-III DATA ACQUISTION BASICS 9

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation

Unit-IV COMMON INSTRUMENT INTERFACES 9

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

Unit-V USE OF ANALYSIS TOOLS 9

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gupta	Virtual Instrumentation Using Lab view	Tata McGraw- Hill Education	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gary Jonson	Labview Graphical Programming	Fourth Edition, McGraw Hill, New York	2006
2.	Gupta.S., Gupta.J.P	PC interfacing for Data Acquisition & Process Control	Instrument Society of America	1994
3.	Sokoloff	Basic concepts of Labview 4	Prentice Hall Inc., New Jersey	1998

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23MZE16	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

Course Objective:

- To study the concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of Expert Systems and machine learning.
- To learn about planning and reasoning artificial intelligence.
- To solve the risk in artificial intelligence.

Course Outcomes:

23MZE16.CO1	Identify problems that are amenable to solution by AI methods.
23MZE16.CO2	Identify appropriate AI methods to solve a given problem.
23MZE16.CO3	Formalize a given problem in the language/framework of different AI methods
23MZE16.CO4	Implement basic AI algorithms.
23MZE16.CO5	Design and carry out an empirical evaluation of different algorithms on a problem formalization and state the conclusions that the evaluation supports.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE16.CO1	X	-	-	-	X	-	X	X	-	X	X	X	X	-	X
23MZE16.CO2	X	-	-	X	X	-	X	X	-	X	X	X	X	X	X
23MZE16.CO3	X	-	-	X	X	-	X	X	-	X	X	X	X	X	X
23MZE16.CO4	X	-	-	X	X	-	X	X	-	X	X	X	X	X	-
23MZE16.CO5	X	-	-	X	X	-	X	X	-	X	X	X	X	-	-

Unit-I INTRODUCTION **9**

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

Unit-II PLANNING **9**

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

Unit-III REASONING: **9**

Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

Unit-IV LEARNING **9**

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception..

Unit-V AI IN ROBOTICS **9**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Stuart Russell, Peter Norvig	Artificial Intelligence: A modern approach	Pearson Education	2003
2.	Negnevitsky, M	Artificial Intelligence: A guide to Intelligent Systems	Harlow: Addison- Wesley	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David Jefferis	Artificial Intelligence: Robotics and Machine Evolution	Crabtree Publishing Company	1992

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23MZE17	SPECIAL MACHINES AND CONTROLLERS	L	T	P	C
		3	0	0	3

Course Objective:

- To know about stepper motors.
- To know about switched reluctance motors
- To know about permanent magnet brushless D.C. Motors
- To know about permanent magnet synchronous motors
- To know about linear motors

Course Outcomes:

23MZE17.CO1	Understanding principles of operation, types and applications of stepper motors
23MZE17.CO2	Understanding principles of operation, types and applications of switched reluctance motors
23MZE17.CO3	Knowledge in evaluating the performance of dc motors
23MZE17.CO4	To evaluate knowledge in permanent magnet synchronous motors.
23MZE17.CO5	Understand the working and applications linear motors and servo motors.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE17.CO1	X	-	-	-	X	X	X	X	-	-	-	X	X	-	-
23MZE17.CO2	X	-	-	X	X	-	X	X	-	-	-	X	X	X	-
23MZE17.CO3	X	-	-	X	X	-	X	X	-	-	-	X	X	X	-
23MZE17.CO4	X	-	-	X	X	-	X	X	-	-	-	X	X	X	-
23MZE17.CO5	X	-	-	X	X	-	X	X	-	-	-	X	X	-	-

Unit-I STEPPER MOTORS **9**

Types - Constructional features – principle of operation – variable reluctance motor – single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Different modes of Excitation - theory of torque predictions – Drive systems and circuit for open loop and closed loop control of stepper motor.

Unit-II SWITCHED RELUCTANCE MOTORS **9**

Constructional features – principle of operation –Torque Equation - Power Converters for SR Motor – Rotor Sensing Mechanism & Logic Controller – Sensorless Control of SR motor - Applications.

Unit-III PERMANENT MAGNET BRUSHLESS D.C. MOTORS **9**

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control – Applications.

Unit-IV PERMANENT MAGNET SYNCHRONOUS MOTORS **9**

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes – Applications.

Unit-V LINEAR MOTORS **9**

Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous motor(LSM) – Types–Applications SERVOMOTORS: Servomotor

- Types – Constructional features, principle of operation - control application.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K. Venkataratnam	Special Electrical Machines	Universities Press	2009
2.	Kenjo, T and Naganori, S	Permanent Magnet and brushless DC motors	Clarendon Press, Oxford	1989

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kenjo T	Stepping Motors and their Microprocessor Controls	Clarendon Press London	2003
2.	Miller T J E	Brushless Permanent Magnet and Reluctance Motor Drives	Clarendon Press, Oxford	1989
3.	Naser A and Boldea L	Linear Electric Motors: Theory Design and Practical Applications	Prentice Hall Inc., New Jersey	1987
4.	Floyd E Saner	Servo Motor Applications	Pittman USA	1993
5.	William H Yeadon, Alan W Yeadon	Handbook of Small Electric Motors	McGraw Hill, INC	2001

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23MZE18	ADVANCED CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

Course Outcomes:

23MZE18.CO1 Design in state variable form

23MZE18.CO2 Knowledge in phase plane analysis

23MZE18.CO3 Describe function analysis.

