SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

Puducherry

B.TECH. MECHATRONICS ENGINEERING

ACADEMIC REGULATIONS 2020 (R-2020)

CURRICULUM

VOLUME – 3

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1- Quality Education: To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2 - Research and Innovation: To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3 - Employability and Entrepreneurship -: To inculcate the employability and entrepreneurial skills through value and skill based training.

M4 - Ethical Values: To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of the society.

DEPARTMENT VISION AND MISSION

Vision

To be a department with outstanding competencies in education and research in interdisciplinary field of Mechatronics Engineering for the prosperity of students and society.

Mission

M1 - Quality Integration: To uphold excellence in education by integrating the teaching learning process with hands-on trainings in updated technologies.

M2 - Research Exploration: To maintain a dynamic balance between learning and research by encompassing activities related to Research, Industrial projects and Innovation Contests.

M3 – Personality Development: To enrich the team spirit and entrepreneurship skills through training programmes on personality development for career prospects.

M4 – Social Ethics: To enhance the principle of highest ethical values by inculcating code of conduct for the betterment of the Society.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

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

PO5: **Modern tool usage:**

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

PO6: The engineer and society:

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

PO7: Environment and sustainability:

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

PO8: Ethics:

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

PO9: Individual and team work:

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

PO10: Communication:

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

PO11: Project management and finance:

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

PO12: Life-long learning:

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Strong Knowledge

To provide comprehensive knowledge on Science, Mathematics & multiple Engineering disciplines, along-with the ability to apply the gained knowledge.

PEO2: Technical Competency

To produce graduates who can demonstrate technical competence in the field of Mechatronics Engineering and develop solutions to the complex problems.

PEO3: Task Orientation

To produce graduates who function effectively in a multi-disciplinary environment, individually and within a society towards accomplishing tasks.

PEO4: Team Work

To produce graduates who would be able to take individual responsibility and work as a part of a team towards the fulfillment of both individual and organizational goals.

PEO5: **Professional Competency**

To produce graduates with professional competence by life-long learning on advanced studies, professional skills and other professional activities related to Mechatronics Engineering society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Understanding the Concepts

To comprehend the concepts of Mechatronics and their applications in the field of Automated Manufacturing Systems, Robotics, Automobile Technology, Aerial vehicles and other relevant areas.

PSO2: Application of Knowledge

To apply technical knowledge in modern hardware and software tools related to Mechatronics for solving real world problems.

PSO3: Solution Development

To develop the ability to analyze, comprehend and design mechatronics subsystems for a variety of engineering applications for the benefits of society

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl.No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	7
2	Basic Sciences(BS)	19
3	Engineering Sciences (ES)	27
4	Professional Core (PC)	72
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC)	-
9	Mandatory courses (MC)	-
	Total	**164**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Science (HS)	-	-	1	1	-	3	1	1	7
2	Basic Sciences(BS)	6	3	3	4	3	-	-	-	19
3	Engineering Sciences (ES)	8	11	4	4	-	-	-	-	27
4	Professional Core (PC)	4	7	14	8	12	15	9	3	72
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	2
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
	Total	**18**	**21**	**22**	**23**	**21**	**21**	**20**	**18**	**164**

**** EEC and MC are not included for CGPA calculation***

SEMESTER – I

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST101	Engineering Mathematics – I (Calculus and Linear Algebra)	BS	2	2	0	3	25	75	100
2	U20BST109	Biology for Engineers	BS	3	0	0	3	25	75	100
3	U20EST129	Introduction to Electrical Engineering	ES	3	0	0	3	25	75	100
4	U20EST130	Fundamentals of Mechanical Engineering	ES	3	0	0	3	25	75	100
5	U20MCT101	Thermodynamics and Heat Transfer	PC	2	2	0	3	25	75	100
Practical										
6	U20ESP131	Basic Electrical Engineering Lab	ES	0	0	2	1	50	50	100
7	U20ESP112	Engineering Graphics using Auto CAD	ES	0	0	2	1	50	50	100
8	U20MCP101	Thermal Engineering Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20MCC1XX	Certification Course - I **	EEC	0	0	4	-	100	-	100
10	U20MCS101	Skill Development Course 1: Demonstration of Workshop Practices	EEC	0	0	2	-	100	-	100
Mandatory Course										
11	U20MCM101	Induction Programme	MC	3 Weeks			-	-	-	-
							18	475	525	1000

SEMESTER – II

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics – II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST201	Programming in C	ES	3	0	0	3	25	75	100
3	U20EST219	Engineering Mechanics	ES	2	2	0	3	25	75	100
4	U20EST249	Introduction to Electronics Engineering	ES	3	0	0	3	25	75	100
5	U20MCT202	Material Science and Metallurgy	PC	3	0	0	3	25	75	100
6	U20MCT203	Manufacturing Technology	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP202	Programming in C Lab	ES	0	0	2	1	50	50	100
8	U20ESP250	Basic Electronics Engineering Lab	ES	0	0	2	1	50	50	100
9	U20MCP202	Manufacturing Technology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MCC2XX	Certification Course – II**	EEC	0	0	4	-	100	-	100
11	U20MCS202	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
12	U20MCM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	600	600	1200

**** Certification courses are to be selected from the list given in Annexure III**

**** Skill Development Courses (2 and3) are to be selected from the list given in Annexure IV***

SEMESTER – III										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST320	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20MCT304	Analog and Digital Circuits Design	PC	3	0	0	3	25	75	100
4	U20MCT305	Strength of Materials	PC	2	2	0	3	25	75	100
5	U20MCT306	Fluid Mechanics and Hydraulic Machinery	PC	2	2	0	3	25	75	100
6	U20MCT307	Sensors, Transducers and Measurement systems	PC	3	0	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U20ESP357	Data Structures Lab	ES	0	0	2	1	50	50	100
9	U20MCP303	Analog and Digital Circuits Lab	PC	0	0	2	1	50	50	100
10	U20MCP304	Strength of Materials and Fluid Machinery Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20MCC3XX	Certification Course – III**	EEC	0	0	4	-	100	-	100
12	U20MCS303	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MCM303	Physical Education	MC	0	0	2	-	100	-	100
							22	700	600	1300

SEMESTER – IV										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST438	Numerical Methods and Statistics	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in Java	ES	3	0	0	3	25	75	100
3	U20MCT408	Power Electronics and Drives	PC	3	0	0	3	25	75	100
4	U20MCT409	Theory of Machines	PC	2	2	0	3	25	75	100
5	U20MCE4XX	Professional Elective - I	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective - I	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency – II	HS	0	0	2	1	50	50	100
8	U20BSP439	Numerical Methods Lab	BS	0	0	2	1	50	50	100
9	U20ESP468	Programming in Java Lab	ES	0	0	2	1	50	50	100
10	U20MCP405	Power Electronics and Drives Lab	PC	0	0	2	1	50	50	100
11	U20MCP406	Dynamics of Machinery Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
12	U20MCC4XX	Certification Course – IV**	EEC	0	0	4	-	100	-	100
Mandatory Course										
13	U20MCM404	NSS	MC	0	0	2	-	100	-	100
							23	650	650	1300

 # Professional Electives are to be selected from the list given in Annexure I
$ Open electives are to be selected from the list given in Annexure II

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST553	Operational Research for Mechatronics	BS	2	2	0	3	25	75	100
2	U20MCT510	Control Systems for Mechatronics Systems	PC	2	2	0	3	25	75	100
3	U20MCT511	Microprocessors and Controllers	PC	3	0	0	3	25	75	100
4	U20MCT512	CNC and Metrology	PC	3	0	0	3	25	75	100
5	U20MCE5XX	Professional Elective -II	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective -II	OE	3	0	0	3	25	75	100
Practical										
7	U20MCP507	Microprocessors and Controllers Lab	PC	0	0	2	1	50	50	100
8	U20MCP508	Virtual Instrumentation Lab	PC	0	0	2	1	50	50	100
9	U20MCP509	CNC and Metrology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MCC5XX	Certification Course – V**	EEC	0	0	4	-	100	-	100
11	U20MCS504	Skill Development Course 4: Foreign Language / IELTS – I/Career and professional skill development program-5	EEC	0	0	2	-	100	-	100
12	U20MCS505	Skill Development Course 5: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MCM505	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MCT613	Embedded System Design	PC	3	0	0	3	25	75	100
2	U20MCT614	Fluid Power Systems	PC	2	2	0	3	25	75	100
3	U20MCT615	Industrial Robotics	PC	3	0	0	3	25	75	100
4	U20MCT616	Design of Mechanical Elements	PC	2	2	0	3	25	75	100
5	U20MCE6XX	Professional Elective – III	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective III	HS	3	0	0	3	25	75	100
Practical										
7	U20MCP610	Embedded System Design Lab	PC	0	0	2	1	50	50	100
8	U20MCP611	Fluid Power Systems Lab	PC	0	0	2	1	50	50	100
9	U20MCP612	Industrial Robotics Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MCC6XX	Certification Course – VI**	EEC	0	0	4	-	100	-	100
11	U20MCS606	Skill Development Course 6: Foreign Language / IELTS - II/Career and professional skill development program-6	EEC	0	0	2	-	100	-	100
12	U20MCS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20MCS608	Skill Development Course 8: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20MCM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

MESTER – VII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MCT717	PLC and Data Acquisition Systems	PC	3	0	0	3	25	75	100
2	U20MCT718	Design of Mechatronics System	PC	2	2	0	3	25	75	100
3	U20MCE7XX	Professional Elective – IV	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective – IV	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U20MCP713	Computer Aided Engineering Lab	PC	0	0	2	1	50	50	100
7	U20MCP714	Industrial Automation Lab	PC	0	0	2	1	50	50	100
8	U20MCP715	Comprehensive Viva-voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20MCW701	Project Phase – I	PW	0	0	4	2	50	50	100
10	U20MCW702	Internship / Inplant Training	PW	0	0	0	2	100	-	100
Mandatory Course										
11	U20MCM707	Professional Ethics	MC	2	0	0	-	100	0	100
							20	600	500	1100

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MCT819	Artificial Intelligence and Machine Learning	PC	3	0	0	3	25	75	100
2	U20MCE8XX	Professional Elective – V	PE	3	0	0	3	25	75	100
3	U20MCE8XX	Professional Elective – VI	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U20MCW803	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20MCS809	Skill Development Course 9: NPTEL / MOOC -II	EEC	0	0	0	-	100	-	100
							18	315	285	600

Annexure - I
PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE401	Additive Manufacturing
2	U20MCE402	Heating Ventilation and Air-Conditioning
3	U20MCE403	Computer Integrated Manufacturing
4	U20MCE404	Instrumentation for Automotive Industries
5	U20MCE405	Data Communication and Networking
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE506	MEMS and Nano Technology
2	U20MCE507	Smart materials for Mechatronics
3	U20MCE508	IoT for Mechatronics
4	U20MCE509	Biomedical Instrumentation
5	U20MCE510	Data Base Management System
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE611	Introduction to Finite Element Analysis
2	U20MCE612	Automotive Electronics
3	U20MCE613	VLSI Design
4	U20MCE614	Virtual Instrumentation
5	U20MCE615	Intelligent Control System
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE716	Non-Destructive Testing Methods
2	U20MCE717	Product Design and Development
3	U20MCE718	Automated Material Handling Systems
4	U20MCE719	Autonomous Mobile Robots
5	U20MCE720	Digital Image Processing and Machine Vision
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE821	Reliability Engineering
2	U20MCE822	Automation in Manufacturing Systems
3	U20MCE823	Mechatronics System Applications
4	U20MCE824	Robotics and Machine Vision
5	U20MCE825	Project Management
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE826	Power Plant Instrumentation and Control
2	U20MCE827	Unconventional Machining Processes
3	U20MCE828	Unmanned Aerial Vehicles
4	U20MCE829	Building Automation
5	U20MCE830	Industrial Engineering

Annexure – II

OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Industrial Safety Management	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS
17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics

Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	

Open Elective – II / Open Elective – III
(Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**)
(Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)

1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS
9	U20ICO503/ U20ICO603	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics
17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME

18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT
Open Elective – IV (Offered in Semester VII)				
1	U20EEO705	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECO705	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Sensors for Industrial Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT
6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITO705	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Industrial Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Ultrasonic Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE

19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT
25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

Annexure - III
EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20MCCX01	3ds Max
2	U20MCCX02	Advance Structural Analysis of Building using ETABS
3	U20MCCX03	Advanced Java Programming
4	U20MCCX04	Advanced Python Programming
5	U20MCCX05	Analog System Lab Kit
6	U20MCCX06	Android Medical App Development
7	U20MCCX07	Android Programming
8	U20MCCX08	ANSYS -Multiphysics
9	U20MCCX09	Artificial Intelligence
10	U20MCCX10	Artificial Intelligence and Edge Computing
11	U20MCCX11	Artificial Intelligence in Medicines
12	U20MCCX12	AutoCAD for Architecture
13	U20MCCX13	AutoCAD for Civil
14	U20MCCX14	AutoCAD for Electrical
15	U20MCCX15	AutoCAD for Mechanical
16	U20MCCX16	Azure DevOps
17	U20MCCX17	Basic Course on ePLAN
18	U20MCCX18	Basic Electro Pneumatics
19	U20MCCX19	Basic Hydraulics
20	U20MCCX20	Bio Signal and Image Processing Development System
21	U20MCCX21	Blockchain
22	U20MCCX22	Bridge Analysis
23	U20MCCX23	Building Analysis and Construction Management
24	U20MCCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20MCCX25	CATIA
26	U20MCCX26	CCNA (Routing and Switching)
27	U20MCCX27	CCNA (Wireless)
28	U20MCCX28	Cloud Computing

29	U20MCCX29	Computer Programming for Medical Equipments
30	U20MCCX30	Corel Draw
31	U20MCCX31	Creo (Modeling and Simulation)
32	U20MCCX32	Cyber Security
33	U20MCCX33	Data Science and Data Analytics
34	U20MCCX34	Data Science using Python
35	U20MCCX35	Data Science using R
36	U20MCCX36	Deep Learning
37	U20MCCX37	Design and Documentation using ePLAN Electric P8
38	U20MCCX38	Design of Biomedical Devices and Systems
39	U20MCCX39	Digital Marketing
40	U20MCCX40	Digital Signal Processing Development System
41	U20MCCX41	DigSILENT Power Factory
42	U20MCCX42	Electro Hydraulic Automation with PLC
43	U20MCCX43	Embedded System using Arduino
44	U20MCCX44	Embedded System using C
45	U20MCCX45	Embedded System with IoT
46	U20MCCX46	ePLAN Data Portal
47	U20MCCX47	ePLAN Electric P8
48	U20MCCX48	ePLAN Fluid
49	U20MCCX49	ePLAN PPE
50	U20MCCX50	Fusion 360
51	U20MCCX51	Fuzzy Logic and Neural Networks
52	U20MCCX52	Google Analytics
53	U20MCCX53	Hydraulic Automation
54	U20MCCX54	Industrial Automation
55	U20MCCX55	Industry 4.0
56	U20MCCX56	Internet of Things
57	U20MCCX57	Introduction to C Programming
58	U20MCCX58	Introduction to C++ Programming
59	U20MCCX59	IoT using Python
60	U20MCCX60	Java Programming
61	U20MCCX61	Machine Learning

62	U20MCCX62	Machine Learning and Deep Learning
63	U20MCCX63	Machine Learning for Medical Diagnosis
64	U20MCCX64	Mechatronics
65	U20MCCX65	Medical Robotics
66	U20MCCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20MCCX67	Mobile Edge Computing
68	U20MCCX68	Modeling and Visualization using Micro station
69	U20MCCX69	MX Road
70	U20MCCX70	Photoshop
71	U20MCCX71	PLC
72	U20MCCX72	Pneumatics Automation
73	U20MCCX73	Project Management
74	U20MCCX74	Python Programming
75	U20MCCX75	Revit Architecture
76	U20MCCX76	Revit Inventor
77	U20MCCX77	Revit MEP
78	U20MCCX78	Robotics
79	U20MCCX79	Search Engine Optimization
80	U20MCCX80	Software Testing
81	U20MCCX81	Solar and Smart Energy System with IoT
82	U20MCCX82	Solid Works
83	U20MCCX83	Solid Works with Electrical Schematics
84	U20MCCX84	Speech Processing
85	U20MCCX85	STAAD PRO V8i
86	U20MCCX86	Structural Design and Analysis using Bentley
87	U20MCCX87	Total Station
88	U20MCCX88	Video and Image Processing Development System
89	U20MCCX89	VLSI Design
90	U20MCCX90	Web Programming - I
91	U20MCCX91	Web Programming - II

Annexure - IV

EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U20MCS101	Skill Development Course 1 : Demonstration in Engineering Practice Lab
2	U20MCS202	Skill Development Course 2 *
		1) Excel for Statistical Approach
		2) Training on Arduino
		3) Computer Vision
3	U20MCS303	Skill Development Course 3 *
		1) Power Transmission Systems
		2) 3D Printing
		3) Non-Destructive Testing
4	U20MCS504	Skill Development Course 4 : Foreign Language/ IELTS -I
5	U20MCS505	Skill Development Course 5 : Presentation Skills using ICT
6	U20MCS606	Skill Development Course 6 : Foreign Language/ IELTS - II
7	U20MCS607	Skill Development Course 7 : Technical Seminar
8	U20MCS608	Skill Development Course 8 : NPTEL/MOOC - I
9	U20MCS809	Skill Development Course 9 : NPTEL/MOOC-II

**** Any one course to be selected from the list***

U20BST101	ENGINEERING MATHEMATICS-I CALCULUS AND LINEAR ALGEBRA	L	T	P	C	Hrs
		2	2	0	3	60

(Common to all branches)

Course Objectives

- To familiarize the concept of matrices.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.
- To understand the concept of partial differentiation.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus.

Course Outcomes

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

CO 1 - Find eigen values and eigen vectors, diagonalization of a matrix. **(K5)**
CO 2 - Solve differential equations**. (K3 & K4)**
CO 3 - Solve higher order differential equations. **(K3 & K4)**
CO 4 - Solve different types of partial differential equation. **(K3 & K4)**
CO 5 - Understand the use of vector calculus. **(K2)**

UNIT-I MATRICES (12Hrs)

Rank of a Matrix- Consistency of system of equations. Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors. Cayley-Hamilton Theorem -Diagonalization of matrices.

UNIT – II DIFFERENTIAL EQUATIONS (12 Hrs)

Exact equations, First order linear equations, Bernoulli's equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT – III DIFFERENTIAL EQUATIONS (HIGHER ORDER) (12 Hrs)

Linear differential equations of higher order with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, Solution by variation of parameter method.

UNIT – IV PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Maxima and Minima of two variables. Partial differential equations of higher order with constant coefficients.

UNIT – V VECTOR CALCULUS (12 Hrs)

Gradient, divergence and curl - Directional derivative- Irrotational and Solenoidal vector fields - Gauss Divergence Theorem and Stoke's Theorem.

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, Tenth edition, 2019
2. B.V.Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, Sixth edition 2018.
3. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, Ninth Edition, 2018

Reference Books

1. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3th Edition, 2019
2. Singaravelu. A., "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019
3. M.K. Venkataraman, "Engineering Mathematics (Third Year-Part A)", The National Publishing

Company, Madras, 2016.
4. **S. Narayanan," Differential Equations and Its Applications", Viswanathan, S., Printers & Publishers Pvt Ltd , 2009**
5. Dr.G Balaji., " Engineering Mathematics-I", G.Balaji publishers, 2017

Web Resources

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra –slides-systemsofquation-handout.pdf
2. http://www.math.cum.edu/~wn0g/2ch6a.pdf
3. https://nptel.ac.in/courses/122/104/122104017/
4. https://nptel.ac.in/courses/111/106/111106051/
5. https://nptel.ac.in/courses/111/108/111108081/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	3	2	-	-	1	1	-	-	-	-	1	-	-	-
2	3	3	2	-	-	-	1	-	-	-	-	1	-	-	-
3	3	3	2	-	-	-	1	-	-	-		1	-	-	-
4	3	2	2	-	-	-	1	-	-	-	-	-	-	-	-
5	2	2	1	-	-	-	1	-	-		-	-	-	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BST109	BIOLOGY FOR ENGINEERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the basic structural and functional elements of human body.
- To know the significance of biomolecules in biological systems.
- To get a clear idea of macromolecules and their functions.
- To study about the mechanics involved with various physiological systems.
- To know the various static and dynamic human activities.

Course Outcomes

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

CO1 - Describe basic structural and functional elements of human body **(K1)**
CO2 - Assess the significance of Enzymes in biological systems **(K2)**
CO3 - Explain functions of bio molecules **(K2)**
CO4 - Understand the functional mechanism of biological systems **(K2)**
CO5 - Knowledge about Gait analysis, body and limbs of movement mechanics **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Exciting aspect of Biology as an independent Scientific Discipline - Structure and function of Cell & cellular components – Membrane Potential – Action Potential – NUCLEIC ACID: Composition and Function, Genes, Outline of DNA Structure, Re-Combinant DNA and its applications.

UNIT II ENZYMES (9 Hrs)

Enzymes: Chemical Nature, General Properties, Spectrophotometric measurement of enzymes, Isolation techniques, Diagnostic enzymes. Enzyme biotechnology. Hormones: Chemical Nature, Properties of hormones, Hormonal Assay and their Significance.

UNIT III MACROMOLECULES (9 Hrs)

Carbohydrate: Classification of carbohydrates mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates

Protein: Classification, Amino acids, Chromatography, electrophoresis and architecture of protein molecules.

UNIT IV BIOLOGICAL SYSTEMS (9 Hrs)

Cardiovascular system – Heart and vascular system, Nervous System – Structure and functions of Neurons, Synapse, Reflex action and Receptors, Respiratory system - Physiological aspects of respiration - Exchange of gases, Temperature regulation.

UNIT V JOINTS AND MOVEMENT BIOMECHANICS (9 Hrs)

Types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle. Gait analysis, body and limbs- mass and motion characteristics actions, forces transmitted by joints. Joints forces results in the normal and disable human body, normal and fast gait on the level.

Text Books

1. Guyton, “Text book of Medical Physiology”,Tenth edition, WB Jaunder company Philadelphia, 2010
2. David L.Nelson, Michael M.Cox, Lehninger “Principles of Biochemistry Macmillan”, 6th Edition 2013.
3. Carol A. Oatis, “The Mechanics and Pathomechanics of Human Movement”, Lippincott Williams and Wilkins, 2010

Reference Books

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, “Fundamentals of Anatomy and Physiology”, Pearson Publishers, 2014

2. Gillian Pocock, Christopher D. Richards, “The Human Body – An introduction for Biomedical and Health Sciences”, Oxford University Press, USA, 2013
3. Pamela. C. Champe and Richard. A. Harvey, “Biochemistry Lippincott’s Illustrated Reviews. Lippincott” Raven publishers, 6th Edition, 2013.
4. Keith Wilson and John Walker, “Practical Biochemistry– Principles &Techniques”, Oxford University press, 7th Edition, 2010.
5. Sean P. Flanagan, Flanagan, “Biomechanics: A case based Approach”, Jones and Bartlett Publishers, March 2018

Web References

1. https://byjus.com/biology/human-body-anatomy/
2. https://www.khanacademy.org/
3. https://www.youtube.com/channel/UCJayvjGvKEblkA3KYK1BQQw
4. https://tinyurl.com/y8osnq6d
5. https://tinyurl.com/y78y4cvy

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
2	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
4	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
5	3	2	2	-	2	-	-	1	-	-	-	-	2	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST102 INTRODUCTION TO ELECTRICAL ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce fundamental concepts, various laws and principles associated with electrical circuits and its analysis.
- To provide knowledge about the various factors in AC circuits and resonance condition.
- To establish the concepts of three-phase circuits and measuring instruments.
- To describe the concept of electrical safety, power system and working of transformers.
- To explain the concepts of generators, motors and their applications.

Course Outcomes

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

CO1 - Interpret the basic concepts, various laws and theorems used in DC circuits.
CO2 - Analyze and solve the AC circuits and develop resonance circuits for transmitter and receiver circuits.
CO3 - Gain knowledge about the three phase circuits and its advantages and working principle of measuring instruments.
CO4 - Diagnose the concept of power system, importance of electrical safety measures and application of transformers.
CO5 - Inspect the concept of electromechanical energy conversion and its working principles of generators and motors.

UNIT I D.C CIRCUIT ANALYSIS AND NETWORK THEOREMS (9 Hrs)

Circuit concepts: Concept of network, Active and passive elements, concept of linear network, unilateral and bilateral elements, source transformation, ohm's law, Kirchhoff's current and voltage Law- Series and Parallel Combination - loop and nodal methods of analysis, star-delta transformation
Network theorems: Superposition Theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

UNIT II STEADY STATE ANALYSIS OF AC CIRCUITS (9 Hrs)

AC fundamentals: Sinusoidal, square and triangular waveforms- Instantaneous, Peak, average and effective value,formfactor and peak factors, Phasor diagram, phasors representation of sinusoidally varying voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, Impedance diagram, power triangle, power factor, causes and problems of low power factor, power factor improvement, Resonance in series and parallel circuits, bandwidth and quality factors.

UNIT III THREE PHASE AC CIRCUITS AND MEASUREMENT INSTRUMENTS (9 Hrs)

Three phase system: Necessity and advantages, phase sequence, star and delta connections, balanced supply and balanced/unbalanced load, line and phase voltage/current relation, three phase power measurements-two wattmeter method .
Types of instruments: Construction and working principle of PMMC and MI type instruments, single phase dynamometer type wattmeter and induction type energy meter, use of multipliers.

UNIT IV INTRODUCTION OF POWER SYSTEM (9 Hrs)

General layout of electrical power system and its functions, Safety measures in electrical system, insulators, cables, fuse and circuit breakers.
Magnetic Circuit: Concepts, analogy between electric and magnetic circuit, magnetic circuits with DC and AC excitation, magnetic leakage, BH curve, hysteresis and eddy current losses, mutual coupling-Single/Three Phase Transformer- construction-Principle of operation, emf equation, load test, OC and SC test, equivalent circuit, power losses, efficiency, Introduction to auto transformers- copper savings in autotransformers.

UNIT V DC AND AC MACHINES (9 Hrs)

DC Machines: Construction-Principle of operation of DC Motor /Generator-Types, Torque equation of motor and Emf equation of generator, load test, Torque-Speed characteristics and applications of DC motors/Generators.

AC Machines: Construction-Principle of operation of single /three phase induction Motors-types- slip-torque Characteristics-applications-Principle of operation of alternator and synchronous motor, load test -applications.

Text Books

1. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
2. Sudhakar.A and ShyamMohan.S.P, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.
3. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements &Instrumentation' Dhanpat Rai and Co 2004.
4. V. K. Metha&RohitMetha,"Principles of Power System", S.Chand, 2005

Reference Books

1. V.Deltoro, "Principle of Electrical Engg." PHI.
2. M.A Mallick, Dr. I. Ashraf, "Fundamental of Electrical Engg," Word Press, Lucknow.
3. A. Hussain, "Basic Electrical Engg" DhanpatRai& sons.

Web References

1. https://www.youtube.com/watch?v=Vd2UJiIPbag
2. https://www.youtube.com/watch?v=GHrHRBMjno0
3. https://nptel.ac.in/courses/108/108/108108076/
4. https://nptel.ac.in/courses/108/105/108105112/
5. https://www.allaboutcircuits.com/video-lectures/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	3	-	-	-	-	-	-	3	3	3	2
2	3	3	2	1	3	-	-	-	-	-	-	3	3	3	2
3	3	3	2	1	3	-	-	-	-	-	-	3	3	3	2
4	3	3	2	1	3	-	-	-	-	-	-	3	3	3	2
5	3	3	2	1	3	-	-	-	-	-	-	3	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST130 FUNDAMENTALS OF MECHANICAL ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To discuss various Energy Resources available for power generation.
- To explain the various methods of power generation.
- To describe different types of combustion systems such as Internal and External Combustion systems.
- To discuss various methods of air-conditioning systems
- To explain the working of various metal machining processes.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Identify various energy resources used for power generation (**K1**)
CO2 Understand various power generating systems (**K2**)
CO3 Understand different types of combustion systems(**K2**)
CO4 Define the air-conditioning system required for various applications (**K3**)
CO5 Develop various shapes through different machining processes.(**K3**)

UNIT I ENERGY RESOURCES (9 Hrs)

Non-renewable and renewable energy resources, Petroleum based solid, liquid and gaseous fuels, Calorific values of fuels, Combustion and combustion products of fubbels, Solar Power: Solar radiation, solar constant (Definitions only), Solar Thermal energy harvesting, ex: liquid flat plate collectors, solar ponds (Principle of operation only), Solar photovoltaic principle. Bio Fuels: Introduction to biofuels, examples of various biofuels used in engineering applications, Comparison of biofuels with petroleum fuels in terms of calorific value and emission.

UNIT II POWER GENERATION SYSTEMS (9 Hrs)

Power Generation Systems – Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear power plants – Schemes and layouts (Description Only) Solar – wind –Geothermal - Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

UNIT III INTERNAL AND EXTERNAL COMBUSTION SYSTEMS (9 Hrs)

IC engines – Classification – Working principles – Diesel and Petrol Engines: Two stroke and Four stroke engines – merits and demerits. Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

UNIT IV REFRIGERATION AND AIR CONDITIONING SYSTEM (9 Hrs)

Refrigerants: Properties of refrigerants, list of commonly used refrigerants, Refrigeration: Definition, Refrigeration effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, Unit of Refrigeration, Principle and working of vapour compression refrigeration and vapour absorption refrigeration, Principles and applications of air conditioners, Room air conditioner.

UNIT V MACHINE TOOLS (9 Hrs)

Machine Tools (Basic elements, Working principle and types of operations): Lathe, Drilling Machine, Shaper Machine, Planner Machine, Slotter Machine, Milling Machine and Grinding Machine.

TextBooks

1. Shanmugam G, Palanichamy MS, Basic Civil and Mechanical Engineering,1st Edition, McGraw Hill Education, 2018.
2. Vaishnavi R., Prabhakaran M, Vijayan .V, Basic Civil and Mechanical Engineering, S. Chand Publisher, 2013.
3. Pravin Kumar, Basic Mechanical Engineering Pearson Publications, May 2018.

Reference Books

1. Rai G.D, Non-Conventional Energy Resources, Khanna Publishers, 6th Edition.
2. Poonia M.P., Sharma S.C &. Banga T.R, Basic Mechanical Engineering, Khanna Publishing House 2018.
3. Rameshbabu V, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
4. Rajput RK, Basic Mechanical Engineering, Laxmi Publications; Third edition, 2015.
5. Rajan T.S, Basic Mechanical Engineering, New Age International Pvt. Ltd, 2015.

Web References

1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/lecture-notes/
4. https://nptel.ac.in/courses/105102088/
5. https://nptel.ac.in/courses/105104101/

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	1	2	-	-	-	-	3	-	2	2
2	3	2	2	2	2	2	2	-	-	-	-	3	1	2	2
3	3	2	2	2	2	2	2	-	-	-	-	3	1	2	2
4	3	2	2	2	2	1	2	-	-	-	-	3	1	2	2
5	3	2	2	2	2	1	-	-	-	-	-	3	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT101	THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C	Hours
		2	2	0	3	60

Objectives:

- To discuss first law of thermodynamics with respect to closed and open systems
- To impart the knowledge on second law of thermodynamics and entropy
- To teach the students to understand various modes of heat transfer in steady and transient condition.
- To discuss convective heat transfer in various systems.
- To describe radiation heat transfer for various geometries.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Understand the basic concepts associated with the first law of thermodynamics.(K2)
CO2 Understand the basic concepts associated with the second law of thermodynamics.(K2)
CO3 Analyze steady state and transient heat conduction problems of real life Thermal systems.(K4)
CO4 Understand the convective heat transfer problems in various thermal systems.(K2)
CO5 Analyze radiation heat transfer problems in various thermal systems.(K4)

UNIT I –BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS (12 Hrs)

Thermodynamic systems, concepts of continuum, basic definitions, heat and work, zeroth law, First law, SFEE, First Law for closed and open systems.

UNIT II - SECOND LAW OF THERMODYNAMICS (12 Hrs)

Second law of thermodynamics Statements, reversibility, causes of irreversibility, Carnot cycle, reversed Carnot cycles. Thermodynamic Temperature Scale, entropy, Clausius inequality, Entropychange in isothermal and adiabatic processes. Isentropic processes.

UNIT III - CONDUCTION (12 Hrs)

Introduction of heat transfer – conduction - convection and radiation – Laws – General equation of heat conduction – Derivation in Cartesian - cylindrical and spherical coordinates – One dimensional steady state heat conduction in simple geometries – plane wall - cylinder and sphere – Heat transfer composite walls - composite cylinders and composite spheres –Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts

UNIT IV - CONVECTION (12 Hrs)

Boundary layer theory – Hydrodynamic and Thermal Boundary Layer- Dimensional Analysis-Flow over a flat– Flow over cylinders -spheres - tube bank – Internal flow through pipes in forced heat transfer – Natural convection in vertical - inclined and horizontal surfaces – Mixed convection.

UNIT V - RADIATION (12 Hrs)

Radiation heat transfer –Thermal radiation – Laws of radiation – Black body concept – Greay body radiation - Emissive power – Radiation shape factor-radiation heat exchange between surfaces – Electrical Analogy – Radiation Shields-Radiation through gases.

Text book:

1. Nag P. K., Engineering Thermodynamics, McGraw Hill Education India Pvt. Ltd, 2017.
2. Sachdeva R. C., Fundamentals of Heat and Mass Transfer, New AgeInternationalPublishers, 2017.
3. Rajput R K "A text book of Engineering Thermodynamics", S. Chand publishers, 2016

Reference books:

1. Moran and Shapairo, Principles of Engineering Thermodynamics, 8th Edition, Wiley, 2015
2. Yunus A. Cengel, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 2016.
3. Frank P. Incropera and David P. Dewitt, Incropera's principles of Heat and MassTransfer, Wiley India Edition,

2018.
4. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book,Fifth Edition, New Age International Publishers, 2018.
5. Arora C.P, "Thermodynamics", 25th Reprint, McGraw-Hill, New Delhi, 2013.

Web References

1. https://nptel.ac.in/courses/112105266/
2. https://nptel.ac.in/courses/112108148/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://www.linkedin.com/company/heat-transfer-and-process-design-htpd
5. https://www.udemy.com/course/an-introduction-to-heat-transfer/

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	-	-	-	-	-	-	3	2	2	1
2	3	2	2	2	2	-	-	-	-	-	-	3	2	2	1
3	3	2	3	3	2	-	-	-	-	-	-	3	2	2	1
4	3	2	3	3	-	-	-	-	-	-	-	3	2	2	1
5	3	2	3	3	-	-	-	-	-	-	-	3	2	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ESP101	BASIC ELECTRICAL ENGINEERING LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce practical knowledge for the analysis of laws and theorems.
- To devise the methods to evaluate and test the devices and machines.

Course Outcomes

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

CO1 - Implement the network theorems and validate the results through simulation.
CO2 - Apply proper measurement techniques for the calculation of power and calibration of meters.
CO3 - Estimate the performance of DC and induction motor by conducting load and no load tests.

List of Experiments

1. Verification of Network Theorems.
2. To study the phenomenon of resonance in series RLC circuit.
3. Measurement of 3-phase power using two wattmeter methods.
4. Calibration of a single phase induction type energy meter.
5. Load test on single phase transformer.
6. Determination of losses in single phase transformer by OC and SC Test.
7. Load test on DC shunt motor.
8. Load test on single phase induction motor.
9. To study the running and reversing of a three phase SCIM.
10. Load test on Single phase alternator.

ReferenceBooks

1. D P Kothari and I.J Nagarath, ”Electrical Machines “Basic Electrical and Electronics Engineering”, McGraw Hill Education(India) Private Limited, Third Reprint ,2016
2. Sudhakar.A and ShyamMohan.S.P, “Circuits and Networks Analysis and Synthesis”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.

Web References

1. https://mrcet.com/downloads/digital_notes/HS/BEE%20LAB%20MANUAL%20PRINTING%20COPY.pdf
2. https://www.dbit.ac.in/applied-sciences/syllabus/basic-electrical-engineering-lab.pdf
3. http://www.nitrr.ac.in/downloads/syl_new/1st%20Yr/BEE%20Lab%20manual.pdf
4. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2018/18EES101J-basic-electrical-engineering-eee.pdf
5. https://www.iare.ac.in/sites/default/files/lab1/BEE%20LAB%20Manual_0.pdf

COs/POs/PSOs Mapping

CO / PO / PSO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	3	2	2	3	3	3	3
CO2	3	3	3	3	3	-	-	-	3	2	2	3	3	3	3
CO3	3	3	3	3	3	-	-	-	3	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ESP112	ENGINEERING GRAPHICS USING AUTOCAD	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To develop graphic skills for communication of concepts, ideas and design of engineering products
- To expose them to standardized technical drawings
- To extend the skill to use software for creating 2D and 3D models
- To draw a simple steel truss.
- To develop the isometric projection of simple objects

Course Outcomes

On successful completion of this course, the student will be able to:

CO1-Familiarize with the fundamentals and standards of engineering graphics**(K1,K2)**

CO2- Perform freehand sketching of basic geometrical constructions and multiple views of objects **(K2,K3)**

CO3-Visualize the project isometric and perspective sections of simple solids and to be familiar on software packages for drafting and modelling**(K3)**

CO4 – Connect side view associate on front view.(**K4**)

CO5 – Correlate sectional views of prism, pyramid, cylinder, cone. (**K4**)

CO6 – Plan 2D multi-view drawings from 3-Dmodel (**K5**)

List of Experiments

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3D models of simple objects and obtaining 2D multi-view drawings from 3Dmodel.
    Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

Reference Books

1. James D. Bethune, Engineering Graphics with AutoCAD A Spectrum book 1st Edition, Macromedia Press, Pearson, 2020
2. NS Parthasarathy and Vela Murali, Engineering Drawing, Oxford university press, 2015.
3. M.B Shah, Engineering Graphics, ITL Education Solutions Limited, Pearson **Education** Publication, 2011
4. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017.
5. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, 7th Edition, Vikas Publishing House Pvt Ltd., New Delhi, 2016
6. C M Agrawal, Basant Agrawal, Engineering Graphics, McGraw Hill, 2012
7. Dhananjay A. Jolhe, Engineering Drawing: With An Introduction To CAD McGraw Hill, 2016
8. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.

Web Resources

1.http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php

2.http://www.nptelvideos.in/2012/12/computer-aided-design.html

3.https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4.https://autocadtutorials.com
5.https://dwgmodels.com

CO/PO/PSO Mapping

COs	Program Outcomes												Program Specific outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	-	3	-	-	2	3	3	3
2	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3
3	3	1	-	-	3	-	-	-	3	-	-	2	3	3	3
4	3	1	-	-	3	-	-	-	3	-	-	2	3	3	3
5	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP101 **THERMAL ENGINEERING LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives:

- To discuss various properties of liquid fuels.
- To apply convection heat transfer concepts to do experimentation on the heat transfer systems.
- To apply conduction heat transfer concepts to do an analysis on heat transfer equipment.
- To understand the functioning and performance of Air compressor and Blower.
- To describe the principle of parallel flow and counter flow heat exchangers.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Understand about various fuels and their properties.(K2)
CO2 Demonstrate the fundamental principles of convective heat transfer in practice (**K3**)
CO3 Demonstrate the fundamental principles of conductive heat transfer in real life systems practice (**K3**)
CO4 Analyse and assess the performance of Air compressor and Blower (**K4**)
CO5 Model and test heat exchanging system.(**K5**)

List of Experiments

1. Determination of Kinematic Viscosity using Redwood viscometer
2. Determination of Flash and fire point using Cleveland apparatus
3. Determination of Heat transfer coefficient for heat transfer from cylindrical surface by natural convection
4. Determination of Heat transfer coefficient for heat transfer from cylindrical surface by forced convection
5. Determination of Heat transfer coefficient for heat transfer from Pin fin by natural convection
6. Determination of Heat transfer coefficient for heat transfer from Pin fin by forced convection
7. Determination of thermal resistance and conductivity of a composite wall
8. Determination of emissivity of a specimen
9. Performance test on reciprocating air compressor
10. Performance test on air blower
11. Performance analysis of Parallel and Counter flow heat exchanger
12. Heat transfer studies using a plate type heat exchanger

Reference Books

1. Sachdeva R. C. Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd, (2017),
2. Holman J. P.Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited, 2011),
3. Kothandaraman C. P. and Subramanyan.S, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers (2018),
4. R.K.Rajput, Thermal Engineering, 10th edition, Lakshmi Publications, 2018.
5. Yunus A. Cengel, Robert H. Turner, John M. Cimbala, Fundamentals of Thermal-Fluid Sciences, Indian edition, 2016

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	-	-	-	3	-	-	3	1	2	2
2	3	3	3	3	3	-	-	-	3	-	-	3	1	2	2
3	3	3	3	3	3	-	-	-	3	-	-	3	1	2	2
4	3	2	2	3	3	-	-	-	3	-	-	3	1	2	2
5	3	2	2	3	3	-	-	-	3	-	-	3	1	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCC1XX	CERTIFICATION COURSE - I	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCS101	DEMONSTRATION OF WORKSHOP PRACTICES (Common to ECE, CSE, IT, ICE, BME,CCE)	L	T	P	C	Hrs
		0	0	2	-	30

Course Objectives

- To have practical exposure to various welding and joining processes.
- To impart skill in fabricating simple components using sheet metal
- To train the students in metal joining processes like soldering in PCB.
- To understand the working procedure of various Conventional Machines.
- To cultivate safety aspects in handling of tools and equipment.

Course Outcomes

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

CO1 - Identify different prototypes in the carpentry trade such as lap joint, Butt joint. **(K1)**
CO2 - Classify the fabrication of simple sheet metal parts. **(K2)**
CO3 - Interpret the casting preparation. **(K2)**
CO4 - Identify the conventional machine operations. **(K1)**
CO5 - Describe the skills, and modern engineering tools necessary for engineering practice. **(K1)**

DEMONSTRATION OF EXPERIMENTS

1. Welding Exercises
   a. Introduction to BI Standards and reading of welding drawings.
   b. Butt Joint
   c. Lap Joint
   d. Arc Welding
   e. Gas Welding
2. Sheet Metal Exercises
   a. Making of Cube
   b. Making of Cone using development of surface
3. Casting
   a. Green Sand Moulding preparation
4. Demonstration of Conventional Machines.
5. Bosch Tools Demonstration
   a. Demonstration of all Bosch tools.

Reference Books

1. K.C. John, “Mechanical Workshop Practice”, PHI Learning Private Limited, 2010
2. KA Navas, “Electronics Lab Manual”, Fifth edition, PHI Learning Private Limited, 2015
3. S K Hajra, Choudhary and A K Chaoudhary, Workshop Technology I,II,III, by. Media Promoters and Publishers Pvt. Ltd., Bombay
4. T Jeyapoovan, Basic Workshop Practice Manual, Vikas Publishing House (P) Ltd.,New Delhi
5. K Venkata Reddy, KL Narayana, Manual on Workshop Practice, MacMillan India Ltd.

Web References

1. https://www.weld.com/
2. https://welding.com/
3. https://sciencing.com/soldering-desoldering-techniques-8288017.html
4. https://nptel.ac.in/courses/112/107/112107084/
5. https://nptel.ac.in/courses/112/106/112106153/

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	1	-	-	-	3	-	-	3	2	2	2
2	3	1	-	-	1	-	-	-	3	-	-	3	2	2	2
3	3	1	-	-	1	-	-	-	3	-	-	3	2	2	2
4	3	1	-	-	1	-	-	-	3	-	-	3	2	2	2
5	3	1	-	-	1	-	-	-	3	-	-	3	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCM101 **INDUCTION PROGRAM**

Induction program for students to be offered right at the start of the first year

Duration of the Program	3 Weeks
Induction program	• Physical Activity • Creative Arts and Culture • Mentoring and Universal Human Values • Familiarization with College, Dept./Branch • Literary Activity • Proficiency Modules • Lectures and Workshops by Eminent People • Visits in Local Area • Extra-Curricular Activities in College

1. Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health. Each student could pick one game and learn it for the duration of the induction program and hopefully, continue with it later.

2. Creative Arts

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

3. Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

4. Other Activity

Activities that are not there on a daily basis, but are conducted for 3-4 days (typically in the afternoons) and change thereafter.

4.1. Familiarization with College, Department/Branch

The incoming students should be told about the credit and grading system, and about the examinations. They should be informed about how study in college differs from study in school. They should also be taken on a tour of the college and shown important points such as library, canteen, and other facilities. They should be shown their department, and told what it means to get into the branch or department. Describe what role the technology related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the Dept. would be very helpful in this regard. They should also be shown the laboratories, workshops and other facilities. The above should be done right in the first two days, and then over the afternoons thereafter, as appropriate.

4.2. Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

4.3. Proficiency Modules

The induction program period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.4. Lectures and Workshops by Eminent People

Lectures by eminent people should be organized, say, once a week. It would give the students exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni could be invited as well. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, Vivekanand Kendras, S-VYASA, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops (3 sessions, 9 hours).

4.5. Visits in Local Area

A couple of visits to the local landmarks including historical monuments should be organized. This would familiarize the students with the area together with bonding with each other, like in a picnic. Visits should also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

4.6. Extra-Curricular Activities in College

The new students should be introduced to the extra-curricular activities at the college/university. They should be shown the facilities and informed about activities related to different clubs etc. This is when selected senior students involved in or leading these activities can give presentations, under faculty supervision.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BST215	ENGINEERING MATHEMATICS II MULTIPLE INTEGRALS AND TRANSFORMS (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To equip themselves familiar with Laplace, transform and solve the differential equations using Laplace transform techniques.
- To enable the students to expand functions into Fourier series using change of intervals.
- To gain good knowledge in application of Fourier transform.
- To inculcate the computational knowledge in Z-transforms.

Course Outcomes

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

CO1 - Understand the concept of double and triple integrals. **(K2)**
CO2 - Apply Laplace transform and inverse Laplace transform of simple functions**. (K3)**
CO3 - Convert a periodic function into series form. **(K3)**
CO4 - Compute Fourier transforms of various functions. **(K3)**
CO5 - Solve difference equations using Z – transforms. **(K3)**

UNIT I MULTIPLE INTEGRALS (12 Hrs)

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT II LAPLACE TRANSFORMS AND INVERSE LAPLACE TRANSFORMS (12 Hrs)

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems, Methods for determining inverse Laplace Transforms, Convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT III FOURIER SERIES (12 Hrs

Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

UNIT IV FOURIER TRANSFORMS (12 Hrs)

Fourier Integral theorem Fourier transform and its inverse, properties. Fourier sine and cosine transforms their properties, Convolution and Parseval's identity.

UNIT V Z - TRANSFORMS (12 Hrs)

Difference equations, basic definition, z – transform - definition, Standard z – transforms, Damping rule, Shifting rule, Initial value and final value theorems and problems, Inverse z – transform. Applications of z – transforms to solve difference equations.

Text Books

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, 1st Edition, New Delhi, 2016.
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons, New Delhi, 2017.
3. M.D.Petale, "A text book on Z- Transforms (Engineering Mathematics)", Bames and Noble, New Edition, 2020.

Reference Books

1. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co. New Delhi, 2019.
2. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th

Edition, 2015.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, New Delhi, 10th Edition, 2019.
4. C. B. Gupta, Shree Ram Singh, M. Kumar, “Engineering Mathematics for semester I & II”, Tata McGraw Hill, New Delhi, 2016.
5. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill, New Delhi 2018.

Web References

1. https://nptel.ac.in/courses/111105121/
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/111107119/
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	2	1	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-
3	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-
4	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-
5	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST201	PROGRAMMING IN C (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME,MECHTRONICS, CCE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the Fundamentals of Computers and introduction to C language.
- To study about the programs using Control structures.
- To understand the programs using looping and arrays.
- To understand the concepts of Functions and Pointers.
- To study about Structure, Union and File Management Operations in C.

Course Outcomes

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

CO1 - Comprehend the basic constructs of C programming. **(K2)**
CO2 - Illustrate the concepts of sequential, selection and repetition control structures in C program. **(K2)**
CO3 - Implement simple programs using looping structure and arrays. **(K3)**
CO4 - Demonstrate programs using Functions and Pointers. **(K3)**
CO5 - Build programs using Structure, Union and understand the concept of File management Operations.**(K3)**

UNIT I INTRODUCTION TO C (9 Hrs)

C programming: Overview of C - Visual Studio code-Constants- Compiling a C Program -Variables and Data Types- Technical Difference between Keywords and Identifiers- - Types of C Qualifiers and format specifies - Operators and Expressions-Operators Precedence-Type conversion-Input-Output Statements.

UNIT II DECISION MAKING (9 Hrs)

Decision making and branching- Relational operators – Logical operators- if – if else-if else if –nested if. Switch-case.

UNIT III LOOPING AND ARRAYS (9 Hrs)

Looping: while - do while – for – break – continue - nested loop Arrays: One Dimensional Arrays-Two-Dimensional Arrays-Multi-Dimensional Array-Dynamic arrays-Character Arrays and String-Sorting - Searching.

UNIT IV FUNCTIONS, POINTERS (9 Hrs)

Functions: Introduction - Definition – Declaration – Categories of Functions - Nesting of Functions, Recursive functions - Passing Arrays to Functions - Strings – String library function. Pointers: Introduction - Declaring Pointer Variables - Initialization of Pointer Variables - Accessing the address of a variable - Accessing a variable thorough Pointer - Chain of Pointers - Pointer Expressions - Pointers and arrays – Pointers and functions – Call by Reference - Pointers and character strings - Array of Pointers - Pointers and Structures.

UNIT V STRUCTURES AND UNIONS, FILE MANAGEMENT (9 Hrs)

User defined data types: Introduction – Structure: definition - declaration - Arrays of Structures – Nested structures – Passing structures to functions –– Union - Enumeration and Typedef. Introduction to File Handling in C, Input and Output operations on a file – Error Handling - Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. E.Balagurusamy, “Programming in ANSI C”, Tata McGraw Hill, 8th Edition, 2019.
2. Herbert Schildt,” C: The Complete Reference”, McGraw Hill, Fourth Edition, 2014.
3. Yashvant Kanetkar, “Let us C”, BPB Publications, 16th Edition, 2017.

Reference Books

1. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Impression, 2012.
2. Vikas Verma, “A Workbook on C “, Cengage Learning, Second Edition, 2012.
3. Dr.P. Rizwan Ahmed, “Office Automation”, Margham Publications, 2016.

4. P.Visu, R.Srinivasan and S.Koteeswaran, “Fundamentals of Computing and Programming”, Fourth Edition, Sri Krishna Publications, 2012.
5. Pradip Dev, Manas Ghoush, “Programming in C”, Second Edition, Oxford University Press, 2011.

Web References

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://www.tutorialspoint.com/cprogramming
4. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c
5. https://nptel.ac.in/courses/106/104/106104128/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
2	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST219 **ENGINEERING MECHANICS**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the basics of force and moment, static equilibrium of particles in two and three dimensions.
- To examine the equilibrium of rigid bodies and components of a moment.
- To discuss the properties of surfaces and solids.
- To integrate the relationship between the motion of bodies
- To associate the various structural analysis and load on system of rigid bodies.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 - Recognize the basics of equilibrium of particles in 2D and 3D. **(K1)**
CO2 - Review the requirements of equilibrium of rigid bodies in 2D and 3D. **(K2)**
CO3 - Compute the center of mass and moment of inertia of surfaces and solids. **(K2)**
CO4 - Predict displacement, velocity and acceleration of dynamic particles. **(K3)**
CO5 - Solve for friction force and rigid body dynamics. **(K4)**

UNIT I BASICS AND STATICS OF PARTICLES (12 Hrs)

Introduction - Units and Dimensions - Vectorial representation of forces and moments –Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces -Resolution and Composition of forces -Equilibrium of a particle - Principle of transmissibility -Single equivalent force - Free body diagram

UNIT II EQUILIBRIUM OF RIGID BODIES (12 Hrs)

Types of supports and their reactions -requirements of stable equilibrium -Moments and Couples -Moment of a force about a point and about an axis -Vectorial representation of moments and couples - Scalar components of a moment -Varignon's theorem -Equilibrium of Rigid bodies in two dimensions –Forces in space -Equilibrium of a particle in space - Equivalent systems of forces - Equilibrium of Rigid bodies in three dimensions –Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS (12 Hrs)

Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas- Parallel axis theorem and perpendicular axis theorem, radius of gyration of area- product of inertia- mass moment of inertia.

