SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

INSTRUMENTATION AND CONTROL ENGINEERING

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABUS
VOLUME 5

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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 society.

DEPARTMENT VISION AND MISSION

Vision

To provide quality education, training and research in the area of Instrumentation and Control Engineering to meet the industrial and societal needs with ethical values.

Mission

M1: Quality education: To impart technical knowledge, leadership and managerial skills to meet the current industrial and societal needs.
M2: Research and Innovation: To foster innovation, research and development for the benefit of global community.
M3: Employability and Entrepreneurship: To enhance the employability skills and inculcate entrepreneurial attitude.
M4: Ethical Values: To provide extension services to rural society and instill ethical values among the students.

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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)

PEO 1: Core Competency:

Solve real-life engineering problems, design and development of innovative and cost-effective products exhibiting a solid foundation in Instrumentation and Control Engineering fundamentals to cater needs of society.

PEO 2: State of the art technology:

To impart state of the art technology to the students in the field of Instrumentation and Control Engineering to meet the industrial needs.

PEO 3: Multi-disciplinary skills:

To develop Multi-disciplinary skills and acquire leadership qualities along with professional and ethical values.

PEO 4: Innovation and entrepreneurship:

To promote innovation and entrepreneurship in designing and developing instrumentation systems to address social and technical challenges.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Basic Knowledge in ICE:

Apply the knowledge of Instrumentation and Control Engineering to relate the fundamental concepts of Instrumentation (measurement, control, operation, monitoring and maintenance) to varied measurement systems and models.

PSO2: Advanced Tools for industrial automation:

Apply the knowledge of hardware and software tools for industrial automation systems

PSO3: Design and development of Instrumentation systems:

Ability to design and develop instrumentation systems to solve real time applications.

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)	28
4	Professional Core (PC)	71
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	**07**
2	Basic Sciences(BS)	6	3	3	3	4	-	-	-	**19**
3	Engineering Sciences (ES)	12	4	8	4	-	-	-	-	**28**
4	Professional Core (PC)	-	14	10	8	12	15	9	3	**71**
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	**18**
6	Open Electives (OE)	-	-	-	3	-	3	3	-	**09**
7	Project Work (PW)	-	-	-	-	-	-	2	8	**10**
8	Internship (PW)	-	-	-	-	-	-	2	-	**02**
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**22**	**22**	**22**	**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	U20BST105	Material Science	BS	3	0	0	3	25	75	100
3	U20EST113	Basic Electronics	ES	3	0	0	3	25	75	100
4	U20EST115	Electrical Technology	ES	3	0	0	3	25	75	100
5	U20EST103	Fundamentals of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
Practical										
6	U20ESP114	Basic Electronics Lab	ES	0	0	2	1	50	50	100
7	U20ESP116	Electrical Technology Lab	ES	0	0	2	1	50	50	100
8	U20ESP112	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20ICC1XX	Certification Course - I **	EEC	0	0	4	-	100	-	100
Mandatory Course										
10	U20ICM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	375	525	900

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	U20ICT201	Circuit Theory	PC	2	2	0	3	25	75	100
4	U20ICT202	Electronic Circuits	PC	3	0	0	3	25	75	100
5	U20ICT203	Signals and Systems	PC	2	2	0	3	25	75	100
6	U20ICT204	Transducer Engineering	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP202	Programming in C lab	ES	0	0	2	1	50	50	100
8	U20ICP201	Electronic Circuits Lab	PC	0	0	2	1	50	50	100
9	U20ICP202	Transducer Engineering Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ICC2XX	Certification Course - II **	EEC	0	0	4	-	100	-	100
11	U20ICS201	Skill Development Course 1: Demonstration of Workshop Practices	EEC	0	0	2	-	100	-	100
Mandatory Course										
12	U20ICM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	600	600	1200