23MZE18.CO4 Know the design of optimal controller.

23MZE18.CO5 Know about the design of optimal estimator including kalman filter

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE18.CO1	X	X	-	-	X	X	X	-	-	X	-	X	X	-	-
23MZE18.CO2	X	X	X	X	X	-	X	-	-	X	-	X	X	X	X
23MZE18.CO3	X	X	X	X	X	-	X	-	-	X	-	X	X	X	X
23MZE18.CO4	X	X	X	X	X	-	X	-	-	X	-	X	X	-	-
23MZE18.CO5	X	-	X	X	X	-	X	-	-	X	-	X	X	-	-

Unit-I STATE VARIABLE DESIGN 9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

Unit-II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits

- Phase plane analysis of linear and non-linear systems – Isocline method.

Unit-III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

Unit-IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti‟s equation – Application examples.

Unit-V OPTIMAL ESTIMATION 9

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman Filter- Application examples.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mohandas K. P	Modern Control Engineering	Sanguine Technical Publishers	2006
2.	Thaler G.J	Automatic Control Systems	Jaico Publishing House	1993
3.	Gopal ,M	Modern control system theory	New Age International Publishers	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William S Levine	Control System Fundamentals : The Control Handbook	CRC Press, Tayler and Francies Group	2011
2.	Ashish Tewari	Modern control Design with Matlab and Simulink	John Wiley, New Delhi	2002
3.	Ogata K	Modern Control Engineering	PHI, New Delhi	2002
4.	Glad T. and Ljung L	Control theory –Multivariable and Non-linear methods	Taylor & Francis	2002
5.	Naidu D.S	Optimal Control Systems	CRC Press	2009

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23MZE19	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product
- To understand requirement engineering and know how to collect, analyze and arrive at requirements
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- 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

Course Outcomes:

23MZE19.CO1 Define, formulate and analyze a problem

23MZE19.CO2 Solve specific problems independently or as part of a team.

23MZE19.CO3 Gain knowledge of the Innovation & Product Development process in the Business Context

23MZE19.CO4 Work independently as well as in teams

23MZE19.CO5 Manage a project from start to finish

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE19.CO1	X	-	-	-	-	-	X	X	-	X	-	X	X	-	-
23MZE19.CO2	X	-	-	-	-	-	X	X	-	X	-	X	X	-	-
23MZE19.CO3	X	-	-	-	-	-	X	X	-	X	-	X	X	-	-
23MZE19.CO4	X	-	-	-	-	-	X	X	-	X	-	X	X	-	-
23MZE19.CO5	X	-	-	-	-	-	X	X	-	X	-	X	X	-	-

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 Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Karl T Ulrich and Stephen D Eppinger	Product Design and Development	Tata McGraw Hill	2011
2.	John W Newstorm and Keith Davis	Organizational Behavior	Tata McGraw Hill	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hiriyappa B	Corporate Strategy – Managing the Business	Author House	2013
2.	Peter F Drucker	People and Performance", Butterworth – Heinemann	Oxford	2004
3.	Vinod Kumar Garg & Venkita Krishnan N K	Enterprise Resource Planning – Concepts	Prentice Hall	2003
4.	Mark S Sanders and Ernest J McCormick	Human Factors in Engineering and Design	McGraw Hill	2013

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23MZE20	MAINTENANCE AND SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge in maintenance
- To know about the fundamentals of maintenance and to implement it.
- To study about safety engineering practices.
- To analyze the hazards in protection.
- To know about the safety in machine operation.

Course Outcomes:

23MZE20.CO1 Maintain the industry without any risk in its operation

23MZE20.CO2 Improve the production

23MZE20.CO3 Analyze the hazards in maintenance and to solve it.

23MZE20.CO4 Identify and prevent chemical, environmental mechanical, fire hazard throughanalysis

23MZE20.CO5 Apply proper safety techniques on safety engineering and management

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE20.CO1	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE20.CO2	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE20.CO3	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE20.CO4	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-
23MZE20.CO5	X	-	-	-	-	-	X	X	X	X	X	X	X	-	-

Unit-I MAINTENANCE 9

Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure

Unit-II 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-III SAFETY SYSTEMS ANALYSIS 9

Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations.

Unit-IV HAZARD ANALYSIS 9

General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies. FIRE PROTECTION SYSTEM: Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO2 system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher.