UNIT IV DYNAMICS OF PARTICLES AND FRICTION (12 Hrs)

Displacements, Velocity and acceleration, their relationship - Relative motion -Curvilinear motion - Newton's law -Work Energy Equation of particles -Impulse and Momentum -Impact of elastic bodies.
Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction -wedge friction- Rolling resistance

UNIT V STRUCTURAL ANALYSIS OF TRUSSES AND RIGID BODY DYNAMICS (12 Hrs)

Trusses: - Definition of a truss - Simple Trusses - Analysis of Trusses - Method of joints- Method of sections. - Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

Text Books

1. F.P.Beer, and Johnston Jr. E.R. "Vector Mechanics for Engineers", McGraw-Hill Education India Pvt Ltd., 11th Edition, 2016.
2. J.L. Meriam & L.G. Karidge, Engineering Volume I and Engineering Mechanics: Dynamics, 8th edition, Wiley student edition, 2016.
3. R.C, Hibbeller, "Engineering Mechanics", Prentice hall, 14th edition, 2016.

Reference Books

1. Arthur P. Boresi and Richard J. Schmidt, “Engineering Mechanics: Statics and Dynamics”, Thomson Asia Private Limited, Singapore, 2010.
2. D.P.Sharma “Engineering Mechanics”, Dorling Kindersley India Pvt. Ltd, New Delhi, 2010
3. S.Rajasekaran, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2012.
4. S.S.Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age International(P) Ltd, New Delhi, 7th Edition, 2019.
5. Dr. I. SGujral “Engineering Mechanical” second edition, Lakshmi Publication (P).Ltd., 2011

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / Engineering mechanics / Table of Contents.html
3. https://nptel.ac.in/courses/112/106/112106286/
4. https://www.coursera.org/learn/engineering-mechanics-statics
5. https://nptel.ac.in/courses/122/104/122104014/

CO/PO Mapping

COs	Program Outcomes												Program Specific outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	1	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	1	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	1	2	2	3
4	3	2	2	3	-	-	-	-	-	-	-	1	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST249	**INTRODUCTION TO ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To give the idea about fundamental properties of semiconductors.
- To prepare students to perform the analysis of any Analog electronics circuit.
- To empower students to understand the design and working of FET amplifiers.
- To Demonstrate and Apply Feedback and Oscillator circuits using FET.
- To perform the analysis and design of various digital electronic circuits.

Course Outcomes

After completion of the course, the students are able to

CO1 – Understand the concept of diode in rectifiers, filters circuits. (K2)
CO2 – Identify the BJT in CE, CB and CC circuits. (K2)
CO3 – Understand the characteristics if JFET and special diodes. (K2)
CO4 - Explain the principles of oscillation with various oscillator circuits. (K3)
CO5 – Discuss the various digital circuits and characteristics of ADC. (K2)

UNIT I SEMICONDUCTORS AND RECTIFIERS (9 Hrs)

Classification of solids based on energy band theory, intrinsic semiconductors, extrinsic semiconductors – P- type and N-type, P- N junction, VI Characteristics of PN junction diode, half and Full wave rectifiers, Zener effect, Zener diode, Zener diode Characteristics, Zener diode as a regulator.

UNIT II TRANSISTOR AND AMPLIFIERS (9 Hrs)

Bipolar junction transistors – CB, CE, CC configurations and characteristics, Biasing circuits – Fixed bias, Voltage divider bias, CE amplifier, Concept of feedback, Negative feedback, voltage series feedback amplifier, Current series feedback amplifier.

UNIT III FET AND POWER ELECTRONIC DEVICES (9 Hrs)

FET – Configuration and characteristics, FET amplifier, Characteristics and simple applications of SCR, Diac, Triac and UJT.

UNIT IV SIGNAL GENERATORS AND LINEAR ICS (9 Hrs)

Positive feedback, Sinusoidal oscillators – RC phase shift, Hartley, Colpitts, Wein bridge oscillators, Operational amplifier – Adder, Inverting and Non-inverting amplifiers, integrator and differentiator, IC 555 based Astable and Monostable Multivibrators.

UNIT V DIGITAL ELECTRONICS (9 Hrs)

Boolean algebra, Logic Gates, , Half and Full adders, Decoder, Encoder, Multiplexer, Demultiplexer, Flip flops, Digital to Analog converters - R-2R and weighted resistor types, Analog to Digital converters - Successive approximation and Flash types.

Text Books

1 Malvino, 'Electronic Principles', McGraw Book Co., 1993.
2 Grob. B and Schultz. M.E. 'Basic Electronics', Tata Mcgraw Hill, 2003.
3 Thomas L. Floyd, 'Electronics Devices', Pearson Education, 2002.
4 Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.

Reference Books

1. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
2. Millman, Halkias Jacob, Jit Christos and Satyabrata, 'Electronic devices and Circuits', Tata McGraw Hill, 2nd Edition.
3. David. A. Bell, "Electric Circuits",Oxford University Press, Seventh impression 2015
4. M.S. Sukhija, T.K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford

University Press, Sixth impression 2015
5. Leonard.S.Bobrow, “Foundations of Electrical Engineering”, Asian Edition 2013

Web References

1. https://www.electronics-tutorials.ws/
2. https://www.makerspaces.com/basic-electronics/
3. https://www.tutorialspoint.com/basic_electronics/basic_electronics_pdf_version.htm.
4. https://nptel.ac.in/courses/108/107/108107128/
5. https://nptel.ac.in/courses/117/103/117103063/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	2	-	-	-	-	-	-	-	-	1	-	-
2	3	1	2	2	-	-	-	-	-	-	-	-	2	-	-
3	3	1	2	2	-	-	-	-	-	-	-	-	2	-	-
4	3	1	2	2	-	-	-	-	-	-	-	-	2	-	-
5	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT202	MATERIALS SCIENCE AND METALLURGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To discuss the fundamental properties and availability of natural engineering materials.
- To discuss the applications of electronic materials and superconducting materials.
- To deal with the magnetic and dielectric materials and their applications.
- To learn about physical metallurgy, corresponding to important engineering materials.
- To discuss the properties of powder metallurgy techniques and their applications.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Identify the materials, based on their properties, for various applications. **(K2)**
CO2 Compare various properties of electronic and photonic materials. **(K4)**
CO3 Select proper electronic and photonic materials for various applications, based on their properties. **(K3)**
CO4 Understand the physical metallurgy of materials and the tools used to analyze the metallic. **(K2)**
CO5 Apply powder metallurgy principles for various applications. **(K3)**

UNIT I NATURE OF MATERIALS (9 Hrs)

Selection process of engineering materials (General aspects) - Chemical and physical properties of materials - chemical structure: Micro and macro structure - corrosion resistance - chemical reactivity. Mechanical properties - stress, strain, strength, hardness, malleability, ductility, elasticity, plasticity, toughness, thermal stability. (General aspects) Types of deformation: Plastic, viscous. Plastic deformation of single crystal, poly crystalline metals: slip, twinning, dislocations - visco elasticity - creep in metals, amorphous materials.

UNIT II ELECTRONIC AND PHOTONIC MATERIALS (9 Hrs)

Electronic Materials: Fermi energy and Fermi - Dirac distribution function - Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors - Hall effect - Dilute Magnetic Semiconductors (DMS) and their applications
Superconducting Materials: Normal and High temperature superconductivity - Applications. **Photonic Materials:** LED – LCD - Photo conducting materials – Photo detectors - Photonic crystals and applications - Elementary ideas of Nonlinear optical materials and their applications.

UNIT III MAGNETIC AND DIELECTRIC MATERIALS (9 Hrs)

Magnetic Materials: Classification of magnetic materials based on spin - Hard and soft magnetic materials - Ferrites, garnets and magnetoplumbites - Magnetic bubbles and their applications - Magnetic thin films – Spintronics and devices (Giant magneto resistance, Tunnel magneto resistance and Colossal magneto resistance).
Dielectric Materials: Polarization mechanisms in dielectrics – Frequency and temperature dependence of polarization mechanism - Dielectric loss - Dielectric waveguide and dielectric resonator antenna - Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT IV PHYSICAL METALLURGY AND MATERIALS ENGINEERING (9 Hrs)

Structure of metals, Phase equilibria, thermodynamics of phase evolution, Construction of equilibrium diagrams, Study of Fe-Fe3C, Cu-Zn, Cu-Sn, Al-Cu and Al-Si ternary diagrams, Diffusion laws, Structure and properties of ceramics, Construction and Principles of Optical and transmission Electron Microscope.

UNIT V POWDER METALLURGY (9 Hrs)

Introduction and History of PM, Different Powder Production Techniques, Importance of Powder Characterization, Particles Size, Distribution, Surface Analysis, Powder Compaction and Process variables, Theory of sintering etc.
Electro Metallurgy and Corrosion: Principles of Corrosion, Forms of Corrosion, Modern Theory-Principles, Corrosion Prevention, and Corrosion rate measurement, High Temperature Corrosion, High temperature materials-mechanical properties, oxidation resistance.

Text Books

1. Thiruvadigal, J. D, Ponnusamy, S, Sudha. D, Krishna mohan M, 'Materials Science', SSS Publication, Chennai, 2015.
2. Lakshminarayana A K, Sridhar Idapalapati, M Vasudevan, 'Advances in Materials and Metallurgy', Springer – 2018.
3. Larry Horath, 'Fundamentals of Materials Science for Technologists: Properties, Testing', Waveland Press – 2017

Reference Books

1. Darvell B W, 'Materials Science for Dentistry', Woodhead Publishing, 2018.
2. June Gunn Lee, 'Computational Materials Science', CRC Press, 2016.
3. Guang Yang, Lin Xiao, Lallepak Lamboni, 'Bioinspired Materials Science and Engineering', John Wiley & Sons, 2018.
4. Yuriy Poplavko, 'Electronic Materials: Principles and Applied Science', Elsevier, 2018.
5. MihaiIrimia-Vladu, Eric D. Glowacki, Niyazi S. Sariciftci, 'Green Materials for Electronics', John Wiley & Sons, 2017.
6. Raghavan V, 'Materials Science and Engineering', PHI Learning Pvt. Ltd, 2015.

Web References

1. https://www.digimat.in/nptel/courses/video/113107078/L01.html
2. https://nptel.ac.in/courses/122/102/122102008/
3. https://swayam.gov.in/nd1_noc20_mm09/preview
4. https://nptel.ac.in/courses/113/102/113102080/
5. https://www.linkedin.com/company/material-science

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	2	2	-	-	-	-	-	-	3	1	2	-
2	3	2	-	2	2	-	-	-	-	-	-	3	1	2	-
3	3	2	-	2	2	-	-	-	-	-	-	3	1	2	-
4	3	2	-	2	2	-	-	-	-	-	-	3	1	2	-
5	3	2	1	2	2	-	-	-	-	-	-	3	1	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT203	MANUFACTURING TECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To impart knowledge on casting technology and foundry shop
- To familiarize with various metal joining processes
- To discuss the mechanical deformation processes
- To impart knowledge on various non-metallic processes
- To learn about the various methods for processing plastic materials.

Course Outcomes

On successful completion of this course, the student will be able to

CO1	Identify the suitable casting process as required.(**K3**)
CO2	Select the required metal joining process.(**K3**)
CO3	Understand the differences among various metal deformation processes. (**K3**)
CO4	Choose the suitable metal removal process as per the requirement.**(K3)**
CO5	Identify the best method for processing plastics.(**K3**)

UNIT I CASTING PROCESSES **(9 Hrs)**

Introduction to Moulding and Casting, Moulding sand: Types, properties, preparation of dry and green sand molding. Pattern making: Pattern materials, types and allowances. Core making: Types of core, core materials, making of cores. Casting methods: Die casting, Centrifugal Castings, Investment Casting and Shell mold Casting. Defects in casting.

Unit II JOINING PROCESSES **(9 Hrs)**

Fusion welding processes - Types of Gas Welding, Oxy-Acetylene Welding Equipment - Flame characteristics - Electric-Arc Welding, Electrodes, manual metal arc welding, Carbon Arc Welding, Inert-Gas Shielded Arc Welding, Tungsten Inert-Gas Welding (TIG), Gas Metal-Arc Welding (GMAW), Submerged Arc-Welding (SAW), Resistance Welding and its types and applications-Welding Defects. Soldering and Brazing- welding of non-metals.

Unit III METAL FORMING PROCESSES **(9 Hrs)**

Cold and Hot working: Rolling – Forging – Extrusion – Drawing – Sheet metal forming processes – High Energy Rate Forming Processes: Explosive Forming – Electro Hydraulic Forming – Electro Magnetic Forming.

Unit IV METAL MECHINING PROCESSES **(9 Hrs)**

Mechanics of machinery–Chip formation-types of chips, orthogonal & oblique cutting–Tool wear–Tool life – Nomenclature of single point cutting tool & Twist drill bit – Effect of cutting fluids.

Unit V PROCESSING OF PLASTICS AND COMPOSITE MATERIALS **(9 Hrs)**

Types of Plastics – Types of Molding: Injection molding – Blow molding – Compression molding – Transfer molding – Thermoforming – Reinforced plastics – Metal Matrix Composites – Ceramic Matrix Composites.

Text Books:

1. Rao P N, ‘Manufacturing Technology’, Volume I & II, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2018.
2. Sharma P C, ‘A Text Book of Manufacturing – I’, S Chand & Company Pvt Ltd, 2008.
3. Rajput R K, ‘A Text Book of Manufacturing Technology’, Laxmi Publications, New Delhi, 2nd edition, 2017.

Reference Books:

1. Kaushish J P, ‘Manufacturing Processes’, Second Edition, PHI Learning Pvt. Ltd, 2013.
2. Kalpakjian S, Schmid R, ‘Manufacturing Engineering and Technology’, Seventh Edition, Pearson Education India Edition, 2013.
3. Adithan M, Gupta A B, ‘Manufacturing Technology’, New Age, Fifth Edition, 2012.
4. B S Nagendra Parashar, R K Mittal, ‘Elements of Manufacturing Processes’, Prentice Hall India Pvt. Ltd, 2003.
5. S K Hajra Choudry, ‘Workshop Technology’, Vol – I & II, Media Promoters and Publishers Pvt. Ltd, 2009.

Web References:

1. https://nptel.ac.in/courses/112/107/112107219
2. https://nptel.ac.in/courses/112/105/112105127/
3. https://www.coursera.org/courses?query=manufacturing
4. https://www.udemy.com/topic/manufacturing/
5. https://www.linkedin.com/company/manufacturing-technology-inc

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
2	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
3	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
4	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
5	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ESP202 **PROGRAMMING IN C LABORATORY**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To practice the fundamental programming methodologies in the C programming language.
- To apply logical skills for problem solving using control structures and arrays.
- To design, implement, test and debug programs that use different data types, variables, strings, arrays, pointers and structures.
- To design modular programming and provide recursive solution to problems.
- To understand the miscellaneous aspects of C and comprehension of file operations.

Course Outcomes

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

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**

CO2 - Develop C programs for simple applications making use of basic constructs, arrays and strings. **(K3)**

CO3 - Develop C programs involving functions, recursion, pointers, and structures**. (K3)**

CO4 - Design applications using sequential and random access file processing. **(K6)**

CO5 - Build solutions for online coding challenges**. (K3)**

LIST OF EXERCISES

1. Simple programming exercises to familiarize the basic C language constructs.
2. Develop programs using identifiers and operators.
3. Develop programs using decision-making and looping constructs.
4. Develop programs using functions as mathematical functions.
5. Develop programs with user defined functions – includes parameter passing.
6. Develop program for one dimensional and two dimensional arrays.
7. Develop program for sorting and searching elements.
8. Develop program to illustrate pointers.
9. Develop program with arrays and pointers.
10. Develop program for dynamic memory allocation.
11. Develop programs for file operations.

Text Books

1. Yashwant Kanetkar, “Let us C”, BPB Publications, 16th Edition, 2017.
2. Archana Kumar, “Computer Basics with Office Automation”, Dreamtech Press – Wiley Publisher, 2019.
3. Reema Thareja, “Fundamentals of Computing & C Programming” Oxford University Press, 2012

Reference Books

1. Zed A Shaw,” Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)”, Addison Wesley, 2016.
2. Anita Goel and Ajay Mittal, ”Computer Fundamentals and programming in C”, First edition, Pearson Education ,2011.
3. Yashvanth Kanethkar, “Let us C”, 13th Edition, BPB Publications, 2008.
4. Maureen Sprankle,Jim Hubbard,” Problem Solving and Programming Concepts,” 9th Edition, Pearson, 2011.
5. B.W. Kernighan and D.M. Ritchie, “The C Programming language”, 2nd Edition, Pearson Education, 2006.

Web Resources

1. https://alison.com/course/introduction-to-c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. https://www.tenouk.com/clabworksheet/clabworksheet.html

5. https://fresh2refresh.com/c-programming/

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2	-	2	1	2	2	3	1	3	2
CO2	2	3	3	3	2	1	1	3	-	2	-	2	3	3	3
CO3	3	2	2	2	2	1	2	-	3	3	2	-	3	3	3
CO4	3	3	3	3	2	1	2	3	-	3	-	2	3	3	3
CO5	3	3	3	3	2	1	2	3	3	3	3	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ESP250	BASIC ELECTRONICS ENGINEERING LAB	L	T	P	C	Hrs
		0	0	3	1	30

Course Objectives

1. To Recall the basic Semiconductor Theory related to Diodes
2. To enable the student to understand BJT operations.
3. To enable the student to understand thyristor operations.
4. To Design and analyse the linear and non-linear applications of operational amplifiers
5. Implementation of combinational circuits for operations in logical arithmetic operations.

Course Outcome

After completion of the course, the students are able to

CO1 - Examine the characteristics of Diodes. (K4)
CO2 - Differentiate BJT operations in various configuration. (K4)
CO3 - Deduce the electrical characteristics SCR, UJT, DIAC and TRIAC. (K4)
CO4 - Devise the applications of operational amplifiers. (K4)
CO5 - Test and implement various combinational logic circuits with its truth table. (K4)

LIST OF EXPERIMENTS

1. V-I characteristics of semiconductor diodes.
2. Characteristics of BJT in CB configuration.
3. Characteristics of BJT in CE configuration.
4. Design and testing of biasing circuits for BJT.
5. Characteristics of UJT and SCR.
6. Characteristics of DIAC and TRIAC.
7. Design and realize Inverting and Non-inverting amplifier using IC 741 Op-amp.
8. Design and test an op-amp Integrator and Differentiator.
9. Design and verify their truth tables of half adder and Full adder using basic gates.
10. Design and testing of 4 to 1 multiplexer and de-multiplexer using Logic gates.

References

1. M.S. Sukhija, T.K. Nagsarkar, “Basic Electrical and Electronics Engineering”, Oxford University Press, Sixth impression 2015.
2. Malvino, ‘Electronic Principles’, McGraw Book Co., 1993.
3. Grob. B and Schultz. M.E. ‘Basic Electronics’, Tata Mcgraw Hill, 2003.
4. Thomas L. Floyd, ‘Electronics Devices’, Pearson Education, 2002.

Web References

1. https://www.electronics-tutorials.ws/
2. https://www.makerspaces.com/basic-electronics/
3. https://www.tutorialspoint.com/basic_electronics/basic_electronics_pdf_version.htm
4. https://www.electrical4u.com/diode-working-principle-and-types-of-diode/
5. https://www.allaboutcircuits.com/video-tutorials/transistors/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	-	-	-	-	3	-	1	-	2	-	2
2	3	1	2	-	-	-	-	-	3	-	1	-	2	-	2
3	3	1	2	-	-	-	-	-	3	-	1	-	2	-	2
4	3	3	1	-	-	-	-	-	3	-	1	-	2	-	2
5	3	3	1	-	-	-	-	-	3	-	1	-	2	-	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP202	MANUFACTURING TECHNOLOGY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study and practice the various operations that can be performed on various types of Lathes.
- To study and practice the various operations that can be performed on different types of Grinding machines
- To study about foundry tools and preparation of sand mould, required for casting operations.
- To study and practice various metal joining processes.
- To discuss and practice sheet metal operations required for various components.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Machine parts by performing various types of operations using a lathe. **(K3)**
CO2 Perform grinding operations using various types of grinding machines. **(K3)**
CO3 Design and prepare moulding with different types of patterns. **(K3)**
CO4 Make proper welded joints as per the design requirements. **(K3)**
CO5 Perform sheet metal operations as per the shape and size of the components. **(K3)**

LIST OF EXPERIMENTS

MACHINES

1. Plain Turning and Facing
2. Taper Turning
3. Drilling and Boring
4. Square Head Shaping
5. Hexagonal Head Shaping
6. Plain Surface grinding
7. Cylindrical grinding

FOUNDRY

8. Preparation of a sand mold using split pattern
9. Preparation of a sand mold using solid pattern

WELDING AND SHEET METAL

10. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding
11. Gas welding practice - Demonstration
12. Forming& Bending by sheet metal
13. Model making – Trays and funnels and different type of joints in sheet metal

Reference Books

1. P N Rao, ‘Manufacturing Technology – Metal Cutting and Machine Tools’, Tata McGraw Hill Publishing Company Ltd, NewDelhi, 2008
2. Raghavan V, ‘Physical Metallurgy - Principles and Practice’, Prentice Hall India Pvt. Ltd., NewDelhi, 2006.
3. Kalpakjain S, Schimd S, ‘Manufacturing Engineering and Technology’, Pearson Education,7th edition, New Delhi, 2018
4. B S Nagendra Parashar, R K Mittal, ‘Elements of Manufacturing Processes’, Prentice Hall India Pvt. Ltd., 2003.
5. S K Hajra Choudry, ‘Workshop Technology’, Volume – I & II, Media Promoters and Publishers Pvt. Ltd,

2009.

Web References

1. http://gssl.iitk.ac.in/pssl/
2. https://www.coursera.org/courses?query=manufacturing
3. https://www.linkedin.com/company/laboratory-for-manufacturing-systems
4. https://www.udemy.com/course/non-traditional-manufacturing/
5. https://www.coursera.org/lecture/digital-manufacturing-design/introduction

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	3	-	-	-	3	-	-	3	2	1	1
2	3	3	3	-	3	-	-	-	3	-	-	3	2	1	1
3	3	3	3	-	3	-	-	-	3	-	-	3	2	1	1
4	3	3	3	-	3	-	-	-	3	-	-	3	2	1	1
5	3	3	3	-	3	-	-	-	3	-	-	3	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCC2XX	CERTIFICATION COURSE - II	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCS202	SKILL DEVELOPMENT COURSE II (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. EXCEL FOR STATISTICAL APPROACH

Course Content:

MODULE I SPREADSHEET ADMINISTRATION

Basic Navigation and Editing - Customizing Excel – Housekeeping - Connecting Workbooks - Sharing and Protecting - Excel Crashes

MODULE II ORIENTATION AND EFFICIENCY

Editing – Viewing – Outline - Cell References

MODULE III DATA HANDLING

Data Validation - Sorting and Filtering - Date and Time Functions - Text Functions - Lookup and Reference Functions - Logical and Informational Functions - Named Ranges – Macros

MODULE IV DATA ANALYSIS

Mathematical Functions - Summarising Data - Pivot Tables - Formula Auditing - What-If Analysis - Modelling Principles - Modelling Techniques

MODULE V PRESENTATION

Cell Formatting - Number Formatting - Conditional Formatting - Graphs and Charts – Review - Page and Print Setup

2. TRAINING ON ARDUINO

Course Content:

MODULE I INTRODUCTION OF ARDUINO AND BASIC PROGRAMMING

Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board. Basic Concepts: Arduino data types, Variables and constants, Operators, Control Statements, Arrays, Functions.

MODULE II ARDUINO I/O FUNCTIONS AND ARDUINO TIME

Pins Configured as INPUT, Pull-up Resistors, Pins Configured as OUTPUT, pinMode() Function, digitalWrite() Function, analogRead() function, Arduino Interrupts. Arduino Time: Incorporating Arduino time, delay() function, delayMicroseconds() function, millis() function, micros() function.

MODULE III ARDUINO DISPLAYS AND ARDUINO SENSORS

Working with Serial Monitor, Line graph via serial monitor, Interfacing a 8 bit LCD to Arduino, Fixed one line static message display, Running message display, Using the LCD Library of Arduino. Arduino Sensors: Arduino – Humidity Sensor, Temperature Sensor, Water Detector, PIR Sensor, Ultrasonic Sensor, Connecting Switch (Magnetic relay switches).

MODULE IV ARDUINO SECONDARY INTEGRATIONS AND INPUT TO THE CONTROLLER

Types of Relay, Controlling Electrical appliances with electromagnetic relays, working of a matrix keypad, Using the keypad library to interface with Arduino, Interfacing Servo motors to Arduino, Interfacing a RF Module. Input to the Controller: Using serial input, Controlling LEDs with keys, Keys as toggle switch, Interfacing a piezo Buzzer, Using a buzzer as an alarm unit

MODULE V ARDUINO COMMUNICATIONS AND ARDUINO PROJECTS

Parallel Communication, Serial Communication Modules, Types of Serial Communications, Arduino UART, GSM/GPRS Arduino Interfacing.

Arduino Projects (It involves designing, developing, coding and implement Arduino project): Intelligent home locking system, Intelligent water level management system, Home automation using RFID, Real time clock-based home automation, Intelligent Automatic Irrigation System.

3. COMPUTER VISION

Course Content:

MODULE I INTRODUCTION TO COMPUTER VISION AND IMAGE FORMATION

Background, requirements and issues, human vision. Image formation: geometry and photometry (brightness and color), quantization, camera calibration.

MODULE II SEGMENTATION,EXTRACTION,VIEW GEOMETRY,OBJECTRECOGNITION

Various methods of image segmentation, edge detection, object proposals, SIFT features. Multi-view Geometry: Shape from stereo and motion, feature matching, surface fitting, Active ranging. Object Recognition: Traditional Methods – HoG / SIFT features, Bayes classifiers, SVM classifiers

MODULE III NEURAL NETWORKS AND DEEP LEARNING

Introduction to Neural Networks: Artificial neural networks, loss functions, back propagation and SGD, Batch Normalization. Object Recognition: Deep Learning Methods, Image classification, object detection and semantic segmentation, adversarial attacks. Various neural network architectures, visualization techniques.

MODULE IV MOTION ANALYSIS AND ACTIVITY RECOGNITION

Motion analysis and Activity Recognition: Motion detection and tracking, Inference of human activity from image sequences

MODULE V CASE STUDIES AND EXAMPLES

Examples: Face recognition, Image grounding, Visual question answering

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCM202 ENVIRONMENTAL SCIENCE

L	T	P	C	Hrs
2	0	0	-	30

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii. Slogan making event
iii. Poster making event
iv. Cycle rally
v. Lectures from experts

(b) Actual Activities:

i. Plantation
ii. Gifting a tree to see its full growth
iii. Cleanliness drive
iv. Drive for segregation of waste
v. To live some big environmentalist for a week or so to understand his work
vi. To work in kitchen garden for mess
vii. To know about the different varieties of plants
viii. Shutting down the fans and ACs of the campus for an hour or so

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BST320	COMPLEX ANALYSIS AND APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (Common to EEE, ICE, MECH, MECHATRONICS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the analytic functions of complex variables.
- To apply the analytic function techniques to transform irregular geometry into regular geometry.
- Expose to the concept of complex integration.
- To understand the nature of wave equations.
- To know the solutions of one dimensional and two-dimensional heat flow equations.

Course Outcomes

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

CO1- Understand the concepts of function of a complex variable. **(K2)**
CO2 - Transform complex functions from one plane to another plane. **(K3)**
CO3 - Apply the concepts of complex integration over contour. **(K3)**
CO4 - Understand the concept of initial and boundary value problems **(K2)**
CO5 - Solve the one- and two-dimensional heat equation using Fourier series. **(K3)**

UNIT I FUNCTION OF A COMPLEX VARIABLE (12 Hrs)

Continuity, derivative and analytic functions – Necessary conditions – Cauchy-Riemann equations and sufficient conditions – Harmonic and orthogonal properties of analytic function – Construction of analytic function

UNIT II CONFORMAL MAPPINGS (12 Hrs)

Conformal mapping – Simple and standard transformations like w = z+c, cz, z^2, e^z, sin z, cosh z and z+1/z – Bilinear transformation and cross ratio property - Taylor's and Laurent's theorem – Series expansion of complex valued functions – classification of singularities.

UNIT III COMPLEX INTEGRATION (12 Hrs)

Cauchy's integral theorem and its application – Cauchy's integral formula and problems – Residues and evaluation of residues – Cauchy's residue theorem – Contour integration: Cauchy's and Jordan's Lemma – Application of residue theorem to evaluate real integrals – unit circle and semicircular contour.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solutions of one dimensional wave equation – Transverse vibration of an elastic string.

UNIT V ONE- AND TWO-DIMENSIONAL HEAT EQUATIONS (12 Hrs)

Fourier series solutions of one dimensional heat flow equation – Fourier series solutions of two dimensional heat flow equation under steady state conditions.

Text Books

1. B. S. Grewal., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2020.
2. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons Publications, New Delhi, 4th Edition, 2017.

Reference Books

1. C. Gupta, B. Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill,

New Delhi, 1st Edition, 2015.
2. H.K. Dass & Dr. Rama Verma, “Introduction to Engineering Mathematics – Volume II”, S. Chand & Co, New Delhi, 9th Edition, 2019.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, New Delhi, 10th Edition, 2019.
4. Ravish R. Singh and Mukul Bhatt, “Engineering Mathematics”, Tata McGraw Hill, New Delhi, 1st Edition, 2016.
5. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill, New Delhi, 3rd Edition, 2018.

Web Resources

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111107119/
3. https://youtu.be/W3HXK1Xe4nc
4. https://youtu.be/Mwpz1zjPlzI
5. https://youtu.be/CnrAivf9I6o

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST356 **DATA STRUCTURES**

(Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS,CCE)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart the basic concepts of data structures and its terminologies.
- To understand concepts about stack and queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Sorting, Hashing and Graph.

Course Outcomes

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

CO1 - Compute time and space complexity for given problems **(K3)**
CO2 - Demonstrate stack, queue and its operation. **(K3)**
CO3 - Illustrate the various operations of linked list. **(K3)**
CO4 - Use the concepts of tree for various applications. **(K3)**
CO5 - Outline the various sorting, hashing and graph techniques. **(K3)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES (9 Hrs)

Introduction: Basic Terminologies: Elementary Data Organizations. Data Structure Operations: insertion, deletion, traversal. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT II STACK AND QUEUE OPERATIONS (9 Hrs)

Stacks and Queues: ADT Stack and its operations, Applications of Stacks: Expression Conversion and evaluation. ADT Queue: Types of Queue: Simple Queue, Circular Queue, Priority Queue. Operations on each type of Queues.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion, Deletion in linked list; Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES (9 Hrs)

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, Binary Tree Traversals, AVL Tree. Introduction to B-Tree and B+ Tree.

UNIT V SORTING, HASHING AND GRAPHS (9 Hrs)

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Heap Sort, Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table, Hash Function and its characteristics. Graph: Basic Terminologies and Representations, Graph traversal algorithms.

Text Books

1. Ellis Horowitz, Sartaj Sahni,"Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009.

Reference Books

1. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition,Addison-Wesley Publishing Company, 1995.
2. D.Samanta, "Classic Data Structures, Second Edition, Prentice-Hall of India, Pvt. Ltd., India 2012.
3. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c", Prentice-Hall of India, Pvt.Ltd., Second edition, 2007.
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second edition, 2006.
5. Balagurusamy, "Data Structures", Tata McGraw-Hill Education, 2019.

Web Resources

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	2	2	3
2	3	2	1	1	-	-	-	-	-	-	-	-	2	2	3
3	3	2	1	1	-	-	-	-	-	-	-	-	2	2	3
4	3	2	1	1	-	-	-	-	-	-	-	-	2	2	3
5	3	2	1	1	-	-	-	-	-	-	-	-	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCT304	**ANALOG AND DEGITAL CIRCUITS DESIGN**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To Understand the current voltage characteristics of PN junction diode and special diodes.
- To Explain principle of operation of Bipolar junction transistor.
- To Describe the characteristics of power amplifier and its distortion.
- To present the Digital fundamentals, Boolean algebra and its applications in digital systems.
- To familiarize with the design of various combinational digital circuits using logic gates

Course Outcomes

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

CO1 Understand the current voltage characteristics of PN junction diode and special diodes.(K2)
CO2 Explain principle of operation of Bipolar junction transistor. (K2)
CO3 Describe the characteristics of power amplifier and its distortion. (K2)
CO4 Understand about the logic gates and apply the techniques to simplify the expression.(K3)
CO5 Examine the various combinational digital circuits using logic gates. (K3)

UNIT I SEMICONDUCTOR DIODE **(9 Hrs)**

Theory of PN junction diode, Band structure of open circuited PN junction, Volt-Ampere Characteristics, Temperature Dependence of PN diode, LED, LCD and Photo- diodes, Tunnel diode ,Zener diode as Voltage Regulator

UNIT II TRANSISTORS, CHARACTERISTICS AND BIASING **(9 Hrs)**

Transistor, Types of Transistor, Transistor current components, Transistor as an Amplifier, Transistor characteristics in CB, CE and CC modes. Operating point, bias stability, various biasing circuits, stabilization against Ico, VBE and beta, Construction, Characteristics &applications of Junction Field Effect Transistor (JFET), UJT and MOSFET

UNIT III LARGE SIGNAL AMPLIFIERS **(9 Hrs)**

Class A direct coupled with resistive load, Transformer coupled with resistive load, harmonic distortion, variation of output power with load, Push-Pull Amplifiers, operation of class- B push-pull amplifier, crossover distortion, transistor phase inverter, complementary- symmetry amplifier

UNIT IV DIGITAL FUNDAMENTALS **(9 Hrs)**

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

UNIT V COMBINATIONAL CIRCUIT DESIGN **(9 Hrs)**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder

Text Books

1. Electronic Devices & Circuits by Millman- Halkias, Tata Mcgraw Hill,2015.
2. Electronic Devices & Circuits Theory by Boylested, Pearson Education,2013.
3. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014

Reference Books

1. Electronic Devices, by Floyd, Pearson Education,2012.
2. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
3. S.Salivahanan and S.Arivazhagan“Digital Electronics”, Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4. Anil K.Maini “Digital Electronics”, Wiley, 2014.
5. A.Anand Kumar “Fundamentals of Digital Circuits”, 4th Edition, PHI Learning Private Limited, 2016.
6. Soumitra Kumar Mandal “ Digital Electronics”, McGraw Hill Education Private Limited, 2016

Web Resources

1. https://www.electronics-notes.com/
2. https://www.tutorialspoint.com/semiconductor_devices/index.htm
3. https://www.electronics-tutorial.net/electronic-devices/
4. https://www.allaboutcircuits.com/video-tutorials/
5. https://www.makerspaces.com/basic-electronics/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	-	-	-	-	-	-	-	2	2	-	2
2	2	1	2	3	-	-	-	-	-	-	-	2	2	-	2
3	3	1	2	3	-	-	-	-	-	-	-	2	2	-	2
4	3	3	1	3	-	-	-	-	-	-	-	2	2	-	2
5	3	3	1	3	-	-	-	-	-	-	-	2	2	-	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT305	STRENGTH OF MATERIALS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

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

Course Outcomes

On successful completion of this course, the student will be able to

CO1 - Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2 - Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO3 - Apply basic equation of simple torsion in designing of shafts and helical spring

CO4 - Calculate the slope and deflection in beams using different methods.

CO5 - Analyze and design thin and thick shells for the applied internal and external pressures

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS (12 Hrs)

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

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM (12 Hrs)

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

UNIT III TORSION (12 Hrs)

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS (12 Hrs)

Elastic curve of neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method and Macaulay’s method.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS (12 Hrs)

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure –Deformation in spherical shells – Lame’s theorem.

Text Books

1. Bansal R.K, “Strength of Materials”,Laxmi Publications, Sixth Edition 2019.
2. Bedi D.S, “Strength of Materials”, Khanna Publishing, Sixth 2019.
3. Rajput R.K, “Strength of Materials”, S. Chand Publications, Seventh Edition 2018.

Reference Books

1. Punmia, Jain and Jain, “Mechanics of Materials” , Laxmi Publications, 2019
2. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, 9th Edition, 2018.
3. Egor. P.Popov “Mechanics of Materials” Pearson Education, 2nd Edition, 2016.
4. Subramanian R, “Strength of Materials”, Oxford University Press, 3rd Edition 2016.
5. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., Second Edition New Delhi, 2018.

Web Resources

1. https://nptel.ac.in/courses/112107146/
2. https://nptel.ac.in/courses/112/106/112106141/
3. https://www.udemy.com/course/strengthofmaterials/
4. https://ae.linkedin.com/company/strength-of-materials-dept-spbstu
5. https://www.coursera.org/learn/mechanics

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	-	1	2	1	1
2	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1
3	3	2	2	2	-	-	-	-	1	-	-	1	2	1	1
4	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1
5	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT306	FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the structure and the properties of the fluid
- To understand and appreciate the complexities involved in solving the fluid flow problems.
- To understand the Impact of Fluid Jet on plates
- To understand energy exchange process in turbines
- To understand the working of Pumps and Air Vessels

Course Outcomes

On successful completion of this course, the student will be able to

CO1 - Understand the basic fluid property and law with their application..

CO2 - Acquire knowledge regarding fluid static, kinematic, dynamic and study the different type of flow and boundary layer theory.

CO3 - Complete knowledge in Fluid Jet on plates

CO4 - Calculate the force, Power and efficiency in turbines

CO5 - Understand the working of turbo machine like Pumps and Air Vessels.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS (12 Hrs)

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS (12 Hrs)

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor Moody diagram-commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III IMPACT OF JETS (12 Hrs)

Principles of Turbo Machinery: Fluid Machines – Classification – Impact of Fluid Jet on Stationary plates, Moving Plates and Vanes – Unit and Specific Quantities.

UNIT IV HYDRAULICS TURBINES (12 Hrs)

Classification – Impulse Turbine – Pelton Wheel – Reaction Turbines – Francis and Kaplan Turbines – Draft Tube Theory – Velocity Triangle – Estimation of force, Power and efficiency – General Characteristics of Turbine – Similarity Study – Governing of Turbine – Cavitation in Turbine.

UNIT V HYDRAULICS PUMPS (12 Hrs)

Classification - Centrifugal Pump – Velocity Triangle – Estimation of Power Required and efficiency – General characteristics - Similarity study – Cavitation in Pump – Reciprocating– Ideal and Actual Indicator Diagram – Estimation of Power Required, percentage Slip and Efficiency – Cavitation in Reciprocating pump.

Text Books

1. Streeter, V.L., and Wylie, E.B., “Fluid Mechanics”, McGraw-Hill, 2010.
2. Kumar, K.L., “Engineering Fluid Mechanics”, SchandPublications (P) Ltd., New Delhi (8th edition), 2009
3. Rajput.R.K “Fluid Mechanics and Hydraulics Machines”, S. Chand Limited, 2008.

Reference Books

1. Bansal, R.K., “Fluid Mechanics and Hydraulics Machines”, (5th edition), Laxmi publications (P) Ltd., New Delhi, 2010.
2. White, F.M., “Fluid Mechanics”, Tata McGraw-Hill, 5th Edition, New Delhi, 2016.
3. Som, S.K., and Biswas, G., “Introduction to fluid mechanics and fluid machines”, Tata McGraw-Hill, 2nd edition, 2011.
4. K. Subramanya “Hydraulic Machines” Tata McGraw-Hill Education, 2013.
5. Goyal, Manish Kumar “Fluid Mechanics and Hydraulic Machines” PHI Learning Pvt. Ltd., 31-Aug-2015

Web Resources

1. https://nptel.ac.in/courses/112104118/
2. https://nptel.ac.in/courses/112104117
3. http://fm-nitk.vlabs.ac.in
4. https://www.coursera.org/courses?query=fluid%20mechanics
5. https://www.virtulearn.in/course/fluid-mechanics-and-hydraulic-machines-online-classes

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1
2	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1
3	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1
4	3	2	2	2	-	-	-	-	1	-	-	1	2	-	1
5	3	2	2	2	-	-	-	-	1	-	-	2	2	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT307	SENSORS TRANSDUCERS AND MEASUREMENT SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of measurement systems.
- To know the principle of transduction and the characteristics of different transducers.
- To learn the various sensors used to measure various physical parameters.
- To know the various types of sensors in mechatronics applications.
- To learn the fundamentals of signal conditioning and data acquisition systems.

Course Outcomes

After completion of the course, the students are able to

CO1. Define the role of sensor module for automated system.**(K2)**

CO2. Apply the motion sensors for the required applications. **(K3)**

CO3. Apply the required force and heading sensors for the Mechatronics applications.**(K3)**

CO4. Apply the optical, pressure and temperature sensors for the required applications.**(K3)**

CO5. Find suitable DAQ systems and data logging systems for real time requirements.**(K4)**

UNIT I INTRODUCTION (9 Hrs)

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

UNIT II MOTION, PROXIMITY AND RANGING SENSORS (9 Hrs)

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

UNIT III FORCE, MAGNETIC AND HEADING SENSORS (9 Hrs)

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

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS (9 Hrs)

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

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS (9 Hrs)

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

Text Books

1. Patranabis D, "Sensors And Transducers", Prentice-Hall India, 2nd Edition, 2011.
2. Ramon Pallas & John G. Webster, "Sensors and Signal Conditioning", John Wiley & Sons, 2nd Edition, 2011.
3. Webster John G, "Instrumentation and Sensors Handbook", CRC Press, 1st Edition, 2010.
4. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs and Applications", Springer, 3rd Edition, 2012.
5. Shawhney A. K., "Electrical And Electronics Measurements And Instrumentation", Dhanpat Rai & Sons, 2010.

Reference Books

1. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 2011.
2. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
3. Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw Hill 2010.
4. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India Private Limited, 2012.
5. Doeblin, E.O., Measurement systems, Applications and Design, McGraw Hill, 2009.

Web Resources

1. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
2. https://www.electronics-tutorials.ws/
3. https://www.analog.com/en/analog-dialogue/articles/transducer-sensor-excitation-and-measurement techniques
4. http://www.kelm.ftn.uns.ac.rs/literatura/si/pdf/Measurement%20Instrumentation%20Sensors.pdf
5, https://www.udemy.com/course/sensors-sensor-fundamentals/

CO / PO / PSO Mapping

CO / PO / PSO MAPPING															
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	2	3	-	-	2	-	-	-	-	-	-	3	3	3	2
2	3	2	3	3	3	-	-	-	-	-	-	3	3	3	2
3	3	2	3	3	3	-	-	-	-	-	-	3	-	-	-
4	3	2	3	3	3	-	-	-	-	-	-	3	-	-	-
5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSP301	GENERAL PROFICIENCY–I (Common to all branches)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To build a strong sight of vocabulary and decoding skills
- To improve the communication and leadership skills in an innovative way
- To identify the information and understand the underlying meaning of the given concept
- To build the written communication skills to meet organizational goals
- To extend knowledge on verbal aptitude and prepare for interviews

Course Outcomes

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

CO1- Interpret *meaning and apply reading* strategies in technical and non-technical context *(K2)*
CO2-Develop interpersonal communication skills professionally *(K3)*
CO3-Infer the distinct speech sounds and overcome native language influence (K2)
CO4- Demonstrate various forms of formal writing (K2)
CO5-Apply the techniques of verbal aptitude in competitive exams (K3)

UNIT I - COMPREHENSION ANALYSIS (6Hrs)

Listening: Listening Comprehension (IELTS based) – **Speaking**: Break the iceberg - **Reading:** Reading technical passage (IELTS based) - **Writing:** Writing Task: 1 (IELTS: Graph/ Process /Chart Description) **Vocabulary:** Synonyms (IELTS)

UNIT II - PERSONALITY DEVELOPMENT (6Hrs)

Listening: Interview Videos- **Speaking:** Extempore& Presentation (Soft Skills) - **Reading:** British & American Vocabulary, Read and review (Books, Magazines) - **Writing**: SWOT Analysis **Vocabulary:** Idioms (IELTS)

UNIT III -INFERENTIAL LEARNING (6Hrs)

Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– **Speaking**: Interpersonal Interaction & Situational attribution–**Reading**: Distinguish between facts & opinions - **Writing:** Writing Conversation to different context **Vocabulary:** Phrasal Verbs (IELTS)

UNIT IV - INTERPRETATION AND FUNCTIONAL WRITING (6Hrs)

Listening: Group Discussion videos - **Speaking:** Group Discussion Practice - **Reading:** Interpretation of data - Graph, table, chart, diagram (IELTS based) -**Writing**: Writing Task: 2 (IELTS) **Vocabulary:** Collocations (IELTS)

UNIT V- APTITUDE (6Hrs)

Language Enhancement: Articles**,** Preposition, Tenses
Verbal Ability Enhancement: Blood Relation, Completing Statements- Cloze test, Spotting Errors –Sentence Improvement, One Word Substitution, Word Analogy, Word Groups(**GATE**)

Reference Books

1 Jeff Butterfield, “Soft Skills for Everyone”, Cengage Learning, New Delhi, 2012.
2 Mn,Taylor, and Grant Taylor. “English Conversation Practice”. Tata McGraw-Hill Education, 2004.
3 Bailey, Stephen. “Academic writing: A practical guide for students”. Psychology Press, 2003.
4 Aggarwal, R. S. “A Modern Approach to Verbal & Non Verbal Reasoning”. S. Chand, 2010.
5 Wren, Percival Christopher, and Wren Martin. “High School English Grammar and Composition”. S Chand, 2005.

Web Resources

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
3	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ESP357 DATA STRUCTURES LAB

(Common to CSE, ECE, EEE, IT, ICE, MECH,CIVIL,BME MECHTRONICS,CCE)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn the basic concepts of Data Structures.
- To learn about the concepts of Searching and Sorting.
- To study about the linear and non-linear Data Structures.

Course Outcomes

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

CO1 - Implement exemplary applications related to searching and sorting techniques. **(K3)**
CO2 - Compile, run and manipulate Programs using core data structures. **(K3)**
CO3 - Solve problems by applying linear Data Structures. **(K3)**
CO4 - Solve problems by applying non-linear Data Structures **(K3)**
CO5 -. Build solutions for online coding challenges **(K3)**

List of Exercises

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list.
   b) Delete an element from list c) Search for a key element in list d) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder and c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.

Reference Books

1. Yashavant Kanetkar, “Data Structures through C”, BPB Publications, 3rd edition, 2019.
2. Gav.pai, “Data Structures and Algorithms”, McGraw-Hill India, 1st edition, 2013.
3. Manjunath Aradhya M and Srinivas Subramiam, “C Programming and Data Structures”, Cengage India 1st edition, 2017.
4. Reema Thareja, “Data structures using C”, 2nd edition, Oxford University, 2014.
5. Tenebaum Aaron M, “Data Structures using C’, Pearson Publisher, 1st edition, 2019.

Web Resources

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview

5. https://nptel.ac.in/courses/106103069/

COs/POs/PSOs Mapping (MECHTRONICS)

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	2	3
2	3	2	1	1	3	-	-	-	-	-	-	-	2	2	3
3	3	2	1	1	3	-	-	-	-	-	-	-	2	2	3
4	3	2	1	1	3	-	-	-	-	-	-	-	2	2	3
5	3	2	1	1	3	-	-	-	-	-	-	-	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP303	**ANALOG AND DIGITAL CIRCUITS LAB**	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**2**	**1**	**30**

Course Objectives

- Study the characteristic of CE, CB and CC Amplifier and simulate using SPICE simulation
- Learn the frequency response of CS Amplifiers
- Study the Transfer characteristic of differential amplifier
- Perform experiment to obtain the bandwidth of single stage and multistage amplifiers
- Design and demonstrate various combinational and sequential circuits using Flip-flop

Course Outcomes

After completion of the course, the students are able to

CO1 -Differentiate various amplifiers and Simulate amplifiers using Spice.(K4)

CO2 -Analyse the limitation in bandwidth of single stage and multi stage amplifier. (K4)

CO3 - Measure CMRR in differential amplifier. (K3)

CO4 - Design and demonstrate various combinational logic circuits. (K5)

CO5 - Design and demonstrate various types of counters and Registers using Flip-flops. (K5)

List of Experiments

1. Frequency Response of CE, CB, CC and CS amplifiers
2. Construction of Darlington Amplifier
3. Differential Amplifiers- Transfer characteristic, CMRR Measurement
4. Class A and Class B Power Amplifiers
5. Determination of bandwidth of single stage and multistage amplifiers
6. Spice Simulation of Common Emitter and Common Source amplifiers
7. Design and implementation of code converters using logic gates
(i) BCD to excess-3 code and vice versa (ii) Binary to Gray and vice-versa
8. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483
9. Design and implementation of Multiplexer and De-multiplexer using logic gates
10. Design and implementation of encoder and decoder using logic gates
11. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters
12. Design and implementation of 3-bit synchronous up/down counter
13. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.
14. Study of Shift register IC

References

1. Electronic Devices & Circuits Theory by Boylested, Pearson Education. 2015
2. A.Anand Kumar “Fundamentals of Digital Circuits”, 4th Edition, PHI Learning Private Limited, 2016

Web Resources

1. https://www.industrial-electronics.com/experiments_0.html
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/index.html
3. https://de-iitr.vlabs.ac.in/
4. http://vlabs.iitb.ac.in/vlab/electrical/index.html
5. https://www.iare.ac.in/sites/default/files/lab1/Electronic%20Circuit%20laboratory%20MANUAL%20.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	-	-	-	-	-	-	-	2	2	-	2
2	2	1	2	3	-	-	-	-	-	-	-	2	2	-	2
3	3	1	2	3	-	-	-	-	-	-	-	2	2	-	2
4	3	3	1	3	-	-	-	-	-	-	-	2	2	-	2
5	3	3	1	3	-	-	-	-	-	-	-	2	2	-	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP304	STRENGTH OF MATERIALS AND FLUID MACHINERY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab

Course Outcomes

On successful completion of this course, the student will be able to

CO1 - Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

CO2- Use the measurement equipment's for flow measurement

CO3 - Perform test on different fluid machinery

List of Experiments

STRENGTH OF MATERIALS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs

FLUID MECHANICS AND MACHINES

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
4. Conducting experiments and drawing the characteristic curves of reciprocating pump.
5. Conducting experiments and drawing the characteristic curves of Gear pump.
6. Conducting experiments and drawing the characteristic curves of Pelton wheel.
7. Conducting experiments and drawing the characteristics curves of Francis turbine.
8. Conducting experiments and drawing the characteristic curves of Kaplan turbine

References

1. CWR, Hydraulics Laboratory Manual,2004
2. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd. 2008.
3. S C Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Education India, 2006

Web Resources

6. https://nptel.ac.in/courses/112107146/
7. https://www.udemy.com/course/strengthofmaterials/
8. http://fmc-nitk.vlabs.ac.in/

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	2	3	-	-	1	1	1	1
2	3	2	2	2	-	-	-	2	3	-	-	1	1	1	1
3	3	2	2	2	1	-	-	2	3	-	-	1	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCC3XX	**CERTIFICATION COURSE – III**	**0**	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCS303	Skill Development Course III (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. Power Transmission Systems

Mechanical power transmission involves using different types of systems to transfer energy from one component to another without changing its nature. When motion coming from a driving mechanical component is transferred to another without being changed, there is power transmission. In a mechanical power transmission system, the moving component transfers the energy to the receiving component. These two components can be in direct contact, but power can also be transmitted via an intermediary component.**Gears:** Characteristics of gear systems – Advantages and Limitations - Applications

Chain drive systems: Characteristics of chain drive systems – Advantages and Limitations - Applications

Worm drives: Characteristics of worm systems – Advantages and Limitations – Applications

Rack and Pinion: Characteristics of rack and pinion systems – Advantages and Limitations – Applications

Belt and pulley systems: Characteristics of belt and pully systems – Advantages and Limitations - Applications

2. 3D Printing

The official said that the theory classes have been designed in a simple manner to ensure that the students are able to grasp the topics in a short period of time. On successful completion of this course, student will be able to Acquire knowledge in 3D printing Machine, Analyze the fundamental concepts of software and hardware of 3D printing. Design and development of simple model by 3D printing. Create real time model of 3D Printing object. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. The skill training to improve the employability of the students and also impart industry relevant training for up-skilling the faculty and Industrial persons.