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	U20EST361	Solid and Fluid Mechanics	ES	2	2	0	3	25	75	100
4	U20ICT305	Analog Integrated circuits	PC	3	0	0	3	25	75	100
5	U20ICT306	Digital Logic Circuits	PC	2	2	0	3	25	75	100
6	U20ICT307	Electrical and Electronic Measurements	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	U20ESP362	Solid and Fluid Mechanics Lab	ES	0	0	2	1	50	50	100
10	U20ICP303	Analog and Digital Circuits Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ICC3XX	Certification Course - III **	EEC	0	0	4	-	100	-	100
12	U20ICS302	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ICM303	Physical Education	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER – IV										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST430	Probability and Statistics	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in JAVA	ES	3	0	0	3	25	75	100
3	U20ICT408	Linear Control Systems	PC	2	2	0	3	25	75	100
4	U20ICT409	Microcontroller Based System Design	PC	3	0	0	3	25	75	100
5	U20ICE4XX	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	U20ESP468	Programming in JAVA Lab	ES	0	0	2	1	50	50	100
9	U20ICP404	Microcontroller Based System Design lab	PC	0	0	2	1	50	50	100
10	U20ICP405	Simulation Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ICC4XX	Certification Course - IV **	EEC	0	0	4	-	100	-	100
12	U20ICS403	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ICM404	NSS	MC	0	0	2	-	100	-	100
							22	650	650	1300

**** Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV***

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST547	Numerical Methods	BS	2	2	0	3	25	75	100
2	U20ICT510	Analytical Instrumentation	PC	3	0	0	3	25	75	100
3	U20ICT511	Embedded System Design	PC	3	0	0	3	25	75	100
4	U20ICT512	Industrial Instrumentation - I	PC	3	0	0	3	25	75	100
5	U20ICE5XX	Professional Elective - II #	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective - II $	HS	3	0	0	3	25	75	100
Practical										
7	U20BSP549	Numerical Methods Lab	BS	0	0	2	1	50	50	100
8	U20ICP506	Embedded System Design Lab	PC	0	0	2	1	50	50	100
9	U20ICP507	Industrial Instrumentation Lab	PC	0	0	2	1	50	50	100
10	U20ICP508	Instrumentation System Design Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ICC5XX	Certification Course - V **	EEC	0	0	4	-	100	-	100
12	U20ICS504	Skill Development Course 4: Career and Professional Skill Development Program - I	EEC	0	0	2	-	100	-	100
13	U20ICS505	Skill Development Course 5: Presentation Skill using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20ICM505	Indian Constitution	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ICT613	Medical Instrumentation	PC	3	0	0	3	25	75	100
2	U20ICT614	Industrial Instrumentation - II	PC	3	0	0	3	25	75	100
3	U20ECCM04	Internet of Things	PC	3	0	0	3	25	75	100
4	U20ICT616	Process Control	PC	3	0	0	3	25	75	100
5	U20ICE6XX	Professional Elective - III #	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective - III $	OE	3	0	0	3	25	75	100
Practical										
7	U20ICP609	Medical Instrumentation Lab	PC	0	0	2	1	50	50	100
8	U20ICP610	Process Control Lab	PC	0	0	2	1	50	50	100
9	U20ICP611	Virtual Instrumentation Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ICC6XX	Certification Course - VI **	EEC	0	0	4	-	100	-	100
11	U20ICS606	Skill Development Course 6: Career and Professional Skill Development Program - II	EEC	0	0	2	-	100	-	100
12	U20ICS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20ICS608	Skill Development Course 8: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20ICM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

SEMESTER – VII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ICT717	Computer Control of Processes	PC	3	0	0	3	25	75	100
2	U20ICT718	Process Automation	PC	3	0	0	3	25	75	100
3	U20ICE7XX	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	U20ICP712	Computer Control of Processes Lab	PC	0	0	2	1	50	50	100
7	U20ICP713	Process Automation Lab	PC	0	0	2	1	50	50	100
8	U20ICP714	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20ICW701	Project Phase- I	PW	0	0	4	2	50	50	100
10	U20ICW702	Internship / Inplant Training	PW	-	-	-	2	100	-	100
Mandatory Course										
11	U20ICM707	Professional Ethics	MC	2	0	0	-	100	-	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	U20ICT819	Instrumentation in Process Industries	PC	3	0	0	3	25	75	100
2	U20ICE8XX	Professional Elective - V #	PE	3	0	0	3	25	75	100
3	U20ICE8XX	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	U20ICW803	Project Phase - II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20ICS809	Skill Development Course 9: NPTEL / MOOC - II	EEC	0	0	0	-	100	-	100
							18	315	285	600