Unit-V SAFETY IN MACHINE OPERATION 9

Design for safety, lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation. SAFETY AND LAW: Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John Ridley	Safety at Work	Butter Worth Publisher, Oxford	1997
2.	Robinson C J and Ginder A P	Implementing TPM	Productivity Press, USA	1995

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dhillon B S	Maintainability, Maintenance and Reliability for Engineers	CRC Press	2006
2.	National Safety Council	Personal Protective Equipment	Bombay	1998
3.	Heinrich H W	Industrial Accident Prevention	National Safety Council, Chicago	1998

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23MZE21	NEURAL NETWORKS AND FUZZY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the various soft computing frame works
- To be familiar with design of various neural networks
- To be exposed to fuzzy logic
- To learn genetic programming
- To be exposed to hybrid systems

Course Outcomes:

23MZE21.CO1 Upon completion of the course, the student should be able to

23MZE21.CO2 Apply various soft computing frame works

23MZE21.CO3 Design of various neural networks

23MZE21.CO4 Use fuzzy logic

23MZE21.CO5 Apply genetic programming

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE21.CO1	X	X	X	-	X	X	-	-	-	-	-	X	X	-	-
23MZE21.CO2	X	X	X	X	X	-	-	-	-	-	-	X	X	-	-
23MZE21.CO3	X	X	X	X	X	-	-	-	-	-	-	X	X	-	-
23MZE21.CO4	X	X	X	X	X	-	-	-	-	-	-	X	X	-	-
23MZE21.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	-	-

Unit-I INTRODUCTION TO NEURAL NETWORKS 7

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, McCulloch - Pitts Neuron, Simple Neural Nets for Pattern Classification, Linear Separability - Hebb Net, Perceptron, Adaline, Madaline - Architecture, algorithm, and Simple Applications.

Unit-II PATTERN ASSOCIATION 7

Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative and Iterative Auto associative Net, Bidirectional Associative Memory - Architecture, Algorithm, and Simple Applications.

Unit-III COMPETITION, ADAPTIVE RESONANCE AND BACK PROPAGATION NEURAL NETWORKS 13

Kohonen Self Organising Maps, Learning Vector Quantization, Counter Propagation - Architecture, Algorithm and Applications - ART1 and ART2 - Basic Operation and Algorithm, Standard Backpropagation Architecture, derivation of Learning Rules, Boltzmann Machine Learning - Architecture, Algorithm and Simple Applications.

Unit-IV CLASSICAL AND FUZZY SETS AND RELATIONS 6

Properties and Operations on Classical and Fuzzy Sets, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems.

Unit-V MEMBERSHIP FUNCTIONS 12

Features of membership function, Standard forms and Boundaries, fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods.

APPLICATIONS: Neural Networks: Robotics, Image compression, Control systems - Fuzzy Logic: Mobile robot navigation, Autotuning a PID Controller.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sivanandam S N, Sumathi S, Deepa S N	Introduction to Neural Networks using Mat lab 6.0	Tata McGraw Hill Publications New Delhi	2006
2.	Timothy Ross	Fuzzy Logic with Engineering Applications	McGraw Hill, Singapore	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John Yen and Rezalangari	Fuzzy Logic, Intelligence, Control and Information	Pearson Education	2007
2.	Mohammad H Hassoun	Fundamentals of Neural Networks	Prentice hall of India	2002

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23MZE22	INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors andtheir applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To know about material handling in a system.

Course Outcomes:

23MZE22.CO1	Learn about the basic concepts, parts of robots and types of robots.
23MZE22.CO2	To design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.
23MZE22.CO3	Ability in selecting the required robot
23MZE22.CO4	Know various applications of robots
23MZE22.CO5	Apply their knowledge in handling the materials.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE22.CO1	X	-	-	-	X	X	-	X	-	-	-	X	X	-	-
23MZE22.CO2	X	-	-	X	X	-	-	X	-	-	-	X	X	-	-
23MZE22.CO3	X	-	-	X	X	-	-	X	-	-	-	X	X	-	-
23MZE22.CO4	X	-	-	X	X	-	-	X	-	-	-	X	X	-	-
23MZE22.CO5	X	-	-	X	X	-	-	X	-	-	-	X	X	-	-

Unit-I INTRODUCTION 6

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 ROBOTS FOR INSPECTION 8

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

Unit-III OTHER APPLICATIONS 8

Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

Unit-IV END EFFECTORS 11

Gripper force analysis and gripper design, design of multiple degrees of freedom, active and passive grippers. SELECTION OF ROBOT: Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society.

Unit-V MATERIAL HANDLING 12

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.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Richaerd D Klafter, Thomas Achmielewski and Mickael Negin	Robotic Engineering – An integrated Approach	Prentice HallIndia, New Delhi	2001
2.	Mikell P. Groover	Automation, Production Systems, and Computer Integrated Manufacturing	John Wiley & sons	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	James A Rehg	Introduction to Robotics in CIM Systems	Prentice Hall of India	2002
2.	Deb S R	Robotics Technology and Flexible Automation	Tata McGraw Hill,New Delhi	1994

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23MZE23	TOTALLY INTEGRATED AUTOMATION	L	T	P	C
		3	0	0	3

Course Objective:

- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and their applications.
- To know about the basic in SCADA and DCS systems.
- To gain knowledge in communication protocols in an integrated system
- To know about the advanced in automation industries

Course Outcomes:

23MZE23.CO1 Knowledge of PLC & PAC automation

23MZE23.CO2 Knowledge in HMI systems and to integrate it with other systems.