3. Non – Destructive Testing

Non – Destructive Testing is a testing and analysis technique used by industry to evaluate the properties of a material, component, structure or system for characteristic differences or welding defects and discontinuities without causing damage to the original part.

Electromagnetic Testing (ET) - Ground Penetrating Radar (GPR) - Laser Testing Methods (LM) - Leak Testing (LT) - Magnetic Flux Leakage (MFL) - Microwave Testing - Liquid Penetrant Testing (PT) - Magnetic Particle Testing (MT) - Radiographic Testing (RT).

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCM303	PHYSICAL EDUCATION	L	T	P	C	Hrs
		0	0	2	-	30

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 30 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BST438	NUMERICAL METHODS AND STATISTICS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To learn the techniques of solving algebraic and transcendental equations.
- To introduce the numerical techniques of differentiation and integration.
- To know the basic concepts of statistical parameters like mean, median, mode etc.
- To understand the concept of testing of hypothesis using statistical analysis.
- To identify the direction and strength of a linear correlation between two factors.

Course Outcomes

After completion of the course, students will be able to

CO1 – Solve algebraic and transcendental equations. **(K3)**
CO2 – Apply the knowledge of interpolation by using the numerical methods. **(K3)**
CO3 – Understand the basic concepts of Statistics. **(K2)**
CO4 – Apply the concept of testing of hypothesis for small and large samples. **(K3)**
CO5 – Know the applications of linear regression and correlation. **(K2)**

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS (12 Hrs)

Solution of algebraic and transcendental equations – Newton Raphson method – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT II NUMERICAL DIFFERENTIATION AND INTEGRATION (12 Hrs)

Interpolation: Interpolation by Newton's forward and backward difference formulae for equal intervals – Solution of ordinary differential equations – Single step methods – Taylor series method – Euler methods – Integration by Trapezoidal and Simpson's rules – Lagrange's method for unequal intervals.

UNIT III MEASURES OF DISPERSION (12 Hrs)

Standard deviation – Mean deviation – Quartile deviation – Range – Measures of Skewness and Pearson's coefficient of skewness – Moments about the arbitrary origin and moments based on measures of skewness and kurtosis.

UNIT IV TESTING OF HYPOTHESIS (12 Hrs)

Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviations. Small samples: Test for single mean, difference of means and correlation coefficients – test for ratio of variances – Chi–Square test for goodness of fit and independence of attributes.

UNIT V CORRELATION AND REGRESSION (12 Hrs)

Curve fitting – Method of least squares – Correlation – Rank correlation – Regression – Multiple and partial correlation – Plane of regression – Coefficient of multiple correlation – Coefficient of partial correlation.

Text Books

1. B. S. Grewal, "Numerical Methods in Engineering and Science ", Mercury learning & Information, Kindle Edition, 2018.
2. T. Veerarajan and T. Ramachandran, "Statistics and Numerical methods", McGraw Hill, 1st Edition, 2019.
3. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.

Reference Books

1. Rajesh Kumar Guptat, "Numerical Methods, Fundamental and its Applications", Cambridge University, 2019.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019
3. Timothy Sauer, "Numerical Analysis", Pearson Education, 3rd Edition, 2017.
4. Arvind Pragati Gautam, "Numerical Methods", Alpha Science International Limited, 2019.
5. N. P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.

Web Resources

1. http://nptel.ac.in/courses/111107063/
2. https://nptel.ac.in/courses/111107119/
3. https://easyengineering.net/ma6452-statistics-and-numerical-methods/
4. https://nptel.ac.in/courses/110/105/110105087/
5. https://nptel.ac.in/courses/111/105/111105077/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	3	3	2
2	3	2	1	1	-	1	-	-	-	-	-	1	3	3	2
3	2	1	-	-	-	1	-	-	-	-	-	1	3	2	1
4	3	2	1	1	-	-	-	-	-	-	-	1	3	2	1
5	2	1	-	-	-	-	-	-	-	-	-	1	3	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EST467	PROGRAMMING IN JAVA	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain and explore the knowledge of java programming
- To know the principles of inheritances, packages, interfaces
- To get familiarized to generic programming, multithreading concepts.
- To gain and explore the advanced concepts in Java.

Course Outcomes

After completion of the course, students will be able to

CO1 - Write a maintainable Java Program for a given algorithm and implement the same.**(K3)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications**.(K2)**
CO3 - Create java applications using exception handling, thread and generic programming**.(K6)**
CO4 - Build java distributed applications using Collections and IO streams**.(K3)**
CO5 - Develop simple database programs**.(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING (9 Hrs)

The History and Evolution of Java - Byte code - Java buzzwords - Data types – Variables – Arrays – operators - Control statements - Type conversion and casting. Concepts of classes and objects: Basic Concepts of OOPs – Constructors - Static keyword - Final with data - Access control - This key word - Garbage collection - Nested classes and inner classes - String class.

UNIT II INHERITANCE, PACKAGES AND INTERFACES (9 Hrs)

Inheritance: Basic concepts - Forms of inheritance - Super key word – Method overriding - Abstract classes- Dynamic method dispatch - The Object class. Packages: Defining, Creating and Accessing - Importing packages. Interfaces: Defining – Implementing – Applying - Variables and extending interfaces

UNIT III EXCEPTION HANDLING, MULTITHREADING (9 Hrs)

Concepts of Exception handling - Types of exceptions - Creating own exception - Concepts of Multithreading - Creating multiple threads – Synchronization - Inter thread communication - Enumeration - Autoboxing - Generics.

UNIT IV COLLECTIONS, I/O STREAMS (9 Hrs)

Collections: List –Vector – Stack - Queue – Dequeue –Set - Sorted Set. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT V EVENT DRIVEN PROGRAMMING AND JDBC (9 Hrs)

Events - Delegation event model - Event handling - Adapter classes. AWT: Concepts of components - Font class - Color class and Graphics - Introduction to Swing – Layout management - Swing Components - Java Database Connectivity - Programming Example.

Text Books

1. Herbert Schildt, “Java: The Complete Reference”, TMH Publishing Company Ltd, 11th Edition, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi , “JAVA Programming for core and advanced learners” , Universities Press Private Limited, 2018
3. Herbert Schil dt, “The Complete Reference JAVA 2”, TMH, Seventh E dit ion, 2006. .

Reference Books

1. Cay S. Horstmann, Gary cornell, Core Java Volume –I Fundamentals, 9th Edition, Prentice Hall, 2013.
2. H.M.Dietel and P.J.Dietel, “Java How to Program”, Pearson Education/PHI , 11th Edition, , 2017.
3. Cay.S.Horstmann and Gary Cornell, “Core Java, Vol 2, Advanced Features”, Pearson Education, 8th Edition, 2008.
4. Java for Programmers, P.J. Dietel and H.M Dietel,Pearson Education (OR) JAVA:
5. Programming in Java, S. Malhotra and S. Choudary, Oxford Univ. Press.

.

Web Resources

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM’s tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	1	1	-	2	2	-	-	3	3	3
CO2	2	2	2	3	2	1	1	-	3	-	-	-	2	2	2
CO3	3	2	3	2	2	2	1	-	2	-	-	-	3	3	3
CO4	2	2	2	2	2	1	1	-	2	-	-	-	2	2	3
CO5	3	2	1	2	2	2	1	-	3	2	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT408 POWER ELECTRONICS AND DRIVES

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To get an overview of different types of power 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 study the operation of induction motor drives and various configurations.
- To learn the operation of DC drives and their control using power electronic circuits.

Course Outcomes

After completion of the course, the students are able to

CO1 - Define about various power switching circuits used in Electrical drives. (K1)
CO2 - Explain the operations of controlled converters for different types of Loads.(K2)
CO3 –Classify the different controlled chopper. (K2)
CO4 – Discuss different types of drives used in automation. (K2)
CO5 - Explain the concept of DC motor drives and their control using power electronic circuits. (K2)

UNIT I INTRODUCTION (9 Hrs)

Power Devices-MOSFET, IGBT, SCR- Linear regulated vs Switched mode power supplies Electrical drive system-Advantages-Types of Electric drives-Dynamic of Drives- selection of electrical drives- Modes of operation of electrical drives- -closed loop control of Drives.

UNIT II CONTROLLED RECTIFIERS (CONVERTERS) FED DC DRIVES (9 Hrs)

Single Phase Half wave / full wave half controlled /fully controlled converters with R, RL and RLE loads, Continuous and discontinuous current operations- Evaluation of performance parameters - Phase controlled DC drives.

UNIT III CHOPPER CONTROLLED DC DRIVES (9 Hrs)

Principle of operation of chopper-Types-Four Quadrant Chopper Circuits- Buck and Boost Chopper fed DC machines.

UNIT IV INDUCTION MOTOR DRIVES (9 Hrs)

Dynamic Modelling of Induction machines- Single phase bridge inverters with R, RL and RLE loads -Phase controlled Induction motor drive-Frequency controlled Induction motor drives-Variable frequency Drives Three phase 120 and 180 degree mode Inverter fed AC machine –Vector controlled Induction motor drives –Direct and Indirect vector control.

UNIT V PERMANENT MAGNET SYNCHRONOUS AND BRUSHLESS DC MOTOR DRIVES (9 Hrs)

Synchronous Machines with PMs-Vector control of PMSM-Permanent magnet brushless DC motor-Sensor less control BLDC motor.

Text Books

1. R.Krishnan, “Electrical motor drives modelling, analysis and control” Pearson India, 2015.
2. Gopal K.Dubey, “Fundamentals of Electrical Drives” Narosa Publishing house, 2017.

Reference Books

1. P. S. Bimbhra, “Power Electronics“KHANNA PUBLISHSERS-DELHI, 2012.
2. Mohammed H Rashid, “Power electronics” Pearson Education India, 2009.

3. Bimal Bose, “Power electronics and driver circuits” Elseveir, 2006.
4. Bogdan M. Wilamowski, J. David Irwin,”Power Electronics and Motor Drives”CRC Press, 2011.
5. Bimal K Bose, “Modern Power electronics and AC drives” Prentice hall, 2002.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc19_ee03
2. https://nptel.ac.in/downloads/108105066/
3. https://nptel.ac.in/content/storage2/courses/108105066/PDF/L(SSG)(PE)%20((EE)NPTEL).pdf
4. https://www.hindustanuniv.ac.in/assets/pdf/pg/PED_Syllabus.pdf
5. http://vnit.ac.in/academic/wp-content/uploads/2019/01/M.-Tech.-in-Power-Electronics-and-Drives-.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
3	2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
4	2	2	-	2	-	-	-	-	-	-	-	-	2	-	-
5	2	2	-	1	-	-	-	-	-	-	-	-	2	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT409 THEORY OF MACHINES

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the principles in the formation of mechanisms and their kinematics
- To understand velocity and acceleration of different mechanisms
- To analyze the principles in mechanisms used for speed control and stability control
- To understand balancing of mass and its position
- To understand the effect of Dynamics of undesirable vibrations

Course Outcomes

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

CO1 Understand the principles of mechanisms and their kinematics (K1)
CO2 Extract velocity and acceleration of different mechanisms(K2)
CO3 Apply the forces in speed and stability control systems(K3)
CO4 Analyzing balancing of mass and its position(K4)
CO5 Prioritize different types of vibration, their causes and remedies(K5)

Unit I INTRODUCTION (12 Hrs)

Theory of machines: introduction, need, scope and importance in design and analysis. Kinematics, kinetics and dynamics-concept and examples. Basic terminology related to machines and mechanisms. Development of different mechanisms and its inversions like four bar chain mechanism , slider crank mechanism, double slider crank mechanism

Unit II VELOCITY AND ACCELERATION DIAGRAM (12 Hrs)

Basic concept used in solving velocity and acceleration problems. Approach to solve velocity and acceleration related to mechanisms using, Relative velocity method for single slider crank mechanism and Four bar chain mechanism. Klein's construction for single slider cranks mechanism

Unit III GOVERNOR AND GYROSCOPES (12 Hrs)

Governors – Types – Centrifugal governors, Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

Unit IV BALANCING OFMASSES (12 Hrs)

Concepts and types of balancing. ,Effects of unbalanced masses. Balancing of revolving masses in same plane: Analytical and graphical methods to find balancing mass. Balancing of reciprocating masses

Unit V VIBRATIONS (12 Hrs)

Vibration-Terminology-Effects-Causes-Remedies. Free Vibration – Damped vibrations – Forced vibrations, Transverse vibrations, Torsional Vibrations –Equivalent shaft systems, single, Double and triple rotor systems

Text Books

1. Rattan S.S, "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition - 2005.
2. Sadhu Singh, "Theory of Machines," Pearson Education (Singapore) Pvt. Ltd., India Branch, New Delhi,2ND Edi. 2006.

References

1. Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" OXFORD Universitypress.2004
2. Theory of Machines -I", by A.S.Ravindra, Sudha Publications, Revised 5th Edi. 2004.
3. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 2006.

4. JagadishLal, ‘Theory of Machine’, DhanpatRai Publications, New Delhi.
5. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 2012

Web Resources

1. http://mm-nitk.vlabs.ac.in/
2. https://nptel.ac.in/courses/112104114
3. https:/ocw.mit.edu
4. https://www.researchgate.net/publication/278026450_Introduction_to_Theory_of_Machines
5. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1303

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	-	-	-	-	-	-	2	1	-	1
CO2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	1
CO3	3	2	3	3	-	-	-	-	-	-	-	1	2	2	1
CO4	3	2	3	3	-	-	-	-	-	-	-	1	1	1	2
CO5	3	2	3	3	-	-	-	-	-	-	-	1	1	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSP402	GENERAL PROFICIENCY–II	L	T	P	C	Hrs
	(Common to all branches)	0	0	2	1	30

Course Objectives

- To examine various standardized test in English language
- To recognize the key features of various technical writing
- To integrate LSRW skills to endorse multifarious skill set in practical situation
- To understand the factors that influence the usage of grammar
- To understand the basic concepts of logical reasoning skills

Course Outcomes

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

CO1: Infer ideas to attend international standardized test by broadening receptive and productive skills (K2)

CO2: Interpret the types of writing in different state of affairs (K2)

CO3: Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation (K3)

CO4: Identify the rules of grammar in academic discourse settings (K3)

CO5:Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc. (K2)

UNIT I -CAREER SKILLS (6 Hrs)

Listening: Listening at specific contexts **Speaking:** Mock interview (Personal & Telephonic)-**Reading**: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) **Writing:** Essay Writing (TOEFL) **Vocabulary:** Words at specified context (IELTS)

UNIT II - CORPORATE SKILLS (6 Hrs)

Listening: Listening and replicating **Speaking**: Team Presentation (Work Place Etiquettes) **Reading:** Short texts (signs, emoticons, messages) **Writing:** E-mail writing- Hard skills -Resume' Writing, Job Application Letter, Formal Letter **Vocabulary:** Glossary (IELTS)

UNIT III - FUNCTIONAL SKILLS (6 Hrs)

Listening: Listening TED Talks – **Speaking:** Brainstorming &Individual Presentation, Persuasive Communication –- **Reading:** Text Completion (GRE Based) **Writing:** Expansion of Compound Words **Vocabulary:** Expansion of vocabulary (IELTS)

UNIT IV - TRANSFERABLE SKILLS (6 Hrs)

Listening: Listening Documentaries and making notes –**Speaking:** Conversation practice at formal & informal context **Reading:** Read and transform- report, memo, notice and advertisement, **Writing:** Euphemism, Redundancy, and Intensifiers **Vocabulary:** Refinement of vocabulary (IELTS)

UNIT V –APTITUDE (6 Hrs)

Transformational Grammar: Phrases & Clauses, Concord, Conditional Clauses, Voice, Modals

Verbal Ability Enhancement: Letter Series, Coding &Decoding**,** Sentence Completion (GATE), Critical Reasoning & Verbal Deduction (GATE), Syllogism

Reference Books

1. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
2. Tulgan, Bruce**.** "Bridging the soft skills gap: How to teach the missing basics to today's young talent". John Wiley & Sons, 2015.
3. Sherfield, Robert M. "Cornerstone: Developing Soft Skills". Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman**.** "The official Cambridge guide to IELTS for academic & general training".Cambridge, 2014.
5. Ramesh, Gopalaswamy. "The ace of soft skills: attitude, communication and etiquette for success". Pearson Education India, 2010.

Web References

1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
5	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BSP402 **NUMERICAL METHODS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn the techniques of solving non-linear equation.
- To find the solutions of simultaneous equations.
- To introduce the numerical techniques of differentiation and integration.
- To understand the curve fitting techniques.
- To study about the single mean and difference of means.

Course Outcomes

After completion of the course, students will be able to

CO1 – Solve algebraic and transcendental equations. **(K3)**
CO2 – Solve the system of simultaneous equations. **(K3)**
CO3 – Apply the knowledge of interpolation by using the numerical methods. **(K3)**
CO4 – Apply the concept of least square method. **(K3)**
CO5 – Know the concept of testing of hypothesis. **(K3)**

List of Experiments

1. Roots of non-linear equation using bisection method.
2. Roots of non-linear equation using Newton's method.
3. Solve the system of linear equations using Gauss - Elimination method.
4. Solve the system of linear equations using Gauss - Seidal iteration method.
5. Solve the system of linear equations using Gauss - Jordan method.
6. Find the area by using trapezoidal rule.
7. Fit a straight line by method of least squares.
8. Fit a parabola by method of least squares.
9. Test for Single mean.
10. Test for difference of mean.

Text Books

1. Grewal. B.S., "Numerical Methods in Engineering and Science ", Mercury learning & Information, Kindle Edition, 2018.
2. T. Veerarajan and T. Ramachandran, "Statistics and Numerical methods", Mc Graw Hill, 1st Edition, 2019.
3. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.

Reference Books

1. Rajesh Kumar Guptat, "Numerical Methods, Fundamental and its Applications", Cambridge University, 2019.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019
3. Timothy Sauer, "Numerical Analysis", Pearson Education, 3rd Edition, 2017.
4. Arvind Pragati Gautam, "Numerical Methods", Alpha Science International Limited, 2019.
5. N. P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.

Web Resources

1. http://scilab.in
2. http://nptel.ac.in/courses/111107063
3. http://nptel.ac.in/courses/122102009

4. https://youtu.be/IuEOMyGuuIg
5. https://youtu.be/i_VKsST3kkQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO110	PO111	PO112	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	3	1	-
2	3	2	1	1	-	1	-	-	-	-	-	1	3	1	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ESP468	PROGRAMMING IN JAVA LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To acquire programming skill in core java.
- To learn how to design java program and applications.
- To acquire object oriented skills in java.
- To develop the skill of designing applications.

Course Outcomes

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

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications**. (K2)**
CO3 - Create java applications using exception handling, thread and generic programming**. (K6)**
CO4 - Build java distributed applications using Collections and IO streams**. (K3)**
CO5 - Develop simple database programs**. (K3)**

List of Exercises

1. Develop simple programs using java syntax and semantics.
2. Develop a java program that implements class and object.
3. Write a java program to demonstrate inheritance.
4. Develop a simple real life application program to illustrate the use of Multi Threads.
5. Implement simple applications using Collections.
6. Develop a simple application and use JDBC to connect to a back-end database.
7. Create a student application with Add, Edit, Delete, Show functions using JDBC.
8. Create a Bill Application to store sales details using JDBC.
9. Create java applications using Exception Handling for error handling.
10. Develop a java program that implements the Packages.

Text Books

1. E.Balagurusamy. “Programming with java”, TMH Publ, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL&DIETEL.
3. Herbert Schil dt, “The Complete Reference JAVA 2”, TMH, Seventh E dit ion, 2006

Reference Books

1. Herbert Schildt, “Java: The Complete Reference”, TMH Publishing Company Ltd, New Delhi, ISBN: 9781260440249, 11th Edition, 2018.
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals‖”, Prentice Hall, 9th Edition, 2013.
3. H.M.Dietel and P.J.Dietel,”Java How to Program”, Pearson Education/PHI, Sixth Edition, 2010.
4. Cay.S.Horstmann and Gary Cornell, “Core Java 2, Vol 2, Advanced Features”, Pearson Education, Seventh Edition, 2010.
5. Java for Programmers, P.J. Dietel and H.M Dietel,Pearson Education (OR) JAVA:

Web Resources

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM’s tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog

5. ttps://www.geeksforgeeks.org.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	1	1	2	2	2	2	2	3	3	3
CO2	2	2	2	3	2	1	3	-	-	3	-	-	2	2	2
CO3	2	2	3	-	3	2	3	2	2	-	2	2	3	3	3
CO4	2	2	2	3	2	1	3	2	-	2	-	-	2	2	3
CO5	3	2	1	2	3	2	3	-	3	3	3	3	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP405 POWER ELECTRONICS AND DRIVES LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To study about switching characteristics of different types of power semi-conductor devices
- To determine the operation, characteristics and performance parameters of converters
- To understand the concept of DC and AC drives

Course Outcomes

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

CO1	Know the construction, operation and characteristics of different types of power semiconductor devices.(K2)
CO2	Understand the operation, characteristics and performance parameters of converters and choppers. (K2)
CO3	Interpret the operation and characteristics of invertors and its related techniques.(K3)
CO4	Acquire the knowledge on solid-state DC drives and its control.(k3)

LIST OF EXPERIMENTS

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and TRIAC.
3. Characteristics of MOSFET and IGBT
4. AC to DC half controlled converter
5. AC to DC fully controlled Converter
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter
8. IGBT based Three Phase PWM Inverter Fed AC Drives
9. AC Voltage controller
10. Switched mode power converter.
11. Characteristics of PMBLDC motor.
12. Resonant dc to dc converter
13. Speed control of Universal Motor
14. Intelligent Power Module of DSP based AC Drives
15. Vector control of Induction Motor Drive

References

1. Bogdan M. Wilamowski, J. David Irwin, “Power Electronics and Motor Drives”, CRC Press, 2017.
2. K Sundareswaran, “Elementary Concepts of Power Electronic Drives”, CRC Press, 2019.
3. Vinod Kumar, Ranjan Kumar Behera, Dheeraj Joshi, Ramesh Bansal, “Power Electronics, Drives, and Advanced Applications”,CRC press, 2020.
4. Orlowska-Kowalska, Teresa, Blaabjerg, Frede, Rodríguez, José, “Advanced and Intelligent Control in Power Electronics and Drives”, Springer, 2014.
5. Vukosavic, Slobodan-Boban, “Digital Control of Electrical Drives”, Springer, 2007.

Web Resources

1. https://www.vvitengineering.com/lab/EE6611-POWER-ELECTRONICS-AND-DRIVES-LAB.pdf
2. http://www.srmvalliammai.ac.in/qb/EEE/UG/6th%20Semester/EE8661-Power%20Electronics%20and%20Drives-Lab%20Manual.pdf
3. http://pnbalamurugan.yolasite.com/resources/EE6611%20POWER%20ELECTRONICS%20AND%20DRIVES%20LAB%20MANUAL.pdf

4. https://lecturenotes.in/practicals/19388-lab-manuals-for-power-electronics-and-drives-power-electronics-by-anna-superkings
5. http://ezhil-ecesait.webs.com/Power-Electronics-Lab-Manual.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	3	-	-	-	3	2	2	3	3	2	2
2	3	2	2	3	3	-	-	-	3	2	2	3	3	2	2
3	3	2	2	3	3	-	-	-	3	2	2	3	3	2	2
4	3	2	2	3	3	-	-	-	3	2	2	3	3	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP406	DYNAMICS OF MACHINERY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To teach the students principle of working of various governor
- To teach the students the different modes of balancing
- To teach the students, various modes of vibration

Course Outcomes

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

CO1 Ability to perform the working of various governor
CO2 Ability to perform different modes of balancing and cam analysis
CO3 Ability to perform different types various modes of vibration

List of Experiments

1. Demonstration of four bar inversion mechanism
2. Natural frequency of single mass, single helical spring system.
3. Natural frequency of combination of springs – springs in parallel, springs in series
4. Natural frequency of undamped torsional single rotor, double rotor system. Effect of inertia (I)and stiffness(k).
5. Determination of radius of gyration of a given compound pendulum
6. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifler suspension method
7. Damping coefficient of torsional single rotor system – Effect of depth of immersion in oil and damping ratio
8. Resonance frequency of equivalent spring mass system – undamped and damped condition
   a) To plot amplitude Vs frequency graph for different damping.
9. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors.
10. Static and Dynamic balancing.
11. Whirling of shafts/ determination of critical speed with and without Rotors.
12. Gyroscopic couple verification.
13. Journal bearing – pressure distribution of different loads at different Speeds.
14. Cam motion analysis.

Reference Books

1. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rd Edition, Publisher: Pearson Education India, 2014
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006
4. Ghosh, Amitabha, "Introduction to Dynamics", Springer, 2018.
5. David Myszka, "Machines & Mechanisms: Applied Kinematic Analysis", Pearson, 2010.

Web Resources

1. http://mm-nitk.vlabs.ac.in/
2. https://nptel.ac.in/courses/112104114
3. https:/ ocw.mit.edu

COs/POs/PSOs Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	3	-	-	3	3	2	2
CO2	3	2	2	2	3	-	-	-	3	-	-	3	3	2	2
CO3	3	2	2	2	3	-	-	-	3	-	-	3	3	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCC4XX	**CERTIFICATION COURSE – IV**	**0**	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCM404 **NCC / NSS**

NCC/NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 30 hours.
4. The above activities will be monitored by the respective faculty in-charge.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BST553	OPERATIONS RESEARCH FOR MECHATRONICS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the role of operation research in decision making.
- To provide knowledge and training in using optimization techniques.
- To impart the various operation research models for effective problem solving.
- To know the basics and the methods of solving inventory theory and problems.
- To acquire knowledge in principles of Queuing theory.

Course Outcomes

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

CO1 - Understand the characteristics of different types of decision making environments.(K2)
CO2 - Solve Transportation Models and Assignment Models.(K3)
CO3- Design new simple models by using critical path method.(K3)
CO4- Function of inventory and replacement concepts.(K4)
CO5- Apply Queuing theory and solve problems related to it.(K5)

UNIT I LINEAR PROGRAMMING (12 Hrs)

Stages of Development of Operations Research – Applications of Operations Research – Limitations of Operations – Introduction to Linear Programming – Graphical Method – Simplex Method – Duality.

UNIT II TRANSPORTATION PROBLEMS (12 Hrs)

Basic feasible solution by different methods – Fixing optimal solutions – Stepping stone method – MODI method – Assignment problem – Formulation – Optimal solution.

UNIT III NETWORKS MODELS (12 Hrs)

Shortest Path Problem – Floyd's Algorithm – Minimum Spanning Tree Problem – CPM/PERT – Crashing of a Project network

UNIT IV INVENTORY ANALYSIS AND REPLACEMENT MODELS (12 Hrs)

Inventory cost – Classification of Fixed first order Quantity Inventory Models- Inventory models with Deterministic Demand- Inventory models with probabilistic Demand. Replacement Models –types of failures- Replacement of items that deteriorate

UNIT V QUEUING THEORY (12 Hrs)

Basic Waiting Line Models: (M/M/1):(GD/α/α) – (M/M/1):(GD/N/α) – (M/M/C):(GD/α/α) – M/M/C):(GD/N/α).

Text Books

1. Michael W.Carter, Camille C.Price, GhaithRabadi, "Operation Research – A Practical Introduction", Chapman and Hall/CRC, 2nd Edition 2018.
2. Jiongmin Yong, "Optimization Theory: A Concise Introduction", World scientific publishing company, 2018.
3. John F. Shortle, James M. Thompson, Donald Gross, Carl M. Harris, "Fundamentals of Queuing Theory", 5th Edition,2018.

Reference Books

1. A.RaviRavindran, "Operations Research Methodologies", Taylor and Francis, 2019.
2. Hastings, Kevin J. "Introduction to the Mathematics of Operations Research with Mathematics", Taylor and

Francis, 2019.
3. Er.Prem Kumar Gupta,Dr.D.S.Hira," Operations Research" S.chand& Company Pvt.Ltd, **7th** Edition,2014.
4. J. K. Sharma. "Operations Research Theory and Applications",Macmillan India Ltd, 5th Edition, 2013.

Web Resources

1. https://www.researchgate.net/publication/313880623
2. https://nptel.ac.in/courses/117/103/117103017
3. https://nptel.ac.in/courses/111/107/111107128/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	3	-	-	-	-	-	-	-	1	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	1	3	2	2
3	3	2	3	3	-	-	-	-	-	-	2	1	3	2	2
4	2	1	3	3	-	-	-	-	-	-	2	1	3	2	2
5	3	2	3	3	-	-	-	-	-	-	2	1	3	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT510 CONTROL SYSTEMS FOR MECHATRONICS SYTEMS

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To introduce the elements of control system and their modelling using various techniques.
- To revise the procedures for analyzing the time response in a system.
- To find out the frequency response and analyzing the system.
- To be familiar with the stability of systems.
- To establish the state variable analysis method

Course Outcomes

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

CO1 - Demonstrate the various control system elements and their representations.(K2)
CO2 – Develop the various time domain parameters. (K3)
CO3 - Analyze the various frequency response plots and its system. (K4)
CO4 - Estimate the concepts of various system stability criterions.(K5)
CO5 - Design various transfer function of digital control system using variable models. (K6)

UNIT I CONTROL SYSTEM MODELING (12 Hrs)

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

UNIT II TIME RESPONSE ANALYSIS (12 Hrs)

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

UNIT III FREQUENCY RESPONSE ANALYSIS (12 Hrs)

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, Lead Lag Compensators.

UNIT IV STABILITY ANALYSIS (12 Hrs)

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

UNIT V STATE VARIABLE ANALYSIS (12 Hrs)

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 space representation for Discrete time systems.

Text Books

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5thEdition, 2007.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

Reference Books

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.
2. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 2nd Edition, 2002.
3. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill, 2007.
4. John J.D'Azzo& Constantine H.Houpis, "Linear Control System Analysis and Design'", Tata McGraw-Hill, Inc.,.

Web Resources

1. https://en.wikibooks.org/wiki/Control_Systems/Resources
2. https://www.tutorialspoint.com/control_systems/control_systems_useful_resources.htm
3. https://mechatronics.colostate.edu/resources/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT511	MICROPROCESSORS AND CONTROLLERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To achieve knowledge about 8085 and 8051 microcontrollers
- To know about C programming using 8051 microcontroller
- To expand knowledge of internal and external peripherals
- To apply microcontroller for mechatronics applications
- To pioneer the architecture of advanced microprocessors and microcontrollers.

Course Outcomes

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

CO1 - Explain the basic concepts of 8085 microprocessor and 8051 microcontroller (K2)
CO2 - Interpret the Embedded C programming concepts with 8051 microcontroller (K2)
CO3 - Develop programming using internal and external peripherals with microcontroller (K3)
CO4 - Function of a microcontroller based system for Mechatronics applications (k5)
CO5 - Design the architecture of ARM processor and PIC microcontroller.(K6)

UNIT I 8085 MICROPROCESSOR (9 Hrs)

8085 Architecture – Pin configuration – Register organization – Memory organization – memory and I/O decoding – Interrupts

UNIT II 8051 MICROCONTROLLERS (9 Hrs)

Selection of Microcontrollers - 8051 Microcontroller Architecture – Pin configuration – Memory organization – Special function registers – Program Counter – PSW register – Stack and stack pointer

UNIT III 8051 ASSEMBLY LANGUAGE/EMBEDDED C PROGRAMMING (9 Hrs)

Compiler C - programming structure, Data types, memory models, infinite loops and handling interrupts in C. Intel Hex file format. Instruction set – Addressing modes – I/O port programming – Timer programming – Counter programming – Serial communication programming – Interrupt programming.

UNIT IV PERIPHERAL INTERFACING (9 Hrs)

Introduction to Embedded C programming – Peripheral interfacing Switch –key pad, LCD –LED – A/D and D/A converters – High Power devices using relays. Speed control: DC Motor –Stepper motor, servomotor.

Unit V Microcontroller for Mechatronics Applications (9 Hrs)

Application case studies related to Interfacing of sensors analog and discrete type (Temperature, Pressure, Level, Proximity sensors). Interfacing of actuators (Servo motor, pneumatic cylinders, PWM control of a DC motor). RF module Interfacing – IR module interfacing. Traffic light control application

Text Books

1. Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlayRolin, “The 8051 Microcontroller and Embedded Systems”, 2nd Edition, Prentice Hall of India, New Delhi, 2013.
2. Patel, “The 8051 Microcontroller based Embedded Systems”, 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
3. Ramesh Goankar, “Microprocessor 8085 Architecture, Programming and Interfacing”, Penram International publishers, Mumbai, 2013.

Reference Books

1. A Nagoorkani, “8085 Microprocessor and its Applications”, 2017
2. Kenneth Ayala, “The 8051 Micro controller”, 3rd edition cengage learning 2007
3. SubrataGhoshal, “Embedded Systems &Robots : Projects Using the 8051 Microcontroller”, 2009.
4. Lyla B. Das,” The X86 Microprocessor”, Pearson India, 2014
5. Dan Harres “MSP430-based Robot Applications: A Guide to Developing Embedded Systems” Newnes; 1 edition 2013

Web Resources

1. https://swayam.gov.in/nd1_noc20_ee42/preview
2. https://nptel.ac.in/courses/108/105/108105102/
3. https://www.youtube.com/watch?v=liRPtvj7bFU

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20MCT512	CNC AND METROLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To be familiar with about basic concepts of metal cutting and CNC machines
- To recognize about various tooling systems and fixtures
- To expand knowledge in economics
- To grow up knowledge in angular measurement systems
- To determination of the process capabilities and ensure that these are better than the relevant component tolerances.

Course Outcomes

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

CO1 - Explain the parameters of metal cutting and comprehend the basic components, drives and controls involved in a CNC system (K2)
CO2 - Select various tooling systems and fixtures for CNC and identify maintenance features of CNC machines (K3)
CO3 - Apply the concepts of economics in CNC machine handling (K3)
CO4 - Infer linear and angular measurements using various instruments (K2)
CO5 - Conclude methods of measurement for various physical quantities.(K5)

UNIT I BASICS OF CNC MACHINES **(9 Hrs)**

CNC machines: Classification – Construction details: Structure, Configuration of CNC system – Compensations for Machine accuracy – DNC – Adaptive control CNC systems, Drives and Controls - Drive Mechanism, gearbox, Spindle Drives, Axes drives - Magnetic Levitation and Linear motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways.

UNIT II TOOLING FOR CNC MACHINES **(9 Hrs)**

Interchangeable tooling system – Preset and qualified tools – coolant fed tooling system – Modular fixturing – Quick change tooling system – Automatic head changers – Tooling requirements for Turning and Machining centres – Tool holders – Tool assemblies – Tool Magazines – ATC Mechanisms – Automatic Pallet Changer-Tool management. Principles of location, clamping and work holding devices.

UNIT III ECONOMICS OF CNC MACHINES **(9 Hrs)**

Economics of CNC Machines and Retrofitting: Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements. Retrofitting.

UNIT IV LINEAR AND ANGULAR MEASUREMENTS **(9 Hrs)**

Basic concepts: Legal metrology- Precision- Accuracy- Types of errors – Standards of measurement- Traceability – Interchangeability and selective assembly. Introduction to limits, fits and tolerances, Gauge design-Comparators-Angular measurement: bevel protractor - Angle gauges - Sine bar.

UNIT V INTERFEROMETRY AND LASER METROLOGY **(9 Hrs)**

Principle of light wave interference – Optical flats -Michelson and NPL flatness interferometer, Laser interferometer. Advances in Metrology: Coordinate Measuring Machine (CMM): Types - Constructional features-Possible causes of errors in CMM - Probing system – Performance and applications of CMM. Machine Vision System: Applications of machine vision in measurement- In process and On line measurement.

Text Books

1. Narang J.S. and Narang V.D.S., "CNC Machines and Automation", Dhanpat Rai and Co. Pvt. Ltd., 2016.
2. HMT Limited, "Mechatronics", Tata McGraw-Hill, New Delhi, 2001
3. Jain R.K., ―Engineering Metrology‖, Khanna Publishers, New Delhi, 2013

Reference Books

1. M. Adithan, B.S. Pable, "CNC Machines", New age international publications,2016
2. Mahesh Dhotre, D. Rao, "CNC Machine Tool Technology with Programming and Operating", Saitech publications 2016
3. Mahajan M, "Textbook Of Metrology", Dhanpat rai & Co.2010.
4. Raghavendra,, Krishnamurthy," Engineering Metrology and Measurements" OUP India, 2013
5. Anil Akdogan" Metrology " BoD – Books on Demand – 2018
6. E. Mainsah, J.A. Greenwood, D.G. Chetwynd Metrology and Properties of Engineering Surfaces" Springer Science & Business Media – 2013.

Web Resources

1. https://nptel.ac.in/courses/112/105/112105211/
2. https://nptel.ac.in/courses/112/106/112106179/
3. https://swayam.gov.in/nd1_noc19_me46/preview
4. https://swayam.gov.in/nd1_noc20_me94/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP507	**MICROPROCESSORS AND CONTROLLERS LAB**	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**2**	**1**	**30**

Course Objectives

- To know about programming for 8085 microprocessor and 8051 microcontrollers
- To enlarge a microcontroller based system for Mechatronics applications
- To Verify programming logic and interfacing circuits using simulation software
- To develop the quality of assessing and analyzing the obtained data.
- To expose students to the operation of typical microprocessor (8085) trainer kit.

Course Outcomes

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

CO1 - Relate programming for 8085 microprocessor and 8051 microcontroller (K2)
CO2 - Utilize programming logic and interfacing circuits using simulation software (K3)
CO3 - Develop a microcontroller based system for Mechatronics applications (K3)
CO4 - Compare testing and experimental procedures on Microprocessor and Microcontroller analyze their operation under different cases. (K5)
CO5 - Prove professional quality textual and computational results, incorporating accepted data analysis and synthesis methods, simulation software, and word-processing tools.(K5)

List of Experiments

Assembly Language Programming

1. Arithmetic functions using 8085 Microprocessor
2. Arithmetic functions using 8051 Microcontroller.

Embedded C Programming and hardware interfacing using 8051 Microcontroller

3. Interfacing of switch, LED and seven segment LED
4. Interfacing of LCD
5. DC motor programming for the given case study
6. Stepper motor programming for the given case study
7. Servo motor programming for the given case study
8. Actuation of pneumatic cylinders for the given case study
9. Interfacing of high power devices for the given case study
10. Study on Interfacing sensors, microcontroller with IoT module

Reference Books

1. G.T. Swamy “Microprocessor (8085) Lab Manual” Firewall Media. – 2006
2. KalpathiRamani “Microcontrollers And Applications With Lab Manual” Pearson Education India – 2010
3. Navas, K. A. “Electronics Lab Manual (Volume 2)” PHI Learning Pvt. Ltd. 2018
4. D.A.GodseA.P.Godse” Microprocessors and microcontroller” Technical Publications. – 2008
5. Dr Anita Gehlot, Dr Rajesh Singh, P. Raja “Microprocessor and Microcontroller Interview Questions: A complete question”BPB Publication – 2020

Web Resources

1. https://www.iitk.ac.in/new/microprocessor-and-microcontroller-laboratory.
2. http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php
3. http://iiekalyani.com/electronics-communication-engineering/microprocessor-microcontroller-lab/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
2	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
3	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
4	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
5	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP508 **VIRTUAL INSTRUMENTATION LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To enable the students to model, simulate and test the Electronics & Instrumentation based design
- To provide a design flexibility using graphical programming language
- To provide a platform for the students to do multidisciplinary projects
- To facilitate the conduct of short term and continuous learning programmes.
- To familiarize the basics and interfacing of VI

Course Outcomes

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

CO1 - Describe acquisition methodologies. (K2)
CO2 - Compare traditional and virtual instrumentation. (K3)
CO3 - Discuss operating systems required for virtual instrumentation (K3)
CO4 - Illustrate implementation methods for instrumentation. (K3)
CO5 - Familiarize the basics and interfacing of VI.(K3)

List of Experiments

Repetition and Loops:
1. GSD using For loops, while loops with shift registers / feedback nodes
2. GSD using Local variables and Global variables

Structures
3.GSD using Case structures and Sequence structures
4.GSD using Timed structures, Formula nodes and Event structures

Plotting data:
5. GSD using Waveform graph, Waveform chart, XY graph

Strings:
6. GSD using string functions, editing, formatting and parsing string

Arrays and clusters:
7. GSD using arrays functions and multi-dimensional arrays
8. GSD using clusters operations: assembling clusters and disassembling clusters

Modular Programming:
9. Creating sub VIs from section of a VI
10. File Input / File Output function Read / Write a file.

Data Acquisition system (DAQ or MyRio):
11. GSD for real time measurement using Thermistor / Piezo-electric sensor

12. GSD for real time monitoring using Seven-Segment LED Display/ Motor/ Buzzer/ Speaker

Reference Books

1. LabView Tutorial Manual, National InstrumentsCorp., 1996-2010 (www.ni.com).
2. LabVIEW. Basics Course Manual, National Instruments Corp., USA, 1998-2010
3. http://www.plasma.uaic.ro/ro/downloads/cat_view/59-instrumentatie-virtuala - course support
4. LabVIEW Graphical Programming, Gary W. Johnson, Richard Jennings 3rd edition , McGraw-Hill Professional Publishing
5. Lisa K Wells, Lab view for Everyone‖, Prentice Hall of India.

Web Resources

1. https://www.unibo.it/en/teaching/course-unit-catalogue/course-unit/2013/376395
2. https://jecassam.ac.in/wp-content/uploads/2018/10/12Virtual-Instrumentation-lab_.pdf
3. https://www.bits-pilani.ac.in/uploads/Pilani_Upload/EEE/VIRTUAL%20INSTRUMENTATION.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
2	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
3	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
4	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
5	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP509	CNC AND METROLOGY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To practice and execute the part program using CNC trainer machines
- To interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments
- To measurements with and calibration of instruments
- To simulate using CAM package and interface the developed program with the machines
- To develop, simulate and execute part program using CNC production machines

Course Outcomes

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

CO1 - Relate and execute the part program using CNC trainer machines (K2)
CO2 - Develop, simulate and execute part program using CNC production machines(K3)
CO3 - Discover using CAM package and interface the developed program with the machines(K4)
CO4 - Interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments(K5)
CO5 - The select and use the appropriate measuring instrument according to a specific requirement (K5)

List of Experiments

1. Study of G codes and M codes for machining centre and turning centre
2. Programming and machining of given component using MTAB trainer machine
3. Programming and machining of given component using CNC turning centre
4. Programming and machining of given component using CNC turning centre
5. CNC code generation of given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre
6. Programming and machining of given component using CNC machining centre
7. Programming and machining of given component using CNC machining centre
8. CNC code generation of given component using MASTER CAM (Mill) and interfacing it to CNC machining centre
9. Calibration of Vernier / Micrometer; static characteristic study- Measurement of Components like V block etc.
10. Calibration of Dial Gauge; static characteristic study; Use of dial gauge as measuring device and Comparator.
11. Calibration of profile projector and measurement of micro components.
12. Study of Autocollimator, Surface roughness tester and coordinate measuring machine (CMM).

Reference Books

1. Peter Smid “CNC Control Setup for Milling and Turning: Mastering CNC Control Systems“Industrial Press Inc - 2010
2. Dennis A. Keeling “How to Use a Cnc Router: A Practical Guide for Beginners “Create Space Independent Publishing Platform, 2017
3. James A. Harvey” CNC Trade Secrets: A Guide to CNC Machine Shop Practices” Industrial Press, Incorporated, 2014
4. Bewoor “Metrology & Measurement” Tata McGraw-Hill Education 2009
5. Zhiyong Ma, David G. Seiler “Metrology and Diagnostic Techniques for Nanoelectronics CRC Press. “– 2017.
6. Jerzy A. Sładek “Coordinate Metrology: Accuracy of Systems and Measurements **“**Springer**.- 2015**

Web Resources

1. https://www.youtube.com/watch?v=pPwyYFvRLts
2. https://www.youtube.com/watch?v=HpIEeBtJupY
3. https://mech.iitd.ac.in/content/cnc-lab

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
2	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
3	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
4	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
5	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCC5XX	**CERTIFICATION COURSE – V**	**0**	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCS504	**SKILL DEVELOPMENT COURSE – IV**	**0**	**0**	**2**	**-**	**30**

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCS505	**SKILL DEVELOPMENT COURSE – V** **(Presentation Skills using ICT)**	**0**	**0**	**2**	**-**	**30**

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

CT skills

- Understand ICT workflow in cloud computing.
- Manage multitasking.
- Deal with main issues using technology in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Teaching tools

- Different ways to create audiovisual activities.
- Handle audiovisual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained for this course is not considered for CGPA calculation.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCM505	**INDIAN CONSTITUTION**	**2**	**0**	**0**	**-**	**30**

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT613	EMBEDDED SYSTEM DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the Embedded concepts and Embedded System Architecture
- To learn the architecture and programming of ARM Cortex Microcontroller
- To select a proper Microcontroller for an application
- To understand the usage of the development and debugging tools
- To learn and apply the knowledge of Memory systems and Peripherals

Course Outcomes

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

CO1- Infer the fundamentals of an embedded system and compare with general purpose System (K2)
CO2- Illustrate the methods adapted for the development of a typical Embedded system (K3)
CO3- Demonstrate the RTOS and related mechanisms like an ability to design a system, component, or process to meet desired needs within realistic constraints (K3)
CO4- Identify, formulate, and solve engineering problems (K4)
CO5- Use the techniques, skills, and modern engineering tools necessary for engineering practice (K4)

UNIT I INTRODUCTION TO EMBEDDED SYSTEM (9 Hrs)

Embedded system processor, hardware unit, software embedded into a system, Example of an embedded system, Embedded Design life cycle, Embedded System modelling [flow graphs, FSM, Petri nets], Layers of Embedded Systems.

UNIT II PROCESSOR AND MEMORY ORGANIZATION (9 Hrs)

Bus Organization, Memory Devices and their Characteristics, Instruction Set Architecture [RISC, CISC], Basic Embedded Processor/Microcontroller Architecture [8051, ARM, DSP, PIC], memory system architecture [cache, virtual, MMU and address translation], DMA, Co-processors and Hardware Accelerators, pipelining.

UNIT III I/O DEVICES AND NETWORKS (9 Hrs)

I/O Devices[Timers, Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices], Memory Interfacing, I/O Device Interfacing [GPIB, FIREWIRE, USB, IRDA], Networks for Embedded systems(CAN, I2C, SPI, USB, RS485, RS 232), Wireless Applications [Bluetooth, Zigbee].

UNIT IV OPERATING SYSTEMS (9 Hrs)

Basic Features of an Operating System, Kernel Features [polled loop system, interrupt driven 113 system, multi rate system], Processes and Threads, Context Switching, Scheduling[RMA, EDF, fault tolerant scheduling], Inter-process Communication, real Time memory management [process stack management, dynamic allocation], I/O[synchronous and asynchronous I/O, Interrupts Handling, Device drivers], RTOS [VxWorks, RT-LINUX].

UNIT V EMBEDDED SYSTEM DEVELOPMENT (9 Hrs)

Design Methodologies [UML as Design tool, UML notation, Requirement Analysis and Use case Modeling],Design Examples[Telephone PBX, Inkjet Printer, PDA ,Elevator Control System, ATM System], Fault-toleranceTechniques, Reliability Evaluation Techniques.

Text Books

1. Rajkamal, Embedded System-Architecture, Programming, Design, Mc Graw Hill, 2013.
2. Peckol, Embedded system Design, John Wiley and Sons,2010

3. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013

Reference Books

1. Shibu. K.V, Introduction to Embedded Systems, Tata Mcgraw Hill,2009.
2. Elicia White, Making Embedded Systems, O Reilly Series, SPD,2011.
3. Tammy Noergaard Embedded Systems Architecture, Elsevier, 2006.
4. Han-Way Huang, Embedded system Design Using C8051, Cengage Learning,2009.
5. Rajib Mall Real-Time systems Theory and Practice Pearson Education, 2007.

Web Resources

1. https://www.inspirenignite.com/anna-university/introduction-to-embedded-systems-mechatronics-7th-sem-syllabus-for-be-2017-regulation-anna-univ-open-elective-ii/
2. https://www.edn.com/mechatronics-based-embedded-design/
3. https://www.intechopen.com/books/design-control-and-applications-of-mechatronic-systems-in-engineering/embedded-controller-design-for-mechatronics-system
4. https://www.embeddedcomputing.com/application/misc/mechatronics-aids-in-embedded-system-design
5. https://www.hindawi.com/journals/jr/2012/932305/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	1	1	2
2	3	3	3	2	2	-	-	-	-	-	-	2	1	1	2
3	2	2	2	-	1	-	-	-	-	-	-	2	1	1	2
4	2	3	3	2	2	-	-	-	-	-	-	2	1	1	2
5	3	3	3	-	2	-	-	-	-	-	-	2	1	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT614	FLUID POWER SYSTEMS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the concepts, construction and working principles of fluid power system
- To recognize the construction and working of pumps and actuators for hydraulic system
- To identify the usage of various directional control valves in hydraulic systems
- To be aware of the performance of pneumatic systems
- To apply various methods to design and execute hydraulic and pneumatic systems.

Course Outcomes

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

CO1 - Illustrate the fundamentals of hydraulic systems and determine losses incurred in hydraulic circuit (K2)
CO2 - Experiment with the suitable pump and actuators for particular application.(K3)
CO3 - Make use of various hydraulic valves.(K3)
CO4 - Analyze various fundamentals of pneumatic systems. (K4)
CO5 - Develop hydraulic and pneumatic circuits for simple application (K5)

UNIT I FLUID POWER SYSTEMS **(12 Hrs)**

Introduction to fluid power – History – Pascal's law – Components - Advantages – Drawbacks – Applications. Hydraulic fluids: Functions, Properties. Darcy's equation – Frictional losses – Losses in valves and fittings – Determination of head losses & pump power in a hydraulic circuit.

UNIT II HYDRAULIC PUMPS AND ACTUATORS **(12 Hrs)**

Positive and Non-positive displacement pumps – Pumping theory – Pump classification – Construction and working principle of Gear, Vane and Piston pumps. Pump performance – Pump performance curves. Hydraulic cylinder (double acting) – Construction & Working principle – Double rod cylinder – Telescopic cylinder. Hydraulic motors: Gear, Vane and Piston motor.

UNIT III HYDRAULIC VALVES **(12 Hrs)**

Directional control valves: Check valve – Pilot operated check valve – 3/2 valves – 4/2 valves – methods of valve actuation – Shuttle valve. Pressure control valves: Pressure relief valves - Pressure reducing valve, Unloading valves, Counter balance valves - Flow control valves - Servo valves: Mechanical type.

UNIT IV PNEUMATIC SYSTEMS **(12 Hrs)**

Introduction – Properties of air – gas laws – Compressors: Piston compressor, Screw compressor and Vane compressor. Fluid conditioners: Air filters, Air pressure regulators, Air lubricators, Pneumatic silencers and Air dryers. Pneumatic actuators: Pneumatic cylinders, Rotary air motors – Performance curves.

UNIT V DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS **(12 Hrs)**

Sequential circuit design for simple applications: Step counter method, Cascade methods &KarnaughVeitch map method – PLC circuit design using ladder logic.

Text Books

1. S. R. Majumdar, Oil Hydraulics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014
2. James L. Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2013.
3. Patrick J. Klette "Fluid Power Systems" American Technical Publishers, Incorporated, 2014

Reference Books

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2015.
2. Md Faiyaz Ahmed “Fluid Power Control Systems“Lulu.com. – 2016.
3. NicolaeVasiliu, Daniela Vasiliu, Constantin C?Linoiu” Simulation of Fluid Power Systems with SimcenterAmesim “CRS Press – 2018
4. Yaobao Yin “Electro Hydraulic Control Theory and Its Applications Under Extreme Environment“Butterworth-Heinemann– 2019
5. P.K. Guha “Hydraulic Pumps & Motors and their Applications” Dog Ear Publishing. 2018

Web Resources

1. https://nptel.ac.in/courses/112/104/112104117/
2. https://nptel.ac.in/courses/112/105/112105206/
3. https://swayam.gov.in/nd1_noc20_me55/preview
4. https://www.youtube.com/watch?v=S_4anj7GpRo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT615	INDUSTRIAL ROBOTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge on direct and inverse kinematics of manipulator
- To understand the basic elements of serial and parallel robots
- To learn trajectory and motion analysis of robotic movements
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To develop the student's knowledge in various robot structures and their workspace.