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

Annexure – I

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20ICE401	Digital Signal Processing
2	U20ICE402	Electric and Hybrid Vehicles
3	U20ICE403	Communication Systems
4	U20ICE404	Electric Drives and Control
5	U20ICE405	Mechatronics and Instrumentation
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20ICE506	Telemetry and Telecontrol
2	U20ICE507	Non-Linear control system
3	U20ICE508	Industrial Electronics
4	U20ICE509	MEMS and NEMS
5	U20ICE510	Industrial Unit Operations
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20BMCM01	Soft Computing
2	U20ICCM02	Virtual Instrumentation
3	U20ECCM02	Robotics and Automation
4	U20EECM01	Renewable Energy Sources
5	U20ICE615	Digital Control System
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ICE716	Power Plant Instrumentation
2	U20ICE717	Automotive Instrumentation System
3	U20ICE718	Industry 4.0
4	U20ICE719	Modern Electronic Instrumentation
5	U20ICE720	Fiber Optics and Laser Instrumentation
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ICE821	Industrial Safety

2	U20ICE822	System Identification and Adaptive Control
3	U20ICE823	Advanced Instrumentation System
4	U20ICE824	Industrial Data Networks
5	U20ICE825	Field Instrumentation and Cabling
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ICE826	Design of Process Control System Components
2	U20ICE827	Web Based Instrumentation
3	U20ICE828	Instrumentation for Agricultural and Food Processing Industries
4	U20ICE829	Cyber Security in Industrial Automation
5	U20ICE830	Safety Instrumented System

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 and 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, BME
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
9	U20ICCM01	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	U20ITCM08	Automation Techniques & Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME
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	U20ICCX01	3ds Max
2	U20ICCX02	Advance Structural Analysis of Building using ETABS
3	U20ICCX03	Advanced Java Programming
4	U20ICCX04	Advanced Python Programming
5	U20ICCX05	Analog System Lab Kit
6	U20ICCX06	Android Medical App Development
7	U20ICCX07	Android Programming
8	U20ICCX08	ANSYS -Multiphysics
9	U20ICCX09	Artificial Intelligence
10	U20ICCX10	Artificial Intelligence and Edge Computing
11	U20ICCX11	Artificial Intelligence in Medicines
12	U20ICCX12	AutoCAD for Architecture
13	U20ICCX13	AutoCAD for Civil
14	U20ICCX14	AutoCAD for Electrical
15	U20ICCX15	AutoCAD for Mechanical
16	U20ICCX16	Azure DevOps
17	U20ICCX17	Basic Course on ePLAN
18	U20ICCX18	Basic Electro Pneumatics
19	U20ICCX19	Basic Hydraulics
20	U20ICCX20	Bio Signal and Image Processing Development System
21	U20ICCX21	Blockchain
22	U20ICCX22	Bridge Analysis
23	U20ICCX23	Building Analysis and Construction Management
24	U20ICCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20ICCX25	CATIA
26	U20ICCX26	CCNA (Routing and Switching)

27	U20ICCX27	CCNA (Wireless)
28	U20ICCX28	Cloud Computing
29	U20ICCX29	Computer Programming for Medical Equipments
30	U20ICCX30	Corel Draw
31	U20ICCX31	Creo (Modeling and Simulation)
32	U20ICCX32	Cyber Security
33	U20ICCX33	Data Science and Data Analytics
34	U20ICCX34	Data Science using Python
35	U20ICCX35	Data Science using R
36	U20ICCX36	Deep Learning
37	U20ICCX37	Design and Documentation using ePLAN Electric P8
38	U20ICCX38	Design of Biomedical Devices and Systems
39	U20ICCX39	Digital Marketing
40	U20ICCX40	Digital Signal Processing Development System
41	U20ICCX41	DigSILENT Power Factory
42	U20ICCX42	Electro Hydraulic Automation with PLC
43	U20ICCX43	Embedded System using Arduino
44	U20ICCX44	Embedded System using C
45	U20ICCX45	Embedded System with IoT
46	U20ICCX46	ePLAN Data Portal
47	U20ICCX47	ePLAN Electric P8
48	U20ICCX48	ePLAN Fluid
49	U20ICCX49	ePLAN PPE
50	U20ICCX50	Fusion 360
51	U20ICCX51	Fuzzy Logic and Neural Networks
52	U20ICCX52	Google Analytics
53	U20ICCX53	Hydraulic Automation
54	U20ICCX54	Industrial Automation
55	U20ICCX55	Industry 4.0
56	U20ICCX56	Internet of Things
57	U20ICCX57	Introduction to C Programming
58	U20ICCX58	Introduction to C++ Programming
59	U20ICCX59	IoT using Python
60	U20ICCX60	Java Programming
61	U20ICCX61	Machine Learning
62	U20ICCX62	Machine Learning and Deep Learning
63	U20ICCX63	Machine Learning for Medical Diagnosis
64	U20ICCX64	Mechatronics