23MZE23.CO3 Apply SCADA and usage of C programming for report generation

23MZE23.CO4 Acquire information's on communication protocols in automation systems

23MZE23.CO5 Design and develop automatic control system using distributed control systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
23MZE23.CO1	X	-	-	X	X	-	X	-	-	X	-	X	X	-	-
23MZE23.CO2	X	-	-	X	X	-	X	-	-	X	-	X	X	X	X
23MZE23.CO3	X	-	-	X	X	-	X	-	-	X	-	X	X	X	X
23MZE23.CO4	X	-	-	X	X	-	X	-	-	X	-	X	X	X	X
23MZE23.CO5	X	-	-	X	X	-	X	-	-	X	-	X	X	-	-

Unit-I TOTALLY INTEGRATED AUTOMATION 9

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

Unit-II HMI SYSTEMS 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). Check with PLC 502 and remove

Unit-III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

Overview – Developer 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 – 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 Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John.W.Webb & Ronald A. Reis	Programmable logic controllers: Principles and Applications	Prentice Hall India	2003
2.	Michael P. Lukas	Distributed Control systems	Van Nostrand Reinfold Company	1995

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Win C C	Software Manual	Siemens	2003
2.	CIMPLICITY	SCADA Packages Manual	Fanuc India Ltd	2004

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23MZE24	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objective:

- To provide the overview of embedded system design principles
- To understand the concepts of real time operating systems
- To provide exposure to embedded system development tools with hands on experience inusing basic programming techniques.
- To provide knowledge on PIC micro controller.
- To provide knowledge on I/O systems used in embedded systems

Course Outcomes:

23MZE24.CO1 Explain the need of embedded systems and their development procedures.

23MZE24.CO2 Summaries the concepts involved in Real time operating systems.

23MZE24.CO3 Use various tools for developing embedded applications.

23MZE24.CO4 Explain the construction, addressing modes and instructions sets of PIC microcontroller.

23MZE24.CO5 Conduct experiments with I/O systems used in embedded systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE24.CO1	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-
23MZE24.CO2	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZE24.CO3	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZE24.CO4	X	-	-	X	X	-	-	-	-	-	-	X	X	X	-
23MZE24.CO5	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-

Unit-I INTRODUCTION TO EMBEDDED SYSTEMS 7

Overview of embedded systems, embedded system design process, challenges - common design metrics and optimizing them. Hardware - Software code sign embedded product development.

Unit-II REAL TIME OPERATING SYSTEM 7

Real time operating systems Architecture - Tasks and Task states - Tasks and Data - Semaphone and shared data - Message queues, mail boxes and pipes - Encapsulating semaphores and queues - interrupt routines in an RTOS Environment. Introduction to Vx works, RT Linux.

Unit-III PIC MICROCONTROLLER 9

Architecture - Instruction set - Addressing modes - Timers - Interrupt logic - CCP modules - ADC.

Unit-IV EMBEDDED NETWORKING 7

Introduction - CAN BUS - I2C - GSM - GPRS - Zig bee.

Unit-V EMBEDDED PROGRAMMING 15

I/O Programming, Interrupts and Timer application Interfacing Keypad Interfacing LCD Interfacing ADC/DAC

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Frank Vahid, Tony John Givargis	Embedded System Design: A Unified Hardware/ Software Introduction	Wiley & Sons	2002
2.	Rajkamal	Embedded System – Architecture, Programming, Design'	Tata Mc Graw Hill	2011
3.	John B. Peatman	Design with PIC Microcontrollers	Prentice Hall	2003

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Steve Heath	Embedded System Design	Elsevier	2003
2.	David E. Simon	An embedded software primer	Addison Wesley	2009
3.	Robert Foludi	Building Wireless Sensor Networks	O'Reilly	2011

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23MZE25	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objective:

- To know the basic knowledge about wireless sensor networks
- To impart knowledge in networking using sensors
- To know about the tools used in networking
- To understand the basic in wireless architecture
- To know about the different techniques used in networking

Course Outcomes:

23MZE25.CO1 Explain about the different techniques used in networking

23MZE25.CO2 Expose basic knowledge about wireless sensor networks

23MZE25.CO3 Familiarize the tools in networking

23MZE25.CO4 Understand the basic in wireless architecture

23MZE25.CO5 Apply protocols used in networking concepts.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE25.CO1	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-
23MZE25.CO2	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZE25.CO3	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZE25.CO4	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZE25.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-

Unit-I OVERVIEW OF WIRELESS SENSOR NETWORKS 8

Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, types of wireless sensor networks.