Course Outcomes

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

CO1- Understand the components and parameters of industrial robots (K2)
CO2 - Solve forward kinematics, inverse kinematics and Jacobian for serial and parallel robots (K3)
CO3 - Analyze the classification of end effectors.(K4)
CO4 - Evaluate the kinematic calculations to the industrial robots.(K5)
CO5 - Choose the trajectory planning to the robots.(K5)

(9 Hrs)

UNIT I INTRODUCTION

A brief history – Definition - Laws of Robotics - Basic components of robot - concept of work cell - degrees of freedom (DOF) – Resolution – Accuracy – Repeatability – Payload – Precision - classification of Industrial robot manipulator - common kinematic arrangement.

(9 Hrs)

UNIT II END EFFECTORS

Unilateral Vs Multilateral end effectors - mechanical grippers: gripping force estimation with payload under acceleration – vacuum - magnetic - air operated grippers Remote centre compliance - Robot cell layouts.

UNIT III KINEMATICS OF ROBOT MANIPULATOR

Representing position and rotation - rotation in plane - rotation in three dimension - Rotational transformation - Rotation with respect to the current frame and fixed frame - Rule for composition of rotational transformation - Parameterization of rotation - Euler angle, Roll, Pitch, Yaw angles Axis/angle representation - rigid motion - Homogeneous transformation - DenavitHartenberg convention

(9 Hrs)

UNIT IV ROBOT DYNAMICS AND TRAJECTORY PLANNING

Velocity kinematics - Jacobian - Derivative of rotation matrix - addition of angular velocity - Derivation of Jacobian combining the linear and angular velocity Jacobian - Euler Lagrange equation, kinetic and potential energy, Equation of motion, Newton Euler formulation - Trajectory planning for point to motion - Cubic polynomial - Quintic polynomial trajectory - Linear segment with parabolic bend (LSPB) minimum time trajectory - trajectory for path specified by via point.

(9 Hrs)

UNIT V ROBOT SENSOR

Ultrasonic sensors -Range finding- time of flight LIDAR- triangulation techniques -Vision for 3D measurement - structured lighting stereo vision and camera calibration. For Further Reading**-**Industrial robots for welding, painting and assembly, remote Controlled robots, Robots for nuclear thermal and chemical plants, Industrial automation, typical example of automated industries, application of visual inspection.

Text Books

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012
2. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2008

Reference Books

1. J.J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall Inc. / Pearson Education, 2008
2. Tsai, L. W., Robot Analysis: The Mechanics of Serial and Parallel Manipulators, John Wiley & Sons, Inc, New York, 1999.
3. RamachandranNagarajan “Introduction to Industrial Robotics” Pearson Education India, 2016
4. TadejBajd, MatjazMihelj, JadranLenarcic, Ales Stanovnik, Marko Munih “Robotics (Intelligent Systems, Control and Automation: Science and Engineering)’Springer 2012
5. James Perlberg” Industrial Robotics” Cengage Learning, 2016.

Web Resources

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://swayam.gov.in/nd1_noc20_me03/preview
3. https://www.youtube.com/watch?v=xrwz9IxpMJg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT616	DESIGN OF MECHANICAL ELEMENTS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To familiarize the various steps involved in the design process.
- To design shafts, keys and couplings
- To plan gears and analyzing the influence of stresses on it
- To propose brakes and clutches for automobiles with appropriate assumptions
- To devise bearings and springs with appropriate assumptions

Course Outcomes

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

CO1 - Interpret the influence of steady and variable stresses in machine component design.(K2)
CO2 - Make use of concepts of shafts, keys and couplings with proper assumptions. (K3)
CO3 - Analyze of spur, helical, bevel, worm gear drives and multi speed gear box (K4)
CO4 - Function of clutches and braking systems (K4)
CO5 - Evaluate bearings and springs problems.(K5)

(12 Hrs)

UNIT I DESIGN FUNDAMENTALS

Design Process – Computer aided design – Optimum design – Material Standards – Industrial design form and shape design, embodiment design and design for manufacture. Types of loads –Stresses – Static, varying, thermal, impact and residual. Factors of safety – Theories of failure – Stress concentration factors – S-N curves and its applications.

(12 Hrs)

UNIT II SHAFTS AND COUPLINGS

Design of Shafts, Keys and Couplings: Design of Solid and Hollow shafts – Based on strength, rigidity and deflection – Torsional rigidity – Lateral rigidity – Material constants. Design of Keys – Types – Keyways. Design of rigid and flexible couplings.

(12 Hrs)

UNIT III DESIGN OF SPUR, HELICAL GEARS

Principles of gear tooth action – Gear correction – Gear Materials- Gear tooth failure modes. Design of spur, helical gears – Multi speed gear box design –Spur gear – Forward Traverse.

(12 Hrs)

UNIT IV DESIGN OF BRAKES AND CLUTCHES

Brakes – Types – Dynamic and thermal aspects of Braking – Braking system in automobiles. Design of clutches – Single plate – Multi plate –Conical clutch – Over running clutch.

(12 Hrs)

UNIT V DESIGN OF BEARINGS AND SPRINGS

Study of Bearings – Design of Bearings – Sliding contact –Rolling contact – Cubic mean load. Design of Journal Bearings – Calculation of Bearing dimensions – Springs - Design of Helical spring, Leaf springs – Types of springs – Wahl factor – Problems.

Text Books

1. Bhandari***V***.B., Design of Machine Elements,4th edition, McGraw Hill Education India ,2017
2. Ganesh Babu K., K. Srithar, Design Of Machine Elements,1st Edition, McGraw Hill,2009
3. Spotts M.F., Shoup T.E., Hornberger L.E., Design of Machine Elements: 8th edition, Pearson /Prentice Hall,2003

Reference Books

1. Hamrock B.J., Fundamentals of Machine Elements, 2nd edition, McGraw Hill,2004
2. Juvinall R.C. ,K.M. Marshek, Fundamentals of machine component design: 6th edition, John Wiley.2011
3. Ansel C. Ugural, Mechanical Design of Machine Components, SI Version CRC Press, 2018·
4. Wei Jiang, Analysis and Design of Machine Elements. Wiley, 2019
5. Vijay Kumar Jadon, Suresh Verma, Analysis and Design of Machine Elements, I.K. International Publishing House Pvt. Limited, 2010

Web Resources

1. https://mech.iitm.ac.in/meiitm/course/design-of-machine-elements/
2. https://nptel.ac.in/courses/112/105/112105125/
3. http://www.nptelvideos.in/2012/12/design-of-machine-elements.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP610	EMBEDDED SYSTEM DESIGN LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce using microcontrollers with foundational concepts of microcontroller architecture and programming.
- To establish hardware and software integration for real time systems using microcontrollers
- To commence to embedded systems design tools and hardware.
- To gain both simulation and practical implementation of microcontroller including timers and counters,
- To produce embedded systems I/O techniques and requirements, A/D conversion, serial communications

Course Outcomes

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

CO1 - Understand about Analog to digital converting technique(K2)
CO2 - communication techniques, Real time clock and various sensor handling methods.(K2)
CO3 - Relate in different Operating systems such as Ubuntu, Rasbian OS. (K3)
CO4 - Apply programs in various platforms such as Embedded C, C++, HTML, DBMS. (K4)
CO5 - Analyze different types of analog and digital sensors. (K5)

List of Experiments

1. Voltage Measurement with display
2. Designing a voltmeter to measure voltage from0to5voltsanddisplaying the measured value using7segment displays
3. Design of Real Time Clock using MCS 51 using segment Displays.
4. Design of Water Pump Controller to sense the water level in a tank
5. Digital Clock with LCD display a. Temperature Measurement with 7 segment display
6. Implementation of UART, ADC and DAC features
7. Design of Single Channel Data Acquisition System
8. PC Communication
9. Interfacing the microcontroller to a PC through RS232 interface and displaying themessagessentbythemicrocontrolleronthePCusingVisualBasicprogram running in PC
10. Remote Control through FM Link
11. Establishing an FM link between two microcontrollers for data transfers.
12. Hot Chamber Controller to maintain the temperature at the set point.
13. Obstacle Detector using ultrasonic transmitter-receiver
14. Moisture sensor and sprinkler controller design

Reference Books

1. KalpathiRamani “Microcontrollers And Applications With Lab Manual” Pearson Education India2010.
2. Manish K. Patel “The 8051 Microcontroller Based Embedded Systems” Tata McGraw-Hill Education. – 2014
3. Perry Xiao “Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed” John Wiley & Sons– 2018
4. Jonathan W. Valvano “Embedded Systems: Introduction to Robotics” Independently Published, 2019
5. James K. Peckol “Embedded Systems: A Contemporary Design Tool“ John Wiley & Sons.- 2019

Web Resources

1. https://nptel.ac.in/courses/106/105/106105159/
2. https://www.youtube.com/watch?v=9Q-3c0gQcok
3. https://www.youtube.com/watch?v=G9_pQzt1sts

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
2	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
3	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
4	3	2	3	3	2	-	-	-	3	-	-	2	2	2	3
5	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP611	FLUID POWER SYSTEMS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the concepts, construction and working principles of fluid power system Components
- To design and test the hydraulic and pneumatic circuits using MATLAB/LABVIEW software and simulate the circuits using Automation studio software.
- To familiarize in fluid power automation and different components of Hydraulics, pneumatics, electro hydraulic/ electro pneumatic and PLC based systems
- To Hands on experience in designing and executing of circuits for real systems.
- To build the circuit using Fluid SIM and try different loads in order to realize its effect on the system performance.

Course Outcomes

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

CO1- Show the actuators and valves for the design of fluid power circuits. (K2)
CO2 - Identify design and simulate the fluid power circuits using software tool. (K3)
CO3 - Analyzing the fluid power circuits using suitable actuators and valves.(K4)
CO4 - Evaluate operation and maintenance of common fluid power components. (K5)
CO5 - Choose standard schematic symbols for common fluid power components (K5)

List of Experiments

Design and testing of hydraulic circuits such as

- Pressure control
- Flow control
- Direction control
- Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer kit.

Design and testing of pneumatic circuits such as

- Pressure control
- Flow control
- Direction control
- Circuits with logic controls
- Circuits with timers
- Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
- Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using MATLAB/LABVIEW software

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

Reference Books

1. BireswarMajumdar “Fluid Mechanics with Laboratory Manual” PHI Learning Pvt. Ltd – 2016
2. R. V. RAIKAR “LABORATORY MANUAL HYDRAULICS AND HYDRAULIC MACHINES **“** PHI Learning Pvt. Ltd **– 2012**
3. Cameron Tropea, Alexander L. Yarin, John F. Foss “Springer Handbook of Experimental Fluid Mechanics” Springer Science & Business Media – 2007
4. Zh. Zhang “Hydraulic Transients and Computations “Springer International Publishing, 2020

5. Gustavo Costa, NarimanSepehri "Hydrostatic Transmissions and Actuators: Operation, Modelling and Applications" John Wiley & Sons. – 2015.

Web Resources

1. http://fm-nitk.vlabs.ac.in/#
2. http://fmc-nitk.vlabs.ac.in/
3. http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/fluid-machinarylab/index.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
2	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
3	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
4	3	2	3	3	2	-	-	-	3	-	-	2	2	2	3
5	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U91MCP612 **INDUSTRIAL ROBOTICS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn about different types of robots and its components.
- To understanding Robot kinematics – forward and reverse kinematics
- To gain the programming for the required robot motion
- To determine the robotic applications, by interfacing it with real environment.
- To provide analysis skills associated with trajectory planning and robot control.

Course Outcomes

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

CO1 - Show the type of robot and various motions.(K2)
CO2 - Build the robot forward and reverse kinematics. (K2)
CO3 - Select a suitable robot for a specific application. (K3)
CO4 - Analyzing programming Robots for performing various tasks.(K4)
CO5 - Evaluate simulate a robot which meets kinematic requirements. (K5)

List of Experiments

1. Study of the major components of the robot.
2. Study of the robotic simulation/ programming software.
3. Study of forward and reverse kinematics, to program the sequence of motion of a robot.
4. Programming an industrial robot for performing various applications involving Point-to-point motion of the manipulator arm.
5. Programming an industrial robot for performing various applications involving continuous path motion of the manipulator arm.
6. Interfacing an industrial robot with a belt conveyor.
7. Developing program for an industrial robot to perform pick and place operation.
8. Programming of Industrial Robot for material handling application
9. Programming of industrial robot for processing application
10. Simulation of various Robot work cells (SOFT WARE).
11. Programming an industrial robot for a sorting operation using a sensing system.

Reference Books

1. Rex Miller, Mark R. Miller “Robots and Robotics: Principles, Systems, and Industrial Applications “McGraw Hill Professional, 2017
2. Bruno Siciliano, OussamaKhatib “Springer Handbook of Robotics“Springer. – 2016
3. Kevin M. Lynch, Frank C. Park “Modern Robotics” Cambridge University Press - 2017
4. Thomas R. Kurfess “Robotics and Automation Handbook” CRC Press. – 2018
5. Mark W. Spong, Seth Hutchinson, M. Vidyasagar “Robot Modeling and Control” John Wiley & Sons. 2020

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P 11	O12	PSO1	PSO2	PS 3
1	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
2	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
3	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
4	3	2	3	3	2	-	-	-	3	-	-	2	2	2	3
5	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCC6XX **CERTIFICATION COURSE – VI**

L	T	P	C	Hrs
0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCS606	**SKILL DEVELOPMENT COURSE – VI**	**0**	**0**	**2**	**-**	**30**

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20MCS607	**SKILL DEVELOPMENT COURSE – VII** **(Technical Seminar)**	**2**	**0**	**0**	**-**	**30**

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

Course Outcomes

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

CO1 - Review, prepare and present technological developments.

CO2 - Face the placement interviews.

Method of Evaluation:

- During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 20 minutes.
- In a session of three periods per week, 8 to 10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluated based on that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCS608	SKILL DEVELOPMENT COURSE – VIII (NPTEL / MOOC - I)	L	T	P	C	Hrs
		0	0	0	-	30

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCM606 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

L	T	P	C	Hrs
2	0	0	-	30

Course Objectives

The course will introduce the students to

- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

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

CO1- Understand philosophy of Indian culture.

CO2 -Distinguish the Indian languages and literature.

CO3 -Learn the philosophy of ancient, medieval and modern India.

CO4 - Acquire the information about the fine arts in India.

CO5 - Know the contribution of scientists of different eras.

UNIT - I INTRODUCTION TO CULTURE:

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT - II INDIAN LANGUAGES, CULTURE AND LITERATURE:

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

UNIT - III RELIGION AND PHILOSOPHY:

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING):

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT – V EDUCATION SYSTEM IN INDIA:

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Reference Books

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal BanarsidassPublishers, ISBN 13: 978- 8120810990, 2014

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT717	PLC AND DATA ACQUISITION SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the evolution and advantages of PLC
- To understand the various PLC instructions.
- To study the used of PLC for some specific applications
- To understand the need of computer control in automation
- To study the data acquisition systems.

Course Outcomes

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

CO1- Understand the fundamental of PLC.(K2)
CO2- Program a PLC with different logical languages(K3)
CO3- Various industrial applications of PLCs are studied (K2)
CO4- Understand the need of computer in Automation(K2)
CO5- Understand the basics of data conversion and data acquisition. (K2)

UNIT I BASICS OF PLC (9 Hrs)

Definition and History of PLC-PLC advantage and disadvantages- Over all PLC systemsCPU and Programmer/Monitors-PLC input and output models – Architecture- PLC Programming language – Relay logic – Ladder logic – Programming of Gates – Flow charting as a programming method – connecting PLC to computer - PLC Troubleshooting and Maintenance.

UNIT II PLC PROGRAMMING (9 Hrs)

Programming of Timers – Introduction - ON delay, OFF delay, Retentive Timers – PLC Timer functions – Examples of timer function Industrial application. Programming Counters – up/down counter – Combining counter - Examples of counter function Industrial application.PLC Arithmetic Functions – PLC number Comparison function

UNIT III PLC DATA HANDLING FUNCTIONS (9 Hrs)

PLC Program Control Instructions: Master Control Reset - Skip – Jump and Move Instruction. Sequencer instructions - Types of PLC Analog modules and systems, PLC analog signal processing – BCD or multi bit data processing – Case study of Tank level control system, bottle filling system and Sequential switching of motors

UNIT IV COMPUTER CONTROL – INTRODUCTION (9 Hrs)

Need of computer in a control system-Functional block diagram of a computer control system-Data loggers-Supervisory computer control- Direct digital control-Digital control interfacing-SCADA.

UNIT V DATA ACQUISITION SYSTEMS (9 Hrs)

Sampling theorem – Sampling and digitizing – Aliasing – Sample and hold circuit – Practical implementation of sampling and digitizing – Definition, design and need for data acquisition systems – Interfacing ADC and DAC with Microprocessor / Multiplexer - Multiplexed channel operation –Microprocessor/PC based acquisition systems

Text Books

1. Petrezeulla, “Programmable Logic Controllers”, McGraw Hill, 1989.
2. Curtis D. Johnson,” Process Control Instrumentation Technology”, 8th edition Prentice Hall June 2005
3. D.Roy Choudhury and Shail B.Jain, Linear Integrated circuits, New age International Pvt .Ltd, 2003.

Reference Books

1. Hughes .T, "Programmable Logic Controllers", ISA Press, 1989.
2. G.B.Clayton," Data Converters", The Mac Millian Press Ltd., 1982.
3. John w.Webb & Ronald A.Reis., "Programmable logic controllers- principles and applications", 5th Edition – PHI Learning Pvt. LTd, New Delhi -2010
4. Prof. Rajesh Mehra, Plcs & Scada - Theory And Practice, Laxmi Publication
5. Bolton W. , "Mechatronics", Pearson Education, 2009

Web Resources

1. https://www.youtube.com/watch?v=I_9Pwyxhe40
2. https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada
3. https://onlinecourses.nptel.ac.in/noc20_me39/preview
4. https://nptel.ac.in/courses/108/105/108105062/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
2	3	2	1	-	-	-	-	-	-	-	2	2	3	2	3
3	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3
4	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
5	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT718	DESIGN OF MECHATRONICS SYSTEM	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To study Mechatronics system design and simulation, ergonomics and safety
- To gain knowledge on theoretical and practical aspects of computer interfacing, real time data acquisition and control
- To study design of motion control, motion converter and temperature control
- To gain knowledge on real time interfacing
- To undergo case studies on Mechatronic system

Course Outcomes

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

CO1- Understand the basics and key elements of Mechatronics design process(K2)
CO2- Familiar with basic system modeling(K2)
CO3- Realize the concepts of real time interfacing and data acquisition(K3)
CO4- Realize the concepts of real time interfacing and data acquisition(K3)
CO5- Understanding the concepts of design of Mechatronic system through case studies(K2)

UNIT I INTRODUCTION TO DESIGN OF MECHATRONICS SYSTEM **(12 Hrs)**

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

UNIT II BASIC SYSTEM MODELLING **(12 Hrs)**

Basic building blocks of system modelling. Modelling of mechanical system- Modelling of mechanical and electrical systems - Simple exercises in linear, rotary motions.

UNIT III INTERFACING AND DATA ACQUISITION **(12 Hrs)**

Sensor selection, Real-time interfacing – Introduction - Elements of data acquisition and control and Frequency Domain- Applications.

UNIT IV ALGORITHMS FOR ADVANCED CONTROL **(12 Hrs)**

Advanced applications in Mechatronics: Mechatronic Control in Automated Manufacturing – Artificial intelligence in Mechatronics – Fuzzy Logic Applications in Mechatronics

UNIT V CASE STUDIES ON DESIGN OF MECHATRONICS SYSTEM **(12 Hrs)**

Motion control using DC Motor, AC Motor and Servomotor - Temperature control of hot/cold reservoir – Pick and place robot – Carparking barriers – Motion and temperature control of washing machine – Auto focus camera, exposure control

Text Books

1. S Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition,Cengage Learning 2011
2. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003.

Reference Books

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
2. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

3. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print 2010.
4. Theory and Practice of Mechatronics System, Pearson Education, 2007.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_me129/preview
2. https://onlinecourses.nptel.ac.in/noc21_me27/preview
3. https://www.edx.org/course/mechatronics
4. https://www.classcentral.com/course/edx-the-mechatronics-revolution-fundamentals-and-core-concepts-19083

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	2	1	3	2	3
2	3	2	2	2	-	-	-	-	-	-	2	2	3	2	3
3	3	2	2	2	-	-	-	-	-	-	2	3	3	2	3
4	3	2	2	2	-	-	-	-	-	-	2	1	3	2	3
5	3	2	2	2	-	-	-	-	-	-	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSP703	BUSINESS BASICS FOR ENTREPRENEUR	L	T	P	C	Hrs
		0	0	2	1	18

Course Objectives

- To develop a clear understanding on Business Plans and their significance.
- To be familiar with various forms of business appropriate for an individual entrepreneur
- To understand various ways of judging a successful opportunity for an entrepreneur
- To know the ways to formulate a successful Operation Plan
- To be aware of things to know to prepare effective financial and marketing plans

Course Outcomes

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

CO1 - Impact comprehensive knowledge of an entrepreneurial ecosystem**. (K6)**
CO2 - Understand the need and significance of Business Plan in the success of an Enterprise.**(K2)**
CO3 - Understand the ways to judge the economic and business viability of proposed venture. **(K2)**
CO4 - Utilize the elements of success of entrepreneurial ventures. **(K3)**
CO5 -Evaluate the effectiveness of different entrepreneurial strategies. **(K5)**

UNIT I THE ENTREPRENEURIAL PERSPECTIVE (6 Hrs)

Entrepreneurship and Family Business Management, Entrepreneurship theory and practice, The Nature and Importance of Entrepreneurs, The Entrepreneurial and Intrapreneurial Mind, The Individual Entrepreneur, International Entrepreneurship Opportunities

UNIT II CREATING AND STARTING THE VENTURE (6 Hrs)

Creativity and the Business Idea, Legal Issues for the Entrepreneur, the Business Plan, the Marketing Plan, the Financial Plan, the Organizational Plan

UNIT III FINANCING THE VENTURE (6 Hrs)

Raising Finance, scaling up the venture, NDA'S and term sheet, Sources of the Capital, Informal Risk Capital and Venture Capital

Report Submission:

- Grooming Entrepreneurial Mind-set
- Interaction with Business Leaders/Bankers/Venture Capitalists
- Finding and evaluating an idea
- Develop a business plan
- Financing for a company start-up
- Setting up a company-legal entity
- Entrepreneurial development and employment creation
- Effects of creativity and innovation on the entrepreneurial performance of family business

Text Books

1. Friend, G., & Zehle, S. (2004). Guide to business planning. Profile Books Limited.
2. Lasher, W. (2010). The Perfect Business Plan Made Simple: The best guide to writing a plan that will secure financial backing for your business. Broadway Books.
3. Arjun Kakkar. (2009). Small Business Management: Concepts and Techniques for improving Decisions. Global India Publications.

Reference Books

1. Alexander Osterwalder and Yves Pigneur – Business Model Generation.
2. Arthur R. DeThomas – Writing a Convincing Business Plan.
3. Ben Horowitz – The Hard Thing About Hard Things.
4. Guy Kawasaki – The Art of Start 2.0
5. Hal Shelton – The Secrets to Writing a Successful Business Plan

Web Resources

1. https://www.waveapps.com/blog/entrepreneurship/importance-of-a-business-plan
2. https://www.entrepreneur.com/article/200516
3. https://smallbusinessbc.ca/article/how-to-use-viability-to-test-if-you-should-invest-in-your-business/
4. https://www.infoentrepreneurs.org/en/guides/strategic-planning/
5. http://www.marketingmo.com/strategic-planning/marketing-plans-budgets/
6. https://www.mbda.gov/page/loan-documentation

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	2	-	-	3	3	2	3	1	2	1	2	1
2	1	2	2	2	-	-	3	3	3	2	1	2	2	2	1
3	1	2	2	1	-	-	3	3	3	3	2	3	1	2	3
4	1	3	2	2	-	-	3	3	3	3	2	3	1	2	2
5	1	3	2	2	-	-	3	3	3	2	2	3	1	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP713 COMPUTER AIDED ENGINEERING LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To draw the models in 3Dusing Pro-E/ SOLIDWORKS
- To understand assembly process using Pro-E/ SOLIDWORKS
- To analyze the models using ANSYS

Course Outcomes

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

CO1- Explore various CAD packages and CAE tools(K4)

CO2- Interpret drawings and develop machine components using standard CAD packages (K4)

CO3- Solve the structural, contact and vibrational problems with different loadings using analysis tools(K5)

List of Experiments

1. Part and Assembly drawing of Couplings using Pro-E/ SOLIDWORKS.
2. Part and Assembly drawing of Bearings using Pro-E/ SOLIDWORKS.
3. Part and Assembly drawing of Valves using Pro-E/ SOLIDWORKS.
4. Modeling and Drafting of Machine Elements i.e. Tail Stock/ Screw Jack / Connecting Rod using Pro-E/ SOLIDWORKS
5. Structural analysis of a given component using ANSYS.
6. Thermal analysis of a given application using ANSYS.
7. Modal analysis of a given model using ANSYS.
8. Contact analysis of a model using ANSYS.
9. Shear Force and bending moment diagram using ANSYS.
10. Vibration analysis of an object using ANSYS.
11. Modeling and analyzing of any part models using CAD and CAE packages

Reference Books

1. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, “Computer Integrated Design and manufacturing”, Mc Graw Hill International series, 1991
2. Ibrahim Zeid and R. Sivasubramanian, “CAD/CAM Theory and Practice”, Revised First special Indian Edition, Tata Mc Graw Hill Publication, 2007
3. Ibrahim Zeid, “Mastering CAD/CAM”, special Indian Edition, Tata Mc Graw Hill Publication, 2007

Web Resources

1. https://www.iitr.ac.in/departments/ME/pages/Computer_Aided_Engineering_Laboratory.html
2. https://www.odu.edu/mae/instructional-laboratories/cae
3. https://research.fit.edu/computer-aided-engineering-lab/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	3	-	-	-	3	2	2	1	3	2	3
2	3	2	1	-	3	-	-	-	3	2	2	2	3	3	3
3	3	2	1	-	3	-	-	-	3	2	2	3	3	2	3
4	3	2	1	-	3	-	-	-	3	2	2	1	3	3	3
5	3	2	1	-	3	-	-	-	3	2	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP714	INDUSTRIAL AUTOMATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To identify the differences between various PLCs
- To control some process parameters and test PID algorithm.
- To use the VFD to control the speed of AC motor.

Course Outcomes

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

CO1- Carryout wiring connections and troubleshoot in different PLCs. (K3)
CO2- Develop simple applications using LD, ST and FBD mode of programming. (K4)
CO3- Develop SCADA application using open source software and Perform speed control on AC motor using VFD and PLC. (K4)

List of Experiments

1. Study of different PLCs and their specification
2. Study of installations and troubleshooting of PLC.
3. Development of Ladder Diagram (LD) and Structured Text (ST) programming in PLC for simple applications.
4. Development of an application by using timer and counter of PLC.
5. Solving simple problems using Functional Block Diagram (FBD) programming in PLC
6. Interfacing between PLC and Process loop (temperature)
7. Interfacing between PLC and Process loop (level)
8. Interfacing between PLC and Process loop (flow)
9. Verification and testing of PID controller in a process loop.
10. Develop one application using SCADA system.
11. AC motor speed control using PLC and VFD

Reference Books

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
3. Industrial control handbook, Parr, Newnem
4. Programmable logic controller, Dunning, Delmar

Web Resources

1. https://fac.ksu.edu.sa/sites/default/files/lab-manual_v3.pdf
2. http://iotmumbai.bharatividyapeeth.edu/media/pdf/lab_manuals/Manual_EE5I_EIA_22526.pdf
3. https://pdfcoffee.com/automation-lab-manual-5-pdf-free.html

COs/POs/PSOs Mapping

Program Outcomes (POs)												Program Speci Outcomes (PS(		
PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
3	2	1	-	-	-	-	-	3	1	2	1	3	2	
3	2	1	-	-	-	-	-	3	2	2	2	3	3	
3	2	1	-	-	-	-	-	3	1	2	3	3	2	
3	2	1	-	-	-	-	-	3	2	2	1	3	3	
3	2	1	-	-	-	-	-	3	2	2	3	3	2	

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCP715	COMPREHENSIVE VIVA VOCE	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering concepts, tools, and the process of identifying and solving engineering Problems acquired over 4 years of study in the undergraduate program.

Course Outcomes

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

CO1 - Revise the Mechatronics engineering principles postulations and other technical information in order to apply in various conditions.(K2)

CO2 - Communicate effectively and knowledge of contemporary issues.(K4)

CO3 - Collate and justify the design by the acquired comprehensive technical knowledge and skill.(K5)

CO4 - Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety, manufacturability and sustainability.(K5)

CO5 - Explain the relevance of a technical note for a given application.(K5)

CONTENTS

- The viva shall normally cover the all subjects taught in all the semesters of B.Tech Programme.
- The internal assessment for a total of 50 marks will be made by an internal assessment committee.
- The committee will conduct two written examinations of objective or short questions type from all the core subjects.
- The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the committee.

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCW701	PROJECT PHASE - I	L	T	P	C	Hrs
		0	0	4	2	60

Course Objectives

- To enable students to use all concepts of Mechanical engineering in creating a solution for a problem
- To offer students a glimpse into real world problems and challenges that need.
- To create awareness among the students of the characteristics of several domain areas where Mechanical engineering can be effectively used.
- To improve the team building, communication and management skills of the students.
- To introduce students to the vast array of literature available of the various research challenges in the field of Mechanical engineering.

Course Outcomes

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

CO1 -Identify an innovative or creative idea/concept/solution to a problem. (K2)
CO2 -Design and Develop the working model. (K3)
CO3 -Work independently to lead the project along with team members. (K3)
CO4 -Interpret the results and document the report. (K4)
CO5 -Communicate effectively through presentation.(K5)

CONTENTS

- The Project is a theoretical study/analysis/prototype design/modeling and simulation or a combination of these should be done as group (preferably four students) project.
- The progress of the project is evaluated based on a minimum three reviews and final viva-voce examination.
- A project report is required to be submitted in the standard prescribed format.

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCW702	INTERNSHIP / INPLANT TRAINING	L	T	P	C	Hrs
		0	0	0	2	-

Course Objectives

- An In plant training is a learning opportunity for students. Students should therefore receive feedback on their performance so that they can grow professionally. Overall professional development of diploma mechanical engineers is the need of the day for enabling them to sustain in competitive global environment

Course Outcomes

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

CO1 - Exposure to the industrial environment and Recognize the requirement of the industry and cope up with the industrial scenario. **(K1)**

CO2 - Identify career paths taking into account their individual strengths and aptitude and Prepare a report about the work experience in industry. **(K2)**

CO3 - Communicate effectively through technical presentation. **(K2)**

CO4 - Enhancing the employability skills and start-up skills to increase his ability to engage in, life-long learning. **(K4)**

CO5 - Develop individual confidence to handle various engineering assignments and expose themselves to acquire life skills to meet societal challenges. **(K5)**

CONTENTS

1. The Guide allotted by the department head have liberty to select nearby organization/industry of local vicinity with prior approval of principal of the institute. Structured training to be arranged by guide and report of the same shall be submitted by the individual student, to full fill their term work.
2. The mechanical engineering diploma students can take in plant training in any one of the following industries.
   a. Public sector enterprises
   b. State government undertaking
   c. Public limited companies
   d. Private limited companies
   e. Individual ownership organisations.

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCM707	PROFESSIONAL ETHICS	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

The course will introduce the students to

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Course Outcomes

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

Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

UNIT I HUMAN VALUES (6 Hrs)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS (6 Hrs)

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

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION (6 Hrs)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS (6 Hrs)

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES (6 Hrs)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development– Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

Reference Books

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004. 3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics –Concepts and Cases”, Cengage Learning, 2009
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
6. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi2013.
7. World Community Service Centre, '' Value Education'', Vethathiri publications, Erode,2011

Web Resources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCT819	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the various characteristics of intelligent agents.
- To learn the different search strategies in AI.
- To gain knowledge in solving AI problems.
- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.

Course Outcomes

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

CO1 - Familiarize on characteristics Intelligent agents(K1)
CO2 - Interpret on various problem solving methods(K2)
CO3 - Understand AI techniques(K2)
CO4 - Understand Machine learning(K2)
CO5 - Interpret the supervised and unsupervised learning(K2)

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE (9 Hrs)

Introduction - Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents -Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

UNIT II PROBLEM SOLVING METHODS (9 Hrs)

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.

UNIT III KNOWLEDGE REPRESENTATION (9 Hrs)

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT IV INTRODUCTION TO MACHINE LEARNING (9 Hrs)

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT V LINEAR MODELS (9 Hrs)

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

Text Books

1. Russell S. and P. Norvig,”Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.
2. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011

3. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2015.

Reference Books

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press,2009.
3. William F. Clocksin and Christopher S. Mellish," Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003
4. Tom M Mitchell, —Machine Learning‖, First Edition, McGraw Hill Education, 2013

Web Resources

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://nptel.ac.in/courses/106/102/106102220/
3. https://nptel.ac.in/courses/106/105/106105079/
4. https://nptel.ac.in/courses/106/106/106106202/
5. https://www.greatlearning.in/great-lakes-artificial-intelligence-and-machine-learning?&utm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	1	2	2	1	1	2	2	2	2	3	2	3
2	3	2	-	2	2	1	1	2	2	1	2	2	3	3	3
3	3	2	-	1	1	1	2	1	1	1	2	2	3	2	3
4	3	2	-	2	2	2	3	2	2	2	2	2	3	3	3
5	3	2	-	2	2	2	3	2	2	2	2	2	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSP804	ENTREPRENEURSHIP MANAGEMENT	L	T	P	C	Hrs
		0	0	2	1	18

Course Objectives

- To develop an ability to identify the critical challenges hindering growth of entrepreneurs
- To understand the significance of Finance Skills, Branding, and Sales Skills for an Entrepreneur
- To be aware of various Government Schemes and Subsidies available for Entrepreneurs

Course Outcomes

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

CO1 - Develop and demonstrate the business models. **(K2)**
CO2 - Practice cash management, brand building and enhancing turnover. **(K6)**
CO3 - Understand various schemes and subsidies that are offered by various Government agencies. **(K2)**
CO4 - Effectively tackle growth challenges of their venture. **(K5)**
CO5 - Manage and grow their business in terms of expansion and look for partnerships. **(K3)**

UNIT I ENTRPRENEURIAL SKILLS 1 (6 Hrs)

Introduction to Business Model Generation , Developing Lean Business Model for the Business Idea, Developing Prototype and Evaluating assumptions in Business Model using prototype cheaply, Presentation of Business Model, Business Fair

UNIT II ENTREPRENEURIAL SKILLS 2 (6 Hrs)

Financial Skills – Cash Management – Problems of Poor Cash Management – Learning to be Frugal. Branding – Building a ‘niche’ follower for your product/service – Developing and Establishing a Brand, Sales skills – KPI of Success of Entrepreneurship – Ensuring Growth in Turnover

UNIT III ENTREPRENEURIAL OPPORTUNITIES (6 Hrs)

Awareness of Government Schemes and Subsidies for various Entrepreneurial Categories – Special Schemes for Women Entrepreneurs – Understanding the Procedure and Documentation Process for availing the Government Schemes – Venture Capital – Crowdfunding – Angel Investors.

Report Submission:

1. How can I get first 100 customers to pay for my products/services?
2. Information technology as a resource
3. Marketing skill and promotion for entrepreneurs
4. Assessment of factors affecting performance of women entrepreneurs
5. Entrepreneurship as a tool for sustainable employment
6. Examination of problem facing small scale business
7. Survival strategies in small business
8. The role of insurance in minimizing business risk

Text Books

1. Storey, D. J., & Greene, F. J. (2010). Small business and entrepreneurship. Financial Times/Prentice Hall.
2. Scarborough, N. M. (2011). Essentials of entrepreneurship and small business management. Prentice Hall.
3. Gupta C.B., & Srinivasan N.P. (2020). Entrepreneurial Development. Sultan Chand and Sons

Reference Books

1. Brian Tracy – The Psychology of Selling.
2. Dale Carnegie – How to Win Friends & Influence People.

3. Robert Kiyosaki and Sharon Lechter – Rich Dad, Poor Dad.
4. Reid Hoffman – The Startup of You: Adapt to the Future, Invest in Yourself, and Transform Your Career.
5. Michael E. Gerber – The E-Myth Revisited.
6. Chris Guillebeau – The Art of Non-Conformity.
7. Eric Ries – The Lean Startup.
8. Kevin D. Johnson – The Entrepreneur Mind.

Web Resources

1. https://www.helpguide.org/articles/stress/stress-management.htm
2. https://bscdesigner.com/8-entrepreneurial-kpis.htm
3. https://www.inc.com/ilya-pozin/5-problems-most-entrepreneurs-face.html
4. https://www.inc.com/jessica-stillman/how-to-network-with-super-successful-people.html
5. https://www.entrepreneur.com/article/251603
6. https://seraf-investor.com/compass/article/understanding-crowdfunding

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	1	2	2	1	3	1	1	3	2	2	2	3	3
2	1	1	2	2	1	1	3	2	2	3	3	2	2	2	2
3	1	2	1	1	1	2	3	2	2	3	3	2	1	2	3
4	1	2	2	2	2	3	3	3	3	3	2	3	2	2	2
5	1	2	2	2	2	3	3	3	3	3	2	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCW803	PROJECT PHASE - II	L	T	P	C	Hrs
		0	0	16	8	45

Course Objectives

- To develop students ability to apply Mechanical Engineering knowledge to transfer ideas to solve real life problems in industries as an individual or as a team.
- To develop effective communication skills and financial management for presentation of project related activities.
- To apply and integrate knowledge and understanding of other engineering disciplines to overcome technical uncertainty and to prepare project proposals.

Course Outcomes

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

CO1 - Demonstrate and practice the concepts of basics sciences and mechanical engineering principles in addressing a real time and real life situation. **(K6)**

CO2 - Enhance the financial management skills to achieve project goal in a stipulated time by working as a Team. **(K5)**

CO3 - Familiarize in technical writing skills and create a project proposal and report on completion. **(K5)**

CO4 - Develop a model comprising of real time application in the industry. **(K6)**

CO5 - Design a system under the domain of mechanical engineering also Evaluate for simulation design, analysis and manufacturing facts of the system. **(K6)**

Guidelines For Carrying Out Project Work

- Create a model/fabricate a model/conduct experiment/simulate mechanical system/implement improved ideas for the project work.
- Analyze data, evaluate the results and conclude the appropriate solution, suggestion for feature work.
- The continuous assessment shall be made as prescribed in the regulations.
- The review committee may be constituted by the Head of the Department.
- The progress of the project is evaluated based on a minimum of three reviews.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- This final report shall be typewritten form as specified in the guidelines.

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCS809	SKILL DEVELOPMENT COURSE - X (NPTEL / MOOC - II)	L	T	P	C	Hrs
		0	0	0	-	-

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

PROFESSIONAL ELECTIVES

U20MCE401	ADDITIVE MANUFACTURING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
- To usage of CAD & Reverse Engineering concept in Additive Manufacturing
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
- To be familiar with various rapid prototyping and additive Manufacturing Techniques
- To usage of Additive Manufacturing in Bio Products.

Course Outcomes

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

CO1	Compare various methods of Additive Manufacturing technologies(K2)
CO2	Use apply latest technologies like CAD Modeling and Simulation tools and do computer assisted Additive Manufacturing(K3)
CO3	Analyze the characteristics of the different materials in Additive Manufacturing.(K4)
CO4	Will learn the latest trends and opportunities in 3D printing, localize services, production parts(K2)
CO5	Understand the latest trends and business opportunities in Additive Manufacturing, distributed manufacturing and mass customization.(K2)

UNIT I INTRODUCTION (9 Hrs)

Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications.

UNIT II CAD & REVERSE ENGINEERING (9 Hrs)

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing–Tool path Generation – Software for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III LIQUID AND SOLID BASED ADDITIVE MANUFACTURING (9 Hrs)

Classification – Liquid based system – Stereo-lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS (9 Hrs)

Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications-Laser Engineered Net Shaping (LENS),Electron Beam Melting

UNIT V BIO-ADDITIVE MANUFACTURING & SOFTWARES (9 Hrs)

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies Preparation of Drawings for Parts and Assembly of the following by using Drafting software. Designing for Additive Manufacturing (DfAM), Software Tools vs. Requirements

Text Books

1. John O. Milewski" Additive Manufacturing of Metals:" Springer, 2017
2. Li Yang, Keng Hsu, Brian Baughman, Donald Godfrey, Francisco Medina, "Additive Manufacturing of Metals: The Technology, Materials, Design and Production" Springer, 2017
3. Ian Gibson, David Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer Nature; 2nd ed., 2015.

References Books

1. Manu Srivastava, Sandeep Rathee, Sachin Maheshwari" Additive Manufacturing: Fundamentals and Advancements" CRC Press2019
2. Rupinder Singh, J. Paulo Davim, "Additive Manufacturing: Applications and Innovations Manufacturing Design and Technology" CRC Press / Taylor & Francis Group 2018
3. Amit Bandyopadhyay, Susmita Bose, "Additive Manufacturing" CRC Press/Taylor & Francis Second Edition 2019
4. Martin Leary, " Design for Additive Manufacturing", Elsevier2019.
5. David J. Fisher, "Additive Manufacturing of Metals", Materials Research Forum LLC2020.

Web Resources

1. http://www.digimat.in/nptel/courses/video/112104204/L47.html
2. https://www.coursera.org/lecture/digital-thread-implementation/additive-manufacturing-Ah2w6
3. https://nptel.ac.in/courses/110/106/110106146/
4. https://learn-xpro.mit.edu/additive-manufacturing
5. https://www.youtube.com/watch?v=BdyQSC0tbqU

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	-	-	-	-	-	3	2	2	2
CO2	3	2	3	2	3	-	-	-	-	-	-	3	3	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	3	2	2	3
CO4	3	2	3	2	3	-	-	-	-	-	-	3	3	3	2
CO5	2	2	2	2	3	-	-	-	-	-	-	3	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE402	HEATING VENTILATION AND AIR CONDITIONING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the thermodynamic concepts to be used for HVAC applications
- Understand and describe the major concepts of the psychrometric chart.
- Define heating, ventilating and air conditioning.
- Define the heating and cooling loads to be considered in designing a HVAC system.
- Explain how a HVAC system can be controlled for better performance.

Course Outcomes

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

CO1 Apply the law of thermodynamics for simple HVAC systems(K3)
CO2 Solve problems using refrigerant table / charts and psychrometric charts(K3)
CO3 Recognizing various components needed for HVAC systems(K2)
CO4 Able to estimate the heating and cooling loads to design HVAC units. (K3)
CO5 Developing control systems for controlling the performance of HVAC units. (K3)

UNIT I INTRODUCTION (9 Hrs)

Fundamentals of Thermodynamics - Conservation of Mass, Laws of Thermodynamics, Thermodynamic Cycles, Fundamentals of Heat Transfer, Conduction, Convection, Thermal Radiation. HVAC - Scope of HVAC, Air-Conditioning Processes, Environment for Human Comfort.

UNIT II PSYCHROMETRY (9 Hrs)

Psychrometrics, Ideal Gas Approximation, Fundamental Parameters, Equation of State, Humidity, Degree of Saturation, Wet Bulb Temperature, Partial Pressure of Water Vapor, Dew Point Temperature, Saturation, Enthalpy, Thermodynamic Wet Bulb Temperature, Properties of Moist Air, Psychrometric Chart, simple exercises using psychrometry

UNIT III AIR CONDITIONING PROCESSES AND VENTILATION (9 Hrs)

Introduction, Basic processes - Heating and Cooling Process, Cooling with Dehumidification, Heating with Humidification, Adiabatic Mixing of Two Air Streams, Evaporative Cooling, Heating and Air Conditioning System Cycles. Basic air-conditioning system and zoned air-conditioning system. Indoor air quality and ventilation - Indoor Air Quality, Ventilation Procedure, Concentration of Air Pollutants, Indoor Air Quality Procedure, Filters – Types, Ozone, Ultraviolet Light

UNIT IV HEATING AND COOLING LOAD CALCULATIONS (9 Hrs)

Emissivities of Materials, Heat Transfer Coefficient, Coefficient of Transmission, Thermal Conductivities of Materials, Thermal Resistances of Materials, Outdoor Air Load Components – introduction, Basic Concepts and Terminologies. Heating load calculations – Introduction, Calculating Design Heating Loads. Cooling load calculations - Basic Definitions, Transfer Function Method (TFM), Heat Sources and heat gains, CLTD / SCL / CLF Calculation Procedure, Cooling Load by CLTD/SCL/CLF Method

UNIT V DIGITAL CONTROLS FOR HVAC SYSTEMS (9 Hrs)

Introduction, control types, Basic Control – open and closed loop controls, Typical Control Loops, Direct Digital Control – Introduction, control schemes, Direct Digital Control of an Air-Handler – Introduction, Schemes, Architecture and Advantages of Direct Digital Controls.

Text Books

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ",Fifth Edition,2017.
2. Joseph Wagner, Kirk VanGelder "Automotive Heating, Ventilation, and Air Conditioning" Jones & Bartlett Learning, 2018.
3. A. Vedavarz, S. Kumar, M. Hussain, "Heating, Ventilation and Air Conditioning Handbook", Industrial Press Inc., 2006

Reference Books

1. Red-Hot Careers "Heating, Ventilation, and Air Conditioning (HVAC) "CreateSpace Independent Publishing Platform, 2018– 2018
2. Jan F. Kreider, "Handbook of Heating, Ventilation, and Air Conditioning", Taylor & Francis Limited, 2019.
3. Amrutha Rao MALLI, "A Practical Approach on Heating Ventilation and Air Conditioning Technology", Independently Published, 2017.
4. Russell E. Smith, "Electricity for Refrigeration, Heating, and Air Conditioning", Cengage Learning- 2018
5. David W. Bearg, "Indoor Air Quality and HVAC Systems", Routledge, 2019.

Web Resources

1. https://nptel.ac.in/courses/112/105/112105129/
2. https://swayam.gov.in/nd1_noc19_me58/preview
3. https://drive.google.com/open?id=0B7JWdKw_4Q07VWNrLVNkRXpyUmM
4. https://www.google.com/url?sa=t&source=web&rct=j&url=https://ocw.mit.edu/courses/architecture/4-401-environmental-technologies-in-buildings-fall-2018/lecture-slides-lec17.pdf&ved=&usg=AOvVaw3XYdn
5. https://www.epa.gov/iaq-schools/heating-ventilation-and-air-conditioning-systems-part-indoor-air-quality-design-tools

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	3	3	1	2	2	1	1	2	3	3	2	2
CO 2	3	3	3	3	3	2	2	1	1	2	2	3	3	3	3
CO 3	3	3	3	3	3	1	1	1	2	1	1	3	3	3	3
CO 4	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE403 COMPUTER INTEGRATED MANUFACTURING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To discuss the basic concepts of CIM and Communication.
- To deal with the information related to Database management system and Product design
- To learn the principles of Concurrent engineering and Process planning
- To discuss about basic principles of Automatic Data Collection and Quality inspection
- To introduce various concepts of FMS, AGV and Industrial robotics

Course Outcomes

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

CO1 Apply the knowledge of computer integrated manufacturing and communication.(K3)
CO2 Identify the required DBMS architecture and product design details for various systems.(K2)
CO3 Apply the knowledge of Concurrent engineering and process planning in manufacturing planning.(K3)
CO4 Identify the methods for Automated Data Collection and Quality inspection, as required.(K2)
CO5 Determine the required Flexible manufacturing system components along with the required AGV and Robotics.(K3)

UNIT I INTRODUCTION TO CIM AND COMMUNICATION (9 Hrs)

Introduction to CIM, Evolution, Benefits, Computers in Manufacturing: Factory tasks for Computer Integration, CIM Hardware and Software.
Fundamentals of Communication: Representation of data, Coding, Transmission, Medium, Types of Communication Lines and Hardware, Network Architectures.

UNIT II DATABASE MANAGEMENT SYSTEMAND PRODUCT DESIGN (9 Hrs)

Data base: Introduction, Manufacturing data, Data base models, Data base Management, Data base required for a shop floor control (Fundamentals only)
Product Design: Design Process, CAD – areas of Application, Benefits, Fundamentals of CAD. CAM, CAE.

UNIT III CONCURRENT ENGINEERING AND PROCESS PLANNING (9 Hrs)

Concurrent / Simultaneous engineering: Introduction, Design for manufacturing and assembly, and other product design objectives. Advanced Manufacturing Planning. Introduction to Reverse Engineering. Process Planning: CAPP, Retrieval and Generative Model.

UNIT IV DATA COLLECTION AND QUALITY INSPECTION (9 Hrs)

Automated Data Collection – Bar Codes, OCR, Image Processing, Computer vision, RF Identification, Magnetic Identification, Voice Technology, Comparison.
CAQC, Contact &Non-Contact type inspection, Introduction to CMM, Application of Various Techniques and Equipments in inspection, interfacing inspection with CAD/CAM.

UNIT V FLEXIBLE MANUFACTURING SYSTEM (9 Hrs)

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits. Automated Guided Vehicle System– AGVS Application – Vehicle Guidance technology – Vehicle Management &Safety. Industrial robotics: Robot Anatomy, Classification of Robots –End Effectors – Sensors in Robotics- Industrial Robot Applications.

Text Books

1. Mikell. P. Groover, 'Automation, Production Systems and computer integrated manufacturing', Prentice Hall of India, New Delhi, 2007.
2. P. Radhakrishnan , S. Subramanyan, V. Raju, 'CAD/CAM/CIM', New Age International (P) Ltd., New Delhi, 2000.
3. Bedworth, Henderson & Wolfe, 'Computer Integrated Design and Manufacturing', McGraw Hill
4. William. W. Luggen, 'Flexible Manufacturing Cells and System', Prentice Hall, New jersy
5. Rao. P, N Tewari & T. K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

References Books

1. S. Kant Vajpayee, 'Principles of Computer Integrated Manufacturing', Prentice Hall of India, 2003.
2. Teicholtz, Orr, 'CIM Handbook', McGraw Hill publishing.
3. Roger Hanman, 'Computer Intergrated Manufacturing', Addison Wesley, 1995.
4. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach"
5. James A. Rehg, H. W. Kraebber, "Computer Integrated Manufacturing, 2nd edition, Pearson Education

Web Resources

1. www.cimlearningzone.co.uk/
2. http://nptel.ac.in/courses/112102101/
3. http://nptel.ac.in/courses/112102103/
4. http://elearning.vtu.ac.in/06ME72.html
5. https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	1	2	-	3	-	3	3	3	2
CO2	3	3	3	2	3	-	2	2	-	-	-	3	3	3	2
CO3	3	3	2	2	3	-	1	1	-	-	-	3	3	3	2
CO4	3	3	2	2	3	-	2	2	-	-	-	3	3	3	3
CO5	3	3	2	2	3	-	2	2	-	-	-	3	3	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE404	INSTRUMENTATION FOR AUTOMOTIVE INDUSTRIES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

1. To provide knowledge about various techniques used for the measurement of industrial parameters
2. To provide knowledge on measurement of velocity, displacement, viscosity, temperature using various types of sensors and related circuits
3. To introduce Force & Torque Measuring Instruments
4. To introduce Pressure & flow Measuring Instruments
5. To impart knowledge on measuring of process variables, analytical instrumentation, automatic process controls

Course Outcomes

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

CO1 Capable to select and use strain measuring instruments(K2)

CO2 Check various available techniques available and select appropriate to obtain satisfactory task for the parameter to be measured like displacement, Force & Torque(K3)

CO3 Be acquainted with measurement of Pressure & flows. (K2)

CO4 Be acquainted with measurement of Level & Temperature of a system(K2)

CO5 Acquire and Interpret the measurement results and cause of any possible error(K4)

UNIT I INTRODUCTION AND STRAIN MEASUREMENT (9 Hrs)

Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system. Strain Gauge and Strain Measurement: Factors affecting strain measurements, Types of strain gauges, theory of operation of resistive strain gauge, gauge factor, types of electrical strain gauges, strain gauge materials, gauging techniques and other factors, strain gauge circuits and temperature compensation, applications of strain gauges

UNIT II DISPLACEMENT, FORCES AND TORQUE MEASUREMENT (9 Hrs)

Resistive potentiometer (Linear, circular and helical), LVDT, RVDT and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders. Load cells and their applications, various methods for torque measurement. Use of torque wrenches.