65	U20ICCX65	Medical Robotics
66	U20ICCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20ICCX67	Mobile Edge Computing
68	U20ICCX68	Modeling and Visualization using Micro station
69	U20ICCX69	MX Road
70	U20ICCX70	Photoshop
71	U20ICCX71	PLC
72	U20ICCX72	Pneumatics Automation
73	U20ICCX73	Project Management
74	U20ICCX74	Python Programming
75	U20ICCX75	Revit Architecture
76	U20ICCX76	Revit Inventor
77	U20ICCX77	Revit MEP
78	U20ICCX78	Robotics
79	U20ICCX79	Search Engine Optimization
80	U20ICCX80	Software Testing
81	U20ICCX81	Solar and Smart Energy System with IoT
82	U20ICCX82	Solid Works
83	U20ICCX83	Solid Works with Electrical Schematics
84	U20ICCX84	Speech Processing
85	U20ICCX85	STAAD PRO V8i
86	U20ICCX86	Structural Design and Analysis using Bentley
87	U20ICCX87	Total Station
88	U20ICCX88	Video and Image Processing Development System
89	U20ICCX89	VLSI Design
90	U20ICCX90	Web Programming - I
91	U20ICCX91	Web Programming - II

Annexure – IV

EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U20ICS201	Skill Development Course 1 : Demonstration of Workshop Practices
2	U20ICS302	Skill Development Course 2 *
		1) Troubleshooting of Electronic Equipments
		2) Office Automation
		3) Mobile Phone Servicing
3	U20ICS403	Skill Development Course 3 *
		1) Calibration of Measuring Instruments
		2) Introduction to Robotics
		3) Labview Implementation
4	U20ICS504	Skill Development Course 4 : Career and Professional Skill Development Program - I
5	U20ICS505	Skill Development Course 5 : Presentation Skills using ICT
6	U20ICS606	Skill Development Course 6 : Career and Professional Skill Development Program - II
7	U20ICS607	Skill Development Course 7 : Technical Seminar
8	U20ICS608	Skill Development Course 8 : NPTEL / MOOC - I
9	U20ICS809	Skill Development Course 9 : NPTEL / MOOC-II

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

U20BST101	ENGINEERING MATHEMATICS I (Calculus and Linear Algebra) (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

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

CO1 - Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K3)**
CO2 - Solve differential equations. **(K3)**
CO3 - Solve higher order differential equations. **(K3)**
CO4 - Solve different types of partial differential equation. **(K3)**
CO5 - Understand the use of vector calculus. **(K2)**

UNIT I MATRICES (12 Hrs)

Rank of a Matrix, Consistency of system of equations. Eigenvalues and Eigenvectors of a real matrix- Characteristic equation - Properties of Eigenvalues 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, equation 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 parameters method.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Maxima and Minima of two variable, 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 Stokes Theorem.

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", Wiley, 10th edition, 2019
2. B.V.Ramana," Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi,6th2018
3. N.P. Bali and Manish Goyal,"A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9thEdition, 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 References

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linear algebra –slides-systems of Equation-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	2	1	-	-	-	1	1	-	-	-	-	1	-	-	1
2	3	2	1	1	-	1	1	-	-	-	-	1	-	-	1
3	3	2	1	1	-	1	1	-	-	-	-	1	-	-	1
4	3	2	1	1	-	1	1	-	-	-	-	1	-	-	1
5	2	1	-	-	-	-	1	-	-	-	-	1	-	-	1

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

U20BST105	MATERIAL SCIENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize the concept of Dielectric Materials.
- To introduce about the various magnetic materials and superconductors.
- To understand the concept of Semiconductor materials and its applications.
- To learn about the nuclear reactors and materials.
- To introduce the concepts of smart materials and nano materials.