Unit-II ARCHITECTURES 9

Single -Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit-III NETWORKING SENSORS 9

Sensors Networks,Low Duty Cycles Protocols And Wakeup Concepts – S-MAC,The Mediation Device Protocol,Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

Unit-IV INFRASTRUCTURE ESTABLISHMENT 9

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit-V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Holger Karl & Andreas Willig	Protocols And Architectures for Wireless Sensor Networks	John Wiley	2005
2.	Feng Zhao & Leonidas J. Guibas	Wireless Sensor Networks- An Information Processing Approach	Elsevier	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	KazemSohraby, Daniel Minoli, &TaiebZnati	Wireless Sensor Networks- Technology, Protocols, And Applications	John Wiley	2007
2.	Anna Hac	Wireless Sensor Network Designs	John Wiley	2003

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23MZE26	MEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
- To educate on the rudiments of micro fabrication techniques
- To introduce various sensors and actuators
- To introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:

23MZE26.CO1	Describe new applications and directions of modern engineering
23MZE26.CO2	Understand the sensors and actuators-I.
23MZE26.CO3	Explain working principles of sensors and actuators-II.
23MZE26.CO4	Analysis the Microsystems and Micromachining technology for technicalfeasibility as well as practicality.
23MZE26.CO5	Explain the principles on Polymers and Optical MEMS

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE26.CO1	X	-	-	X	X	-	X	X	-	X	-	X	X	-	-
23MZE26.CO2	X	-	-	X	X	-	X	X	-	X	-	X	X	X	-
23MZE26.CO3	X	-	-	X	X	-	X	X	-	X	-	X	X	X	-
23MZE26.CO4	X	-	-	X	X	-	X	X	-	X	-	X	X	X	-
23MZE26.CO5	X	-	-	X	X	-	X	X	-	X	-	X	X	-	-

Unit-I INTRODUCTION TO PROCESS PLANNING 8

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 of MEMS-Semiconductor devices-Stress and Strain analysis-Flexural beam bending-Torsional deflection

Unit-II SENSORS AND ACTUATORS-I 9

Electrostatic sensors-Parallel plate capacitors-Applications-Interdigitated Finger capacitor-Comb drive devices-Micro Grippers-Micro Motors-Themal Sensing and actuation- Thermal expansion-Thermal couples-Thermal resistors-Thermal Bimorph-Applications-Magnetic Actuators-Micromagnetic components

Unit-III SENSORS AND ACTUATORS-II 9

Piezo resistive sensors-Piezo resistive sensor materials-Stress analysis mechanical elements-Applications to inertia, Pressure, Tactile and Flow Sensors-Piezoelectric sensors and actuators-piezoelectric effects-piezoelectric materials-Application to inertia, Acoustic, Tactile and Flow sensors

Unit-IV MICROMACHINING 9

Silicon Anisotropic Etching-Anisotrophic 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- Assembly of 3D MEMS-Foundry process.

Unit-V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS-Polimide-SU-8-Liquid Crystal Polymer(LCP)-PDMS-PMMA-Parylene-Fluorocation-Application to Acceleration, Pressure, Flow and Tactile Sensors-Optical MEMS-Lenses and Mirrors-Actuators for Active Optical MEMS

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chang Liu	Foundations of MEMS	Pearson Education	2006
2.	Stephen D Senturia	Microsystem Design	Springer	2000

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nadim Maluf	An Introduction to Micro Electro Mechanical System Design	Artech House	2000
2.	Mohamed Gad-el- Hal	The MEMS Handbook	CRC press Baco Raton	2000
3.	Tai Ran Hsu	MEMS&Micro systems Design and Manufacture	Tata McGraw Hill	2002
4.	E. H. Tay, Francis and W. O. Choong	Micrfluids and Bio MEMS applications	Springer	2002
5.	Gardner, W. Julian, K. Varadan Vijay and O. Awadelkarim, Osama	Micro sensors MEMS and Smart Devices	Jhon Wiley & Sons Ltd	2001

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23MZE27	INTERNET TOOLS AND JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objective:

- Learn about the various tools used in internet
- Learn Java Programming.
- Understand different Internet Technologies and the way to handle it.
- Be familiar with client – side programming and server – side programming.
- Learn to develop web applications.

Course Outcomes:

23MZE26.CO1	Implement Java programs and to create a basic website using HTML andCascading Style Sheets.
23MZE26.CO2	Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
23MZE26.CO3	Design rich client presentation using AJAX.
23MZE26.CO4	Design and implement simple web page in PHP, and to present data in XMLformat.
23MZE26.CO5	Design and implement server-side programs using Servlets and JSP.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZE26.CO1	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-
23MZE26.CO2	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZE26.CO3	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZE26.CO4	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
23MZE26.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	-	-

Unit-I INTERNET TOOLS 11

Major Internet Services – Net Telephony – Internet Relay Chat – Newsgroups – File Transfer Protocol (FTP) – Remote Login – Telnet, Gopher, and Veronica Clients OBJECT ORIENTATION IN JAVA: Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/Ouput.-Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based Vs oriented programming - Inheritance-Reusability - Composing class.

Unit-II ABSTRACT FUNCTIONS AND PACKAGES 6

Abstract classes - Abstract Functions – Method Overloading and Method Overriding- Wrapper Classes. Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces.