UNIT III PRESSURE AND FLOW MEASUREMENT (9 Hrs)

Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, LVDT for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration. Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter, hot wire anemometer, Ultrasonic flow meter.

UNIT IV LEVEL AND TEMPERATURE MEASUREMENT (9 Hrs)

Resistive, inductive and capacitive techniques for level measurement, Ultrasonic and radiation methods, Air purge system (Bubbler method).Resistance type temperature sensors – RTD & Thermistor, Thermocouples & Thermopiles, Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output - Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers

UNIT V DIGITAL DATA ACQUISITION SYSTEMS & CONTROL (9 Hrs)

Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition. Instrumentation systems. Types of Instrumentation systems. Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems. Uses of Data Acquisition systems. Use of Recorders in Digital systems. Digital Recording systems. Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits.

Text Books

1. Salah H. R. Ali, "Automotive Engine Metrology", CRC Press, 2017.
2. Tom Denton, "Automotive Technician Training: Theory", Routledge, 2014.
3. S Sheeba Rani, P Subha Hency Jose, P Rajalakshmy, "**Automotive Electrics and Instrumentation",** Educreation Publishing, **2**019

Reference Books

1. Frank Lamb, "Industrial Automation: Hands On", McGraw Hill Professional, 2013
2. Jerker Delsing, "IoT Automation: Arrowhead Framework", CRC Press, 2017.
3. Gregory K. McMillan, P. Hunter Vegas, "Process / Industrial Instruments and Controls Handbook", McGraw-Hill Education, 2019.
4. Bela G. Liptak, Kriszta Venczel, "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Taylor & Francis, 2016.
5. Ronald L Krutz, "Industrial Automation and Control System Security Principles", International Society of Automation

Web Resources

1. https://nptel.ac.in/course.html
2. https://nptel.ac.in/courses/108/105/108105062/
3. https://swayam.gov.in/nd1_noc20_me39/preview
4. https://www.aimil.com/blog/role-of-instrumentation-in-automobile-industry/
5. https://sites.google.com/site/sjredu/subje/instru-auto

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	2	2	1	1	-	3	3	3	3
CO2	3	3	3	3	3	2	2	1	1	2	-	3	3	2	3
CO3	3	3	3	3	3	1	1	1	2	1	-	3	3	2	3
CO4	3	3	3	3	3	2	2	2	3	2	-	3	3	2	3
CO5	3	3	2	3	3	2	2	2	3	2	-	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U200MCE405 DATA COMMUNICATION AND NETWORKING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce UDP and TCP Models.
- To develop an understanding of computer networking basics

Course Outcomes

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

CO1 Students should be understanding and explore the basics of Computer Networks and Various Protocols. He / She will be in a position to understand the World Wide Web concepts.(K2)

CO2 Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and adhoc networks.(K3)

CO3 Recognize the technological trends of Computer Networking. (K2)

CO4 Discuss the key technological components of the Network. (K2)

CO5 Evaluate the challenges in building networks and solutions to those. (K4)

UNIT I DATA COMMUNICATIONS (9 Hrs)

Components – Direction of Data flow – Networks – Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN Physical layer: Transmission modes, Multiplexing, Transmission Media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

UNIT II DATA LINK LAYER (9 Hrs)

Introduction, Framing, and Error – Detection and Correction – Parity – LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols. 111 Medium Access sub layer: ALOHA, CSMA/CD, LAN – Ethernet IEEE 802.3, IEEE 802.5 – IEEE 802.11, Random access, Controlled access, Channelization.

UNIT III NETWORK LAYER (9 Hrs)

Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols.

UNIT IV TRANSPORT LAYER (9 Hrs)

Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, QoS in Switched Networks

UNIT V APPLICATION LAYER (9 Hrs)

Domain name space, DNS in internet, electronic mail, SMTP, FTP, WWW, HTTP, SNMP.

Text Books

1. Lakhmi C. Jain, George A. Tsihrintzis, Valentina E. Balas, Dilip Kumar Sharma, "Data Communication and Networks: Proceedings of GUCON 2019", Springer Nature, 2019.
2. Dr M. P. Vani, "Data Communication and Computer Network: Easy to Learn and Simple to Develop", Notion Press, 2019.
3. Forouzan, "Data Communications and Networking", McGraw Hill Education; Fifth edition, 2017.

References Books

1. Oliver C. Ibe, "Fundamentals of Data Communication Networks", John Wiley & Sons, 2017.
2. Shashi Banzal, "Data and Computer Network Communication", Laxmi Publications Pvt. Limited, 2015
3. R. K. Ghosh, "Wireless Networking and Mobile Data Management", Springer, 2017.
4. Thiagarajan, Viswanathan, Manav Bhatnagar, "Telecommunication Switching Systems And Networks", PHI Learning Pvt. Ltd, 2015.
5. Adamu, Murtala Zungeru, S Subashini, P Vetrivelan, "Wireless Communication Networks and Internet of Things: Select Proceedings", Springer, 2018.

Web Resources

6. https://nptel.ac.in/courses/106/105/106105082/
7. https://nptel.ac.in/courses/106/105/106105080/
8. https://swayam.gov.in/nd2_cec19_cs07/preview
9. https://nptel.ac.in/courses/117/105/117105076/
10. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/lecture-notes/

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	1	2	2	1	1	2	3	2	3	2
CO2	3	2	3	2	3	2	2	1	1	2	2	3	3	2	3
CO3	3	3	3	3	3	1	1	1	2	1	1	3	2	3	2
CO4	3	2	3	2	3	2	2	2	3	2	2	3	3	2	2
CO5	2	2	2	2	3	2	2	2	3	2	2	3	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE506	MEMS AND NANO TECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge about the latest trends in manufacturing micro components and measuring systems to Nano scale.
- To provide knowledge on processing techniques of micro-electro mechanical systems
- To enumerate the concepts on applications of micro devices
- To gain knowledge on the properties of nano materials
- To perform characterization study on nano materials

Course Outcomes

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

CO1 - Familiarize on MEMS and Microsystems (K2)
CO2 - Recognize the processing techniques of MEMS(K2)
CO3 - Comprehend the need for smart materials(K3)
CO4 - Value the science of nano materials(K4)
CO5 – Analyze on various characterization tests for nano materials(K4)

Unit I OVERVIEW OF MEMS AND MICROSYSTEMS **(9 Hrs)**

Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication of micro-system, microelectronics, working principle and applications of micro system

Unit II MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING **(9 Hrs)**

Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon pies resistors, Gallium arsenide, quartz, polymers for MEMS,conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapor deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

Unit III MICRO DEVICES AND MATERIALS **(9 Hrs)**

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measured displacement sensors, pressure and flow sensors, and micro actuators – smart materials – applications.

Unit IV SCIENCE OF NANO MATERIALS **(9 Hrs)**

Classification of Nano structures – effect of the nanometer length scale effects of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of Nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

Unit V CHARACTERIZATION OF NANO MATERIALS **(9 Hrs)**

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques –spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

Text Books

1. Zhaoying Zhou, Zhonglin Wang, Liwei Lin, “Microsystems and Nanotechnology”, Springer-Verlag Berlin Heidelberg 2012
2. Amretashis Sengupta, Chandan Kumar Sarkar “Introduction to Nano: Basics to Nanoscience and Nanotechnology” Springer.– 2015

Reference Books

1. Jeremy Ramsden “Nanotechnology: An Introduction” William Andrew.– 2016
2. Vikas Choudhary, Krzysztof Iniewski “MEMS: Fundamental Technology and ApplicationsCRC Press.– 2017
3. Sunipa Roy, Chandan Kumar Ghosh, Chandan Kumar Sarkar “Nanotechnology: Synthesis to Applications“-CRC Press.2017
4. Patrick M. Boucher” Nanotechnology: Legal Aspects” CRC Press – 2018
5. Nandita Dasgupta, Shivendu Ranjan, Eric Lichtfouse “Environmental Nanotechnology: Volume 2Springer. -2018

Web Resources

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://swayam.gov.in/nd1_noc20_ee52/preview
3. https://www.edx.org/course/nanotechnology-fundamentals-of-nanotransistors
4. https://www.my-mooc.com/en/mooc/micro-nanofabrication-mems-epflx-memsx/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	3	-	-	3	1	2	2
2	3	3	3	3	-	-	-	-	3	-	-	3	1	2	2
3	3	3	3	3	-	-	-	-	3	-	-	3	1	2	2
4	3	2	2	3	-	-	-	-	3	-	-	3	1	2	2
5	3	2	2	3	-	-	-	-	3	-	-	3	1	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE507 SMART MATERIALS FOR MECHATRONICS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide comparative analysis of different smart materials
- To educate the students on piezoelectric materials
- To provide knowledge on shape memory alloys
- To provide knowledge on application of electro-active polymers
- To provide knowledge on applications of magnetostrictive materials for active vibration control

Course Outcomes

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

CO1 - Outline the properties and applications of smart materials and Nano materials (K2)
CO2 - Value the piezoelectric materials applications (K2)
CO3 - Interpret the usage of shape memory alloys (K3)
CO4 - Interpret the applications of EAP (K4)
CO5 – Analyze on the applications of magnetostrictive materials (K4)

UNIT I INTRODUCTION OF NANO MATERIALS (9 Hrs)

Smart materials and their application for sensing and actuation, Mechatronics aspects, properties and applications Nano Materials: Low dimensional structures (quantum dot, wire and well) – Features of nano materials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Physical and chemical vapor phase depositions – Sol gel method.

UNIT II PIEZOELECTRIC MATERIALS (9 Hrs)

Piezoelectricity and piezoelectric materials, Constitutive equations of piezoelectric materials, Piezoelectric actuator types, Control of piezoelectric actuators, Applications of piezoelectric actuators for precise positioning and scanning

UNIT III SHAPE MEMORY ALLOYS (SMA) (9 Hrs)

Properties of shape memory alloys, Shape memory effects, Pseudo-elasticity in SMA, Design of shape memory actuator, selection of materials, Smart actuation and control, Applications of SMA in precision equipment for automobiles, trains and medical devices**.**

UNIT IV ELECTRO-ACTIVE POLYMERS (EAPS) (9 Hrs)

Ionic polymer metal composites (IPMC), Conductive polymers, Carbon nanotubes, Dielectric elastomers, Design & control issues for EAP actuators, Applications of EAP for biomemetic, tactile display and medical devices.

UNIT V MAGNETOSTRICTIVE MATERIALS (9 Hrs)

Basics of magnetic properties of materials, magnetostriction: constitutive equations, types of magnetostrictive materials, Design & control of magnetostrictive actuators, Applications of magnetostrictive materials for active vibration control.

Text Books

1. Jose L. Pons, Emerging Actuator Technologies, a Micro mechatronics Approach, John Wiley & Sons Ltd, 2005
2. Mel Schwartz, “Smart Materials”, CRC Press New York, 2009
3. M.V. Gandhi and B.S. Thompson, “Smart Materials and Structures”, Chapman & HallUK, 1992.

Reference Books

1. Cohen Y. B., Electroactive Polymer (EAP) Actuators as Artificial Muscles Reality, Potential and Challenges, SPIE press, USA, 2004.
2. William D. Callister, “Materials Science and Engineering”: An Introduction, Wiley, 2004.
3. Brian Culshaw, “Smart Structures and Materials”, Artech House, Boston, 2000.
4. Jeremy Ramsden “Nanotechnology: An Introduction” William Andrew.– 2016
5. Sunipa Roy, Chandan Kumar Ghosh, Chandan Kumar Sarkar “Nanotechnology: Synthesis to Applications“- CRC Press.2017

Web Resources

1. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_1.pdf
2. https://nptel.ac.in/courses/112/104/112104251/
3. https://drive.google.com/file/d/19A5yvkuceYGMx-eGrXdWZVJBXAvFIxCP/view
4. https://www.edx.org/course/nanotechnology-fundamentals-of-nanotransistors

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	3	-	-	3	1	2	2
2	3	3	3	3	-	-	-	-	3	-	-	3	1	2	2
3	3	3	3	3	-	-	-	-	3	-	-	3	1	2	2
4	3	2	2	3	-	-	-	-	3	-	-	3	1	2	2
5	3	2	2	3	-	-	-	-	3	-	-	3	1	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE508	IOT FOR MECHATRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart necessary and practical knowledge of components ofInternet of Things
- To understand about the smart objects and how to connect these smart objects.
- To develop skills required to build real-life IoT based projects.
- Gateway installations and cloud analytics
- Understand Security, privacy and Trust in IoT

Course Outcomes

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

CO1 - Understand the fundamentals of Internet of Things (K2)
CO2 – Analyze the hardware and software components used in IoT. (K3)
CO3 - Assortment of sensors & networking protocols. (K3)
CO4 - Progress of application on IoT and securing the IoT framework. (K4)
CO5 - Evaluate life IoT based projects(K5)

UNIT I INTRODUCTION TO IOT **(9 Hrs)**

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals - Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT II ELEMENTS OF IOT **(9 Hrs)**

Hardware Components - Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components - Programming API's (using Python / Node.js / Arduino) for Communication Protocols - MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT III SMART OBJECTS: THE "THINGS" IN IOT **(9 Hrs)**

Sensors, Actuators, and Smart Objects – Sensors, Actuators, Micro-Electro-Mechanical Systems (MEMS), Smart Objects: Smart Objects: A Definition, Trends in Smart Objects. Sensor Networks: Wireless Sensor Networks (WSNs), Communication Protocols for Wireless Sensor Networks. Connecting Smart Objects: Communications Criteria – Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained-Node Networks, IoT Access Technologies: IEEE 802.15.4, LoRaWAN.

UNIT IV IOT APPLICATION DEVELOPMENT AND SECURING IOT **(9 Hrs)**

Solution framework for IoT applications - Implementation of Device integration, Data acquisition and integration, Device data storage - Unstructured data storage on cloud / local server, Authentication, authorization of devices. Securing IoT: A Brief History of OT Security, Common Challenges in OT Security:
Erosion of Network Architecture, Pervasive Legacy Systems, Insecure Operational Protocols
.

UNIT V IOT IN INDUSTRY **(9 Hrs)**

IoT Strategy for Connected Manufacturing, Connected Factory: Industrial Automation and Control Systems Reference Model and Control Protocols, Connected Factory Security. Smart and Connected Cities: IoT Strategy and architecture for Smarter Cities and Security Architecture for Smarter Cities, IoT Use Cases for Transportation: Connected Cars, Connected Fleets, Infrastructure and Mass Transit, IoT Architecture for Transportation: IoT Technologies for Roadways.

IoT case studies and mini projects based on Industrial automation, Transportation, Home Automation.

Text Books

1. Ismail Butun "Industrial IoT: Challenges, Design Principles, Applications, and Security" Springer International Publishing, 2020
2. Dr. Rajesh Singh, Dr. Anita Gehlot, Dr. Lovi Raj Gupta "Internet of Things with Raspberry Pi and Arduino " CRC Press. – 2020
3. Ruben Oliva Ramos" Internet of Things Programming with JavaScript" Packt Publishing Ltd – 2017.

Reference Books

1. Nilanjan Dey, Parikshit N. Mahalle, Pathan Mohd Shafi "Internet of Things, Smart Computing and Technology: A Roadmap Ahead" Springer Nature. – 2020
2. Dr. Rajesh Singh, Dr. Anita Gehlot, Dr. Lovi Raj Gupta, Ms. Navjot Rathour, Mahendra Swain, Bhupendra Singh "IoT based Projects: Realization with Raspberry Pi, NodeMCU and Arduino" BPB Publications. 2020
3. Peter Waher "Learning Internet of Things" Packt Publishing Ltd.- 2015
4. Sheng-Lung Peng, Souvik Pal, Lianfen Huang "Principles of Internet of Things (IoT) Ecosystem: Insight Paradigm" Springer Nature- 2019
5. Eric M. H. Goh " Learn By Examples - A Quick Guide To Internet of Things With Arduino and Data" SVBook. 2020

Web Resources

6. https://nptel.ac.in/courses/112/103/112103174/
7. https://www.iiitnr.ac.in/content/internet-things-and-sensor
8. https://www.captechu.edu/blog/internet-of-things-and-mechatronics

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	1	2	2	1	1	2	3	1	2	3
2	3	3	3	3	-	2	2	1	1	2	2	3	1	2	3
3	3	3	3	3	-	1	1	1	2	1	1	3	1	2	3
4	3	2	2	3	-	2	2	2	3	2	2	3	1	2	3
5	3	2	2	3	-	2	2	2	3	2	2	3	1	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE509	BIOMEDICAL INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Illustrate origin of bio potentials and its propagations
- To understand the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recordings
- To learn the different measurement techniques for non-physiological parameters.
- To Summarize different biochemical measurements.

Course Outcomes

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

CO1 - Differentiate different bio potentials and its propagations (K2).
CO2 - Illustrate different electrode placement for various physiological recordings (K2).
CO3 - Design bio amplifier for various physiological recordings (K3).
CO4 - Explain various technique for non-electrical physiogical measurements(K4).
CO5 - Demonstrate different biochemical measurement techniques. (K5).

UNIT I INTRODUCTION TO BIO-MEDICAL INSTRUMENTATION (9 Hrs)

Basic concept of biomedical instrumentation. Electrodes, transducers, biosensors and their characteristics. Biopotential amplifiers. Biotelemetry.

UNIT II ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS (9 Hrs)

Recording of ECG, EEG, EMG, ERG, evoked potentials etc. Cardiovascular measurements. Measurement of the respiratory system.

UNIT III MEASUREMENT AND DIAGNOSTIC (9 Hrs)

Cardiovascular measurements. Cardiac pacemakers – internal and external pacemakers, defibrillators. Electro encephalogram –neuronal communication, Measurement of the respiratory system.

UNIT IV IMAGING MODALITIES AND ANALYSIS (9 Hrs)

Analytical instruments in Biomedical Engineering; oximeter, spectrophotmeter, colorimeter, blood gas analyzer, blood cell counter.

UNIT V LIFE ASSISTING, THERAPEUTIC DEVICES (9 Hrs)

Therapeutic & assist devices for cardiovascular system and respiratory system. Physiotherapy devices. Electrosurgical units. Safety aspects of biomedical equipment.

Text Books

1. Leslie Cromwell, Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill,2005
3. J. J. Carr and J. M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education. 2004

Reference Books

1. John G. Webster, Medical Instrumentation Application and Design, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015.

2. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill Publisher, 2003.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, 3rd edition, Tata McGraw-Hill New Delhi, 2014

Web Resources

1. https://nptel.ac.in/courses/108/105/108105101/
2. https://onlinecourses.nptel.ac.in/noc21_ee17/preview
3. https://nptel.ac.in/courses/102/101/102101068/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	3	-	-	-	-	-	-	-	2	2	1	3
2	3	2	3	3	-	-	-	-	-	-	-	2	3	2	3
3	2	1	3	3	-	-	-	-	-	-	-	2	2	1	3
4	3	2	3	3	-	-	-	-	-	-	-	2	3	2	3
5	3	2	3	3	-	-	-	-	-	-	-	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE510	DATA BASE MANAGEMENT SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Understand the basic concepts and the applications of database systems
- To Master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrency control
- To become familiar with database storage structures and access techniques

Course Outcomes

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

CO1 - Demonstrate the basic elements of a relational database management system (K2)
CO2 - Identify the data models for relevant problems(K3)
CO3 - Design entity relationship and convert entity relationship diagrams into RDBMS (K3)
CO4 - Formulate SQL queries on the respect data (K4)
CO5 - Apply normalization for the development of application software's(K5)

UNIT I INTRODUCTORY CONCEPTS OF DBMS **(9 Hrs)**

Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- levels, Mappings, Database, users and DBA.
Relational Model : Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus

UNIT II ENTITY-RELATIONSHIP MODEL **(9 Hrs)**

Basic concepts, Design process, constraints, Keys, Design issues, E-R diagrams, weak entity sets, extended E-R features – generalization, specialization, aggregation, reduction to E-R database schema
Relational Database design : Functional Dependency – definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization – 1Nf, 2NF, 3NF, Decomposition using FD- dependency preservation, BCNF, Multivalued dependency, 4NF, Join dependency and 5NF

UNIT III QUERY PROCESSING & QUERY OPTIMIZATION **(9 Hrs)**

Overview, measures of query cost, selection operation, sorting, join, evaluation of expressions, transformation of relational expressions, estimating statistics of expression results, evaluation plans, materialized views
Transaction Management : Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation, Intent locking

UNIT IV SECURITY **(9 Hrs)**

Introduction Discretionary access control, Mandatory Access Control, Data Encryption.SQL Concepts : Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator

UNIT V FUNCTIONS **(9 Hrs)**

Aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. transaction control commands – Commit, Rollback, Savepoint, PL/SQL Concepts : Cursors, Stored Procedures, Stored Function, Database Triggers

Text Books

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, McGrawHill Education, 3rd Edition, 2003.
2. Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan, McGraw Hill, VI edition, 2006.
3. Mukesh Neg, Fundamentals of Database Management System,Learn Essential Concepts of Database Systems, BPB PUBN, 2019.

Reference Books

1. Panneerselvam, R, Data Base Management Systems, PHI Learning Pvt. Ltd. 2018
2. Michael M. Gorman, Database Management Systems Understanding and Applying Database Technology, Elsevier Science 2014
3. Rajesh Narang, Database Management Systems, Prentice Hall India Pvt., Limited, 2018
4. P.S. Gill,Database Management Systems, I.K. International Publishing House Pvt. Limited , 2010
5. Dr. Rajni Sharma, Dr. Sarita Kaushik, Database Management System, Horizon Books (A Division of Ignited Minds Edutech P Ltd) 2015

Web Resources

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs09/
2. https://nptel.ac.in/courses/106/106/106106093/
3. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs15/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	3	-	1	2	-	-	-	-	2	2	1	3
2	3	2	3	3	-	2	2	-	-	-	-	2	3	2	3
3	2	1	3	3	-	1	1	-	-	-	-	2	2	1	3
4	3	2	3	3	-	2	2	-	-	-	-	2	3	2	3
5	3	2	3	3	-	2	2	-	-	-	-	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE611 INTRODUCTION TO FINITE ELEMENT ANALYSIS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To learn the basic principles of finite element analysis procedure.
- To understand the concepts of discretization
- To learn the theory and characteristics of finite elements that represent engineering structures.
- To understand the nature of iso-parametric and iso-perimetric elements
- To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.

Course Outcomes

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

CO1 - Understand the concepts behind various methods and weighted residual methods in FEM.**(K2)**
CO2 - Understand the discretization concepts.**(K2)**
CO3 - Identify the application and characteristics of FEA elements such as bars, beams, plane and isoperimetric elements, and 3-D element.**(K3,K4)**
CO4 - Differentiate the iso-parametric and iso-perimetric elements. **(K3,K4)**
CO5 - Identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.**(K3,K4)**

UNIT I INTRODUCTION (9 Hrs)

Finite element method, stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, various and weighted residual methods, concept of potential energy, one dimensional problems.

UNIT II DISCRETIZATION (9 Hrs)

Element shapes, discretization procedures, assembly of stiffness matrix, bandwidth, node numbering, mesh generation, interpolation functions, and local and global coordinates, convergence requirements, and treatment of boundary conditions.

UNIT III ANALYSIS OF TRUSSES (9 Hrs)

Finite element modeling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. Analysis of Beams: Element stiffness matrix for Hermit beam element, derivation of load vector for concentrated and UDL, simple problems on beams. Modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.

UNIT IV HIGHER ORDER AND ISOPARAMETRIC ELEMENTS (9 Hrs)

One dimensional quadratic and cubic elements in natural coordinates, two dimensional four nodded isoperimetric elements and numerical integration.

UNIT V STEADY STATE HEAT TRANSFER ANALYSIS (9 Hrs)

One-dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.

Text Books

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering,4th Edition, Prentice Hall, 2012.

2. Singiresu S Rao,The Finite Element Methods in Engineering, 6th Edition, Elsevier Butterworth–Heinemann, 2017.
3. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.

Reference Books

1. Seshu, P, "Text Book of Finite Element Analysis", 3rd Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
2. G.Ramamurthy, "Applied Finite Element Analysis", 2nd Edition, Wiley Publication,2010
3. Siddu S. AnupGoel, ParmeshwarPatil, N. I. Jamader, "Finite Element Analysis", Technical publications, 2019.
4. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw-Hill, 2000.
5. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4th edition, John Wiley and Sons, Inc., 2003.

Web Resources

1. https://nptel.ac.in/courses/112104193/
2. https://www.coursera.org
3. https://www.featutorials.com
4. https://www.sciencedirect.com/topics/engineering/finite-element-analysis
5. https://www.comsol.co.in/multiphysics/finite-element-method

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	-	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	-	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	-	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	-	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	-	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE612	AUTOMOTIVE ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- The intention and purpose of this course is 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.
- To explore practically about the components present in an Automotive electrical and electronics system.
- To know the concepts and develop basic skills necessary to diagnose automotive electrical problems

Course Outcomes

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

CO1 - Know the importance of emission standards in automobiles.(K2)
CO2 - Understand the electronic fuel injection/ignition components and their function.(K2)
CO3 - Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.(K3)
CO4 – Analyze electronic engine control systems problems with appropriate diagnostic tools.(K4)
CO5 - Design the chassis and vehicle safety system.(K4)

UNIT I INTRODUCTION (9 Hrs)

– Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits

UNIT II IGNITION AND INJECTION SYSTEMS (9 Hrs)

Approach to Control and Instrumentation: Concept of a system, Analog and digital systems, Basic measurement systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modeling, Smart Nodes.

UNIT III SENSOR AND ACTUATORS IN AUTOMOTIVES (9 Hrs)

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 Hrs)

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 Hrs)

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.

Text Books

1. Williams. B. Ribbens: "Understanding Automotive Electronics", 6th Edition, Elsevier Science, Newnes

Publication, 2003.
2. Robert Bosch: "Automotive Electronics Handbook", John Wiley and Sons, 2004.
3. David Alciatore & Michael Histand: "Introduction to Mechatronics and Measurement Systems (SIE)", TMH, 2007.

Reference Books

1. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. James D. Halderman: "Automotive Electricity and Electronics", PHI Publication.
3. Terence Rybak & Mark Stefika: "Automotive Electromagnetic Compatibility (EMC)", Springer, 2004.
4. Allan Bonnick: "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science, 2001.
5. Uwe Kieneke and Lars Nielsen: "Automotive Control Systems: Engine, Driveline and Vehicle", 2nd Edition, Springer Verlag, 2005

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_ee18/preview
2. https://nptel.ac.in/courses/108/106/108106170/
3. https://nptel.ac.in/courses/107/106/107106080/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	2	2	1	1	2	2	1	1	2	2	3
2	3	2	2	2	2	1	1	2	2	1	1	2	2	2	3
3	3	2	2	1	1	1	2	1	1	1	2	1	2	2	3
4	3	2	3	2	2	2	3	2	2	2	3	2	2	2	3
5	3	2	2	2	2	2	3	2	2	2	3	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE613 **VLSI DESIGN**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study the fundamentals of CMOS circuits and its characteristics
- To Learn the design and realization of combinational & sequential digital circuits
- To acquire knowledge about Architectural choices
- To study the performance trade-offs involved in designing and realizing the circuits in CMOS technology
- Learn the different FPGA architectures and testability of VLSI circuits

Course Outcomes

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

CO1- Infer the fundamentals of CMOS circuits and its characteristics (K2)
CO2- Illustrate the design and realization of combinational digital circuits (K3)
CO3- Demonstrate the design and realization of sequential digital circuits (K3)
CO4- Explain the performance trade-offs involved in designing and realizing the circuits in CMOS technology (K4)
CO5- Classify FPGA architectures and testability of VLSI circuits (K4)

UNIT I INTRODUCTION TO MOS TRANSISTOR **(9 Hrs)**

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS **(9 Hrs)**

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN **(9 Hrs)**

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 Hrs)**

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

UNIT V IMPLEMENTATION STRATEGIES AND TESTING **(9 Hrs)**

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

Text Books

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997

3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.

Reference Books

1. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addision Wesley 1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005
3. Wayne wolf, —Modern VLSI Design: System on Chip Design, Prentice Hall of India, 2012
4. DebaPrasad Das, —VLSI Design, Oxford University Press, 2012.
5. Neil He Weste,David Harris and Ayan Banerjee, —CMOS VLSI design-A circuits and Systems Perspective,‖Dorling Kindersley (india) Pvt Ltd, 2009.

Web Resources

1. https://www3.nd.edu/~kogge/courses/cse40462-VLSI-fa18/www/links.html
2. https://www.tutorialspoint.com/vlsi_design/index.htm
3. http://www.cmosvlsi.com/
4. http://www.csit-sun.pub.ro/courses/vlsi/Modern_VLSI_Design.pdf
5. https://www.maven-silicon.com/online-vlsi-design-course

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	2	1	2	2	1	1	2	2	2	1	2
2	3	1	1	-	2	2	2	1	1	2	2	1	2	1	2
3	2	1	1	-	2	1	1	1	2	1	1	1	2	1	2
4	2	1	1	-	2	2	2	2	3	2	2	2	2	1	2
5	3	1	1	-	2	2	2	2	3	2	2	2	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE614	**VIRTUAL INSTRUMENTATION**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basics of data acquisition are introduced in mechatronics systems.
- To provide knowledge on design of process control by using virtual instrumentation techniques
- To give knowledge in process analysis by VI tools.
- To provide basic knowledge in describing function analysis.
- To get adequate knowledge VI tool sets

Course Outcomes

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

CO1 - Identify about virtual instrumentation tools. (K2)
CO2 – Frame adequate knowledge VI tool sets (K2)
CO3 – Apply various filed of VI data acquisition (K3)
CO4 – Develop VI conventional programming techniques (K4)
CO5 – Create VI programming techniques for various fields. (K5)

UNIT I PREVIEW OF VIRTUAL INSTRUMENTATION **(9 Hrs)**

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, dataflow techniques, graphical programming in data flow, comparison with conventional programming. Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI,

UNIT II PROGRAMMINGTECHNIQUES **(9 Hrs)**

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 ACQUISITION BASICS **(9 Hrs)**

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

UNIT IV COMMON INSTRUMENT INTERFACES **(9 Hrs)**

PXI, etc., networking basics for office &Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

UNIT V USE OF ANALYSIS TOOLS **(9 Hrs)**

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

Text Books

1. I.Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011
2. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.
3. Norbert Meyer, Roberto Pugliese, Sandro Zappatore Remote Instrumentation and Virtual Laboratories, Service Architecture and Networking, Springer US, 2010

Reference Books

1. Gerhard Weiss, “Multi Agent Systems”, Second Edition, MIT Press, 2013
2. M. Tim Jones, “Artificial Intelligence: A Systems Approach(Computer Science)”, Jones and Bartlett Publishers,

Inc.; First Edition, 2008
3. Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press, 2009Alan S. Morris, Reza Langari “Measurement and Instrumentation: Theory and Application” Academic Press – 2015
4. JOVITHA JEROME “VIRTUAL INSTRUMENTATION USING LABVIEW” PHI Learning Pvt. Ltd – 2010
5. Gupta” Virtual Instrumentation Using Labview 2E” Tata McGraw-Hill Education – 2010

Web Resources
1. https://swayam.gov.in/nd1_noc19_ee44/preview
2. https://nptel.ac.in/courses/106/104/106104122/
3. https://www.mooc-list.com/tags/electrical-instruments

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	1	2	-	-	-	-	-	-	2	1	2
2	3	2	2	-	2	2	-	-	-	-	-	-	2	1	2
3	2	2	2	-	1	1	-	-	-	-	-	-	2	1	2
4	2	2	2	-	2	2	-	-	-	-	-	-	2	1	2
5	3	2	2	-	2	2	-	-	-	-	-	-	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE615	INTELLIGENT CONTROL SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the structure of Neural Networks and learning algorithms.
- To Implement ANN based Intelligent system for real time engineering application.
- To recognize and implement the structure of a fuzzy PID controller and its components.
- To be value how the concepts of Fuzzification and Defuzzification are used in a fuzzy PID controller.
- To identify with how to create a PID controller using genetic algorithms concepts.

Course Outcomes

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

CO1 - Plan and implementation of intelligent system for industrial process control and Industrial drives control application. (K2)
CO2 - Propose and implementation of intelligent system for Research Activity in Medicine and Biological Sciences. (K3)
CO3 - Devise and implementation of intelligent system in Cancer Research (K4)
CO4 - Produce and implementation of intelligent system for Biosignal Detection, processing Correction. (K5)
CO5 - Create and developing Simple Models from a Relay Feedback. (K6)

UNIT I INTRODUCTION (9 Hrs)

Motivation, Neural Networks, Rationale for Using NN in Engineering, Fuzzy Logic Control, Rationale for Using FL in Engineering, Evolutionary Computation, Hybrid Systems

UNIT II FUNDAMENTALS OF NEURAL NETWORKS (9 Hrs)

Introduction, Basic Structure of a Neuron, Model of Biological Neurons, Elements of Neural Networks, Weighting Factors, Threshold, Activation Function, ADALINE, Linear Separable Patterns, Single Layer Perceptron, General Architecture, Linear Classification. Perceptron Algorithm, Multi-Layer Perceptron, General Architecture, Input-Output Mapping, XOR Realization

UNIT III INTRODUCTION TO FUZZY SETS (9 Hrs)

Basic definitions and relations Introduction, Classical Sets, Classical Set Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Alpha-Cut Fuzzy Sets, Extension Principle, Classical Relations vs. Fuzzy Relations

UNIT IV INTELLIGENT AUTO TUNING OF PID CONTROLLLER (9 Hrs)

Process Reaction Curve and Relay Methods Identification and PID Tuning, Introduction, Developing Simple Models from the Process Reaction , Identification Algorithm for Oscillatory Step Responses, Identification Algorithm for Non-Oscillatory Responses Without Overshoot , Developing Simple Models from a Relay Feedback.

UNIT V FUZZY LOGIC AND GENETIC ALGORITHM METHODS IN PID TUNING (9 Hrs)

Introduction, Fuzzy PID Controller Design , Fuzzy PI Controller Design, Fuzzy D Controller Design , Fuzzy PID Controller Design, Fuzzification, Fuzzy Control Rules, Defuzzification, A Control Example, Multi-Objective Optimised Genetic Algorithm Fuzzy PID Control , Genetic Algorithm Methods Explained.

Text Books

1. Vojislav Kecman, Learning and Soft Computing: Support Vector Machines, Neural Networks, and Fuzzy Logic Models, The MIT Press, 2001

2. Amit Konar, Computational Intelligence: Principles, Techniques and Applications, Springer, 2005
3. T. Nanayakkara, F. Sahin, and M. Jamshidi, Intelligent Control Systems with an Introduction to Systems of Systems, CRC Press, 2008

Reference Books

1. Sankar K. Pal and Sushmita Mitra, Neuro-Fuzzy Pattern Recognition: Methods in Soft Computing, John Wiley & Sons, 1999
2. Antonio Ruano, Intelligent Control Systems Using Computational Intelligence Techniques, Institution of Engineering and Technology, 2005
3. Y. Sin and C. Xu, Intelligent Systems: Modeling, Optimization, and Control, CRC Press, 2008
4. Dr. K.P. Mohandas, “Modern Control Engineering”, revised edition, Sanguine Publishers, Bangalore, 2006.
5. Norman S. Nise, “Control System Engineering”, John Wiley & Sons, Inc, Sixth Edition, 2010.

Web Resources

1. https://nptel.ac.in/courses/108/104/108104049/
2. https://nptel.ac.in/courses/108/107/108107115/
3. https://nptel.ac.in/courses/107/106/107106081/

COs/POs/PSOs Mapping

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	-	-	-	-	-	-	-	-	-	2	1	2
2	3	2	2	-	-	-	-	-	-	-	-	-	2	1	2
3	2	2	2	-	-	-	-	-	-	-	-	-	2	1	2
4	2	2	2	-	-	-	-	-	-	-	-	-	2	1	2
5	3	2	2	-	-	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE716 **NON-DESTRUCTIVE TESTING METHODS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.
- To impart knowledge in various methods of Non Destructive Testing.
- To overview the concepts, principles, and methods employed for NDT of structures and materials.
- To evolve eddy current testing methods.
- To characterization of ultrasonic testing and acoustic emission systems

Course Outcomes

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

CO1- Observe various Non-Destructive Testing and characterization of industrial components.(K1)
CO2- Interpret basic principles of various NDT methods.(K2)
CO3- Estimate various NDT and industrial applications.(K3)
CO4- Distinguish NDT methods and other techniques tools.(K4)
CO5- Understand specifications related to non-destructive testing technology.(K2)

UNIT I INTRODUCTION OF NDT (9 Hrs)

NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection – Unaided and aided.

UNIT II SURFACE NDE METHODS (9 Hrs)

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism. (Image Processing)

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (9 Hrs)

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation

UNIT IV ULTRASONIC TESTING AND ACOUSTIC EMISSION (9 Hrs)

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-scan, B-scan, C-scan(Conversion). Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

UNIT V RADIOGRAPHY (9 Hrs)

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed

Text Books

1. Mayorkinos Papaelias, Fausto Pedro Garcia Marquez, Alexander Karyotakis “Non-Destructive Testing and Condition Monitoring Techniques for Renewable “Butterworth-Heinemann - 2019

2. Jean-Paul Balayssac, Vincent Garnier “Non-destructive Testing and Evaluation of Civil Engineering Structures” Elsevier. – 2017.
3. Baldev Raj, T. Jayakumar, M. Thavasimuthu Practical Non-destructive Testing, Woodhead 2002

Reference Books

1. J. B. Hull, Vernon John “Non-Destructive Testing” Macmillan International Higher Education. – 2015
2. Nathan Ida, Norbert Meyendorf “Handbook of Advanced Nondestructive Evaluation Springer International Publishing, 2019
3. Gerhard Huebschen, Iris Altpeter, Ralf Tschuncky “Materials Characterization Using Nondestructive Evaluation (NDE) Methods” Woodhead Publishing. – 2016
4. Songling Huang, Shen Wang “New Technologies in Electromagnetic Non-destructive Testing” Springer. – 2016
5. Raman Singh, Baldev Raj, U. Kamachi Mudali “Non-Destructive Evaluation of Corrosion and Corrosion-assisted Cracking” John Wiley & Sons. - 2019

Web Resources

1. https://nptel.ac.in/courses/113/106/113106070/
2. https://swayam.gov.in/nd1_noc20_mm07/preview
3. https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-9872.
4. https://onlinecourses.nptel.ac.in/noc20_mm07/preview.
5. https://www.youtube.com/watch?v=oqMXbxk4RHI

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	1	1	2	2	2	1	3	2	3
2	3	2	1	2	2	1	1	2	2	1	2	2	3	2	3
3	3	2	1	1	1	1	2	1	1	1	2	3	3	2	3
4	3	2	1	2	2	2	3	2	2	2	2	1	3	2	3
5	3	2	1	2	2	2	3	2	2	2	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE717	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To goal of the course is to give an introduction to multidisciplinary aspects of product development and innovation.
- To familiarize basic methodology and tools that can be used in product development projects.
- To Practical problems will be considered in cooperation with companies in order to simulate real product development situations.
- To development of product design architecture.
- To design the innovation of new product methods.

Course Outcomes

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

CO1- Remembering the technical and business aspects of the product development process (K1)

CO2-Summarizing skilled in implementation of gathering data from customers and establish technical specification (K2)

CO3- Determining product functional decomposition engineering problem solving.(K3)

CO4- Distinguishing the principles behind product modularization.(K2)

CO5-Predicting intellectual property issues in product development and ethical issues in product development.(K3)

UNIT I INTRODUCTION (9 Hrs)

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION (9 Hrs)

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE (9 Hrs)

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN (9 Hrs)

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT (9 Hrs)

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

Text Books

1. Dr. Ali Jamnia "Introduction to Product Design and Development for Engineers" CRC Press-2018
2. Vivek D. Bhise "Automotive Product Development: A Systems Engineering Implementation" CRC Press–2017
3. Karl T. Ulrich, Steven D. Eppinger Product Design and Development McGraw Hill Education, McGraw Hill Education (India) Private Limited. 2016

Reference Books

1. Bjarki Hallgrimsson "Prototyping and Modelmaking for Product Design "Laurence King Publishing, 2019
2. Peter N. Golder, Debanjan Mitra "Handbook of Research on New Product Development" Edward Elgar Publishing. – 2018
3. Regine M. Gilbert "Inclusive Design for a Digital World: Designing with Accessibility in Mind" Apress. – 2019
4. Omera Khan "Product Design and the Supply Chain: Competing Through Design "Kogan Page, 2018
   Steven Eppinger, Karl Ulrich, Maria C. Yang "Loose Leaf for Product Design and Development "McGraw-Hill Education, 2019

Web Resources

1. https://swayam.gov.in/nd1_noc20_me12/preview
2. https://nptel.ac.in/courses/112/107/112107217/
3. https://www.mooc-list.com/course/medtech-trends-and-product-design-futurelearn.
4. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-me16/
5. https://www.youtube.com/watch?v=HN9GtL21rb4

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
2	3	2	1	-	-	-	-	-	-	-	2	2	3	2	3
3	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3
4	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
5	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE718	AUTOMATED MATERIAL HANDLING SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study about the fundamentals of automation in material handling
- To provide knowledge on common material handling systems
- To impart knowledge on automated material handling systems like RGVS, AGVS, AS/RS, etc.
- To provide knowledge on transfer mechanisms, conveyors, part feeding devices, robots in material handling
- To discuss various case studies related to automated material handling

Course Outcomes

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

CO1- Acquire knowledge on automation in material handling systems (K1)
CO2- Acquire knowledge on RGVS, AGVS, AS/RS (K2)
CO3- Familiarize on robots in material handling (K2)
CO4- Recognize the automated systems with real time applications (K2)
CO5- Understand the Principles of work holding devices and apply in real time Applications (K2)

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to work handling concepts in manufacturing – configuration, symbolic representation, workpiece characteristics and their significance, Facilities planning process, Facilities design and diagrams, Storage facilities planning, Materials flow, Activity relationship, Space requirements, Facility lay out –computerized lay outs, Evaluation and selection of alternatives, Defined materials handling, Storage –open and closed storage systems, Bulk loading, Unloading, Shipping and Receiving systems and operations.

UNIT II COMMON MATERIAL HANDLING EQUIPMENT'S **(9 Hrs)**

Concepts of Unit Loads, Material handling and Storage equipment's operation and selection, Containers, Pallets, Conveyor systems, Industrial trucks, Wagon tipplers, Transporters, Stackers, Reclaimers, Silos &hoppers and their accessories, Ropeways, Ship loaders, Cable cranes, Container handling systems, Electric lifts & Hoists, EOT cranes, Elevators, Material handling equipment's in Steel mills, Power plants, Mines, Automobile and Transport 27 CIM-2013 SRM(E&T) Industries, Large scale Constructions etc.,

UNIT III AUTOMATION OF MATERIAL HANDLING **(9 Hrs)**

Automated feeding arrangements for discrete parts, their design based in work piece requirements, orienting methods, one by one feeding, agonizing, stapling etc., - Feeding continuous material liquids, granules etc.,- Automated assembly system, elements, configuration design, details and control – Special feeding mechanisms – Automated inspection and their design

UNIT IV CLASSIFICATION OF AUTOMATED SYSTEMS **(9 Hrs)**

Concepts of Unit Built Machines (UBM) – classification and elements, Power Units, self-contained and separate feed type, Change over UBMs, Transfer lines – classification and their components, Automated systems for handling and transfer of prismatic, axis symmetric parts and asymmetric parts in transfer lines, Case studies on transfer lines – interlocked, palletized and flexible inter linkage transfer lines, control systems – SWARF handling and disposal systems.

UNIT V AUTOMATED MATERIAL HANDLING EQUIPMENT'S **(9 Hrs)**

Automated handling and storage systems in manufacturing environment, Rail Guided Vehicles (RGVs), Automated Guided Vehicles (AGVs), Applications of RGVs and AGVs, Automated Storage a Retrieval Systems (AS / RS), AS

/ RS in the Automated factory, Considerations for planning an AS /RS system, Applications of AS / RS, Principles of work holding devices – Modular fixturing, Flexible fixturing systems – Fixturing for FMS, Robots and their applications in handling and storage.

Text Books

1. Bandyopadhyay, Susmita “Intelligent Vehicles and Materials Transportation in the Manufacturing” IGI Global.- 2017
2. Hamed Fazlollahtabar, Mohammad Saidi-Mehrabad “Autonomous Guided Vehicles: Methods and Models for Optimal Path Planning” Springer.– 2015

Reference Books

1. K. C. Arora “Aspects of Materials Handling” Laxmi Publications, 2011
2. Eugene L. Magad “Total Materials Management: Achieving Maximum Profits Through Materials” Springer Science & Business Media. - 2013
3. J.M. Tanchoco” Material Flow Systems in Manufacturing” Springer Science & Business Media- 2012
4. Robert J. Graves, Leon F. McGinnis, Mickey R. Wilhelm “Material Handling ’90” f Springer Science & Business Media. – 2012
5. P.J. O'Grady “Controlling Automated Manufacturing Systems“ Springer Science & Business Media.- 2012

Web Resources

1. https://nptel.ac.in/courses/112/102/112102011/
2. https://swayam.gov.in/nd1_noc20_me44/preview
3. https://www.youtube.com/watch?v=iVPbB8YRM_E

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
2	3	2	1	-	-	-	-	-	-	-	2	2	3	2	3
3	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3
4	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
5	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE719	AUTONOMOUS MOBILE ROBOTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

1. To students will learn about basics and applications in robots
2. To discuss technical definitions, laws, concept and theories.
3. To study technical terminology and conventions.
4. To understand localization of mobile robot.
5. To train path planning and navigation architectures

Course Outcomes

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

CO1- Discuss about the basics of robot cognition and perception (K2)
CO2- Understand the kinematic motions calculations and its functions. (K2)
CO3- Apply the machine vision and motion concept of image processing (K3)
CO4- Develop knowledge about simultaneous localization and mapping based techniques and paradigms. (K3)
CO5- Analyze the various path planning techniques by briefing about the robot's environment and explaining about the programs used (K3)

UNIT I INTRODUCTION **(9 Hrs)**

Introduction, Locomotion: Key issues for locomotion, legged Mobile Robots-Leg configurations and stability-Examples of legged robot locomotion, Wheeled Mobile Robots-Wheeled locomotion-case studies

UNIT II MOBILE ROBOT KINEMATICS AND WORKSPACE **(9 Hrs)**

Introduction, Kinematic Models and Constraints-Representing robot position-Forward kinematic models-Wheel kinematic, Examples: robot kinematic models and constraints, Mobile Robot Manoeuvrability. Mobile Robot Workspace-Degrees of freedom-Path and trajectory considerations, Motion Control - Open loop control-Feedback control

UNIT III PERCEPTION AND LOCALIZATION **(9 Hrs)**

Sensors for Mobile Robots: Sensor classification - Characterizing sensor performance – Wheel/motor sensors - Heading sensors – Ground based beacons - Active ranging – Motion/speed sensors - Vision-based sensors, Representing Uncertainty, Feature Extraction: Feature extraction based on range data (laser, ultrasonic, vision-based ranging) - Visual appearance-based feature extraction,

UNIT IV MOBILE ROBOT LOCALIZATION **(9 Hrs)**

Introduction - The Challenge of Localization: Noise and Aliasing, Localization-Based Navigation versus Programmed Solutions Map Representation, Probabilistic Map-Based Localization, Other Examples of Localization Systems, Autonomous Map Building.

UNIT V PLANNING AND NAVIGATION **(9 Hrs)**

Introduction, Competences for Navigation: Planning and Reacting - Path planning Obstacle avoidance, Navigation Architectures: Modularity for code reuse and sharing - Control localization - Techniques for decomposition - Case studies: tiered robot architectures

Text Books

1. Roland Siegwart, IllahR. Nourbakhsh, "Autonomous Mobile Robots, The MIT Press, 2014.
2. John.J.Craig, "Introduction to Robotics: Mechanics &control", Pearson Publication, Fourth edition, 2018
3. Eugene Kagan, Irad Ben-Gal, Nir Shvalb, Autonomous Mobile Robots and Multi-Robot Systems, Wiley , 2019

Reference Books

1. Sathya Ranjan Deb, “Robotics Technology & flexible Automation”, Second edition, Tata McGraw-Hill Publication, (2nd edition) 2017.
2. Xiaorui Zhu, Youngshik Kim, Mark A. Minor “Autonomous Mobile Robots in Unknown Outdoor Environments“CRC Press. – 2017
3. Ingemar J. Cox, Gordon T. Wilfong “Autonomous Robot Vehicles” Springer Science & Business Media – 2012
4. Nikolaus Correll” Introduction to Autonomous Robots: Kinematics, Perception, Localization and Planning" Magellan Scientific, 2016
5. Shawn M. Walsh, Michael S. Strano “Robotic Systems and Autonomous Platforms: Advances in Materials and Manufacturing “Elsevier Science, 2018

Web Resources

1. https://swayam.gov.in/nd1_noc19_me74/preview
2. https://nptel.ac.in/courses/112/105/112105249/
3. https://www.mooc-list.com/course/autonomous-mobile-robots-edx
4. http://www.mobilerobots.org.
5. https://www.youtube.com/watch?v=Za49iugVQWg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	1	1	2	2	2	1	3	2	3
2	3	2	1	2	2	1	1	2	2	1	2	2	3	2	3
3	3	2	1	1	1	1	2	1	1	1	2	3	3	2	3
4	3	2	1	2	2	2	3	2	2	2	2	1	3	2	3
5	3	2	1	2	2	2	3	2	2	2	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE720	DIGITAL IMAGE PROCESSING AND MACHINE VISION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamentals of Digital Image Processing, including image acquisition.
- To discuss simple image enhancement techniques in various domains.
- To study various image segmentation and representation techniques
- To understand the fundamentals of machine vision system.
- To familiarize the Industrial applications of machine vision.

Course Outcomes

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

CO1- interpret image in its numeric and graphical form and Understand geometric relationship of pixels (K1)
CO2- Write simple codes for improving image quality (K2)
CO3- Extracting useful information from image contents through processing (K3)
CO4- Analysis the needs of a machine vision system (K3)
CO5- Developing machine vision system based on the application. (K3)

UNIT I INTRODUCTION (9 Hrs)

Definition, Digital image representation, fundamental steps in image processing, elements of digital image processing systems, image acquisition, storage, processing, communication and display. Digital Image Fundamentals - Structure of the human eye, image formation, a simple image model, some basic relationships between pixels, neighbours of a pixel, connectivity, Labelling, distance measures, imaging geometry

UNIT II IMAGE ENHANCEMENT (9 Hrs)

Image enhancement in the spatial domain - Basic gray level transformations, histogram processing, Enhancement using arithmetic/ logic operations, Basics of spatial filtering-comparison between smoothing and sharpening spatial filters. Image Enhancement in the frequency domain - 1D Fourier transform, 2D Fourier transform and its Inverse-Smoothing & sharpening frequency domain filters (Ideal, Butterworth, Gaussian)-homo-morphic filtering.

UNIT III IMAGE SEGMENTATION (9 Hrs)

Edge detection, Edge linking via Hough transforms – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – dam construction - Watershed segmentation algorithm.

UNIT IV MACHINE VISION (9 Hrs)

Introduction, definition, Machine vision components, hardware and algorithms, image function and characteristics, segmentation, data reduction, feature extraction, edge detection, image recognition and decisions, machine learning, CCD line scan and area scan sensor, Videcon and other cameras, Triangulation geometry, resolution passive and active stereo imaging, laser scanner, data processing.