Course Outcomes

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

CO1 - To understand the dielectric polarization. **(K1)**
CO2 - Learn the basics of various magnetic materials with its properties for various applications. **(K1)**
CO3 - Learn the basic principles of semiconductors. **(K3)**
CO4 - Understand the nuclear reactors and its materials. **(K3)**
CO5 - Exploring the concept of smart materials and nanomaterials. **(K3)**

UNIT I DIELECTRIC MATERIALS (9 Hrs)

Dielectric Polarization and its Mechanisms – Calculation of Polarizabilities (for electronic and ionic polarizations only) - Temperature dependence of polarization-Internal Field in solids - Clausius- Mossotti relation.– Elementary ideas of Piezo- Pyro- and Ferro-electric materials and Applications. NLO materials and piezoelectric actuators (introductory concepts).

UNIT II MAGNETIC MATERIALS AND SUPERCONDUCTORS (9 Hrs)

Magnetic Materials: Origin of atomic magnetic moment – Bohr magneton-classification of magnetic materials (Dia,Para, Ferro, antiferro&Ferri) – Domain Theory of Hysteresis – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic Hard Disk. Ferro-fluids and applications.

Superconductors: Basic concepts – properties of superconductors –Meissner effect – Type I and II superconductors – BCS theory (qualitative) - High Temperature Superconductors– Qualitative ideas of Josephson effect, quantum interference and SQUID – their applications.

UNIT III SEMICONDUCTORS (9 Hrs)

Semiconductors –Concept of Fermi Distribution Function, Fermi Energy Level- Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors -temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors -- Application of Hall Effect. Basic Ideas of Compound Semiconductors (II-VI & III-V).Photovoltaic Effect-Solar photovoltaic cells.

UNIT IV NUCLEAR REACTORS & MATERIALS (9 Hrs)

Mass Defect & Binding Energy of Nucleus - Disintegration in fission –Nuclear Reactors: BWR – FBR. Materials used in Nuclear Reactors; Materials for Moderator, coolant, reactor control elements containment shell. Nuclear Fuel materials and Fuel processing - Fuel enrichment. Nuclear fusion reactions for fusion reactors-D-D and D-T reactions, Basic principles of Nuclear Fusion reactors

UNIT V SMART MATERIALS AND NANOMATERIALS (9 Hrs)

Smart Materials: Introduction –definitions. Shape Memory alloys (SMA): One way and two way Shape memory effect, pseudo elasticity, Properties and applications of SMA- features of Ni-Ti SMA alloy. Liquid Crystals : Types –nematic, cholesteric, smectic- Application to Display Devices

Metallic Glasses: preparation by melt spinning. Properties and applications Nanomaterials : Introduction to Nanomaterials–Methods of synthesis (CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials.C60-Buck Minister Fullerence, carbon nanotubes– synthesis (Plasma arc, Pulsed Laserevaporation methods) Properties and applications.

Text Books

1. Avadhanulu M N, “Engineering Physics”, Vol.-II, S. Chand & Co, 2009.
2. Arthur Beiser, “Concepts of Modern Physics”, 6th Edition, TMH, New Delhi 2008. (For Unit V only)

Reference Books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.
2. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad, 2012.
3. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
4. Pillai S.O, Solid State Physics, 6th Edition – New Age International, 2005.
5. Vijayamohanan K Pillai and Meera Parthasarathy, Functional Materials, Universities Press Hyderabad, 2012.
6. C.M. Srivastava and C. Srinivasan, Science of Engineering Materials, 2nd Edition, New Age Int. (P) Ltd, New Delhi, 1997.

Web References

1. https://nptel.ac.in/courses/122/102/122102008/
2. https://lecturenotes.in/subject/23/material-science-ms
3. http://people.virginia.edu/~lz2n/mse209/
4. https://www.youtube.com/playlist?list=PLE34EAAA410160DD6

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

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

U20EST113	BASIC ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquaint the students with semiconductor diodes.
- To familiarize the students with Bipolar Transistors.
- To acquaint the students with Field effect Transistors
- To impart knowledge on special semiconductor devices.
- To familiarize the student with the design and analysis of Rectifiers and power supplies.