Unit-III EXCEPTION HANDLING 9

Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses. MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization – Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock.

Unit-IV I/O, APPLETS 11

I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods.- GUI Components - Applets - Java Scripts – AWT / Swings.

Unit-V INTRODUCTION TO NETWORK PROGRAMMING 9

Fundamentals - Internet Addresses - Internet Protocols - DNS - Internet Services - Socket programming, UDP, TCP. JAVA DATABASE PROGRAMMING: JDBC –Database Connection and Table Creation – Execution of Embedded SQL Statements – Result Set and Result Set Meta Data – Examples.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Patrick Naughton	JAVA - The Complete	Tata McGraw Hill	1997
2.	Deitel and Deitel	JAVA - How to	Prentice Hall	2003

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William Stanek and Peter Norton	Peter Norton's Guide to Java Programming	Tech Media Publications	1997
2.	Mark Grand	JAVA Language Reference	O'Reilly & Associates Inc	1997
3.	Horstmann and Cornell	Core Java	Pearson Education	2001
4.	Kennath Litwak	Pure Java 2: A Code-Intensive Premium	Tech Media Publications	2000
5.	James K L	The Internet: A Users Guide	Prentice Hall of India	2003

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Employability Enhancement Courses (EEC)
For
Mechatronics

23MZS01	PROJECT WORK PHASE -I	L	T	P	C
		0	0	6	3

Course Objective:

- To achieve integrated mechanical design of a product through parts design, assembly and preparation of manufacturing drawings.

Course Outcomes:

23MZS01.CO1 Choose an engineering problem in a current industrial scenario.

23MZS01.CO2 Do related literature review

23MZS01.CO3 Do intensive literature review

23MZS01.CO4 Decide the working methodology of the project

23MZS01.CO5 Make an analysis and produce a report over it

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS01.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS01.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS01.CO3	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X
23MZS01.CO4	-	-	-	-	X	-	-	X	X	X	X	X	X	X	X
23MZS01.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Students are asked to form a team which consists of 4 members, maximum. Each team has to work under a project supervisor. Based on the current industrial scenario, any relevant problem should be selected for the project with the consultation of the supervisor. Literature review should be done related to the problem considered. The working methodology of the project work for the phase II should be decided. These activities should be registered in a report and submitted by the student which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report, jointly by external and internal examiners.

Total Periods: 90

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23MZS02	PROJECT WORK PHASE -II	L	T	P	C
		0	0	20	10

Course Objective:

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

Course Outcomes:

23MZS02.CO1	Apply knowledge and demonstrate to manage project in multi-disciplinary.
23MZS02.CO2	Design and conduct experiments to interpret data pertaining to engineering problems.
23MZS02.CO3	Apply contextual knowledge to assess social, health and cultural issues and endue to professional engineering practice.
23MZS02.CO4	Prepare documentation and presentation for engineering activities for society.
23MZS02.CO5	Perform effectively as leader in multi-disciplinary terms.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS02.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS02.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS02.CO3	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X
23MZS02.CO4	-	-	-	-	X	-	-	X	X	X	X	X	X	X	X
23MZS02.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Based on the work methodology decided in the Phase I, the project is further developed. Necessary modeling and analysis is done using required software. The project is fabricated. The analytical results and the experimental results are validated. Three reviews will be conducted periodically by a committee constituted by the Head of the Department. A project report to be prepared by the students along with which the project has to be submitted for the final viva voce examination.

Total Periods: 300

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23MZS03	VALUE ADDED COURSE /INTERNSHIP-I	L	T	P	C
		0	0	2	1

Course Objective:

- To provide students an understanding of the expectations of industry.
- To improve employability skills.
- To bridge the skill gaps and make students industry ready.
- To provide an opportunity to develop inter-disciplinary skills.
- To Discover the Society Issues.

Course Outcomes:

23MZS03.CO1 Understand the expectations of industry.

23MZS03.CO2 Learn the employability skills.

23MZS03.CO3 Apply the skill industry ready.

23MZS03.CO4 Usage of inter-disciplinary kills.

23MZS03.CO5 Discovered the Society Issues.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS03.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS03.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS03.CO3	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X
23MZS03.CO4	-	-	-	-	X	-	-	X	X	X	X	X	X	X	X
23MZS03.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Value Added Courses

- Fusion 360
- Modeling Software
- Analysis Software
- GRE/ GATE
- DFMA
- 3D Printing
- PLC
- Optimization

Internship Training

- Inplant Training in Industry.
- Training from Industry.
- Solve the Problems from Industry.
- Do the Project in Industry.

Total Periods: 45

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23MZS04	INTERDISCIPLINARY PROJECT	L	T	P	C
		0	0	3	1

Course Objective:

- To help the students look into the functioning of simple to complex devices and systems.
- To enable the students to design and build simple systems on their own.
- To help experiment with innovative ideas in design and team work.
- To create an engaging and challenging environment in the engineering lab.