UNIT V INDUSTRIAL APPLICATIONS OF MACHINE VISION (9 Hrs)

Application of machine vision such as inspection of parts, identification, industrial robot control. Industrial machine vision in production and services, structure of industrial machine vision, rules of thumb, illumination, optics, image processing, interfacing machine vision system, vision system calibration.

Text Books

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Education India, 2018.

2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 2015.
3. Gerardus Blokdyk, “Machine Vision A Complete Guide - 2019 Edition”, 5STARCooks, 2019.

Reference Books

1. Alan V. Oppenheim, Ronald W. Schafer, “Discrete-Time Signal Processing”, Pearson Education, 2014.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, Digitized 2007.
3. Borko Furht, Esad Akar, Whitney Angelica Andrews, “Digital Image Processing: Practical Approach”, Springer International Publishing, 2018.
4. Poonam Yadav, Abhishek Yadav, “Digital Image Processing” Kindle Edition, Laxmi Publisher, 2009.
5. Jürgen Beyerer, Fernando Puente León, Christian Frese, “Machine Vision - Automated Visual Inspection: Theory, Practice and Applications”, Springer Berlin Heidelberg, 2015.

WEB RESOURCES

1. https://swayam.gov.in/nd1_noc19_ee55/preview
2. https://nptel.ac.in/courses/117/105/117105079/
3. https://www.coursera.org/learn/digital
4. https://www.mooc-list.com/tags/image-processing
5. https://www.youtube.com/watch?v=1I6kfkY4GyQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
2	3	2	1	-	-	-	-	-	-	-	2	2	3	2	3
3	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3
4	3	2	1	-	-	-	-	-	-	-	2	1	3	2	3
5	3	2	1	-	-	-	-	-	-	-	2	3	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE821	RELIABILITY ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To apply engineering knowledge and specialist techniques to prevent or to reduce the failures
- To identify and correct the causes of failures that occur despite the efforts to prevent them
- To determine ways of coping with failures that occur, if their causes have not been fixed
- To apply methods for estimating the likely reliability of new software and for analyzing reliability data.
- To calculate the machine maintenance and of service of the equipment.

Course Outcomes

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

CO1 – Understand major concepts of reliability prediction. **(K2)**
CO2 – Analyze statistical experiments leading to reliability modeling.(**K2**)
CO3 - Identify reliability testing components.(**K3**)
CO4 - Apply reliability theory to assessment of reliability in engineering design.(**K3**)
CO5 – Evaluate reliability standard systems.(**K4**)

UNIT I INTRODUCTION (9 Hrs)

Concept of reliability, reliability indices, component reliability –Introduction, non repairable component, hazard models, components with preventive maintenance, repairable components.

UNIT II SYSTEM RELIABILITY (9 Hrs)

Network methods, Introduction; series configuration parallel configuration, mixed configuration, the r out of n configuration d composition method minimal-tie and minimal –cut methods logic diagrams.

UNIT III REDUNDANCY TECHNIQUES (9 Hrs)

Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method.

UNIT IV FAILURE MODES (9 Hrs)

System reliability state space method system representation basic concepts state probability state frequency and duration system of two independent component two components with dependent failures combining states failure effect analysis state enumeration methods

UNIT V RELIABILITY EVALUATION (9 Hrs)

System reliability evaluation using probability distribution series system parallel system partially redundant system mean time to failure stand by system

Text Books

1. Mangey Ram ,Reliability Engineering Methods and Applications, CRC Press/Taylor and Francis Group, 2018.
2. K. Gupta, Reliability, Maintenance and Safety Engineering, University Science Press · 2009
3. Charles E. Ebeling ,An Introduction to Reliability and Maintainability Engineering, Waveland Press, Third Edition, 2019

Reference Books

1. Alessandro Birolini, Reliability Engineering Theory and Practice, Springer Berlin Heidelberg · 2013
2. Edgar Bradley, Reliability Engineering A Life Cycle Approach, CRC Press, 2016
3. Kailash C. Kapur, Michael Pecht, Reliability Engineering, Wiley,2014

4. Pethuru Raj Chelliah, Shreyash Naithani, Shailender Singh, Practical Site Reliability Engineering, Packt Publishing, 2018
5. Singiresu S. Rao, Reliability Engineering, Pearson Education, 2014

Web Resources
1. https://onlinecourses.nptel.ac.in/noc20_mg43/preview
2. https://nptel.ac.in/courses/114/106/114106041/
3. https://onlinecourses.nptel.ac.in/noc20_mg18/preview
4. https://onlinecourses.nptel.ac.in/noc20_mg18/preview
5. https://onlinecourses.nptel.ac.in/noc20_me26/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	2	-	2	3	2	3	1
2	3	3	2	2	-	-	-	-	-	-	1	3	2	2	3
3	3	3	2	2	-	-	-	-	2	-	2	3	2	1	3
4	3	3	3	2	-	-	-	-	1	-	1	3	1	2	3
5	3	3	3	2	-	-	-	-	1	-	2	3	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE822	AUTOMATION IN MANUFACTURING SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge in the field of Automated Manufacturing system.
- To illustrate the basic concepts of automation in production lines.
- To understand the fundamentals of automation in multi station assembly machines
- To describe the importance of automated material handling and storage systems.
- To understand automated inspection principles and strategies in manufacturing.

Course Outcomes

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

CO1 - Understand the basic types, levels, strategies of automation. **(K1)**
CO2 - Understand basic components and their functions of automated production line system.**(K2)**
CO3 - Apply the quantitative analysis and assembly systems.**(K2)**
CO4 – Examine various storage system and transportation requirements of automated systems.**(K2)**
CO5 - Evaluate the process control strategy to an automated system.**(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Facilities - Manual work systems, worker - machine systems and automated systems. Manufacturing support systems, Automation in Production systems - Automated Manufacturing systems, Computerized manufacturing support systems, Manual labour in Production systems, Automation principles and strategies.

UNIT II AUTOMATED PRODUCTION LINES **(9 Hrs)**

Fundamentals - System configurations, work part transfer mechanisms, Storage buffers, and Control of the production line. Applications - Machining systems and System Design Considerations. Analysis of Transfer lines - Transfer lines with No internal parts storage, Transfer lines with internal storage buffers.

UNIT III AUTOMATED ASSEMBLY SYSTEMS **(9 Hrs)**

System configurations, Parts delivery at workstations and applications, quantitative analysis of assembly systems - Parts Delivery System at Workstations, Multi - Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

UNIT IV AUTOMATED MATERIAL TRANSPORT & STORAGE SYSTEMS **(9 Hrs)**

Automated Material Transport & Storage systems: Automated Guided Vehicle (AGV) Systems, Types and applications, Vehicle Guidance Technology, Vehicle Management and Vehicle safety. Automated Storage and Retrieval Systems (ASRS) and Carousel Storage Systems.

UNIT V AUTOMATEDINSPECTIONSYSTEMS **(9 Hrs)**

Quality in Design and manufacturing, inspection principles and strategies, automated inspection, contact Vison-contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

Text Books

1. Beno Benhabib Manufacturing: Design, Production, Automation, and Integration, CRC Press, 2009.
2. R. Thomas Wright, Mich+ael Berkeihiser, ‘Manufacturing and Automation Technology’, 2011.
3. Mikell P. Groover, ‘Automation, Production Systems and Computer-Integrated Manufacturing’, Pearson Publisher, Fourth Edition, 2016.

Reference Books

1. P. Radhakrishnan, S. Subramanyan andV. Raju, 'CAD/CAM/CIM', New Age International (P) Ltd.,New Delhi,2009.
2. S.R.Deband Sankha Deb,'Robotics Technology and Flexible Automation',TataMcGrawHill,Second Edition, NewDelhi, 2010.
3. Peter Corke, 'Robotics, Vision and Control:Fundamental Algorithms in MATLAB', Springer,2011.
4. Nicholas Odrey, Mikell P Groover, Roger Nagel, Ashish Dutta, 'Industrial Robotics(SIE): Technology, Programming and Applications',McGraw Hill, 2012.
5. Caustic Kumar (Editor), Divya Zindani (Editor), J. Paulo Davim,' Digital Manufacturing and Assembly Systems in Industry 4.0', CRC Press, 2021

Web Resources

1.https://nptel.ac.in/courses/108/105/108105063/
2.https://www.automationmag.com/
3.https://www.springer.com/gp/book/9783319771786.
4.https://library.automationdirect.com/industrial-automation-top-10-trends/
5. https://nptel.ac.in/courses/112/102/112102011/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	1	1	2	2	3	2	3	2	3
2	3	2	1	2	2	1	1	2	2	1	3	2	3	2	3
3	3	2	1	1	1	1	2	1	1	1	3	2	3	1	3
4	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3
5	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE823 **MECHATRONICS SYSTEM APPLICATIONS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart knowledge in the field of modern mechatronics components
- To illustrate the basic concepts of mechatronics systems design
- To understand the fundamentals and elements of mechatronics systems
- To describe the importance of mechatronics system for various applications.
- To understand the implementation of mechatronics systems in manufacturing.

Course Outcomes

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

CO1 - understand the modern mechatronics components.
CO2 - understand the principles and alternatives for mechatronics systems design (K2)
CO3 - understand the elements of mechatronics systems (K3)
CO4 - familiarise mechatronics system for various applications. (K3)
CO5 - Understand the various applications, justification and implementation of mechatronics systems. (K2)

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to basics mechatronics components - Sensors, Actuators, Micro-controllers, PLC's

UNIT II BIOMIMICRY USING MECHATRONICS **(9 Hrs)**

Biomimicry – Introduction, Concept, Advantages. Bio-Inspired Robots – Mechanisms, Controls, Actuations. Case Studies - Wall-Climbing Caterpillar Robot, Hexapedal robot inspired by cockroach locomotion.

UNIT III MEDICAL APPLICATIONS **(9 Hrs)**

Introduction to mechatronics for medical applications, Importance of Mechatronics in Medical Applications, Applications of Mechatronics in Medicine - Robotics in Medicine, Smart Instruments and Probes. Case Studies - Handheld Snake-Like Robots, 3D Printed Skull.

UNIT IV SAFETY, SECURITY AND DEFENCE APPLICATIONS **(9 Hrs)**

Industrial safety systems, Smart security systems, Mechatronics in defence, Artificial Intelligence in security systems. Case Studies: Cobots (Collaborative Robots), Smart Doors, Heat-seeking missiles.

UNIT V MANUFACTURING APPLICATIONS **(9 Hrs)**

Introduction to manufacturing systems, Retrofitting, CNC machines, Rapid Prototyping, Industrial Robots. Case Studies – Laser cutting, Quality inspecting robots.

Text Books

1. W Bolton, Mechatronics, Pearson Education, Fourth Edition, 2011.
2. Siamak Najarian, Javad Dargahi, Ph.D.,, Goldis Darbemamieh, Siamak Hajizadeh Farkoush, Mechatronics in Medicine: A Biomedical Engineering Approach, 2012 McGraw-Hill Education, ISBN: 9780071768962

Reference Books

1. David G. Alciatore & Michael B Histand., Introduction to Mechatronics and Measurement systems, Tata McGraw Hill, 2003
2. Mechatronic Systems, Applications - Edited by Annalisa Milella, Donato Di Paola and Grazia Cicirelli, 2010 In-the. www.intechweb.org, ISBN 978-953-307-040-7

Web Resources

1. http://controlmanuals.com/files/Automation/Mechatronics-p1.html
2. www.mooc-list.com/course/me209x-thermodynamics-edx
3. http://www.springer.com/in/book/9783642175305

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	2	2	1	1	2	3	2	3	2	3
2	3	2	2	1	2	2	1	1	2	2	3	2	3	2	3
3	3	2	2	1	1	1	1	2	1	1	3	2	3	1	3
4	3	2	2	1	2	2	2	3	2	2	3	2	3	2	3
5	3	2	2	1	2	2	2	3	2	2	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE824	ROBOTICS AND MACHINE VISION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn kinematics equation for robots.
- To introduce the design philosophy for grippers for various robotic applications
- To analyze the sensors and actuators for different robotic applications.
- To apply performance criteria in the design of basic amplifier circuits and verify that the criteria were met.
- To learn operations on digital images.
- To analyze and evaluate performance of images and work with multiple images.

Course Outcomes

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

CO1 - Derive kinematics equation for robots (K2)
CO2 - Design appropriate grippers for various robotic applications.(K2)
CO3 – Select appropriate sensors and actuators for different robotic applications.(K3)
CO4 – Perform operations on digital images.(K3)
CO5 – Extract features from images and work with multiple images.(K4)

UNIT I INTRODUCTION (9 Hrs)

Introduction to robotics, Robot Transformations – Rotation Matrix – Forward and Inverse Kinematics – DH Representation. Basics of Trajectory planning

UNIT II END EFFECTORS (9 Hrs)

Types of end effectors –Mechanical grippers –Types of Gripper mechanisms–Grippers force analysis –Other types of Grippers –Vacuum cups –Magnetic Grippers –Adhesive Grippers –Robot end effector interface.

UNIT III SENSORS & ACTUATORS (9 Hrs)

Functions of Drive Systems – AC, DC Motors – Pneumatic and Hydraulic Actuators – Selection of Sensors – Classification of Sensors – Data Acquisition

UNIT IV IMAGE PROCESSING (9 Hrs)

Image Acquisition – Operation on images: Mondic – Diadic – Spatial – Morphology – Boundary detection – Hit and miss transform – Shape changing: Cropping – resizing – pyramids – warping

UNIT V USING MULTIPLE IMAGES (9 Hrs)

Region Features: Classification – Representation – Description. Line Features – Point features - Feature correspondence – Geometry of multiple views – Stereo vision – Structure and motion, interfacing with industrial robots

Text Books

1. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, 2nd edition, Springer, 2017
2. John Billingsley and Robin Bradbeer, Mechatronics and Machine Vision in Practice, Springer, 2007

Reference Books

1. González, Rafael C. and Woods, Richard Eugene, Digital Image Processing, 3rd Edition, Prentice Hall, 2008.
2. Davies, E.R., Machine Vision: Theory, Algorithms, Practicalities , Academic Press, London, 2012

Web Resources

1. http://zums.ac.ir/files/research/site/ebooks/Robotics/Robot%20Vision.pdf
2. https://www.mooc-list.com/course/robotic-vision-qut

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	1	1	2	2	3	2	3	2	3
2	3	2	1	2	2	1	1	2	2	1	3	2	3	2	3
3	3	2	1	1	1	1	2	1	1	1	3	2	3	3	3
4	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3
5	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE825	PROJECT MANAGEMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of Project Management for planning to execution of projects.
- To understand the time needed to successfully complete a project, considering factors such as task dependencies and task lengths
- To understand the feasibility analysis in Project Management and network analysis tools for time estimation.
- To comprehend the fundamentals of Contract Administration, Costing and Budgeting.
- To make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Outcomes

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

CO1 - Explain project, project management, life cycle and influencing factors (k1)
CO2 - Analyze and manage project formulation in projects parametrics (K2)
CO3 - Manage time in projects through Gantt charts, CPM and PERT techniques, (K3)
CO4 – Optimize resources of projects using scheduling, fast tracking and re-estimation techniques (K3)
CO5 - Identify risk management in projects with emerging trends in project management (K2)

UNIT I PROJECT AND ITS PROCESS (9 Hrs)

Define project and process, boundaries of project, Objectives and functions of Project management, characteristics and types of projects, organization structure / styles, roles of project management group, project management office and its role, project knowledge area, project integration- process group interaction. Project flow, project life cycle- influencing factors.

UNIT II PROJECT FORMULATION (9 Hrs)

Generation and Screening of PM ideas- Triple Constraint – Time, Cost and Scope. TOR/ Project Charter/ SOW (Statement of Work) - Creation of project Charter. Preliminary planning and estimate. Types of estimate- Ball park, Parametric and Bottom up estimates. Project Presentation & Approval – Detailed Project Report & Approval (Technical and Budget Sanction).

UNIT III TIME MANAGEMENT (9 Hrs)

Project Scope Management - Work break down structure- Activity/ Task- Events- Case study. Project planning tools Rolling wave planning. Gantt Charts, Milestone chart, Program Progress chart- Creating milestone plan. Project Network- Fulkerson’s rules – Activity-On-Arrow and Activity- On - Node networks. Analyze project time- Critical path method.

UNIT IV RESOURCE MANAGEMENT AND OPTIMIZATION (9 Hrs)

Types of resource - Balancing of resource - Resource Smoothing technique - Time constraint. Resource leveling technique- Resource constraint- Case study.
Resource optimization, Types of cost - Direct, Indirect and Total Cost. Variation of Cost with time. Schedule Compression Techniques- Crashing, Fast Tracking & Re-estimation- Crash time and crash cost. Optimize project cost for time and resource. CPM Cost model.

UNIT V RISK MANAGEMENT (9 Hrs)

Risk management – meaning and process, Risk identification and analysis techniques- FMEA and SWOT analysis- Risk reporting and monitoring- Case study.

Text Books

1. Dennis Lock, Project Management, Taylor & Francis, 2017
2. Albert Lester Project Management, Planning and Control Managing Engineering, Construction and Manufacturing Projects to PMI, APM and BSI Standards, Elsevier/Butterworth-Heinemann 2007

Reference Books

1. Terry Schmidt Strategic Project Management Made Simple Practical Tools for Leaders and Teams,Wiley,2009.
2. R. B. Khanna Project Management, PHI Learning 2011
3. Garth G.F. Ward Effective Project Management Guidance and Checklists for Engineering and Construction, Wiley, 2018.

Web Resources

1. https://nptel.ac.in/courses/110/104/110104073/
2. https://nptel.ac.in/courses/110/107/110107081/
3. https://www.youtube.com/watch?v=5pwc2DYlKQU
4. https://www.youtube.com/watch?v=wJ8HZ7hqUs8

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3
2	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3
3	3	2	1	-	-	-	-	-	-	-	3	2	3	1	3
4	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3
5	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE826 POWER PLANT INSTRUMENTATION AND CONTROL

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide an overview of different methods of power generation with a particular stress on thermal power generation.
- To bring out the various processes involved in power generation plants.
- To provide knowledge about the controlling combustion and draught.
- To impart knowledge about the different types of controls for feed water and steam.
- To familiarize the student with the methods of monitoring different parameters and their control.

Course Outcomes

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

CO1 - Demonstrate knowledge of power plants and instrumentations for controlling.(K1)
CO2 - Identify various elements involved in steam generation for power plants.(K2)
CO3 - Control the combustion to vary the steam generation.(K3)
CO4 - Control the quantity of steam generation and power generation.(K3)
CO5 - Design proper control system with required instrumentation for controlling the power generation.(K3)

UNIT I OVERVIEW OF POWER GENERATING STATIONS AND STEAM GENERATION (9 Hrs)

Brief survey of different methods of conventional power generation (hydro, thermal and nuclear)-Importance of instrumentation in power generating stations.
Steam generation in thermal power plants: Process of power generation in coal-fired and oil fired in thermal power plants-Nature of steam-Thermal efficiency-Gas turbine and combined cycle plants-Steam turbine and use-Steam turbine.

UNIT II CIRCUITS IN STEAM GENERATION AND DEMAND FOR STEAM GENERATION (9 Hrs)

Water, fuel, air and flue gas circuits: The condensate and feed water system - Feed pumps and valves-The water and steam circuits
Setting the demand for the steam generator: nature of the demand-Setting the demand in power stations applications-Master demand in power station applications-Load demand in combined heat and power plants-Waste to energy plants

UNIT III COMBUSTION AND DRAUGHT CONTROL (9 Hrs)

Principles of combustion control, Working with multiple fuels, control of coal mills, Draught control, Binary control of the combustion system

UNIT IV FEED WATER CONTROL AND STEAM-TEMPERATURE CONTROL (9 Hrs)

Feed-water control: principles of feed-water control - One, two and three-element control, Measuring and displaying the drum level, mechanisms used for feed-water control, Pumps, De-aerator control
Steam-temperature control: need of steam-temperature control, spray-water attemperator, Temperature control with tilting burners, Controlling the temperature of reheated steam, Gas recycling

UNIT V CONTROL EQUIPMENT PRACTICE (9 Hrs)

DCS configuration in power plant-A Typical DCS configuration-Interconnections between systems-Equipment selection and environment-Mechanical factors and ergonomics-Electrical Actuators-Hydraulic Actuators-Cabling -Electromagnetic Compatibility-Reliability of systems

Text Books

1. Swapan Basu, Ajay Kumar Debnath “Power Plant Instrumentation and Control Handbook” Academic Press. – 2019.
2. Hegde “Power Plant Engineering” Pearson Education India. – 2015

Reference Books

1. Swapan Basu “Plant Hazard Analysis and Safety Instrumentation Systems” Academic Press. – 2016
2. Philip Kiameh “Power Plant Equipment Operation and Maintenance Guide” McGraw Hill Professional, 2011.
3. Gregory K. McMillan, P. Hunter Vegas “Process / Industrial Instruments and Controls Handbook, Sixth Edition” McGraw-Hill Education, 2019
4. K. Krishnaswamy, M. Ponni bala “power plant instrumentation” PHI learning Pvt. ltd. 2013
5. Mallick, Amiya ranjan “practical boiler operation engineering and power plant, PHI learning pvt. ltd.**. - 2015**

Web Resources

1. https://nptel.ac.in/courses/112/107/112107291/
2. https://swayam.gov.in/nd1_noc20_me10/preview
3. http://www.powerplantinstrumentationcontrol.yolasite.com/upcomming-lecture.php

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	-	-	-	-	-	-	3	2	3	2	3
2	3	2	1	2	-	-	-	-	-	-	3	2	3	2	3
3	3	2	1	2	-	-	-	-	-	-	3	2	3	1	3
4	3	2	1	2	-	-	-	-	-	-	3	2	3	2	3
5	3	2	1	2	-	-	-	-	-	-	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE827	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To differentiation between convention and unconventional machining process and need of unconventional machining in the current scenario.
- To know about the surface finish of different materials using mechanical energy-based processes.
- To know about the surface finish of different materials using electrical energy-based processes.
- To know about the surface finish of different materials using chemical energy-based processes.
- To know about the surface finish of different materials using thermal energy-based processes

Course Outcomes

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

CO1 - Understand the basic principle of conventional machining process(K1)
CO2 - Interpret the mechanical energy-based processes(K2)
CO3 - Familiarize on the various electrical energy-based processes(K3)
CO4 - Interpret the chemical energy-based processes(K3)
CO5 - Familiarize on the various thermal energy-based processes(K2)

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

UNIT II MECHANICAL ENERGY BASED PROCESSES **(9 Hrs)**

Abrasive Jet Machining - Water Jet Machining - Abrasive Water Jet Machining - Ultrasonic Machining. Working Principles - equipment used - Process parameters - MRR – Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES **(9 Hrs)**

Electric Discharge Machining (EDM) - working Principle - equipments - Process Parameters - Surface Finish and MRR - electrode / Tool - Power and control Circuits - Tool Wear - Dielectric - Flushing - Wire cut EDM – Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES **(9 Hrs)**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical Circuit-Process Parameters- ECG and ECH - Applications.

UNIT V THERMAL ENERGY BASED PROCESSES **(9 Hrs)**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications

Text Books

1. T. Jagadeesha “Unconventional Machining Processes “I.K. International Publishing House Pvt. Limited, 2016.
2. Hassan El-Hofy “Fundamentals of Machining Processes: Conventional and Nonconventional Processes “CRC Press/Taylor & Francis Group, 2018.

Reference Books

1. Kumar, Kaushik, Kumari, Nisha, Davim, J. Paulo "Non-Conventional Machining in Modern Manufacturing Systems " IGI Global. – 2018
2. Golam Kibria, B. Bhattacharyya, J. Paulo Davim "Non-traditional Micromachining Processes: Fundamentals and Applications" Springer. – 2017
3. Kaushik Kumar, J. Paulo Davim "Modern Manufacturing Processes" Elsevier Science & Technology, 2020
4. Kapil Gupta "Advanced Manufacturing Technologies"Springer – 2017
5. M. S. Shunmugam, M. Kanthababu "Advances in Micro and Nano Manufacturing and Surface Engineering " Springer Nature - 2019

Web Resources

1. https://nptel.ac.in/courses/112/105/112105126/
2. https://swayam.gov.in/nd1_noc20_me17/preview
3. https://www.youtube.com/watch?v=gFB2PCULf0s

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	-	-	-	-	-	3	2	3	2	3
2	3	2	2	1	-	-	-	-	-	-	3	2	3	2	3
3	3	2	2	1	-	-	-	-	-	-	3	2	3	1	3
4	3	2	2	1	-	-	-	-	-	-	3	2	3	2	3
5	3	2	2	1	-	-	-	-	-	-	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE828	UNMANNED AERIAL VEHICLES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Briefing on overview and background of the development of UAV
- Introducing different components of Unmanned Aerial System (UAS)
- Describing the concepts behind the flight of aerial vehicle systems.
- Explaining the navigation of UAV
- Discussion on UAV launch systems and safety regulations

Course Outcomes

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

CO1 - Understand the development and need for UAV (K1)
CO2 - Design of Unmanned aerial system components (K2)
CO3 - Exhibiting the knowledge of concepts of flight(K3)
CO4 – Analysis navigate UAV by different methods(K3)
CO5 – Experiment proper launching system for UAS(K3)

UNIT I OVERVIEW AND BACKGROUND (9 Hrs)

Definitions, History of unmanned air vehicle (UAV) development, classifications of UAVs: scale, lift generation method, contemporary applications: military, government, civil, societal impact and future outlook, operational considerations: liability / legal issues, insurance, ethical implications, human factors

UNIT II UNMANNED AERIAL SYSTEM (UAS) COMPONENTS (9 Hrs)

Platforms: configurations, characteristics, applications, propulsion: internal combustion engines, turbine engines, electric systems, on-board flight control, payloads: sensing / surveillance, weaponized, delivery, communications: command/control, telemetry. launch / recovery systems. ground control stations

UNIT III CONCEPTS OF FLIGHT (9 Hrs)

Aerodynamics: lift, weight, thrust, drag, flight performance: climbing vs. gliding flight, range / endurance, stability and control: flight axes, flight controls, Autopilots - lateral and longitudinal autopilots, Sensor, Controller, Actuator, Airframe Control, Inner and Outer Loops, Flight-Control Classification, Overall Modes of Operation, Sensors Supporting the Autopilot

UNIT IV UAV NAVIGATION (9 Hrs)

Accelerometers, gyros, GPS, Path planning algorithms: Dubin's curves, way-points, Voronoi partitions. Path following and guidance: Straight line and curve following, vision-based guidance.

UNIT V UAV LAUNCH SYSTEMS AND SAFETY REGULATIONS (9 Hrs)

Launch Systems: Basic Considerations, UAV Launch Methods for Fixed-Wing Vehicles, Rail Launchers, Pneumatic Launchers, Hydraulic/Pneumatic Launchers, Zero Length RATO Launch of UAVs, Vertical Take-off and Landing UAV Launch, Safety considerations, Regulations in India, Future directions and the road ahead.

Text Books

1. Kimon P. Valavanis, George J. Vachtsevanos, “Handbook ofUnmanned Aerial Vehicles”, Springer Reference, 2015
2. Paul GerinFahlstrom, Thomas James Gleason, “Introduction to UAV Systems”, A John Wiley & Sons, Ltd. Publication, 2012.

3. Victor Becerra “Autonomous Control of Unmanned Aerial Vehicles“ MDPI. Copyright. – 2019

Reference Books

1. Randal W. Beard and Timothy W. McLain: Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012
2. Kimon P. Valavanis: Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer, 2007
3. Landen Rosen “Unmanned Aerial Vehicle” Alpha Editions, 2015 “
4. A.R. Jha, Ph.D.” Theory, Design, and Applications of Unmanned Aerial Vehicles” CRC Press– 2016
5. Management Association, Information Resources” Unmanned Aerial Vehicles: Breakthroughs in Research and Practice” IGI Global - 2019

Web Resources

1. https://nptel.ac.in/courses/101/104/101104073/
2. https://swayam.gov.in/nd1_noc19_ae06/preview
3. https://www.youtube.com/watch?v=_RCF2Do4lVY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	1	1	2	2	3	2	3	2	3
2	3	2	1	2	2	1	1	2	2	1	3	2	3	2	3
3	3	2	1	1	1	1	2	1	1	1	3	2	3	1	3
4	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3
5	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE829	BUILDING AUTOMATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Gain knowledge on Building Management System (BMS) and Automation.
- Be familiarized with various transducers and sensors in BMS.
- Be exposed on Control panel and Communication.
- Learn Fire Alarm System (FAS) and security system such as CCTV.
- Gain knowledge on Energy Management in Building Automation.

Course Outcomes

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

CO1 - Remembering current philosophy, technology, terminology, and practices used in building automation(K1)
CO2 - Understand different fire standards, FAS Components, FAS loops, Architectures.(K2)
CO3 - Apply hardware and software for HVAC system (K3)
CO4 - Evaluate energy management system(K3)
CO5 - Design the new concepts materials of building automation(K4)

UNIT I INTRODUCTION TO BMS AND AUTOMATION **(9 Hrs)**

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT II FAS AND SECURITY SYSTEMS **(9 Hrs)**

Fire, Fire modes – Fire Alarm Systems components: Field components, panel components – FAS Architectures – Access Components, Access control system Design - CCTV camera types and operation –camera selection criteria – CCTV Applications.

Security Systems Fundamentals: Introduction to Security Systems, Concepts. Perimeter Intrusion: Concept, Components, Technology. Security Design:Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.

UNIT III HVAC SYSTEM **(9 Hrs)**

Fundamentals: HVAC Fundamentals, Basic Processes (Heating, Cooling etc) Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms. Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heatloss. Processes: Heating Processes (Boiler, Heater),Cooling Process (Chiller), Ventilation Process(Central Fan System, AHU, Exhaust Fans), Unitary Systems(VAV, FCU).Control Theory: Instrumentation Basics, Field components & use, DDC &applications. Control Panel: HVAC Control Panel, MCC Basics, Panel Components.

UNIT IV ENERGY MANAGEMENT SYSTEM **(9 Hrs)**

ASHRAE Symbols Energy Management: Energy Savings concept & methods, lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples

UNIT V BUILDING MANAGEMENT SYSTEM **(9 Hrs)**

IBMS (HVAC, Fire & Security) project cycle, Project steps BMS.Verticals: Advantages & Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS

Text Books

1. Gerardus Blokdyk "Intelligent Building Automation Systems The Ultimate Step-By-Step Guide "5STARCooks, 2018.
2. Phil Zito "Building Automation Systems a to Z: How to Survive in a World Full of Bas "CreateSpace Independent Publishing Platform, 2016

Reference Books

1. Jim Sinopoli "Smart Buildings", Butterworth-Heinemann imprint of Elsevier,2nd ed.,2010.
2. Albert Ting-Pat So, WaiLok Chan, Kluwer "Intelligent Building Systems" Academicpublisher,3rd ed., 2012.
3. James Sinopoli "Advanced Technology for Smart Buildings" Artech House. – 2016
4. Sibanjan Das, Umit Mert Cakmak "Hands-On Automated Machine Learning: A beginner's guide to building" Packt Publishing Ltd. – 2018
5. Gerard Blokdyk "Building Automation: Quickstart Administration" CreateSpace Independent Publishing Platform, 2017

Web Resources

1. https://www.youtube.com/watch?v=wNeYPfNV8QI
2. https://nptel.ac.in/courses/108/105/108105063/
3. https://swayam.gov.in/nd1_noc20_me39/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	1	1	2	2	3	2	3	2	3
2	3	2	1	2	2	1	1	2	2	1	3	2	3	2	3
3	3	2	1	1	1	1	2	1	1	1	3	2	3	1	3
4	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3
5	3	2	1	2	2	2	3	2	2	2	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MCE830	INDUSTRIAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the concepts, principles and framework of contents of Industrial Engineering
- To design and develop algorithms for solving industrial engineering related problems.
- To introduce the concepts of cost accounting and financial management practices as applied in industries.
- To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.

Course Outcomes

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

CO1 - Describe the scope, objectives, application, methods and tools of Industrial Engineering systems. (K1)
CO2 - Apply the various methods of Method study to Improve productivity (K2)
CO3 - Apply the various techniques of work measurement to Improve productivity (K3)
CO4 - Demonstrate the knowledge of designing plants and controlling production.(K3)
CO5 - Explain the decision support system methods to select the right solution to the concerned problems(K2)

UNIT I INDUSTRIAL ORGANISATION (9 Hrs)

Introduction to Industrial Engineering – Concepts - History and Development of Industrial engineering – Roles of Industrial Engineer – Applications – Productivity – Factors affecting productivity – Increasing productivity of resources – Kinds of productivity measures

UNIT II WORK DESIGN (9 Hrs)

Introduction to work study – Method study – Time study – stopwatch time study – Standard data - Method Time Measurement (M-T-M) – Work sampling – Ergonomics

UNIT III DEMAND FORECASTING AND ELEMENTS OF COST (9 Hrs)

Demand Forecasting and Elements of Cost Macro and micro economics - Demand and supply – Factors influencing demand – Elasticity of demand – Demand forecasting – Time series - Exponential smoothing casual forecast - Delphi method – Correlation and Regression - Barometric method – Long run and Short run forecast. Elements of cost – Determination of Material cost - Labour cost - Expenses – Types of cost.

UNIT IV PLANT LAYOUT AND GROUP TECHNOLOGY (9 Hrs)

Plant location - Factors - Plant layout - Types - Layout design process – Computerized Layout Planning – Construction and Improvement algorithms -ALDEP - CORELAP and CRAFT. Group technologyProblem definition - Production flow analysis - Heuristic methods of grouping by machine matrices – Flexible Manufacturing System - FMS work stationsMaterial handling and Storage system-Cellular Manufacturing System

UNIT V PRODUCTION PLANNING AND CONTROL (9 Hrs)

Types of productions, Production cycle-Process planning, Forecasting, Loading, Scheduling, Dispatching, Routing- Simple problems. Materials Planning – ABC analysis – Incoming materials control – Kanban system – Just in time. MRP systems- Master Production Schedule – Bill of Materials – MRP calculations

Text Books

1. O.P. Khanna, “Industrial engineering and management”, Dhanpat Rai Publications, 2018.
2. Martand T. Telsang, “Industrial Engineering and Production Management”,S. Chand Publishing, 2018.
3. Buffa E.S., Modern Production / Operational Management, John Wiley & Sons, 2009

Reference Books

1. Ravi, V. Industrial Engineering And Management" PHI Learning Pvt. Ltd – 2015
2. Pravin Kumar "Industrial Engineering and Management" Pearson Education India – 2015
3. Adedeji B. Badiru "Introduction to Industrial Engineering" CRC Press – 2018
4. Mr. Ashok Keshav Karande "The Story of Industrial Engineering: The Rise from Shop-Floor Management"-2019
5. Panneerselvam. R., Production/Operations Management, Prentice Hall of India, 2006

Web Resources

1. https://online.engineering.arizona.edu/online-programs/industrial-engineering/master-ofscience-in-industrial-engineering/
2. https://nptel.ac.in/courses/112/107/112107142/
3. https://swayam.gov.in/nd1_noc20_me43/preview
4. https://www.youtube.com/watch?v=aYcKw5q6JB4

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	-	-	-	-	-	3	2	3	2	3
2	3	2	3	-	-	-	-	-	-	-	3	2	3	2	3
3	3	2	3	-	-	-	-	-	-	-	3	2	3	1	3
4	3	2	3	-	-	-	-	-	-	-	3	2	3	2	3
5	3	2	3	-	-	-	-	-	-	-	3	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

OPEN ELECTIVES

U20EEO401	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS (Common to ECE, ICE, MECH, CIVIL, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart fundamental knowledge of solar cell formation and its properties.
- To understand the various technologies used to improve solar cells.
- To discuss the various components in On-grid connected systems.
- To gain knowledge on components in Off-grid connected systems using Solar PV.
- To design the PV systems for various real load applications with cost benefits.

Course Outcomes

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

CO1 -Explain the fundamentals of solar cells. **(K2)**

CO2 -Recognize the various solar PV technologies and their up gradations along with their benefits. **(K2)**

CO3 -Design and analyze on–grid PV applications. **(K4)**

CO4 -Design and analyze off–grid PV applications. **(K4)**

CO5 -Realize cost benefit analysis of PV installations. **(K4)**

UNIT I ESSENTIAL BASICS OF SOLAR CELL (9 Hrs)

Solar cell – physics – Photovoltaics in Global Energy Scenario – Fundamentals of Semiconductors, Energy band, Charge carriers – Motion, PN Junction diode, Solar cells – Design characteristics, Solar radiation.

UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES (9 Hrs)

Commercial technologies – Mono crystalline and Multi crystalline, Silicon – Wafer based Solar cell, Thin film solar cells – A–Si, Cd–Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

UNIT III SOLAR PV FOR ON-GRID APPLICATIONS (9 Hrs)

Solar cells to solar array – On–Grid PV system – With and Without storage – Balance of system – DC–DC converters – Inverters – Net Metering – Design and analysis – Performance evaluation and monitoring – Field visit – Grid tied PV power plant.

UNIT IV SOLAR PV FOR OFF–GRID APPLICATIONS (9 Hrs)

Off–Grid stand alone PV system – System sizing – Module and Battery – Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One–axis, Two–axis – Maximum power point tracking – Design and analysis – Performance evaluation and monitoring – Field visit – Off–grid PV system

UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS (9 Hrs)

Cost and manufacturability – Manufacturing economics – Scaling – Pricing – Trends in retail pricing – Energy economics – Grid tied power plant – Solar street lighting system

Text Books

1. C.S. Solanki, “Solar Photovoltaics – Fundamentals, Technologies and Applications”, PHI Learning Pvt. Ltd., 2nd Edition, 2011.
2. Martin A. Green, “Solar Cells Operating Principles, Technology, and System Applications”, Prentice - Hall, 1st Edition, 2008.

Reference Books

1. J. Nelson, “The Physics of Solar Cells”, Imperial College Press, 1st Edition, 2003.
2. Thomas Markvart, “Solar Electricity”, John Wiley and Sons, 2nd Edition, 2000.
3. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish , “Applied Photovoltaics”, Earthscan, 3rd Edition, 2011.

4. Michael Boxwell, “The Solar Electricity Handbook”, Green stream Publishing, 10th Edition, 2016.
5. RikDe Gunther, “Solar Power-Your Home for Dummies”, Wiley Publishing Inc, 2nd Edition, 2010.

Web Resources

1. https://swayam.gov.in/nd1_noc20_ph21/preview
2. https://swayam.gov.in/nd2_nou20_ag13/preview
3. https://www.studentenergy.org/topics/solar-pv
4. https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php
5. https://www.energysage.com/solar/
6. https://www.bca.gov.sg/publications/others/handbook_for_solar_pv_systems.pdf
7. http://www.oas.org/dsd/publications/unit/oea79e/ch05.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	3	-	-	-	-	3	2	2	2
2	3	3	3	3	2	-	3	-	-	-	-	3	2	2	2
3	3	3	3	3	2	-	3	-	-	-	-	3	2	2	2
4	3	3	3	3	2	-	3	-	-	-	-	3	2	2	2
5	3	3	3	3	2	-	3	-	-	-	-	3	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EEO402	ELECTRICAL SAFETY (Common to ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize the Indian Electricity Rules and Act related with electrical safety.
- To provide a knowledge about electrical shocks and safety precautions.
- To create awareness of the electrical safety associated with installation of electrical equipment.
- To analyze different Hazardous areas for electrical safety.
- To expose knowledge about necessity of safety policy and safety management.

Course Outcomes

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

CO1 - Describe the Indian Electricity (IE) acts and various rules for electrical safety.**(K2)**
CO2 - Expose safety measures to prevent electrical shock in handling of domestic electrical appliances**.(K3)**
CO3 - Evaluate the safety aspects during installation of plant and equipment**. (K3)**
CO4 - Describe the various hazardous area and application of electrical safety in various places**. (K3)**
CO5 - Acquire knowledge about importance of electrical safety training to improve quality management in electrical systems**. (K3)**

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS (9 Hrs)

Objective and scope of electrical safety - National electrical Safety code - Statutory requirements – Indian Electricity acts related to electrical Safety - Safety electrical one line diagram - International standards on electrical safety safe limits of current and voltage - Grounding of electrical equipment of low voltage and high voltage systems - Safety policy - Electrical safety certificate requirement

UNIT II ELECTRICAL SHOCKS AND THEIR PREVENTION (9 Hrs)

Primary and secondary electrical shocks - Possibilities of getting electrical shock and its severity - Effect of electrical shock of human being - Shocks due to flash/ Spark over's - Firing shock - Multi storied building - Prevention of shocks - Safety precautions - Safe guards for operators - Do's and Don'ts for safety in the use of domestic electrical appliances - Case studies on electrical causes of fire and explosion

UNIT III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE (9 Hrs)

Need for inspection and maintenance - Preliminary preparations - Field quality and safety - Personal protective equipment - Safe guards for operators - Safety equipment - Risks during installation of electrical plant and equipment - Effect of lightning current on installation and buildings - Safety aspects during installation -Safety during installation of electrical rotating machines - Importance of earthing in installation– Agricultural pump installation

UNIT IV HAZARDOUS ZONES (9 Hrs)

Primary and secondary hazards - Hazardous area classification and of electrical equipments (IS, NFPA, API and OSHA standards) - Explosive gas area classifications: Class I(Division 1) - Zone 0, Zone 1, zone 2 classified locations, Design Philosophy for Equipment and installations-Classification of equipment enclosure for various hazardous gases and vapors - flash hazard calculation and approach distances- calculating the required level of arc protection

UNIT V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS (9 Hrs)

Principles of Safety Management - Occupational safety and health administration standards - Safety organization - Safety auditing - Employee electrical safety teams - Electrical safety training to improve Quality management - Total quality control and management – Importance of high load factor - Causes of low power factor - Disadvantages of low power factor - Power factor improvement - Importance of P.F. improvement - Case studies of electrical workplace safety practices.

Text books

1. John Cadick, Mary CapelliSchellpfeffer, Dennis Neitzel, Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
2. Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, 4th Edition, 2002.
3. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards", CRC Press; 1st Edition, 2013.

Reference books

1. Rob Zachariason, "Electrical Safety", Delmar Cengage Learning, 1st Edition, 2011.
2. Peter E. Sutherland, "Principles of Electrical Safety", Wiley-IEEE Press; 1st Edition, 2014.

Web Resources

1. https://www.apeasternpower.com/downloads/elecact2003.pdf
2. https://safetyculture.com/topics/electrical-hazards/
3. https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment
4. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
5. https://www.electrical4u.com/safety-precautions-for-electrical-system/
6. https://www.constellation.com/energy-101/electrical-safety-tips.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	2	-	-	-	-	-	-	1	1	1
2	3	3	3	2	-	2	-	-	-	-	-	-	2	2	2
3	3	3	3	2	-	2	-	-	-	-	-	-	2	2	2
4	3	3	3	2	-	2	-	-	-	-	-	-	2	2	2
5	3	3	3	2	-	2	-	-	-	-	-	-	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ECO401	ENGINEERING COMPUTATION WITH MATLAB	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To understand basic representation of Matrices and vectors in MATLAB
- To learn various programming structures in MATLAB
- To study built in and user defined functions in MATLAB.
- To become conversant with 2D as well as 3D graphics in MATLAB
- To make a Graphical User Interface (GUI) in MATLAB in order to achieve interactivity

Course Outcomes

After completion of the course, students will be able to

CO1 - State the basics of MATLAB (K1)
CO2 - Explain how to work with matrices, and their operations (K2)
CO3 –Use the MATLAB functions relevant to communication engineering, (K3)
CO4 –Demonstrates various file operations in MATLAB (K3)
CO5 - Applying the plotting capabilities of MATLAB effectively to various systems. (K3)

UNIT 1 INTRODUCTION TO MATLAB (9Hrs)

Menus & Tool bars, Variables - Matrices and Vectors - initializing vectors - Data types- Functions – User defined functions - passing arguments - writing data to a file-reading data from a file - using functions with vectors and matrices- cell arrays & structures - Strings - 2D strings-String comparing - Concatenation - Input and Output statements - Script files .

UNIT 2 LOOPS& CONTROL STATEMENTS (9Hrs)

Introduction; Relational & Logical operations - Example programs - Operator precedence - Control & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR -WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods - Error trapping using eval&lastern commands.

UNIT 3 PLOTS IN MATLAB & GUI (9Hrs)

Basic 2D plots, Labels, Line style, Markers, plot, subplot, LOG, LOG-LOG, SEMILOG-POLARCOMET, Grid axis, labeling, fplot, ezplot, ezpolar, polyval, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, Basic Fitting Interface – Polyfit - 3D plots – Mesh - Contour - Example programs. GUI - Creation Fundamentals – Capturing mouse actions

UNIT 4 MISCELLANEOUS TOPICS (9 Hrs)

File & Directory management - Native Data Files - Data import & Export - Low Level File I/O – Directory management - FTP File Operations - Time Computations -Date & Time – Format Conversions - Date & Time, Functions - Plot labels - Optimization - zero Finding - Minimization in one Dimension - Minimization in Higher Dimensions- Practical Issues. Differentiation & Integration using MATLAB, 1D & 2D Data Interpolation

UNIT 5 SIMULINK & APPLICATIONS (9Hrs)

How to create & run Simulink, Simulink Designing - Using SIMULINK Generating an AM signal & 2nd order systems - Designing of FWR & HWR using Simulink - Creating a subsystem in Simulink. Applications Programs - Frequency response of filters. Open Loop gain of OPAMP, I/P characteristics of BJT, Plotting the graph between Breakdown voltage & Doping Concentration.

Text Books

1. RudraPratap, Getting Started with MATLAB 6.0 ,1st Edition, Oxford University Press-2004.
2. Duane Hanselman ,Bruce LittleField, “Mastering MATLAB 7”, Pearson Education Inc, 2005
3. William J.Palm, “Introduction to MATLAB 6.0 for Engineers”, McGraw Hill & Co, 2001.

Reference Books

1. M.Herniter, “Programming in MATLAB”, Thomson Learning, 2001
2. John OkyereAltla, “Electronics and circuit analysis using MATLAB”, CRC press, 1999
3. K.K.Sharma, “MATLAB Demustifyied”, Vikas Publishing House Pvt Ltd. 2004

Web Resources

1. https://www.mathworks.com/products/matlab.html
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://www.cmu.edu/computing/software/all/matlab/
4. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	2	3	-	-	-	-	-	-	-	1	3	3
CO2	2	2	-	2	3	-	-	-	-	-	-	-	1	3	3
CO3	2	2	-	2	3	-	-	-	-	-	-	-	1	3	3
CO4	2	2	-	2	3	-	-	-	-	-	-	-	1	3	3
CO5	2	2	-	2	3	-	-	-	-	-	-	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hours
U20ECO402	**CONSUMER ELECTRONICS**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To enable thetroubleshoot of different types of microphones and loudspeakers
- To make the students to analyse the working of digital console, digital FM tuner and troubleshoot audio systems
- To train to test the working of various colour TV
- To empower them to troubleshoot colour TV receivers
- To equip them to maintain various electronic home and office appliances

Course Outcomes

After completion of the course, students will be able to

CO1 -Describe the fundamental audio characteristics and measurements, operating principles of microphone and loudspeaker (K1)

CO2 -Explain the working of digital console, digital FM tuner and troubleshoot the audio systems (K2)

CO3 -Distinguish the salient features of colour TV and Monochrome and troubleshoot TV camera (K2)

CO4 -Demonstrate various interfaces in digital TV, the working of DTH receiver, CD/DVD players (K3)

CO5 -Explain the working of FAX, Microwave oven, Washing machine, Air conditioner, Refrigerators and camera (K2)

UNIT -1 AUDIO FUNDAMENTALS AND DEVICES (9Hrs)

Basic characteristics of sound signal, Microphone- working principle, sensitivity, nature of response. Types of Microphone, Loud speaker- working principle, Woofers and Tweeters, characteristics.Types of Loudspeaker. Sound recording

UNIT-II AUDIO SYSTEMS (9Hrs)

Introduction to audio system, Digital Console- Block diagram, working principle, applications, FM tuner- concepts of digital tuning, ICs used in FM tuner TD702IT, PA address system- Planning, speaker impedance matching, characteristics, Power amplifier specification

UNIT -III TELEVISION SYSTEMS (9Hrs)

Monochrome TV standards, Components of TV system, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution. Composite video signal,Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance. Different types of TV camera.

UNIT -IV TELEVISION RECEIVERS AND VIDEO STANDARDS (9Hrs)

Colour TV receiver- block diagram, Digital TVs- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI, Digital Video Interface, CD and DVD player: working principles, interfaces

UNIT -V HOME AND OFFICE APPLIANCES (9Hrs)

Microwave Oven: Types, technical specifications. Washing Machine: hardware and software. Air conditioner and Refrigerators: Components features, applications, and technical specification. Digital camera and cam coder: - pick up devices, picture processing, picture storage

Text Books

1 Bali S.P. , ‘Consumer Electronics’, **copyright 2008**,Pearson Education India

2 Bali R and Bali S.P. ‘Audio video systems : principle practices & troubleshooting’, Khanna Book Publishing Co. (P) Ltd
3 Gulati R.R., ‘Modern Television practices’, 5th edition, 2015, New Age International Publication (P) Ltd

Reference Books

1 Gupta R.G., ‘Audio video systems’, 2nd edition,2017, Tata Mcgraw Hill, New Delhi, India
2 Whitaker Jerry & Benson Blair, ‘Mastering Digital Television’, McGraw-Hill Professional, 2006
3 Whitaker Jerry & Benson Blair, ‘Standard handbook of Audio engineering’, 2nd edition,2002, McGraw-Hill Professional

Web Resources

1 http://www.scientificamerican.com/article.cfm?id = experts.bluetooth-work
2 http://www.cosc.brocku.ca/Offerings/3P92/seminars/HDTV.ppt
3 http://www.circuitstoday.com/blu-ray-technology-working
4 http://www.freevideolectures.com

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	1	-	1	-	-	-	-	-	-	2	-	1
CO2	2	-	2	1	-	1	-	-	-	-	-	-	2	-	1
CO3	2	-	2	1	-	1	-	-	-	-	-	-	2	-	1
CO4	2	-	2	1	-	1	-	-	-	-	-	-	2	-	1
CO5	2	-	2	1	-	1	-	-	-	-	-	-	2	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CSO401	WEB DEVELOPMENT (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts JavaScript and programming fundamentals.
- To study about advance scripting and Ajax applications.
- To understand the working procedure of XML

Course Outcomes

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

CO1 - Develop basic web applications. **(K5)**
CO2 - Design the web applications using CSS. **(K5)**
CO3 - Validate the web pages using javascripts functions. **(K5)**
CO4 - Demonstrate the web 2.0 application to advance scripts. **(K3)**
CO5 - Update the knowledge of XML Data. **(K4)**

UNIT I INTRODUCTION TO WWW & HTML (9 Hrs)

Protocols – Secure Connections – Application and development tools – Web browser – Server definition – Dynamic IP. Web Design: Web site design principles – Planning the site and navigation. HTML: Development process – Html tags and simple HTML forms – Web site structure.

UNIT II STYLE SHEETS (9 Hrs)

Introduction to CSS: Need for CSS – Basic syntax and structure using CSS – Background images – Colors and properties – Manipulating texts using fonts, borders and boxes – Margins, padding lists, positioning using CSS – CSS2.

UNIT III JAVASCRIPTS (9 Hrs)

Client side scripting: Basic JavaScript – Variables – Functions – Conditions – Loops. Applications: Page Validation – Reporting.

UNIT IV ADVANCE SCRIPT (9 Hrs)

JavaScript and objects – DOM and Web browser environments – Forms and Validations – DHTML. AJAX: Introduction – Web applications – Alternatives of AJAX.

UNIT V XML (9 Hrs)

Introduction to XML – Uses of XML – Simple XML – XML key components – DTD and Schemas – Well-formed XML document – Applications of XML – XSL and XSLT.

Text Books

1. Keith Wald, Jason Lengstorf," Pro PHP and jQuery", Paperback, 2016.
2. Semmy Purewal, "Learning Web App Development", O'Reilly Media, 2014.
3. P.J. Deitel AND H.M. Deitel," Internet and World Wide Web - How to Program", Pearson Education, 2009.

Reference Books

1. Yakov Fain, Victor Rasputnis, Anatole Tartakovsky and Viktor Gamov, "Enterprise Web Development ", O'Reilly Media, 2014.
2. Steven Suehring, Janet Valade, "PHP, MySQL, JavaScript & HTML5 All-in-One", John Wiley & Sons, Inc, 2013.

3. UttamK.Roy, “Web Technologies”, Oxford University Press, 2010.
4. Rajkamal, “Web Technology”, Tata McGraw-Hill, 2009.
5. Shklar, Leon, Rosen, Rich, “Web Application Architecture: Principles, Protocols and Practices”, Wiley Publication, 2009.

Web Resources

1. https://www.w3schools.com
2. https://www.geeksforgeeks.org/web-technology/
3. https://www.guru99.com/cakephp-tutorial.html
4. https://www.ithands.com/blog/cms-or-php-framework-which-technology-is-better-for-my-business
5. http://Oriel.ly/learning-web-app

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3	-	-	3	-	1	2	3
2	2	2	2	2	-	2	-	2	-	2	-	2	1	2	3
3	3	3	3	3	3	3	3	3	-	-	3	-	1	2	3
4	2	2	2	2	-	2	-	2	-	2	-	2	1	2	3
5	2	2	2	2	-	2	-	2	-	2	-	2	1	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CSO402	ANALYSIS OF ALGORITHMS (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To analyze the performance of algorithms in terms of time and space complexity.
- To understand the performance of the algorithms such as divide and conquer, greedy method
- To solve problems using Dynamic Programming and derive the time complexity.
- To solve problems using Backtracking technique and derive the time complexity.
- To solve problems using Branch and Bound technique and derive the time complexity.

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Choose the appropriate data structure and algorithm design method for a specified application.**(K2)**

CO2 - Ability to understand the design technique such as divide and conquer, greedy method applied to realistic problems and analyse them. **(K3)**

CO3 - Ability to understand the dynamic programming design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO4 - Ability to understand the backtracking design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO5 - Ability to understand Branch and Bound design technique and how it is applied to realistic problems and analyze them. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis – Time complexity, Space complexity, Asymptotic Notation – Big oh notation, Omega notation, Theta notation and Little oh notation.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD (9 Hrs)

Divide and Conquer method: Applications – Binary search, Merge sort, Quick sort. Greedy method: General method, applications – Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III DYNAMIC PROGRAMMING (9 Hrs)

Dynamic Programming: Applications - Multistage graphs, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT IV BACKTRACKING (9 Hrs)

Backtracking: General method, Applications – N-queen problem, Sum of subsets problem, Graph Coloring – Hamiltonian Cycles.

UNIT V BRANCH AND BOUND (9 Hrs)

Branch and Bound**:** General method, Applications – Traveling sales person problem, 0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution.

Text Books

1. E. Horowitz and S.Sahni, “Fundamentals of Algorithms”, Galgotia Publications, 2nd Edition, 2010.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, “Introduction to Algorithms”, PHI/Pearson Education, 3rd Edition, 2009.
3. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, Third Edition,

2012.

Reference Books

1. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson Education Asia, 3rd Edition, 2010.
3. Donald E Knuth, "The Art of Computer Programming, Volume I & II", Addison Wessely, Third Edition, 2011.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2006.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

Web Resources

1. https://swayam.gov.in/nd1_noc20_cs71/preview
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
3. https://www.javatpoint.com/daa-tutorial
4. https://www.guru99.com/design-analysis-algorithms-tutorial.html
5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	2	1	-	-	-	-	-	2	2	3
2	3	2	3	3	2	2	1	-	-	-	-	-	2	2	3
3	3	3	3	3	2	2	2	-	2	-	-	-	2	2	3
4	3	2	3	3	3	2	2	-	-	-	3	-	2	2	3
5	3	3	3	3	2	2	2	-	-	-	3	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ITO402	R PROGRAMMING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics in R programming in terms of constructs, control statements, string functions
- To learn to apply R programming for Text processing
- To understand the use of data frames and tables
- To able to appreciate and apply the R programming from a statistical perspective
- To understand the interface model

Course Outcomes

After completion of the course the students will be able to:

CO1 - Create artful graphs to visualize complex data sets and functions.**(K3)**
CO2 - Write more efficient code using parallel R and vectorization.**(K3)**
CO3 - Create data frames and working with tables.**(K3)**
CO4 - Interface R with C/C++ and Python for increased speed or functionality.**(K2)**
CO5 - Find new packages for text analysis, image manipulation & perform statistical analysis.**(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II MATRICES AND ARRAYS (9 Hrs)

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III DATA FRAMES (9 Hrs)

Data Frames Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

UNIT IV FUNCTIONS AND ARGUMENTS (9 Hrs)

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

UNIT V INTERFACING (9 Hrs)

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Text Books

1. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.
2. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.

Reference books

1. Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013
2. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.

Web Resources

1. https://www.coursera.org/learn/r-programming
2. https://www.r-project.org/

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	2	2	2
2	3	2	1	1	-	-	-	-	-	-	-	-	2	2	2
3	3	2	1	1	-	-	-	-	-	-	-	-	2	2	2
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	2
5	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MEO402	**MATERIAL HANDLING SYSTEM** (Common to EEE, ICE, CIVIL, Mechatronics)	**L T P C Hrs** **3 0 0 3 45**

Course Objectives

- To understand the principal groups of material handling equipment's
- To learn about the Flexible hoisting appliances
- To learn about the material handling attachments, hook bearings, crane attachment
- To understand about the basic material handling system, selection
- To introduce concepts of ergonomics of material handling equipment and safety in handling

Course Outcomes

On successful completion of this course, the student will be able to

CO1 - Describe the principal groups of material handling equipment's. **(K2)**
CO2 - Describe about the flexible hosting appliances. **(K2)**
CO3 - Explains about the material handling attachments, hook bearings, crane attachment. **(K1)**
CO4 - Illustrate the basic material handling system, selection. **(K1)**
CO5 - Define the ergonomics related to material handling equipment. **(K1)**

UNIT I MATERIAL HANDLING EQUIPMENTS (9 Hrs)

Types of intra plant transporting facility - principal groups of material handling equipments - choice of material handling equipment - hoisting equipment, screw type, hydraulic and pneumatic conveyors - - general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications - Introduction to control of hoisting equipments.

UNIT II FLEXIBLE HOSTING APPLIANCES (9 Hrs)

Flexible hoisting appliances like ropes and chains, welded load chains, roller chains - selection of hemp rope chains and steel wire rope - selection of ropes - fastening of chain sand ropes - different types of load suspension appliances - fixed and movable pulleys, different types of pulley systems, multiple pulley systems - Chain and rope sheaves and sprockets.

UNIT III MATERIAL HANDLING ATTACHMENTS (9 Hrs)

Load handling attachments - standard forged hook, hook weights, hook bearings, cross piece and casing of hook - crane grab for unit and piece loads - carrier beams and clamps - load platforms and side dump buckets - electric lifting magnets - grabbing attachments for loose materials - crane attachments for handling liquid materials.

UNIT IV MATERIAL HANDLING SYSTEMS (9 Hrs)

Basic Material Handling systems - Selection, Material Handling method - path, Equipment - function oriented systems.

UNIT V METHODS TO MINIMIZE COST OF MATERIAL HANDLING (9 Hrs)

Methods to minimize cost of material handling - Maintenance of Material Handling Equipments - Safety in handling - Ergonomics of Material Handling equipment - Design, Miscellaneous equipment

Text Books

1. Rudenko N , Materials Handling Equipment , Envee Publishers, New Delhi, 2017
2. Alexandrov M.P Materials Handling Equipment, Mie publications, Moscow, 2013
3. White, John A., Pence, Ira W, Materials handling and logistics, Envee Publishers, New Delhi, 2016

Reference Books

1. K.C, Arora Vikas, V. Shinde, Aspects of Material handling, Laxmi Publications; First edition, 2015.
2. Siddhartha Ray, Introduction to Material Handling, New Age International, Edition: 2, 2017.
3. RB Chowdary , G. R. N. Tagore,Plant Layout and Material Handling-, Khanna publishers; 2nd edition 2016.
4. James A Apple, Plant layout and Material Handlin, Krieger Pub Co, 2016.
5. P.B Mahapatra, Operations Management, PHI, 2016.

Web Resources

1.https://nptel.ac.in/courses/112/102/112102011/
2. https://nptel.ac.in/courses/112/107/112107142/
3. https://nptel.ac.in/courses/112/107/112107143/
4. https://www.youtube.com/watch?v=WXmIdbVDJqE
5. https://www.youtube.com/watch?v=BBWPIByOEfI

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
2	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
3	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
4	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
5	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CEO401	ENERGY AND ENVIRONMENT (Common to ECE, ECE, MECH, BME, IT, FT, Mechatronics)	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Explain the importance of energy, classifications of energy sources and energy demand scenario
- Analyze the impacts of energy on environment & sustainability energy options
- Outline the harness of hydropower and geothermal energy sources
- Discuss the aspects of solar and wind energy
- To study the importance of biomass energy and its applications

Course Outcomes

At the end of Course students will be able to.

CO1 - Apply the knowledge of science & engineering to the contemporary issues of Energy for better humankind & environment **(K3)**

CO2 - Identify, review & analyze the complex problems of Energy crises in environment **(K4)**

CO3 - Designing solutions for the energy crises in the form of renewable energy systems to meet the needs by understanding the limitations **(K4)**

CO4 - Understanding the impact of energy on environment and providing solutions for sustainable development. **(K5)**

CO5 – Apply biomass energy under relevant technologies **(K3)**

UNIT I ENERGY (9 Hrs)

Introduction, Importance of energy, role of energy consumption in economic and social transformation, Energy needs and crisis. Energy production and utilization. Types and classification of energy sources, Conventional & unconventional energy, Renewable sources & Nonrenewable sources of energy advantages, limitations, comparisons

UNIT II ENVIRONMENT (9 Hrs)

Impact of energy on economy &environment. Regional impacts of temperature change - Global warming, Greenhouse effect, Acid rain, Ozone layer depletion. Indian environment degradation, Environmental laws - Water Act-1974 (Prevention & control of pollution), The environment protection act 1986, Air act.

UNIT III HYDROPOWER & GEOTHERMAL ENERGY (9 Hrs)

Hydropower Energy – Introduction, Site selection, layout of hydro power plant, components & working, classifications, power station, structure and control. Geothermal Energy - Introduction, Site selection, layout of power plant, components & working, Advantages and disadvantages.

UNIT IV SOLAR & WIND ENERGY (9 Hrs)

Sun as source of energy - Introduction, Site selection, layout of power plant components & working, classifications, Types of collectors, collection systems efficiency, Solar cells. Wind Energy - Introduction, advantages/limitations, Site selection, layout of power plant, components &working, classification.

UNIT V BIOMASS ENERGY (9 Hrs)

Introduction, advantages/limitations, Photosynthesis, biomass fuel, biomass gasification, biogas from waste biomass, factors affecting biogas generation, types of biogas plant, Biomass programme in India,

Text Books

1. Trivedi R.R. and Jalka K.R, “Energy Management”, Commonwealth Publication, 20177.
2. Diamant R.M.E., “Total Energy”, Pergamon, OxfordPublishers, 2017.
3. N.G. AJJANNA “ Energy auditing & demand side management” first edition, Gouthami Publications, Shimoga
4. Chakrabarti, M.L.Soni, P.V. Gupta,U.S. Bhatnagar “ Power system Engineering” 2001, DhanpatRai&Co, New Delhi.

5. D.P.Kothari, K.C Singal, Rajesh Ranjan, “Renewable Energy sources and Emerging Technologies” second edition , PHI , India

Reference Books

1. Boyle G, Everett B and Ramett J, “Energy systems and sustainability”, Oxford University Press, 2018
2. "Pollution Control Acts, Rules and Notifications", CPCB, Pollution Control series, PC/2/2014, Vol.I,2014
3. Peavy.H, Rowe.D, and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. S.Rao, Dr. BB Parulekar “Energy Technologies” Khanna Publications , New Delhi
5. David M Buchla, Thomas E Kissel, Thomas L Floyd “Renewable Energy systems” Pearson, India
6. Godfrey Boyle “Renewable Energy power for sustainable future” oxford Publications , New Delhi

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements
2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. www.iucn.org
4. www.cites.org
5. www.thesummitbali.com/
6. http://engineering geology.gov.in/

COs/POs/PSOs Mapping

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2	1	-	-	-	-	3	-	1	2
CO2	1	1	1	-	-	2	1	-	-	-	-	3	-	1	1
CO3	2	2	2	2	2	3	3	-	1	1	2	3	-	2	2
CO4	2	2	2	2	3	3	3	-	1	1	2	3	-	2	2
CO5	2	2	2	2	3	3	3	-	1	1	2	3	-	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BMO401	MEDICAL ELECTRONICS (Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the various physiological parameters measurements
- To understand the various biochemical and nonelectrical sensors
- To study about the assist devices
- To gain knowledge on surgical equipments and telemetry in healthcare
- To understand the concepts of recent advancements in healthcare

Course Outcomes

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

CO1 - Explain the electro- physiological parameters and bio-potentials recording **(K2)**
CO2 - Measure the biochemical and non-electrical physiological parameters **(K2)**
CO3 - Interpret the various assist devices used in the hospitals **(K3)**
CO4 - Identify physical medicine methods and biotelemetry **(K3)**
CO5 - Analyse recent trends in medical instrumentation **(K3)**

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING (9 Hrs)

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (9 Hrs)

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES (9 Hrs)

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters, Heart-Lung Machine.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY (9 Hrs)

Diathermies - Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry - Single Channel and Multiple Channel.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION (9 Hrs)

Telemedicine, Insulin Pumps, Radio pill, Endo-microscopy, Brain machine interface, Lab on a chip, Cryogenic Technique.

Text Books

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2011.
2. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA McGraw-Hill, New Delhi, 2017.
3. John G.Webster, “Medical Instrumentation Application and Design”, Third Edition, Wiley India , 2012.

Reference Books

1. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2011.
2. R.Anandanatarajan, “Biomedical Instrumentation and Measurements”, Second Edition, PHI Learning, 2016.

3. Mandeep singh, “Introduction to Biomedical Instrumentation”, Second Edition, Prentice Hall of India, New Delhi,2014
4. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation Systems”, Cengage Learning, 2012
5. C.Raja Rao, Sujoy K.Guha, “ Principles of Medical Electronics and Biomedical Instrumentation”, Universities Press, 2010

Web Resources

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapetic systems
3. https://nptel.ac.in/courses/127/106/127106136/
4. medicinenet.com/script/main/art.asp?articlekey=6414
5. https://www.verywellhealth.com/cardiopulmonary-bypass-machine-used-for-surgery-3157220

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	2	2	2	-	1	-	-	-	-	-	-	1
2	3	2	-	2	2	2	-	1	-	-	-	-	-	-	1
3	3	-	-	2	3	3	-	1	-	-	-	-	-	-	1
4	3	-	2	2	3	2	-	1	-	-	-	-	-	-	1
5	3	2	2	3	3	2	-	1	-	-	-	-	-	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CCO401	**BASIC DBMS** (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME Branches)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand about basics of Database Management System.
- To provide a general introduction to relational model and relational algebra.
- To study about normalization and SQL.
- To acquire knowledge about storage indexing and transaction management.
- To gain knowledge about the backup and recovery in database.

Course Outcomes

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

CO1 – Explain the concept of database management system.(**K2**)
CO2 – Create conceptual data model using entity relationship diagram.(**K2**)
CO3 – Analyze the various normalization.(**K4**)
CO4 – Describe the concept of storage indexing and transactions.(**K2**)
CO5 – Explain the database recovery and security.(**K2**)

UNIT - I INTRODUCTION TO DATABASE MANAGEMENT (9 Hrs)

Introduction to Database Management systems – History - Characteristics – Users- three-level architecture- Entity-- relationship data model.

UNIT – II - THE RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA (9 Hrs)

Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT - III - STRUCTURED QUERY LANGUAGE AND NORMALIZATION (9 Hrs)

SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security. Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT –IV STORAGE INDEXING AND TRANSACTIONS MANAGEMENT (9 Hrs)

Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree. Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT –V DATABASE BACKUP, RECOVERY AND SECURITY (9 Hrs)

Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations – identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption.

Text Books

1. Gupta.G.K, “Database Management Systems”, Tata McGraw Hill, 2011
2. Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts 7th Edition, McGraw-Hill International Edition, 2019.

3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, "Fundamentals of Database Systems", Pearson Education, United States of America, 2018.

Reference Books

1. Silberschatz, Korth.H and Sudarshan.S, "Database System Concepts", 6th Edition, McGraw-HillInternational, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, "Database System The Complete Book, 1st Edition, Pearson 2002.
3. Date CJ, Kannan A, Swamynathan S, An Introduction to Database System, 8th Edition, Pearson Education-2006.
4. Raghu Ramakrishna, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2014.
5. Ramez Elmasri, Durvasul VLN Somyazulu, Shamkant B Navathe, Shyam K Gupta, Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

Web Resources

1. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
2. http://dev.mysql.com/doc/
3. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
4. http://www.w3schools.com/
5. https://www.codecademy.com/learn/learn-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO2	3	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO3	3	3	1	-	1	-	-	-	-	-	1	1	1	1	-
CO4	3	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO5	3	1	1	-	1	-	-	-	-	-	1	1	1	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CCO402	INTRODUCTION TO COMMUNICATION SYSTEMS (Common **to** EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge of signals
- To study the various analog and digital modulation techniques
- To study the pulse modulation and multiplexing
- To infer Digital transmission techniques
- To provide knowledge about various multiple access technology and advanced communication techniques

Course Outcomes

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

CO1- Comprehend the basic Characteristics of the signals.(**K2**)
CO2- Comprehend needs of modulation and various analog modulation techniques (**K2**)
CO3- Illustrate pulse modulation and multiplexing (**K3**)
CO4- Explain Digital transmission techniques (**K2**)
CO5- Describe multiple access techniques and advanced communication systems.(**K2**)

UNIT I SIGNAL ANALYSIS (9 Hrs)

Introduction to Signals- Representation and classification of Signals, Representation of signal in frequency domain, introduction to Spectrum of signal- Introduction to Fourier series and Fourier Transform

UNIT II ANALOG COMMUNICATION (9 Hrs)

Need for Modulation-– Block diagram of analog communication System- Amplitude Modulation – AM, DSBSC, SSBSC, modulators and demodulators – Angle modulation – PM and FM – modulators and demodulators – Superheterodyne receivers

UNIT III PULSE COMMUNICATION (9 Hrs)

Low pass sampling theorem – Quantization – PAM – PCM, DPCM, DM, and ADPCM And ADM - Time Division Multiplexing, Frequency Division Multiplexing

UNIT IV DIGITAL COMMUNICATION (9 Hrs)

Comparison of digital and analog communication system- Block diagram of digital communication system Phase shift keying – BPSK, DPSK, QPSK

UNIT V MULTIPLE ACCESS TECHNIQUES AND ADVANCED COMMUNICATION (9 Hrs)

Multiple Access techniques- FDMA, TDMA, CDMA- Frequency reuse, Handoff- Block diagram of advanced communication systems – satellite communication – Cellular Mobile Communication – Fibre Optical Communication System.

Text Books

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", 3rd edition, TMH 2007
2. S. Haykin, "Digital Communications", John Wiley, 2005
3. B.P.Lathi," Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007

Reference Books

1. H P Hsu, Schaum Outline Series, “Analog and Digital Communications”, TMH 2006
2. B.Sklar,” Digital Communications Fundamentals and Applications”, 2nd edition Pearson Education 2007.
3. A.Bource Carson and Paul B.Crilly, “Communication Systems”, 5th Edition, Mc Graw Hill, 2010
4. Torrieri, Don, “Principles of Spread Spectrum Communication Systems”, Springer, 2015
5. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley and Sons, 2001.

Web Resources

1. www.allaboutcircuits.com
2. https://nptel.ac.in/courses/108/102/108102096/
3. http://www.electronics-tutorials.ws
4. www.tutorialspoint.com
5. https://nptel.ac.in/courses/108/104/108104091/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	1	-	-	-	-	-	1	1	1	-	1
CO2	3	1	1	-	1	-	-	-	-	-	1	1	1	-	1
CO3	3	3	1	-	1	-	-	-	-	-	1	1	1	-	1
CO4	3	1	1	-	1	-	-	-	-	-	1	1	1	-	1
CO5	3	1	1	-	1	-	-	-	-	-	1	1	1	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ADO401	KNOWLEDGE REPRESENTATION AND REASONING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various processes based on its context techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes

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

CO1 - Acquire the knowledge based systems intended for computer implementation. **(K2)**

CO2 - Acquire theoretical knowledge about principles for logic-based representation and reasoning. **(K2)**

CO3 - Ability to understand knowledge-engineering process. **(K2)**

CO4 - Ability to implement the process according to the context. **(K3)**

CO5 - Learn the process, knowledge acquisition and sharing of ontology. **(K2)**

UNIT I EVOLUTION OF KNOWLEDGE REPRESENTATION (9 Hrs)

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic. Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT II ONTOLOGY AND ITS CLASSIFICATION (9 Hrs)

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT III KNOWLEDGE REPRESENTATION (9 Hrs)

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation.

UNIT IV PROCESSES, CONTEXTS AND AGENTS (9 Hrs)

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT V KNOWLEDGE SOUP, ACQUISITION AND SHARING (9 Hrs)

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics. Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

Text Books

1. John F. Sowa, Thomson Learning “Knowledge Representation logical, Philosophical, and Computational Foundations”, Course Technology Inc. publication, 1999.
2. Ronald J. Brachman, Hector J. Levesque, ”Knowledge Representation and Reasoning”, Morgan Kaufmann; 1st edition, 2004.

3. Eileen Cornell Way "Knowledge Representation and Metaphor" Springer; 1st edition, 1991.

Reference Books

1. Trevor Bench-Capon, "Knowledge representation: an approach to artificial intelligence", Academic Press, 2014.
2. Yulia Kahl, Michael Gelfond "Knowledge Representation, Reasoning, and the Design of Intelligent Agents The Answer-Set Programming Approach", Cambridge University Press; 1st edition, 2014.
3. Arthur B. Markman, "Knowledge representation" Psychology Press; 1st edition, 1998.
4. Sanida Omerović, Grega Jakus, V. Milutinovic, Sašo Tomažič "Concepts, Ontologies, and Knowledge Representation" Springer; 2013.
5. Bernhard Nebel, Gerhard Lakemeyer "Foundations of Knowledge Representation and Reasoning" Springer, 1994.

Web References

1. https://www.javatpoint.com/knowledge-representation-in-ai
2. https://nptel.ac.in/courses/106/106/106106140/
3. https://www.youtube.com/watch?v=kXlr6ydiPAQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	2	-	-	-	-	-	-	-	1	-	-
2	2	2	2	2	2	-	-	-	-	-	-	-	1	-	-
3	1	2	1	2	2	-	-	-	-	-	-	-	-	-	-
4	1	2	1	2	1	-	-	-	-	-	-	-	-	-	-
5	2	1	2	1	2	-	-	2	-	-	-	-	-	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ADO402	INTRODUCTION TO DATA SCIENCE (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of data science
- To enable the students to understand the statistics and probability.
- To understand the tools in developing and visualizing data.
- To gain good knowledge in the application areas of data science.
- To inculcate the perceiving, ethics surrounding privacy and acting of data science applications.

Course Outcomes

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

CO1 - Explore the fundamental concepts of data science. **(K2)**
CO2 - To understand the Mathematical Knowledge for Data Science. **(K2)**
CO3 - Visualize and present the inference using various tools. **(K3)**
CO4 - To expose the different opportunities in Industries. **(K3)**
CO5 - Learn to think through the ethics surrounding privacy, data sharing and decision-making. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE (9 Hrs)

Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation.

UNIT II MATHEMATICAL PRELIMINARIES (9 Hrs)

Probability: Probability vs. Statistics – Compound Events and Independence – Conditional Probability – Probability Distribution. Descriptive Statistics: Centrality Measures – Variability Measures - Interpreting Variance – Characterizing Distributions. Correlation Analysis: Correlation Coefficient – The Power and Significance – Detection Periodicities.

UNIT III DATA SCIENCE TOOLS (9 Hrs)

Introduction to Data Science Tool – Data Cleaning Tools – Data Munging and Modelling Tools – Data Visualization Tools – Tools for Data Science.

UNIT IV INDUSTRIALIZATION, OPPORTUNITIES AND APPLICATIONS (9 Hrs)

Data Economy and Industrialization – Introduction: Data Economy, Data Industry, Data Services – Data Science Application: Introduction, General Application Guidance - Different Domain – Advertising – Aerospace and Astronomy – Arts, Creative Design and Humanities – Bioinformatics – Consulting Services – Ecology and Environment – Ecommerce and Retail - Education – Engineering – Finance and Economy – Gaming.

UNIT V ETHICS AND RECENT TRENDS (9 Hrs)

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, “Introducing Data Science”, Manning Publications Co., 1st edition, 2016.
2. Chirag Shah, “A Hands on Introduction to Data Science“, Cambridge University Press, 2020.
3. SinanOzdemir, “Principles of Data Science”, Packt Publication, 2016.
4. D J Patil, Hilary Mason, Mike Loukides, “Ethics and Data Science”, O’ Reilly, 1st edition, 2018.

Reference Books

1. Hector Guerrero, "Excel Data Analysis: Modeling and Simulation", Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W. Mc Owan, "The Power of Computational Thinking", World Scientific Publishing, 2017.
3. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.
4. Rajendra Akerkar, Priti Srinivas Sajja, "Intelligence Techniques for Data Science", Spring International Publication, 2016.
5. Longbing Cao "Data Science Thinking: The Next Scientific, Technological and Economic Revolution", Spring International Publication, 2018.

Web References

1. https://www.youtube.com/watch?v=-ETQ97mXXF0&ab_channel=edureka%21
2. https://www.javatpoint.com/data-science
3. https://www.coursera.org/browse/data-science /

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	2	2	-	-	-	-	-	-	-	-	-	-
2	2	2	2	1	1	-	-	-	-	-	-	-	-	-	-
3	2	1	2	2	1	-	-	-	-	-	-	-	-	1	-
4	1	2	2	1	1	-	-	-	-	-	-	-	-	-	-
5	2	1	1	2	1	-	-	1	-	-	-	-	-	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EEO503	CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES	L	T	P	C	Hrs
	(Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To get knowledge on the status of conventional and non-conventional energy resources in world.
- To have a clear idea about the operation of conventional power plant and its associated equipment's.
- To learn about the concept of energy harvesting of solar through thermal and PV module
- To understand the technological basis for harnessing wind energy.
- To get a clear knowledge on power generation using Ocean, Tidal Energy and Bio-Energy

Course Outcomes

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

CO1 – Identify the world and Indian energy scenario and the necessity of renewable energy sources **(K1)**
CO2 – Gain knowledge for the generation of electrical power from various power plants **(K1)**
CO3 – Analyze and compare the various solar harvesting techniques **(K3)**
CO4 – Describe the aerodynamics of wind turbines and calculate their power, energy production**(K1)**
CO5 – Describe the construction and working principle of various equipment's used in Ocean, Tidal Energy and Bio-Energy power plants**(K2)**

UNIT I ENERGY RESOURCES (9 Hrs)

Perspective of energy resources – Forms of Energy – Conventional and non-conventional sources of energy– World's energy status - Energy reserves in India. Limitations of Conventional sources of energy efficiency – Renewable Energy Sources – Energy parameters – Energy Intensity - Gross Domestic product.

UNIT II POWER PLANTS (9 Hrs)

Thermal power plant – layout, working principle. Gas turbine power plant – layout, working principle. Nuclear power plants: fuels, nuclear fuel cycle, reactors and nuclear waste management. Hydro Electric plants – Types, energy conversion schemes, environmental aspects.

UNIT III SOLAR ENERGY SYSTEMS (9 Hrs)

Solar radiation - Principles of solar energy collection –Types of collector – working principles - Characteristics - efficiency - Solar Energy applications – water heaters, air heaters, solar cooling; solar drying and power generation – solar tower concept – solar pump. Photovoltaic (PV) technology – photovoltaic effect – modelling - Characteristics – efficiency of solar cells.

UNIT IV WIND ENERGY SYSTEMS (9 Hrs)

General theory of wind mills – Types of wind mills – performance of wind machines–wind power – efficiency. Merits and Limitations of Wind energy system – Modes of wind power generation.

UNIT V ALTERNATE ENERGY SYSTEMS (9 Hrs)

Ocean and Tidal energy conversion - working principle of OTEC – Anderson closed cycle OTEC System. Tidal power – tides - tidal range - types of tidal power plants, single basin and double basins schemes. Bio-mass Energy – Biogas plants.

Text Books

1. S. Rao and Dr. B. B. Parulekar, "Energy Technology", Khanna Publication, 3rd Edition, 1999.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill Education, 2nd Edition, 2009.

3. D. P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI, 2011

Reference Books

1. G. D. Rai, "Non-conventional energy sources", Khanna Publication. 4th Edition, 2002.
2. Pulfrey, David. L, "Photo voltaic Power Generation", Van Nostrand reinhold Company, 1983.
3. Abbasik, "Renewable Energy Sources and their Environment", PHI, 2008.
4. Steve Doty, Wayne C. Turner, "Energy Management Handbook", Fairmont Press, 8th Edition, 2012.
5. S.A.Abbasi and N. Abbasi, "Renewable Energy Sources and Their Environmental Impact", PHI, 2001.

Web Resources

1. https://www.tutorialspoint.com/renewable_energy/index.htm
2. https://nptel.ac.in/courses/112/107/112107291/
3. https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/
4. https://www.jagranjosh.com/general-knowledge/nonconventional-sources-of-energy-1448698715-1
5. https://wb.gov.in/departments-power-and-non-conventional-energy-sources.aspx

COs / POs and PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	2	-	1	2	-	-	-	-	1	1	1	1
2	3	1	1	2	-	1	2	-	-	-	-	1	1	1	1
3	3	1	1	2	-	1	2	-	-	-	-	1	1	1	1
4	3	1	1	2	-	1	2	-	-	-	-	1	1	1	1
5	3	1	1	2	-	1	2	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EEO504

INDUSTRIAL DRIVES AND CONTROL

(Common to ECE, ICE, MECH, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce the concept of selection and Utilization of Electric drives.
- To understand power flow diagram for industrial process and drives.
- To introduce effect of heating and cooling characteristics of drives.
- To introduce the various speed control techniques for DC drives.
- To introduce the various speed control techniques for AC drives

Course Outcomes

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

CO1 – Select the appropriate motors to meet the load requirements.**(K3)**
CO2 – Explain the industrial process and selection of drives for various applications .**(K2)**
CO3 – Describe the thermal characteristics of electric motors.**(K1)**
CO4 – Analyze the speed torque characteristics of converter and chopper fed DC drives. **(K3)**
CO5 – Apply the various speed control methods for Induction and synchronous motor.**(K3)**

UNIT I INTRODUCTION TO ELECTRIC DRIVES (9 Hrs)

Need for Drive – Concept of electric drives – Motors used in drives – Types of loads – Choices – Classification – Multi quadrant operation – Fundamental torque equation – Nature and classification of load torques.

UNIT II INDUSTRIAL PROCESS AND DRIVES (9 Hrs)

Process flow diagram of paper mill – Cement mill – Sugar mill – Steel mill –Textile mills – Hoists and cranes – Centrifugal pumps and compressors – Solar powered pump drives –Selection of drives.

UNIT III THERMAL CHARACTERISTICS OF ELECTRIC MOTORS (9 Hrs)

Effect of heating – Heating and cooling characteristics – Loading condition and classes of duty – Determination of rating of motors – Effect of load inertia – Load equalization – Environmental factors.

UNIT IV SPEED CONTROL OF DC DRIVES (9 Hrs)

Controlled rectifier fed separately excited DC drives – Single phase drives – Three phase drives – Four quadrant operation fully controlled rectifier – Rectifier control of DC series motor – Chopper control of separately excited and series DC motor.

UNIT V SPEED CONTROL OF AC DRIVES (9 Hrs)

VSI and CSI driven induction motor – Closed loop speed control - static rotor resistance control – Slip power recovery schemes – performance comparison of CSI and VSI fed drives – Variable frequency control of multiple synchronous motors.

Text Books

1. B. N. Sarkar, “Fundamentals of industrial drives”, PHI Learning Pvt Ltd Education, 2011.
2. Gobal K. Dubey, “Fundamentals of Electrical Drives”, Alpha Science Int. Ltd., Pangbourne, 2nd Edition, 2002.
3. R. Krishnan, “Electric Motor Drives–Modeling, Analysis and Control”, Pearson Education, 1st Edition, 2002.

Reference Books

1. S. B. Dewan, G. R. Slemon & A. Stranghan, “Power Semiconductor controlled Drives”, John willey Publication
2. KokKiong Tan & Andi Sudjana Putra, “Drives and Control for Industrial Automation Advances in Industrial Control”, Springer Science & Business Media, 2010.
3. Juha Pyrhonen, Valeria Hrabovcova, R. Scott Semken, “Electrical Machine Drives Control: An Introduction”, John Wiley & Sons, 2016

Web Resources

1. www.siemens.com/paperwww.siemens.com/cemet
2. www.siemens.com/metal
3. www.siemens.comn/sugar
4. www.abb.com/industries
5. www.krupp polysius.com
6. www.voith.paper.com
7. www.abb.com/drives

COs / POs and PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
3	3	3	3	1	-	-	-	-	-	-	-	-	2	2	2
4	3	3	3	1	-	-	-	-	-	-	-	-	2	2	2
5	3	3	3	1	-	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ECO503	ELECTRONIC PRODUCT DESIGN AND PACKAGING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge about Electronic Product and Packaging
- To introduce and discuss various issues related to the system packaging
- To get clear idea about design of packages which can withstand higher temperature, vibrations and shock
- To Design of PCBs which minimize the EMI and operate at higher frequency
- To acquire depth knowledge about the concepts of Testing and testing methods

Course Outcomes

After completion of the course, students are able to

CO1 - Explain the basics of Electronic Product and Packaging. (K2)

CO2 - Infer various issues related to the system packaging. (K2)

CO3 - Summarize the clear idea about design of packages which can withstand higher temperature, vibrations and shock (K2)

CO4 - Describe the design of PCBs which minimize the EMI and operate at higher frequency (K2)

CO5 - Explain the various testing methods (K2)

UNIT I : OVERVIEW OF ELECT RONIC SYSTEMS PACKAGING (9 Hrs)

Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.

UNIT II : SEMICONDUCTOR PACKAGES (9 Hrs)

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits;

UNIT III ELECTRICAL ISSUES IN PACKAGING (9 Hrs)

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps – Hybrid circuits – Resistive, Capacitive and Inductive parasitic

UNIT IV CHIP PACKAGES (9 Hrs)

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in – package (SIP); Passives: discrete, integrated, and embedded

UNIT IV TESTING (9 Hrs)

Testing Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures -thermo mechanically induced -electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability

Text Books:

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001
2. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
3. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.

References Books:

1. Blackwell (Ed), “The electronic packaging handbook”, CRC Press, 2000.
2. R.S.Khandpur, “Printed Circuit Board”, Tata McGraw Hill, 2005
3. R. K. Ulrich, “Recent literature in Electronic Packaging”, 2005
4. Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed signal VLSI Circuits”, Kluwer Academic Publishers.2000.
5. M. Abramovici, M. A. Breuer, and A.D. Friedman, “Digital System Testing and Testable Design”, Computer Science Press,

Web Reference

1. http://www.logopeople.in/blog/awesome-packaging-design-of-electronic-products-for-inspiration/
2. https://www.pinterest.com/PackagingTPI/electronic-packaging/
3. https://www.einfochips.com/blog/semiconductor-and-electronic-design-networks-and-profiles-to-follow-in-2018/
4. https://en.wikipedia.org/wiki/Electronic_packaging
5. https://nptel.ac.in/courses/108/108/108108031/

COs /POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	-	-	-	-	1	-	-	2	2	2
2	3	1	1	-	-	-	-	-	-	1	-	-	2	1	2
3	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
4	3	1	1	-	-	-	-	-	-	1	-	-	2	2	1
5	3	1	1	-	-	-	-	-	-	1	-	-	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ITO504	**MOBILE APPLICATION DEVELOPMENT**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basic concepts of mobile computing
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes

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

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER (9 Hrs)

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III MOBILE TELECOMMUNICATION SYSTEM (9 Hrs)

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

UNIT III MOBILE AD-HOC NETWORKS (9 Hrs)

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT V MOBILE PLATFORMS AND APPLICATIONS (9 Hrs)

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007
3. C.K.Toh, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.

Reference Books

2. Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
3. William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition,TataMcGraw Hill Edition ,2006.
4. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

Web Resources

1. Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	1	2	2
2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	1
3	2	1	-	-	1	-	-	-	-	-	-	-	1	2	3
4	3	2	1	1	-	1	-	-	-	-	-	-	1	2	1
5	3	2	1	1	2	1	-	-	-	-	-	-	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ICO504	MEASUREMENT AND INSTRUMENTATION (Common to ECE, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the meters used to measure current & voltage
- To have an adequate knowledge in the measurement techniques for power and energy, power and energy meters are included
- To provide Elaborate discussion about potentiometer & instrument transformers
- To provide detailed study of resistance measuring methods
- To provide detailed study of inductance and capacitance measurement

Course Outcomes

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

CO1 - Measure current and voltage.
CO2 - Understand AC and DC measurements.
CO3 - Measure power and calibration of energy meters
CO4 - Measure current and voltage using potentiometric method.
CO5 - Understand the resistance measurement

UNIT I MEASUREMENT OF VOLTAGE AND CURRENT (9 Hrs)

Galvanometers: – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation

UNIT II MEASUREMENT OF POWER AND ENERGY (9 Hrs)

Electrodynamometer type wattmeter: –Theory & its errors – Methods of correction – LPF wattmeter– Phantom loading –Induction type kWh meter – Induction type energy meter – Calibration of wattmeter and Energy meter.

UNIT III POTENTIOMETERS & INSTRUMENT TRANSFORMERS (9 Hrs)

DC potentiometer:– Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer:-Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Instrument Transformer:-C.T and P.T construction, theory,operation and characteristics

UNIT IV RESISTANCE MEASUREMENT (9 Hrs)

Measurement of low, medium & high resistance: – Ammeter, voltmeter method – Wheatstone bridge– Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement :-Loss of charge method, Megohm bridge method –Megger – Direct deflection methods – Price's guard wire method – Earth resistance measurement

UNIT V IMPEDANCE MEASUREMENT (9 Hrs)

A.C bridges:– Measurement of inductance, capacitance – Q of coil – Maxwell Bridge –Wein's bridge– Schering bridge – Anderson bridge –Hay's bridge- Campbell bridge to measure mutual inductance – Errors in A.C. bridge methods and their compensation – Detectors – Excited field – A.C. galvanometer– Vibration galvanometer.

Text Books

1. E.W. Golding & F.C. Widdis, 'Electrical Measurements & Measuring Instruments', A.H. Wheeler& Co,2001
2. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010

Reference Books

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation Dhanpat Rai and Co, New Delhi, 2010.
2. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2nd edn., 2002.
3. J.B.Gupta 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K. Kataria & Sons, Delhi, 2003.

Web Resources

1. https://lecturenotes.in/notes/7259-notes-for-electrical-measurement-and-instrumentation-mi-by-ranu-singh
2. https://lecturenotes.in/subject/265/electrical-measurement-and-instrumentation

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	2	-	1	1	1	1
2	3	3	-	3	3	2	-	-	-	2	-	2	1	1	1
3	3	3	2	3	3	2	-	-	-	2	-	2	1	1	1
4	3	3	3	3	3	2	-	-	-	2	-	2	1	1	1
5	3	3	3	2	2	2	-	-	-	2	-	2	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MEO505	CREATIVITY INNOVATION AND NEW PRODUCT DEVELOPMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To understand the need for creativity and innovation
- To learn about the project selection and evaluation
- To learn about the Patent and IPR
- To understand the quality standards and new product planning
- To learn model preparation and evaluation

Course Outcomes
After completion of the course, the students will be able to
CO1 - Describe the creativity and problem solving. **(K1)**
CO2 - Analyse the methods for project selection and evaluation. **(K4)**
CO3 - Analyse the patent laws and IPR. **(K4)**
CO4 - Describe the new product planning. **(K1)**
CO5 - Acquire knowledge about the patent applications. **(K1)**

UNIT I INTRODUCTION (9 Hrs)
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving -brainstorming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION (9 Hrs)
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products evaluation techniques

UNIT III NEW PRODUCT DEVELOPMENT (9 Hrs)
Research and new product development - Patents - Patent search - Patent laws-International code for patents - Intellectual property rights (IPR)

UNIT IV NEW PRODUCT PLANNING (9 Hrs)
Design of proto type - testing - quality standards - marketing research introducing new Products

UNIT V MODEL PREPARATION & EVALUATION (9 Hrs)
Creative design - Model Preparation - Testing - Cost evaluation – Patent application

Text Books
1. Twiss, Brian. “Managing Technological Innovation”, Pitman Publishing Ltd., 1992.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.
3. Lawrence Sanders G, Saylor foundation Publishing Ltd., 2012.

Reference Books
1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Dr Paul Trott, Innovation Management and New Product Development, 6th Edition, Pearson Publication, 2017
3. Khandwalla, N – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
4. Bulletins I.P.R, TIFAC, New Delhi, 1997.
5. Jacob Goldenberg, Creativity in Product Innovation, Cambridge University Press, 2002.

Web Resources

1. https://nptel.ac.in/courses/107/103/107103082/
2. https://nptel.ac.in/courses/107/101/107101086/
3. https://nptel.ac.in/courses/110/107/110107094/
4. https://www.youtube.com/watch?v=H6OlyjLJf6k
5. https://www.youtube.com/watch?v=CnKeVs-_9zs

COs/POs/PSOs Mapping For Mechatronics

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
4	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
5	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BMO503	BIOMETRIC SYSTEMS (Common to CSE, IT, MECH, MECHATRONICS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To understand the basics of Biometric systems
- To gain knowledge in different fingerprint technologies
- To understand the classification of face recognition methods.
- To understand multimodal Biometrics and its performance evaluation.
- To know personal privacy and security implications of biometrics systems.

Course Outcomes:

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

CO1 - Explain the fundamentals of biometric systems **(K2)**
CO2 - Describe the various fingerprint technologies **(K3)**
CO3 - Distinguish different face recognition and hand geometry pattern **(K3)**
CO4 - Analyse the multimodal biometrics and performance evaluation of biometrics **(K4)**
CO5 – Recognize various Biometric authentication methods **(K3)**

UNIT I INTRODUCTION TO BIOMETRICS (9 Hrs)

Introduction– biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification – Authentication technologies –Need for strong authentication - Protecting privacy and biometrics policy – Biometric applications – biometric characteristics.

UNIT II FINGERPRINT TECHNOLOGY (9 Hrs)

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modelling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY (9 Hrs)

Introduction to face recognition - face recognition from correspondence maps - Hand geometry- scanning - feature extraction - Adaptive Classifiers - Visual Based feature extraction and Pattern Classification -types of algorithm - Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION (9 Hrs)

Voice scan - Physiological biometrics –Behavioural biometrics - Introduction to multimodal biometric system- Integration strategies - Architecture -level of fusion - combination strategy – training and adaptability - examples of multimodal biometric systems - Performance evaluation - Statistical Measures of Biometrics- FAR - FRR - FTE - EER -Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION (9 Hrs)

Introduction - Biometric Authentication Methods - Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines- Biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.

Text Books

1. Anil K. Jain, Arun Ross, and Karthik Nandakumar " Introduction to Biometrics", Springer ,2011
2. Richard O. Duda, David G.Stork,Peter E. Hart, "Pattern Classification,", Wiley 2007
3. S.Y.Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach", Prentice Hall,2005

Reference Books

1. Anil K. Jain, Patrick Flynn, and Arun A. Ross, "Handbook of Biometrics", Springer, 2008
2. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley, 2003.
3. John R. Vacca, "Biometric Technologies and Verification Systems", Elsevier Inc, 2007
4. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation",Springer,2005
5. Nikolaos V. Boulgouris,Konstantinos N. Plataniotis ,Evangelia Micheli-Tzanakou,"Biometrics: Theory, Methods, and Applications" , Wiley 2009

Web Resources:

1. http://www.findbiometrics.com/Pages/glossary.html
2. http://www.biometrics.gov/Documents/privacy.pdf
3. http://zing.ncsl.nist.gov/biousa/docs/Usability_and_Biometrics_final2.pdf
4. User Interface, System Design
5. http://www.cesg.gov.uk/site/ast/biometrics/media/BEM_10.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-
2	3	2	2	1	1	2	-	-	-	-	-	1	-	1	-
3	3	2	2	1	2	2	-	-	-	-	-	1	-	1	-
4	3	1	1	1	1	1	-	-	-	-	-	1	-	1	-
5	3	1	2	1	2	2	-	-	-	-	-	1	-	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20BMO504	**MEDICAL ROBOTICS** (Common to CSE, IT, MECH, MECHATRONICS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To understand the basics of Robotics
- To gain knowledge in Kinematics
- To know about the robot vision
- To describe various motion planning solutions
- To explain various applications of Robots in Medicine

Course Outcomes:

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

CO1 - Understand the basics of robotic systems**. (K2)**
CO2 - Explore workspace and related motion of the Robots **(K3)**
CO3 - Analyse and extract information from the image using Robots **(K3)**
CO4 - Design of task planning and simulating the task. **(K4)**
CO5 – Construct Robots for Medical applications **(K4)**.

UNIT I INTRODUCTION (9 Hrs)

Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot -Five-axis robot - Six-axis robot.

UNIT II KINEMATICS (9 Hrs)

Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations – Continuous path motion – Interpolated motion – Straight-line motion.

UNIT III ROBOT VISION (9 Hrs)

Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.

UNIT IV PLANNING (9 Hrs)

Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.

UNIT V BIOMETRIC AUTHENTICATION (9 Hrs)

Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.

Text Books

1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003.
2. Paula Gomes, "Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications", Woodhead Publishing, 2012
3. Klafter, Chmielewski and Negin, "Robotic Engineering - An Integrated approach",, PHI, first edition, 2009

Reference Books

1. J.J.Craig, "Introduction to Robotics", Pearson Education, 2005.
2. Fu, Lee and Gonzalez., "Robotics, control vision and intelligence", McGraw Hill International, 2nd edition, 2007
3 John J. Craig, "Introduction to Robotics", Addison Wesley Publishing, 3rd edition, 2010.
4. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, "Robotics", McGraw Hill, 2008.

Web Resources

1.https://nptel.ac.in/courses/112/105/112105249/
2.https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_robotic_surgery
3.https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
4.https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
5.https://www.worldscientific.com/worldscinet/jmrr

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	-	1	-	2	-
2	3	2	-	1	1	1	-	-	-	-	-	1	-	2	-
3	3	2	-	1	1	1	-	-	-	-	-	1	-	2	-
4	3	1	1	1	1	1	-	-	-	-	-	1	-	2	-
5	3	1	1	-	1	1	-	-	-	-	-	1	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CC0503	NETWORK ESSENTIALS (Common to EEEMECH, CIVIL, ICE MECHATRONICS, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of computer communication and data networks
- To gain the necessary knowledge and skills to work effectively with network engineering and administrators
- To learn how to research ,communicated network and IT issuing by reading relevant industry information
- To understanding the basic technologies and step required for setting up managing small LAN
- To understand the various technologies of security to protect the information in network

Course Outcomes

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

CO1- Understand the basic knowledge and skills to implement defined network architecture
CO2- Explain the performances of data link control and their access medium
CO3- Describe about internet Protocol and their working processes in IPV.
CO4- Explain the basic concepts of Transport Protocols and working of TCP layer
CO5- Design and study the operations of Security and their different algorithm

UNIT I NETWORK MODELS (9 Hrs)

Data communications- Networks-PAN,LAN, MAN and WAN- Internet, Intranet and Extranets- Protocols and standards- OSI/ISO reference model- TCP/IP protocol suite-Broadband ISDN-ATM protocol reference model-- SONET/SDH architecture-Bluetooth and UWB –WiFi-WiMax Cognitive Radios- Adhoc and Sensor Networks-Green communications.

UNIT II DATA LINK CONTROL AND MEDIUM ACCESS (9 Hrs)

Types of errors- Error detection and correction- Checksum- Framing-Flow control-Stop and wait protocol-Go-back N- Selective repeat protocols HDLC-Random access protocols- Controlled access- Wired LANs-IEEE standards, IEEE 802.3, 802.4, 802.5 and 802.6- - Fast Ethernet- Gigabit Ethernet –Wireless LANs- IEEE 802.11.

UNIT III NETWORK ROUTING (9 Hrs)

Logical addressing- IPv4 addresses- IPv6- Internet protocol- Transition from IPv4 to IPv6- Mapping logical to physical address- Mapping physical to logical address- ICMP-Direct Vs indirect delivery- Forwarding-Unicast and Multicast routing protocols- Different Routing Algorithms-Internetworking-Routers and gateways.

UNIT IV TRANSPORT AND CONGESTION (9 Hrs)

Elements of Transport Protocols: addressing, Connection Establishment, Connection Release, Error Control and Flow Control – Congestion control: Desirable Bandwidth Allocation, Regulating the Sending Rate, Wireless Issues- UDP, RPC -TCP Protocol, TCP connection management, TCP sliding window and congestion control.

UNIT V SECURITY (9 Hrs)

Introduction to Cryptography, Cipher text, symmetric key cryptography – AES and DES, RSA public key and private keys- Digital signature .Security in the Internet: IPSec, PGP, VPN and Firewalls. Authentication

Protocols: Shared Secret Key, The Diffie-Hellman Key Exchange, Authentication Using Kerberos. Wireless Security- issues and challenge

Text Books

1. William Stallings, “Data and computer communications”, Ninth Edition,Pearson Education, New Delhi, 2014.
2. Behrouz. A. Forouzan, “Data Communication and Networking”, Fifth Edition,McGraw Hill, New Delhi, 2013.
3. Pallapa Venkatram and Sathish Babu.B, “Wireless &Mobile Network security”,Tata McGraw Hill, New Delhi, 2010

Reference Books

1. Douglas E. Comer, “Internetworking with TCP/IP (Volume I) Principles, Protocols and Architecture”, 6th Edition, Pearson Education, 2013.
2. Nader F. Mir, “Computer and Communication Networks”, 2nd Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan and Firouz Mosharraf, “Computer Networks a Top Down Approach”, Tata McGraw-Hill, 2017.
5. Rich Seifert, James Edwards, ”The All New Switch Book: The Complete Guide to LAN Switching Technology”, 2nd Edition , Wiley Publishing Inc, 2011

Web Resources

1. https://tinyurl.com/ycy6x454
2. https://tinyurl.com/yapn9ac7
3. https://tinyurl.com/ydf33ye6
4. https://nptel.ac.in/courses/106/105/106105081/
5. https://nptel.ac.in/courses/106/105/106105183/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1		1	-	-	-	-	-	1	1	1	1
2	2	1	2	1		1	-	-	-	-	-	1	2	2	2
3	2	1	2	1		1	-	-	-	-	-	1	2	1	1
4	2	1	1	1		1	-	-	-	-	-	1	2	2	1
5	2	1	1	1	1	1	-	-	-	-	-	1	1	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Kaj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CCO504	WEB PROGRAMMING (Common to EEE,ECE, MECH, CIVIL, ICE MECHATRONICS, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Learn the fundamentals of web application development
- To understand the design components and tools using CSS
- To Learn the concepts of JavaScript and programming fundamentals.
- To understand the working procedure of XML
- To study about advance scripting and Ajax applications

Course Outcomes

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

CO1 - Comprehend basic web applications using HTML**(K2)**
CO2 - Use CSS to design web applications **(K3)**
CO3 - Use java scripts functions for the web page creation **(K3)**
CO4 - Explain XML structure**(K2)**
CO5 - Demonstrate the web 2.0 application to advance scripts**(K2**

UNIT - I INTRODUCTION TO WWW & HTML (9 Hrs)

Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. **HTML:** The development process, Html tags and simple HTML forms.