Course Outcomes:

23MZS04.CO1 Apply knowledge and demonstrate to manage project in multi-disciplinary

23MZS04.CO2 Design and conduct experiments to interpret data pertaining to engineering problems

23MZS04.CO3 Apply the skill industry ready.

23MZS04.CO4 Usage of inter-disciplinary kills.

23MZS04.CO5 Discovered the Society Issues.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS04.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS04.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS04.CO3	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X
23MZS04.CO4	-	-	-	-	X	-	-	X	X	X	X	X	X	X	X
23MZS04.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

The course will offer the students with an opportunity to gain a basic understanding of electronic devices and apply the concepts to design and build simple to complex devices. As a practical project-based course, the students will be taught the concepts in theory. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from Agriculture, medical and defense and etc. Students will focus primarily on IOT using Arduino and Raspberry pi-based controllers with Python programming.

Total Periods: 45

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23MZS05	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	L	T	P	C
		0	0	3	0

Course Objective:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty.
- To create awareness among engineers about their social responsibilities
- To Appreciate the Ethical issues
- To Know the Human rights and concept of women empowerment
- To know features of our constitution.

Course Outcomes:

23MZS05.CO1	Practice the moral values that ought to guide the Engineering profession.
23MZS05.CO2	Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations.
23MZS05.CO3	Know the definitions of risk and safety also discover different factors that affect the perception of risk.
23MZS05.CO4	Appreciate the Ethical issues and Know the code of ethics adopted in various professional body's and industries.
23MZS05.CO5	Justify the need for protection of human rights and to know about concept of women empowerment and know the successful functioning of democracy in India.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS05.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS05.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS05.CO3	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X
23MZS05.CO4	-	-	-	-	X	-	-	X	X	X	X	X	X	X	X
23MZS05.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Unit-I HUMAN VALUES **9**

Professional Ethics-Objectives of study of professional ethics-Human values- Definition of Morals and Ethics-Difference between Morality and Ethics-Values-Definition-Types of values Definition of Integrity- Concept of Work Ethic- Service Learning- Definition Virtues-Definition Civic Virtue-Duties and Rights - Respect for Others – Attitude and values, opinions-changing attitude-beliefs-Reliability-Living Peacefully-Means to be adopted for leaving peacefully-Caring Sharing-Honesty-Valuing Time- Co-operation- Commitment- Empathy- Self-Confidence Spirituality.

Unit-II ENGINEERING ETHICS **8**

Engineering ethics-Definition-Approach-Senses of Engineering Ethics-variety of moral issues–Inquiry-Types-Moral Dilemmas-Steps to solve dilemma-Moral autonomy –Definition-consensus& controversy –Profession-Definition– Ethical Theories-Theories about right action Personality– Self-control- Self-interest –Self-respect.

Unit-III SAFETY, RESPONSIBILITIES OF ENGINEERS **6**

Safety and risk-definition- - assessment of safety and risk - risk benefit analysis and reducing risk –Personal Risk-Public Risk-Reducing Risk-Voluntary Risk-Collegiality and loyalty– Authority Types- collective bargaining - occupational crime –Responsibility of engineers – Types – Social responsibility- Professional responsibility-confidentiality-conflicts of interest-liability.

Unit-IV ETHICAL ISSUES IN ENGINEERING PRACTICE 6

Ethical issues–Industrial standards-Environmental ethics –Plastic waste disposal-E-Waste Disposal-Semiconductor waste Disposal-Industrial waste disposal-Human centered environmental ethics- computer ethics –Types of issues-Computer as the Instrument and Object of Unethical Acts -Engineers as managers-Codes of ethics-Sample code of Ethics like - Institution of Engineers(India)-Institute of Electrical & Electronics engineers- Institute of Electronics & Telecommunication Engineers - Indian Institute of Materials Management.

Unit-V HUMAN RIGHTS 8

Human Rights-Definition-constitutional provisions-right to life and liberty-Human Rights ofWomen-Discrimination against women- steps that are to be taken to eliminate discriminationagainst women in Education, employment, health care, Economic and social life, Women in ruralareas- Status of Women in India - Constitutional Safeguards - Dowry Prohibition- act 1961- Domestic violence act 2005- Sexual harassment at work place bill 2006-Human Rights ofChildren- Who is a child- list the Rights of the Child- Right to education--Protection of Childrenfrom Sexual Offences Act(POCSO)-2012- National Human Rights Commission- Constitution Powers and function of the Commission-Employee rights- Provisions made-Contractual-Non contractual employee rights-Whistle blowing-definition-Aspects-Intellectual Property Rights (IPR)–Meaning-Need for protection- Briefly description of concept of patents, Copy right, Trade mark.