UNIT – II STYLE SHEETS (9 Hrs)

CSS: Need for CSS, Introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT - III JAVA SCRIPTS (9 Hrs)

Client side scripting, JavaScript, develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.

UNIT –IV XML (9 Hrs)

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT.

UNIT –V ADVANCE SCRIPT (9 Hrs)

JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations **DHTML:** Combining HTML, CSS and JavaScript, events and buttons, controlling your browser, **AJAX**: Introduction, advantages & disadvantages, AJAX based web application, alternatives of AJAX.

Text Books

1. Ralph Moseley, M.T. Savaliya, “Developing Web Applications”, BPB Publications, 2017.
2. Hirdesh Bhardwaj,, “Web Designing”, Pothi.com, 2016
3. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.

Reference Books

1. Ralph Moseley, "Developing Web Applications", Wiley India Pvt. Ltd, 2013
2. Joel Sklar, " Principles of Web Design", 6th edition, Cengage Learning, Inc, 2014
3. B. M. Harwani," Developing Web Applications in PHP and AJAX", Tata McGraw-Hill Education, 2010
4. UttamK.Roy, Web Technologies, Oxford University Press, 2010.
5. Rajkamal, Web Technology, Tata McGraw-Hill, 2009.

Web Resources

1. https://nptel.ac.in/courses/106/106/106106156/
2. https://www.coursera.org/learn/html-css-javascript-for-web-developers
3. https://code.tutsplus.com/courses/how-to-become-a-web-developer
4. https://webdesignerwall.com/
5. https://www.smashingmagazine.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2	1	-	-	-	-	-	1	1	-	-
2	2	1	2	1	2	1	-	-	-	-	-	1	1	-	-
3	2	1	2	1	2	1	-	-	-	-	-	1	1	-	-
4	2	1	1	1	2	1	-	-	-	-	-	1	1	-	-
5	2	1	1	1	2	1	-	-	-	-	-	1	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20ADO504	**DATA SCIENCE APPLICATION OF VISION** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the capability of a machine to get and analyze visual information and makedecisions
- To learn methods and algorithms for Vision
- To learn how to use deep learning for Vision tasks
- To understand the neural network concepts
- To study the real world applications using computer vision

Course Outcomes

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

CO1 - Understand the methods and algorithms for image processing. **(K2)**

CO2 - Apply object detection and segmentation concepts for image processing. **(K4)**

CO3 - Apply scalable algorithms for large datasets in vision. **(K4)**

CO4 - Analyze deep learning and neural network architectures for image and video processing. **(K3)**

CO5 - Apply vision-based solutions for specific real-world applications. **(K4)**

UNIT I IMAGE FUNDAMENTALS (9 Hrs)

Pixels - The Building Blocks of Images - The Image Coordinate System - RGB and BGR Ordering - Scaling and Aspect Ratios. Image filters - Gaussian blur - Median filter - Dilation and erosion - Custom filters - Image thresholding - Edge detection - Sobel edge detector - Canny edge detector.

UNIT II OBJECT DETECTION AND SEGMENTATION (9 Hrs)

Image Features - Harris corner detection - Local Binary Patterns - Image stitching - Segmentation: Contour detection - The Watershed algorithm - Super pixels - Normalized graph cut.

UNIT III MACHINE LEARNING WITH COMPUTER VISION (9 Hrs)

Data pre-processing - Image translation through random cropping - Image rotation and scaling - Applications of machine learning for computer vision - Logistic regression - Support vector machines - K-means clustering.

UNIT IV IMAGE CLASSIFICATION USING NEURAL NETWORKS (9 Hrs)

Image Classification Basics Types of Learning - The Deep Learning Classification Pipeline - Introduction to Neural Networks - The Perceptron Algorithm - Backpropagation and Multi-layer Networks - The Four Ingredients in a Neural Network Recipe - Weight Initialization - Constant Initialization - Uniform and Normal Distributions - LeCun Uniform and Normal - Understanding Convolutions - CNN Building Blocks - Common Architectures and Training Patterns.

UNIT V COMPUTER VISION AS A SERVICE (9 Hrs)

Computer vision as a service – architecture - Developing a server-client model - Computer vision engine.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2009.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, Cengage Learning, 2007.
3. Gary Bradski, “Learning OpenCV”, First Edition, 2008.

Reference Books

1. Alok Kumar Singh Kushwaha, Rajeev Srivastava, "Recognition of Humans and Their Activities for Video Surveillance", IGI Global, 2014.
2. Ying-li Tian, Arun Hampapur, Lisa Brown, Rogerio Feris, Max Lu, Andrew Senior, " Event Detection, Query, and Retrieval for Video Surveillance", IGI Global, 2009.
3. Matthew Turk, Gang Hua, " Vision-based Interaction", First Edition, Morgan Claypool, 2013.
4. Ian Goodfellow, Yoshuo Bengio, Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series)", MIT Press, 2017.
5. Fan Jiang, " Anomalous Event Detection from Surveillance Video", ProQuest, 2012.

Web Resources

1. https://www.kaggle.com/learn/computer-vision
2. https://machinelearningmastery.com/what-is-computer-vision/
3. https://www.udemy.com/course/pythoncv/
4. https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computer-vision-python/
5. https://www.youtube.com/watch?v=N81PCpADwKQ&ab_channel=ProgrammingKnowledge

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	2	2	-
2	2	1	1	2	–	-	-	-	-	-	-	-	1	1	1
3	2	2	2	1	–	-	-	-	-	-	-	-	-	-	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	2	-
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSO601	PRODUCT DEVELOPMENT AND DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide the basic concepts of product design, product features and its architecture.
- To have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To enhance team working skills.
- To design some products for the given set of applications.
- To compete with a set of tools and methods for product design and development.

Course Outcomes

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

CO1 - Apply the concept for new product development. **(K3)**
CO2 - Validate knowledge on the concepts of product specification. **(K5)**
CO3 - Describe the principles of industrial design and prototyping. **(K2)**
CO4 - Apply knowledge on product architecture. **(K3)**
CO5 - Review the concept of product development and customer needs. **(K5)**

UNIT I: INTRODUCTION TO PRODUCT DEVELOPMENT (9 Hrs)

Product development versus design, product development process, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method.

UNIT II: PRODUCT SPECIFICATIONS (9 Hrs)

Establishing the product specifications– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process.

UNIT III: PRODUCT CONCEPTS (9 Hrs)

A: Concept generation, product configuration, concept evaluation and selection, product embodiments.
B: Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments.

UNIT IV: PRODUCT ARCHITECTURE (9 Hrs)

Concept selection- Screening – scoring, Product architecture – Implication of architecture - Establishing the architecture – Related system level design issues.

UNIT V: PROTOTYPING (9 Hrs)

Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging.

Text Books

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood,
3. Otto, K. N. Product design: techniques in reverse engineering and new product development.

Reference Books

1. Ashby, M. F., & Johnson, K... *Materials and design: the art and science of material selection in product design*. Butterworth-Heinemann.
2. Kevin Otto and Kristin Wood, "Techniques in Reverse Engineering and New Product Development", Pearson Education, Chennai, Edition III.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 6th Edition, PHI.
4. Taurt Pugh,"Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY
5. Kumar, A., Jain, P. K., & Pathak, P. M. Reverse engineering in product manufacturing: an overview. DAAAM international scientific book,

Web Resources

1. http://www.worldcat.org/title/product-design-and-development/oclc/904505863
2. https://www.pdfdrive.com/product-design-and-development-e38289913.html
3. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
4. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
5. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/clas1_int_crse_6.pdf
6. https://swayam.gov.in/nd1_noc20_de05/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	-	-	-	-	-	-	2	2	1	3
2	1	-	2	-	3	-	-	-	-	-	-	3	1	2	2
3	1	-	3	-	2	-	-	-	-	-	-	2	1	2	3
4	3	-	1	-	3	-	-	-	-	-	-	1	1	2	3
5	1	-	3	-	3	-	-	-	-	-	-	2	1	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSO602	INTELLECTUAL PROPERTY AND RIGHTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- Awareness about current trends in IPR and Government steps in fostering IPR

Course Outcomes

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

CO1: Complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works **(K2)**

CO2: Presenting useful insight on novelty of their idea from state-of-the art search during their project work period. **(K3)**

CO3: Posting Intellectual Property as a career option like R&D IP Counsel, Government Jobs – Patent Examiner, Private Jobs, Patent agent and/or Trademark agent and Entrepreneur **(K5)**

CO4: Disseminating the knowledge on Design, Geographical Indication, Plant Variety and Layout Design Protection and their registration aspects **(K1)**

CO5: Organizing their idea or innovations and analyse ethical and professional issues which arise in the intellectual property law context. **(K4)**

UNIT I OVERVIEW OF INTELLECTUAL PROPERTY (9 Hrs)

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

UNIT II PATENTS (9 Hrs)

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

UNIT III COPYRIGHTS (9 Hrs)

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT IV TRADEMARKS (9 Hrs)

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

UNIT V OTHER FORMS OF IP (9 Hrs)

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.

Text Books

1. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited, 2019
2. Neeraj, P., & Khusdeep, D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 2014

Reference Books

1. Ahuja, V K. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis, 2017.
2. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
4. Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
5. S.V. Satakar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
6. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

Web Resources

1. http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. Cell for IPR Promotion and Management (http://cipam.gov.in/)
3. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
4. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
5. Journal of Intellectual Property Rights (JIPR): NISCAIR

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	3	-	2	-	1	2	-	-	-	2	1	1	3
2	1	-	3	-	2	-	2	2	-	-	-	2	2	2	1
3	-	-	2	-	1	-	3	3	-	-	-	2	2	2	3
4	2	-	3	-	2	-	2	2	-	-	-	2	2	2	1
5	1	-	1	-	2	-	1	2	-	-	-	2	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSO603	MARKETING MANAGEMENT AND RESEARCH	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To facilitate understanding of the conceptual framework of marketing in engineering.
- To understand the concepts of product and market segmentation for engineering services and technological products.
- Analyzing the various pricing concepts and promotional strategies for engineering and technology markets.
- Learn to focus on a research problem using scientific methods in engineering and technological enterprises.
- To be able to design and execute a basic survey research reports in in engineering and technological enterprises

Course Outcomes

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

CO1 - Analyze the fundamental principles involved in managing engineering and technological markets **(K3)**

CO2 - Understand and develop product, and Market Segmentation for engineering services and technological Products **(K4)**

CO3 - Develop pricing and promotional strategies for engineering and technology markets **(K6)**

CO4 - Analyze market problems and be capable of applying relevant models to generate appropriate solutions to meet challenges in engineering and technological enterprises **(K3)**

CO5 - Identify the interrelationships between market trends, innovation, sustainability and communication in engineering and technological enterprises **(K5)**

UNIT I MARKETING – AN OVERVIEW (9 Hrs)

Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNIT II PRODUCT AND MARKET SEGMENTATION (9 Hrs)

Product, Classifications of product, Product Life Cycle, New product development, Branding, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing.

UNIT III PRICING AND PROMOTIONAL STRATEGIES (9 Hrs)

Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management. Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics.

UNIT IV RESEARCH AND ITS FUNDAMENTALS (9 Hrs)

Research: Meaning, Objectives of Research, Types of Research, Significance of Research - Methods Vs Methodology - Research Process – Components of Research Problem, Literature Survey – Primary Data and Secondary Data, Questionnaire design, Measurement and Scaling Techniques.

UNIT V BASIC STATISTICAL ANALYSIS AND REPORT WRITING (9 Hrs)

Fundamentals of Statistical Analysis and Inference- Measures of Central Tendency -Measures of Dispersion - Measures of Asymmetry - Report Writing: Types of research reports, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Report Writing, Layout of Research Report, Mechanics of Writing Research Report, Ethics in Research

Text Books

1. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, 14th edition, 2012.
2. Lilien, Gary l., and Arvind Rangaswamy. “Marketing managers make ongoing decisions about product features, prices, distribution options”, The Handbook of Marketing Research: Uses, Misuses, and Future Advances (2006).

Reference Books

1. Chandrasekar. K.S., “Marketing Management Text and Cases”, 1st Edition, Tata McGraw Hill - Vijaynicole, 2010.
2. Kothari, C. “Research Methodology Methods and Techniques”, New Age International (P) Ltd., 2017
3. RajanSexena. Marketing Management: Text cases in Indian Context.(3rd edition) New Delhi, Tata McGraw hill, 2006
4. Moisander J, Valtonen A, “Qualitative marketing research: A cultural approach”, Sage Publisher, 2006.
5. Malhotra NK, Satyabhushan Dash, “Marketing Research: An Applied Orientation”, 7th ed, Pearson Education, 2019

Web Resources

1. https://swayam.gov.in/nd1_noc20_mg26/preview
2. https://swayam.gov.in/nd1_noc20_mg26/preview
3. https://www.entrepreneur.com/encyclopedia/market-research

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	-	1	3	-	-
2	-	1	2	-	1	-	3	-	-	2	-	1	2	3	1
3	-	-	1	-	1	-	-	-	2	1	-	1	1	2	3
4	-	3	2	2	-	1	-	1	1	2	-	1	2	2	1
5	-	2	2	1	2	2	-	2	2	2	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Kaj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSO604	PROJECT MANAGEMENT FOR ENGINEERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the various concepts and steps in project management.
- To familiarize the students with the project feasibility studies and project life cycle
- To enable the students to prepare a project schedule
- To understand the risk management and project Control process.
- To learn about the closure of a project and strategies to be an effective project manager.

Course Outcomes

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

CO1 - Interpret the different concepts and the various steps in defining a project. **(K2)**
CO2 - Examining the feasibility of a project. **(K3)**
CO3 - Build a schedule for a Project. **(K6)**
CO4 - Predict the risk associated with a project and demonstrate the project audit. **(K2)**
CO5 - Analyse the project team and outline the Project closure. **(K4)**

UNIT I PROJECT MANAGEMENT CONCEPTS (9 Hrs)

Project: Meaning, Attributes of a project, Project Life cycle, Project Stakeholders, Classification, Importance of project management, Project Portfolio Management System, Different Project Management Structure, Steps in Defining the Project, Project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints

UNIT II PROJECT FEASIBILITY ANALYSIS (9 Hrs)

Opportunity Studies, Pre-Feasibility studies, and Feasibility Study: Market Feasibility, Technical Feasibility, Financial Feasibility and Economic Feasibility. Financial and Economic Appraisal of a project, Social Cost Benefit Analysis in India and Project Life Cycle.

UNIT III PROJECT SCHEDULING & NETWORK TECHNIQUES (9 Hrs)

Scheduling Resources and reducing Project duration: Types of project constraints, classification of scheduling problem, Resources allocation methods, Splitting, Multitasking, Benefits of scheduling resources, Rationale for reducing project duration, Options for accelerating Project completion

Developing and Constructing the Project Network (Problems), PERT, CPM; Crashing of Project Network,

UNIT IV PROJECT RISK MANAGEMENT AND PROJECT CONTROL (9 Hrs)

Project Risk management; Risk concept, Risk identification, Risk assessment, Risk response development, Contingency planning, Contingency funding and time buffers, Risk response control, and Change control management

Budgeting and Project Control Process, Control issues, Tendering and Contract Administration. Steps in Project Appraisal Process and Project Audits

UNIT V PROJECT CLOSURE AND MANAGING PROJECT (9 Hrs)

Project Closure: Team, Team Member and Project Manager Evaluations. Managing versus Leading a Project: Qualities of an Effective Project Manager, Managing Project Stakeholders, Managing Project Teams: Five Stage Team Development Model, Situational factors affecting team development and project team pitfalls.

Text Books

1. Erik Larson and Clifford Gray. "Project Management: The Managerial Process". 6th Edn. McGraw Hill Education; 2017.
2. Harold Kerzner. "Project Management: A systems approach to Planning, Scheduling and Controlling. 12th Edn. John Wiley & Sons; 2017

Reference Books

1. Meredith, J.R. & Mantel, S. J. "Project Management- A Managerial Approach". John Wiley.:2017
2. Prasanna Chandra. "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review". 9th Edn. McGraw Hill Education; 2019.
3. B C Punmia by K K Khandelwal. "Project Planning and Control with PERT and CPM". 4th Edn. Laxmi Publications Private Limited; 2016.
4. Hira N Ahuja, S.P.Dozzi, S.M.Abourizk. "Project Management". 2nd Edn. Wiley India Pvt Ltd; 2013.
5. "A guide to Project Management Body of Knowledge". 6th Edn. Project Management Institute; 2017

Web Resources

1. www.pmi.org
2. www.projectmanagement.com
3. https://www.sciencedirect.com/journal/international-journal-of-project-management
4. https://nptel.ac.in/courses/110/107/110107081/
5. https://nptel.ac.in/courses/110/104/110104073/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	-	-	2	-	2	2	2	1	1
2	-	2	1	-	-	1	-	-	1	1	1	1	2	2	1
3	-	1	3	-	-	-	-	-	-	-	1	-	2	1	1
4	3	1	1	-	-	1	1	-	-	1	1	3	2	2	1
5	3	-	3	-	-	-	-	3	3	2	3	2	1	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20HSO605	FINANCE FOR ENGINEERS	L	T	P	C
		2	2	0	3

Course Objectives

- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes

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

CO1: Understand basic concepts in accounting and finance and their importance for engineers **(K2)**

CO2: Demonstrate knowledge and understanding of the applications of mathematics in finance **(K3)**

CO3: Conduct Financial Analysis and use the outcome in making informed decisions in investing **(K4)**

CO4: Identify and Appreciate various sources of procurement of funds in business and their critical evaluation **(K2)**

CO5: Know how to scientifically determine the investing in long-term and short-term assets in business **(K3)**

UNIT I: UNDERSTANDING THE FUNDAMENTALS (9 hrs)

Assets – Need and Functions of Assets – Types of Assets – Factors determining Investments in Assets. Liabilities – Meaning and Functions of Liabilities – Types of Liabilities – Capital as a Liability: Why and How –– Concept and Meaning of Finance – Distinction between Accounting and Finance – Significance of Accounting and Finance for Engineers.

UNIT II: MATHEMATICS OF FINANCE (9 hrs)

Time Value of Money – Computation of Present Value and Future Value – Implications of TVM in Financial Decisions – Concept of Risk and Return – Measuring Risk and Return – Concept of Required Rate of Return and its significance in Investment Decisions.

UNIT III: FINANCIAL ANALYSIS (9 hrs)

Meaning and Objectives of Financial Analysis – Annual Report As an Input for Analysis – Basic Understanding of Annual Reports - Tools of Financial Analysis – Horizontal Analysis – Vertical Analysis – Trend Analysis – Accounting Ratios – Significance of Ratio Analysis in Decision-making – Snap-shot of the Past to predict the Future – Computation of Key Ratios – Liquidity Ratios – Profitability Ratios – Performance Ratios – Ratios that are helpful for Potential Investors.

UNIT IV: FUNDS PROCUREMENT (9 hrs)

Meaning of Funds – Sources of Funds – Long-Term Sources – Short-Term Sources – Financing Decisions in Business – Capital Structure – Need and Importance of Capital Structure – Determining Optimum Capital Structure – Concept and Computation of Earnings Before Interest and Tax (EBIT), Earnings Before Tax (EBT), and Earnings After Tax (EAT)(Simple Problems) - Leverage in Finance – Types and Computation of Leverages – Operating Leverage, Financial Leverage, and Combined Leverage.

UNIT V: FUNDS DEPLOYMENT (9 hrs)

Investment Decisions – Types of Investment Decisions: Long-Term Investment Decisions. Significance – Methods: Pay-Back Period Method, Net Present Value Method and Benefit-Cost Ratio Method. Short-Term Investment Decisions – Concept of Working Capital – Need and Importance of Working Capital in Business – Determinants of Working Capital in a Business. Components of Working Capital. Dividends: Concept and Meaning – Implications of Dividend Decisions on Liquidity Management.

Text Books

1. R. Narayanaswamy, Financial Accounting – A managerial perspective, PHI Learning, New Delhi. (2015 or later edition)
2. C. Paramasivan and T. Subramanian. Financial Management. New Age International, New Delhi. (2015 or later edition)

Reference Books

1. S.N. Maheswari, Sharad K. Maheswari & Suneel K. Maheswari. Accounting For Management. Vikas Publishing (2017 or later edition)
2. Varun Dawar & Narendar L. Ahuja. Financial Accounting and Analysis. Taxmann Publications. (2018 or later edition)
3. Athma. P. Financial Accounting and Analysis. Himalaya Publishing House. (2017 or later edtion)
4. Prasanna Chandra. Financial Management. Tata-McGraw Hill Publishers, New Delhi. (2019 or later edition)
5. S.C. Kuchhal. Financial Management. Chaitanya Publishing House, Allahabad. (2014 or later edition)

Web Resources

1. http://www.annualreports.com/
2. http://www.mmachennai.org/
3. https://finance.yahoo.com/
4. https://icmai.in/icmai/
5. https://nptel.ac.in/courses/110/107/110107144/
6. https://web.utk.edu/~jwachowi/wacho_world.html
7. https://www.icai.org/indexbkp.html
8. https://www.icsi.edu/home/
9. https://www.investopedia.com/
10. https://www.moneycontrol.com/
11. https://www.rbi.org.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	2	1	3	2	1
2	-	1	2	-	1	-	3	-	-	2	2	1	3	3	1
3	-	-	1	-	1	-	-	-	2	1	2	1	3	2	2
4	-	3	2	2	-	1	-	1	1	2	2	1	1	2	3
5	-	2	2	1	2	2	-	2	2	2	2	1	1	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20EEO705	HYBRID AND ELECTRICAL VEHICLE (Common to ECE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize with the fundamental concept of electrical vehicle
- To understand the concept of hybrid and electrical vehicle architecture, component sizing and electrical motor drive.
- To determine various drives suitable for electrical vehicles.
- To understand the design concepts of electrical vehicle
- To overview the energy storage technologies used for hybrid and electrical vehicle.

Course Outcomes

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

CO1 - Summarize the basics of electrical vehicle based on working principle. **(K2)**
CO2 - Describe the working of different configurations of hybrid vehicles. **(K2)**
CO3 - Apply suitable drives for electrical vehicles. **(K2)**
CO4 - Review the working of different configurations of electrical vehicle and its design concepts **(K2)**
CO5 - Combine the different energy storage and their technologies on implementing hybrid vehicle. **(K3)**

UNIT I INTRODUCTION TO ELECTRICAL VEHICLE (9 Hrs)

History of hybrid and electrical vehicles - social and environmental importance - impact of modern drive - trains on energy supplies - Fundamentals of vehicle propulsion and Braking: Dynamic Equation - Vehicle Power Plant and Transmission Characteristics - Vehicle Performance - Braking Performance.

UNIT II HYBRID VEHICLE (9 Hrs)

Classification - Series and Parallel HEVs - Advantages and disadvantages - Series-Parallel Combination - Internal Combustion Engines: Reciprocating Engines - Gas Turbine Engine- Design of an HEV: Hybrid Drive train - Sizing of Components.

UNIT III ELECTRIC PROPULSION DRIVE SYSTEMS (9 Hrs)

Electric drives used in EV/HEV: Induction motor drives - DC motor drives - Permanent magnet motor drives - their Configuration - Control and Applications in EV/HEV.

UNIT IV DESIGN OF ELECTRICAL VEHICLE (9 Hrs)

Components of EV - advantages - EV transmission configuration: Transmission components - gear ratio - EV motor sizing - EV market.

UNIT V ELECTRICAL VEHICLE STORAGE TECHNOLOGY (9 Hrs)

Battery Types - Parameters - Technical characteristics – modelling and equivalent circuit - Methods of battery charging - Fuel cells: Types - Fuel cell electrical vehicle – Ultra capacitors - Hydrogen storage systems – Flywheel technology.

Text Books

1. Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 3rd Edition, 2019.
2. Iqbal Hussain, “Electric and Hybrid Vehicles – Design Fundamentals”, CRC Press, 2nd Edition, 2011.

Reference Books

1. K. T. Chau, “Electric vehicle machines and drives: Design, analysis and application”, John Willey and Sons Singapore pte. ltd., 1st Edition, 2015.
2. M. Ehsani, Y. Gao and A. Emadi, “Modern electric, hybrid electric and fuel cell vehicles: Fundamentals, Theory and design”, CRC press, 2nd Edition, 2011.
3. J. Larminie and J. Lowry, “Electric vehicle technology explained”, John Willey & Son ltd., 2nd Edition, 2012.
4. I. Husain, “Electric and hybrid vehicles: Design fundamentals”, CRC press, 2003.

Web Resources

1. https://nptel.ac.in/courses/108103009/
2. https://www.evgo.com/why-evs/types-of-electric-vehicles/
3. https://www.electrichybridvehicletechnology.com/
4. http://www.ieahev.org/
5. https://www.sae.org/learn/content/acad06/
6. https://www.intechopen.com/books/electric-vehicles-modelling-and-simulations

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	-	3	-	-	-	-	1	2	2	1
2	2	3	3	3	-	-	3	-	-	-	-	1	3	3	1
3	3	3	2	2	-	-	3	-	-	-	-	1	2	2	1
4	3	3	3	2	-	-	3	-	-	-	-	1	3	2	1
5	2	3	3	2	-	-	3	-	-	-	-	1	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

		L	T	P	C	Hrs
U20EEO706	**ELECTRICAL ENERGY CONSERVATION AND AUDITING** (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To know the necessity of conservation of energy.
- To understand the energy management schemes in motors.
- To understand the energy management methods in lighting schemes.
- To illustrate the metering schemes for energy management.
- To learn economic analysis and management techniques.

Course Outcomes

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

CO1 - Outline about the energy audit process and instruments. **(K2)**
CO2 - Apply the energy efficient methods for improving efficiency of electric motors. **(K2)**
CO3 - Develop good illumination systems and analyze the power factor. **(K3)**
CO4 - Acquire knowledge on various meters used for energy management. **(K2)**
CO5 - Analyze and evaluate cost effective model in electrical equipments. **(K5)**

UNIT I INTRODUCTION (9 Hrs)

Basics of energy – need for energy management – energy accounting – energy monitoring – targeting and reporting – energy audit – definitions – types of energy audit – audit instruments – audit of process industry – Case studies.

UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION (9 Hrs)

Energy management for electric motors: energy efficient controls and starting efficiency – motor efficiency and load analysis – selection of motors – energy efficient motors. Energy management by cogeneration: forms of cogeneration – electrical interconnection.

UNIT III LIGHTING SYSTEMS (9 Hrs)

Energy management in lighting systems: task and the working space – light sources – ballasts – lighting controls – optimizing lighting energy – reactive power management – capacitor sizing – degree of compensation – capacitor losses –effect of harmonics – lighting and energy standards.

UNIT IV METERING FOR ENERGY MANAGEMENT (9 Hrs)

Metering for energy management: units of measure – utility meters – demand meters – paralleling of current transformers – instrument transformer burdens – multi tasking solid state meters – metering location vs requirements – power analyzer – metering techniques and practical examples.

UNIT V ECONOMIC ANALYSIS AND MODELS (9 Hrs)

Power system tariffs – Economic analysis: cash flow model – Time value of money – pay-back method – utility rate structures – cost of electricity – loss evaluation – load management – demand control techniques – utility monitoring and control system – economic analysis of HVAC systems.

Text Books

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", The Fairmont Press, Inc., 5th Edition, 2006.
2. Frank Kreith, D. Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, 2nd Edition, 2016.
3. Wayne C. Turner, "Energy Management Handbook", The Fairmont Press, 4th Edition, 2001.

References Books

1. P. Venkataseshaiah K.V. Sharma, “Energy Management and Conservation”, Dreamtech Press, 1st Edition, 2020.
2. Amit K. Tyagi, “Handbook on Energy Audits and Management”, TERI, 1st Edition, 2003.
3. ICAI, “Electricity in buildings good practice guide”, McGraw-Hill Education, 1st Edition, 2017.

Web Resources

1. https://nptel.ac.in/courses/108/106/108106022/
2. https://www.youtube.com/watch?v=onIhwmbL8CA
3. https://www.youtube.com/watch?v=CTt4y8bokWs
4. https://ieeexplore.ieee.org/document/7977655
5. https://ieeexplore.ieee.org/document/993185
6. https://ieeexplore.ieee.org/document/6450335

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	-	-	-	-	-	-	-	-	1	2	1	2
2	3	2	3	-	-	-	-	-	-	-	-	1	2	1	1
3	3	2	3	-	-	-	-	-	-	-	-	1	2	1	-
4	3	2	2	-	-	-	-	-	-	-	-	1	1	1	-
5	2	2	3	-	-	-	-	-	-	-	-	1	1	1	-

Correlation Level: 1 – Low, 2 – Medium, 3 – High

Dr.G.Balamuruga Mohan Raj, M.Tech., Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ECO706	SENSORS FOR INDUSTRIAL APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study principles of sensor and calibration
- To understand different types of motion sensors
- To demonstrate force, magnetic and heading sensors with its application to the learners
- To enhance students to understand the concept of optical, pressure and temperature sensor
- To select suitable sensor for industrial application

Course Outcomes

After completion of the course, students will be able to

CO1 - Explain principles of sensor and illustrate the calibration (K2)
CO2 - Demonstrate different types of range and sensors (K3)
CO3 - Determine the principles of Force, magnetic and heading sensors (K3)
CO4 - Describe different optical and thermal sensors (K2)
CO5 - Select suitable sensor for real time applications (K3)

UNIT I INTRODUCTION (9 Hrs)

Principles of Physical and Chemical Sensors: Sensor classification, Sensing mechanism of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors.
Sensor Characterization and Calibration: Study of Static and Dynamic Characteristics, Sensor reliability, aging test, failure mechanisms and their evaluation and stability study.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS (9 Hrs)

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

UNIT III FORCE, MAGNETIC AND HEADING SENSORS (9 Hrs)

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

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS (9 Hrs)

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

UNITV APPLICATIONS OF SENSORS (9 Hrs)

Applications of Sensors for Industry Automation - Design of smart Industry using Temperature, Humidity and Pressure sensors - Applications of Flow sensors in Industries-Applications of Gyro sensor. Applications of Position sensors.

Text Books

1. Patranabis D.,” Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd., second edition 2005(revised).
2. Renganathan S.,” Transducer Engineering”, Allied Publishers (P) Ltd., 2005(revised).
3. Ernest O. Doebelin, “Measurement systems Application and Design”, International Student Edition, VI Edition, Tata McGraw-Hill Book Company, 2012.

Reference Books

1. Kr.Iniewski, “Smart Sensors for Industrial Applications” ,CRC Press ,2017
2. Bolton W, “Mechatronics”, Thomson Press, third edition, 2004.
3. Ian R Sinclair, ―Sensors and Transducers‖, Third Edition, Newnes publishers, 2001.
4. Robert B. Northrop, “Introduction to Instrumentation and Measurement”, 3rd Edition”, CRC – Press, Taylor and Francis Group, 2005
5. Curtis D. Johnson, “Process Control Instrumentation Technology”, Prentice Hall International Edition, 2015.

Web Resources

1. https://www.first-sensor.com/en/applications/industrial/
2. https://www.finoit.com/blog/top-15-sensor-types-used-iot/
3. https://www.iaasiaonline.com/smart-sensors-for-industrial-applications-2/
4. https://www.plantautomation-technology.com/articles/types-of-sensors-used-in-industrial-automation
5. https://www.thomasnet.com/articles/instruments-controls/sensors/

COs /POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	-	1	-	-	-	-	1	1	1	2
2	3	1	3	-	-	-	1	-	-	-	-	1	1	1	1
3	2	2	3	-	-	-	1	-	-	-	-	1	1	2	-
4	2	2	3	-	-	-	1	-	-	-	-	1	1	2	-
5	2	2	3	-	-	-	1	-	-	-	-	1	1	2	-

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CSO706	CLOUD TECHNOLOGY AND ITS APPLICATIONS	L	T	P	C	Hrs
	(Common to EEE, ICE, MECH, CIVIL, BME, CCE, Mechatronics)	3	0	0	3	45

Course Objectives

- To define the fundamental ideas behind Cloud Computing.
- To classify the basic ideas and principles in cloud information system.
- To relate cloud storage technologies and relevant distributed file systems.
- To explain the Cloud Applications.
- To define the Future of Cloud.

Course Outcomes

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

CO1 - Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing. **(K1)**

CO2 - Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacentres to build and deploy cloud applications that are resilient, elastic and cost-efficient. **(K3)**

CO3 - Illustrate the fundamental concepts of Cloud Applications. **(K4)**

CO4 - Explain the Applications of cloud. **(K3)**

CO5 - Advancing towards a Cloud. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-a-Service – Platform-as-a-Service – Software-as-a-Service – Building Cloud Network.

UNIT II CLOUD INFORMATION SYSTEMS (9 Hrs)

Federation in the Cloud - Presence in the Cloud - Privacy and its Relation to Cloud-Based Information Systems – Security in the Cloud - Common Standards in the Cloud – End-User Access to the Cloud Computing.

UNIT III CLOUD INFRASTRUCTURE (9 Hrs)

Introduction– Evolving IT infrastructure – Evolving Software Applications –Service Oriented Architecture – Interoperability Standards for Data Center Management - Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment.

UNIT IV CLOUD APPLICATIONS (9 Hrs)

Software Utility Application Architecture - Characteristics of a SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework - Common Enablers – Conceptual view to Reality – Business Profits - Implementing Database Systems for Multitenant Architecture - Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

UNIT V FUTURE OF CLOUD (9 Hrs)

Other Design Considerations - Design of a Web Services Metering Interface - Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service -

Application Transformation Program - Business Model Scenarios - Virtual Services for Organizations - The Future.

Text Books

1. Sandeep Bhowmik,"Cloud Computing",Cambridge University Press; First editiouun,2017.
2. Erl ,'Cloud Computing: Concepts, Technology & Architecture', Pearson Education India, 1st edition, 1 January 2014.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

Reference Books

1. Sanjiva Shankar Dubey ,' Cloud Computing and Beyond', Dreamtech Press 2edition,2019.
2. John W. Rittinghouse and james F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press, Taylor & Francis Group, Boca Raton London New York, 2010.
3. George Reese, "Cloud Application Architectures", O'reilly Publications, 2009.
4. Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC, 2007.
5. Bunker and Darren Thomson, "Delivering Utility Computing", John Wiley & Sons Ltd.2006.

Web Resources

1. www.coltdatacentres.net/Cloud Technology.
2. www.zdnet.com.
3. https://www.cloudbakers.com/blog/what-is-a-cloud-application
4. https://www.cloudbakers.com/blog/what-is-a-cloud-application
5. https://blog.servermania.com/what-is-a-cloud-application/

COs/POs/PSOs Mapping

CO'S	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	1	-	2	1	3	1	2	3	2
2	1	1	2	1	1	3	1	-	2	1	3	1	3	3	2
3	2	2	1	1	-	3	1	1	2	1	3	1	3	3	3
4	1	1	1	1	2	2	1	-	2	1	3	1	2	2	2
5	2	1	1	1	1	3	1	-	2	1	3	1	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ITO705	AUTOMATION TECHNIQUES & TOOLS - DEVOPS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- The Background and mindset of Devops
- To enable students appreciate the agile led development environment.
- To give the students a perspective to grasp the need for Minimum viable product led development using Sprints.
- To enable students acquire fundamental knowledge of CI/CD and CAMS.
- To enable learners realize various aspects of DevOps Ecosystem.

Course Outcomes

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

CO1 - Explain traditional software development methodologies like waterfall. **(K2)**
CO2 - Apply the Agile Methodology and comparing various other software development models with agile. **(K3)**
CO3 - Explain implementing Continuous Integration and Continuous Delivery. **(K2)**
CO4 - Explain CAMS for DevOps (Culture, Automation, Measurement and Sharing). **(K2)**
CO5 - Create quick MVP prototypes for modules and functionalities. **(K3)**

UNIT I TRADITIONAL SOFTWARE DEVELOPMENT (9 Hrs)

The Advent of Software Engineering - Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation - Developers vs IT Operations conflict.

UNIT II RISE OF AGILE METHODOLOGIES (9 Hrs)

Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

UNIT III INTRODUCTION DEVOPS (9 Hrs)

Introduction to DevOps - Version control - Automated testing - Continuous integration - Continuous delivery - Deployment pipeline - Infrastructure management – Databases

UNIT IV PURPOSE OF DEVOPS (9 Hrs)

Minimum Viable Product- Application Deployment- Continuous Integration- Continuous Delivery

UNIT V CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) (9 Hrs)

CAMS – Culture, CAMS – Automation, CAMS – Measurement, CAMS – Sharing, Test-Driven Development, Configuration Management-Infrastructure Automation- Root Cause Analysis- Blamelessness- Organizational Learning

Text Books

1. Dev Ops – Volume 1 , Pearson and Xebia Press
2. Grig Gheorghiu, Alfredo Deza, Kennedy Behrman, Noah Gift, Python for DevOps,2019

Reference Books

1. The DevOps Handbook - Book by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis
2. What is DevOps? - by Mike Loukides
3. Joakim Verona, Practical DevOps ,2016.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
2	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ICO705 **INDUSTRIAL AUTOMATION**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To know about the design of a system using PLC.
- To study about PLC Programming
- To study knowledge on application of PLC
- To have an exposure SCADA architecture
- To know about the fundamentals of DCS.

Course Outcomes

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

CO1- Know the fundamentals of data networks and Understand working of PLC,I/O modules of PLC, automation and applications in industry. (K1)
CO2- Know about the design of systems using PLC and PLC programming. (K1, K2, K3)
CO3- Acquire knowledge on application of PLC (K1, K3)
CO4- Know about the SCADA architecture, communication in SCADA, develop any application based on SCADA along with GUI using SCADA software. (K1, K2, K3)
CO5- Know the fundamentals of DCS. (K1)

UNIT I PLC ARCHITECTURE (9 Hrs)

Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

UNIT II PLC PROGRAMMING (9 Hrs)

Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

UNIT III APPLICATION OF PLC (9 Hrs)

Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

UNIT IV INTRODUCTION OF SCADA (9 Hrs)

Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements.

UNIT V DISTRIBUTED CONTROL SYSTEM (9 Hrs)

Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Field bus and PROFIBUS – Application and case studies of large scale process control using DCS.

Text Books

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, Prentice Hall Inc., New Jersey, 5th Edition, 2002.
2. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.
3. Frank D. Petruzella, Programmable Logic Controllers, McGraw Hill, New York, 4th Edition, 2010.

Reference Books

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi, 8th Edition, 2005.
3. Krishna Kant, Computer-based Industrial Control, Prentice Hall, New Delhi, 2 nd Edition, 2011.

Web Resources

1. https://nptel.ac.in/courses/108105063/
2. https://www.google.com/amp/s/controlstation.com/what-is-a-distributed-control-system/amp/
3. https://nptel.ac.in/courses/108/105/108105088/
4. https://onlinecourses.nptel.ac.in/noc20_me39/preview
5. https://nptel.ac.in/content/syllabus_pdf/108105088.pdf.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	-	-	1	-	-	-	1	1	2	1	3	2
2	3	3	1	-	-	1	-	-	-	1	1	2	1	3	2
3	3	2	1	-	-	1	-	-	-	1	1	2	1	3	2
4	2	3	1	-	-	1	-	-	-	1	1	2	1	3	2
5	3	2	1	-	-	1	-	-	-	1	1	3	1	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ICO706	ULTRASONIC INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know about the ultrasonic waves characteristics
- To study about ultrasonic wave generation
- To study knowledge on ultrasonic test methods
- To have an exposure on ultrasonic measurements
- To explore the ultrasonic applications

Course Outcomes

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

CO1- Know the fundamentals of ultrasonic characteristics (K1).
CO2- Know about the generation of ultrasonic generation (K1).
CO3- Acquire knowledge on ultrasonic test methods (K1, K2)
CO4- Know about the ultrasonic density (K1)
CO5- Explore knowledge on ultrasonic applications (K1,K3)

UNIT I ULTRASONIC WAVES CHARACTERISTICS (9 Hrs)

Ultrasonic waves: principle and propagation of various waves, characterization of ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sounds beam .power level, medium parameters.

UNIT II ULTRASONIC WAVE GENERATION (9 Hrs)

Generation of ultrasonic waves: magnetostrictive and piezoelectric effects, search unit types, construction and characteristics

UNIT III ULTRASONIC TEST METHODS (9 Hrs)

Ultrasonic test methods: pulse echo, transit time, resonance, direct contact and immersion type and ultrasonic methods of flaw detection.

UNIT IV ULTRASONIC MEASUREMENTS (9 Hrs)

Ultrasonic measurements: ultrasonic methods of measuring thickness, depth and flow, variables affecting ultrasonic testing in various applications.

UNIT V ULTRASONIC APPLICATIONS (9 Hrs)

Ultrasonic applications: ultrasonic applications in medical diagnosis and therapy, acoustical holography.

Text Books

1. J.David N. Cheeke, Fundamentals And Applications of Ultrasonic Waves, CRC Press 2002.
2. Dale Ensminger, Ultrasonic: Fundamentals, Technology, Applications, CRC press, 1988, Second Edition.

Reference Book

1. Baldev Raj, Palanichamy P., Rajendran. V, Science And Technology Of Ultrasonic, Alpha Science, 2004
2. Emmanuel P. Papadakis, Ultrasonic Instruments and Devices, ASA, 1998

Web Resources

1. https://www.intechopen.com/chapters/47872
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://www.ti.com/lit/an/slaa907c/slaa907c.pdf?ts=1630072911996&ref_url=https%253A%252F%252Fwww.google.com%252F
4. https://pocketdentistry.com/6-ultrasonic-instrumentation-technique/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	1	1	-	-	-	-	1	-	2	2	1	1
2	3	1	-	1	1	-	-	-	-	1	-	2	2	1	1
3	3	1	-	1	1	-	-	-	-	1	-	2	2	1	1
4	2	1	-	1	1	-	-	-	-	1	-	2	2	1	1
5	3	1	-	2	1	-	2	-	-	1	-	3	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20MEO707	SUPPLY CHAIN MANAGEMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes

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

CO1 - Examine the process and strategy of supply chain management **(K2)**
CO2 - Enumerate the inventory in supply chain management **(K2)**
CO3 - Identify the importance of logistics and information technology in supply chain management **(K3)**
CO4 - Discuss the importance of integrated systems in supply chain management **(K2)**
CO5 - Demonstrate how agile and lean method will help to optimise resources in supply chain management **(K2)**

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT (9 Hrs)

Generic Types of supply chain, Various Definitions and Implications, Major Drivers of Supply chain. Strategic Decisions- in Supply Chain Management-Introduction, Business Strategy, Core Competencies in Supply Chain, Strategic SC Decisions

UNIT II SOURCE OF MANAGEMENT AND INVENTORY IN SUPPLY CHAIN MANAGEMENT (9 Hrs)

Elements of Strategic Sourcing, - Collaborative Perspective, Development of Partnership, Types of Inventory, Supply/ Demand Uncertainties, Inventory costs, Selective Inventory Control, Vendor Manage Inventory system, Inventory Performance Measure

UNIT III LOGISTICS AND INFORMATION TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT (9 Hrs)

Strategy, Transportation Selection, Trade-off, Third Party Logistics,, Overview of Indian Infrastructure for Transportation- Types of IT Solutions like Electronic Data Interchange (EDI), Data Mining/ Data Warehousing, E-Commerce, E- Procurement, Bar Coding Technology- Computer Based Information Systems- ERP, ERP & SCM.

UNIT IV REVERSE AND COLLABORATIVE SUPPLY CHAIN MANAGEMENT (9 Hrs)

Reverse Supply Chain v/s Forward Supply Chain, Types and, Issues, Reverse Supply Chain for Food items, Reverse Logistic and Environment Impact. Evolution of collaborative SCM, Efficient Customer response, Collaboration at various levels, Imperatives for Successful Integrative Supply Chains.

UNIT V AGILE AND LEAN SUPPLY CHAIN MANAGEMENT (9 Hrs)

Source of Variability, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain. Lean supply chain management-Concept and Application, Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food.

Text books

1. Chopra, Sunil, Peter Meindl, and Dharam Vir Kalra. Supply chain management: strategy, planning, and operation. 6/e Edition, MA: Pearson, 2016.

2. Martin Christopher, Logistics and Supply Chain Management, 5th Edition, FT Publishing International, 2016.
3. D K AGRAWAL ,A text book of Logistics and supply chain management, MACMILAN, 2015
4. Badenhorst Weiss H Supply Chain Management: A Logistic Approach, Oxford E-Books,2018
5. Sunil Chopra, Supply Chain Management: Strategy, Planning, and Operation, Pearson, 2017

Reference books

1. Michael H. Hugos, Essentials of Supply Chain Management, 3rd edition, John Wiley & Sons, 2018.
2. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Operations & Supply Chain Management, 15 edition Mc Graw Hill India, 2018.
3. William C Copacino, Supply chain Management, Basics and Beyond, , CRC press,2010.
4. William C Copacino, Retail supply chain Management, James B. Ayers, Mary Ann Odegaard, CRC press, 2018.
5. James R Good, The essentials of Supply Chain Management, ,.Bowling Green state University, 2019

Web Resources

1. https://www.edx.org/learn/supply-chain-management
2. http://library.jgu.edu.in/content/logistics-and-supply-chain-management
3. https://onlinelibrary.wiley.com/ Journal of Supply Chain Management
4. https://www.emerald.com/insight/ An International Journal of Operations and Logistics Management
5. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mg22/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	2	1	-	-	3	1	3	2	3
2	2	2	-	-	-	-	3	-	-	-	1	-	2	2	2
3	1	2	-	-	-	-	3	-	-	-	2	1	1	2	2
4	2	-	-	-	-	-	2	-	-	-	-	-	2	1	-
5	2	1	-	-	-	-	1	1	-	-	-	1	2	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CCO705	DATA SCIENCE USING PYTHON (Common to EEE, ECE, MECH, CIVIL, IC Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of Real world data science and Python.
- To learn the OOPs concepts with data science.
- To understand the NumPy operations with data science.
- To learn the data manipulation with Pandas.
- To clean, prepare and visualize with real data science.

Course outcomes

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

CO1 – Infer the Real world data science and and solve basic problems using Python. **(K2)**
CO2 – Design an application with user-defined modules and packages using OOP concept **(K2)**
CO3 – Employ efficient storage and data operations using NumPy arrays. **(K2)**
CO4 – Apply powerful data manipulations using Pandas. **(K3)**
CO5 – Do data preprocessing using Pandas. **(K2)**

UNIT I: INTRODUCTION TO DATA SCIENCE AND PYTHON (9Hrs)

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators.
Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

UNIT II FILE, EXCEPTION HANDLING AND OOP (9 Hrs)

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods- Python Exception Handling.
OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

UNITIII INTRODUCTION TO NUMPY (9Hrs)

NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes.
Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting Unique and Other Set Logic.

UNIT IV DATA MANIPULATION WITH PANDAS (9Hrs)

Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking.

UNIT V DATA CLEANING AND PREPARATION (9Hrs)

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String.
Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Text Books

1. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson,2012.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition, 2018.
3. 3.Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.

Reference Books

1. Wesley J. Chun, “Core Python Programming”, Prentice Hall,2006.
2. Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.
3. Steven S. Skiena, “Data Science Design Manual”, Spring International Publication,2017.
4. RajendraAkerkar, PritiSrinivasSajja, “Intelligence Techniques for Data Science”, Spring International Publication,2016.
5. Longbing Cao “Data Science Thinking: The Next Scientific, Technological and Economic Revolution”, Spring International Publication,2018.

Web Resources

1. https://www.programmer-books.com/introducing-data-science-pdf/
2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf
4. https://www.edx.org/course/python-basics-for-data-science
5. https://www.edx.org/course/analyzing-data-with-python

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	1	-	-	-	-	-	-	-	1	-	1
2	2	2	2	2	2	-	-	-	-	-	-	-	1	1	-
3	2	2	2	2	2	-	-	-	-	-	-	-	1	-	1
4	3	3	3	3	3	-	-	-	-	-	-	-	1	-	-
5	3	2	2	2	2	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20CCO706	MOBILE APPLICATIONS DEVELOPMENT USING ANDRIOD	L	T	P	C	Hrs
		3	0	0	3	45

(Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)

Course Objectives

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

Course Outcomes

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

CO1- Describe the requirements for mobile applications (**K2**)
CO2- Explain the challenges in mobile application design and development (**K3**)
CO3- Develop design for mobile applications for specific requirements (**K3**)
CO4- Implement the design using Android SDK. (**K2**)
CO5- Implement the design using Objective C and iOS. (**K2**)

UNIT- I INTRODCTION (9 Hrs)

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

UNIT – II BASIC DESIGN (9 Hrs)

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

UNIT – III ADVANCED DESIGN (9 Hrs)

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

UNIT – IV ANDROID (9Hrs)

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

UNIT V IOS (9 Hrs)

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

Text Books

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd edition 2011.
2. Charlie Collins, Michael D. Galpin, Matthias Käppler, “Android in Practise”, Manning Publications Co., 1st

edition, 2012.
3. Jeff McWherter, Scott Gowell, “Professional Mobile Application Development”, John Wiley & Sons, Inc., 2012.

Reference Books

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012
3. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 2013.
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd.

Web Reference

1. http://developer.android.com/develop/index.html
2. http://developer.android.com/reference/
3. https://www.udacity.com/course/developing-android-appsfundamentals--ud853-nd

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	2	3	-	-	-	3	2	2	2	2	2
2	3	2	3	2	2	3	-	-	-	3	2	2	2	2	2
3	3	2	3	2	2	3	-	-	-	3	2	2	2	2	2
4	3	2	3	2	2	3	-	-	-	3	2	2	2	2	2
5	3	2	3	2	2	3	-	-	-	3	2	2	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj, M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.

U20ADO705	DATA SCIENCE APPLICATION OF NLP (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts and techniques of Natural language Processing(NLP)
- To analyzing words based on Text processing.
- To analyzing words based on Morphology.
- To examine the syntax and language modeling
- To get acquainted with syntax and semantics

Course Outcomes

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

CO1 - Understand the principles and process the Human Languages such as English using computers. **(K2)**

CO2 - Creating CORPUS linguistics based on digestive approach (Text Corpus method). **(K2)**

CO3 - Demonstrate the techniques for text-based Processing of NLP with respect to morphology. **(K4)**

CO4 - Perform POS tagging for a given natural language. **(K3)**

CO5 - Check the syntactic and semantic correctness of sentences using grammars and labelling. **(K3)**

UNIT I INTRODUCTION TO NLP (9 Hrs)

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, and machine translation.

UNIT II TEXT PROCESSING (9 Hrs)

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

UNIT III MORPHOLOGY (9 Hrs)

Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers.

UNIT IV LEXICAL SYNTAX AND LANGUAGE MODELING (9 Hrs)

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions - The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

UNIT V SYNTAX AND SEMANTICS (9 Hrs)

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense. Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Applications of NLP.

Text Books

1. Dan Jurafsky, James H. Martin, “Speech and Language Processing”, Third Edition, Prentice Hall, 2018.
2. Emily Bender, “Linguistics Fundamentals for NLP”, Morgan Claypool Publishers, 2013.
3. Jacob Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.

Reference Books

1. Chris Manning, Hinrich Schuetze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
2. Cole Howard, Hobson Lane, Hannes Hapke, “Natural Language Processing in Action” Manning Publication 2019.

3. Li Deng, Yang Liu “Deep Learning in Natural Language Processing” Springer, 2018.
4. Tom Hoobyar, Tom Dotz, Susan Sanders, “NLP The Essential Guide to Neuro-Linguistic Programming”, William Morrow Paperbacks, 2013.
5. Kate Burton, “Coaching With NLP For Dummies”, Wiley, 2011.

Web Resources

1. https://machinelearningmastery.com/natural-language-processing/
2. https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1
3. https://www.nlp.com/what-is-nlp/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	–	1	-	-	-	-	-	-	-	2	1	-
2	2	2	1	–	–	-	-	-	-	-	-	-	1	1	1
3	2	2	1	2	–	-	-	-	-	-	-	-	-	1	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	-	2
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Dr.G.Balamuruga Mohan Raj,M.Tech.,Ph.D.,
Professor & Head,
Dept. of Mechatronics Engineering
Sri Manakula Vinayagar Engineering College,
Madagadipet, Puducherry-605 107.