Unit-IV INDIAN CONSTITUTION 8

Introduction to constitution of India-Formation and Composition of the Constituent Assembly Salient features of the Constitution-Preamble to the Indian Constitution Fundamental Rights Fundamental Duties-Directive principles of state policy. Parliamentary system of governance- Structure of Parliament- Lokhasabha and Rajyasabha -Functions of parliament- Legislative, Executive, Financial Function, Powers of Loksabha and Rajya Sabha- Procedure followed in parliament in making law-Structure of union executive Power and position of President, Vice President, Prime minister and council of ministers. Structure of the judiciary: Jurisdiction and functions of Supreme Court, high court, and subordinate courts Federalism in the Indian constitution, Division of Powers- Union list, State list and concurrent list, Structure of state legislation, Legislative assembly and Legislative council, Functions of state legislature, Structure of state executive-Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and council of minister. Local self-government- meaning-Three tier system-Village panchayath - Taluk panchayath Zilla panchayath – Local bodies –Municipalities and Corporations, Bruhath mahanagara Palike. Functions of Election commission, UPSC, KPSC.

Total Periods: **45**

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23MZS06	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		3	0	0	0

Course Objective:

- The course aims at imparting basic principles of thought process, reasoning and inferencing.
- Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
- Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature is also important in modern society with rapid technological advancements and societal disruptions.
- The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world- view and basic principles of Yoga and holistic health care system.

Course Outcomes:

23MZS06.CO1	To understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS06.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS06.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS06.CO3	X	X	X	-	-	-	-	-	X	X	X	X	X	X	X
23MZS06.CO4	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X
23MZS06.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Syllabus

Basic Structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case Studies.

Total Periods: 45

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23MZS07	VALUE ADDED COURSE /INTERNSHIP-II	L	T	P	C
		0	0	2	1

Course Objective:

- To provide students an understanding of the expectations of industry.
- To improve employability skills
- To bridge the skill gaps and make students industry ready.
- To provide an opportunity to develop inter-disciplinary skills.
- To Discover the Society Issues

Course Outcomes:

23MZS07.CO1 Understand the expectations of industry.

23MZS07.CO2 Learn the employability skills.

23MZS07.CO3 Apply the skill industry ready.

23MZS07.CO4 Usage of inter-disciplinary skills.

23MZS07.CO5 Discovered the Society Issues.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS07.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS07.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS07.CO3	X	X	X	-	-	-	-	-	X	X	X	X	X	X	X
23MZS07.CO4	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X
23MZS07.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Value Added Courses

- Fusion 360
- Modeling Software
- Analysis Software
- GRE/ GATE
- DFMA
- 3D Printing
- PLC
- Optimization

Internship Training

- In plant Training in Industry.
- Training from Industry.
- Solve the Problems from Industry.
- Do the Project in Industry.

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Total Periods: 45

23MZS08	Presentation Skill and Technical Seminar	L	T	P	C
		0	0	2	1

Course Objective:

- To develop Communication and Presentation skill.
- To expose students to the real working environment and get acquainted with the organization structure.
- To develop the business organizations and administrative functions.
- To promote and develop the presentation skills and impart a knowledgeable society.
- To set the stage for future recruitment by potential employers.

Course Outcomes:

23MZS08.CO1 Develop a skill for actual working environment.

23MZS08.CO2 Utilize the available technical sources in efficient manner.

23MZS08.CO3 Write technical documents.

23MZS08.CO4 Prepare a presentation in latest trends in Mechatronics Engineering.

23MZS08.CO5 Implement a presentation in latest trends in Mechatronics Engineering.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS08.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS08.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS08.CO3	X	X	X	-	-	-	-	-	X	X	X	X	X	X	X
23MZS08.CO4	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X
23MZS08.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Seminar Topics:

- Mobile Robotic System
- Laser Ignition System
- Glove Hand Arm System
- Spheroidal Graphite (S.G) Iron
- Solar Cooling
- Plasma Assisted Milling Of HRSA
- Carbon Credits
- Formula One Racing Car Technologies
- Backhoe Loader
- Thrust Vectoring
- Hydrofoil
- Traffic Building
- Shaper Machine
- Electronic Fuel Injection
- Electromagnetic Clutch System
- Osmotic Power Generation
- Stratified Charged Engine

Total Periods: 45

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23MZS09	INTERNSHIP-III	L	T	P	C
		0	0	2	1

Course Objective:

- To provide students an understanding of the expectations of industry.
- To improve employability skills
- To bridge the skill gaps and make students industry ready.
- To provide an opportunity to develop inter-disciplinary skills.
- To Discover the Society Issues

Course Outcomes:

23MZS09.CO1 Understand the expectations of industry.

23MZS09.CO2 Learn the employability skills.

23MZS09.CO3 Apply the skill industry ready.

23MZS09.CO4 Usage of inter-disciplinary skills.

23MZS09.CO5 Discovered the Society Issues.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MZS09.CO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23MZS09.CO2	X	X	X	-	-	-	X	X	X	-	-	-	X	X	X
23MZS09.CO3	X	X	X	-	-	-	-	-	X	X	X	X	X	X	X
23MZS09.CO4	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X
23MZS09.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	X

Internship Training

- In plant Training in Industry.
- Training from Industry.
- Solve the Problems from Industry.
- Do the Project in Industry.
- Prepare the report.

Total Periods: 45

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