Course Outcomes

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

CO1 - Understand the basic semiconductor diodes and its applications **(K2)**

CO2 - Gain knowledge about the working and characteristics of transistors. **(K2)**

CO3 - Understand the operation of Field Effect Transistor **(K2)**

CO4 - Acquire knowledge on special semiconductor devices **(K4)**

CO5 - Analyze the rectifiers and power supplies **(K4)**

UNIT I SEMICONDUCTOR DEVICES (9 Hrs)

Introduction. Intrinsic and Extrinsic semiconductor - charge density, Mobility and conductivity, Drift and diffusion current, Continuity equation, PN junction - Energy band diagram of PN junction, V-I characteristics, Current components in PN junction, Application of diode - Diode switch, Clipper, Clamper, Voltage Multiplier : Voltage doubler.

UNIT II BIPOLAR JUNCTION TRANSISTORS (9 Hrs)

Operation of NPN and PNP transistor - Current components in a transistor, Characteristics of CE, CB, CC configuration - Switching characteristics - Biasing of BJT- Types of Biasing- Analysis and design. Bias stability. Thermal runaway. Temperature compensation. Applications

UNIT III FIELD EFFECT TRANSISTORS (FET) (9 Hrs)

JFET- Construction, Operation and Characteristics, Expression for pinch off voltage and drain current - MOSFET- Enhancement and Depletion mode operation and characteristics- Biasing of FET- Comparison of BJT and FET. Applications

UNIT IV SPECIAL SEMICONDUCTOR DEVICES (9 Hrs)

Zener Diode- V-I characteristics, SCR- UJT- DIAC- TRIAC - Varactor diode - PIN diode - Tunnel diode - Gunn diode - Principle of photo electronic devices - Solar cell, Photo diode - LED, LCD, LASER diode.

UNIT V RECTIFIERS AND POWER SUPPLIES (9 Hrs)

Half Wave Rectifier - Full Wave Rectifier – Bridge Rectifier – Performance of Rectifiers – Filters – Types of Filters – L, C, LC, pi Filters – Regulators – Shunt and Series Voltage Regulator – IC Regulator – SMPS.

Text Books

1. Jacob Millman, Millman's Electronic Devices and Circuits, McGraw Hill Education; 4 edition 2015.
2. G.K. Mithal, “Basic Electronic Devices and circuits”, 2nd Edition, G.K. Publishers Pvt. Ltd., 2004.
3. David Bell, “Fundamentals of Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2012

Reference Books

1. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, Prentice Hall,2013.
2. R.S. Sedha, A Text Book of Applied Electronics S. Chand Publications, 2014.
3. Salivahanan. S, Electronic Devices and Circuits, TMH, 2013.
4. Sedra and Smith," Microelectronic Circuits, Oxford University Press, 5th Edition, 2012.
5. Schultz, Mitchel. Grob's basic electronics.McGraw-Hill, 2019.

Web References

1. https://wiki.analog.com/university/courses/electronics/text/electronics-toc
2. https://www.makerspaces.com/basic-electronics/
3. https://www.electronics-tutorials.ws/
4. 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	2	3	1	2	1	-	3	2	-	2	3	3	2	3
2	3	2	3	1	2	1	-	3	2	-	2	3	3	2	3
3	3	2	3	1	2	1	-	3	2	-	2	3	3	2	3
4	3	2	3	1	2	1	-	3	2	-	2	3	3	2	3
5	3	2	3	1	2	1	-	3	2	-	2	3	3	2	3

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

U20EST115	ELECTRICAL TECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide an introduction about the magnetic circuits.
- To introduce the concepts of transformers.
- To introduce the principles of operations of DC machines.
- To introduce the principles of operations of Induction motors
- To study special machines and give an overview of domestic wiring.

Course Outcomes

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

CO1 - Gain Knowledge about the basic concepts of magnetic circuits. **(K2)**

CO2 - Describe the working of transformer, auto transformer and assess the regulation and efficiency of transformer. **(K2)**

CO3 - Demonstrate the operation of DC machines and their performance characteristics. **(K3)**

CO4 - Explain the working concept of single phase, three phase induction motor and analyse the operating behaviour of induction motor and special machines. **(K3)**

CO5 - Gain knowledge about stepper motor, servo motors and electric traction. **(K2)**

UNIT I MAGNETIC CIRCUITS (9 Hrs)

Definition of MMF, Flux and Reluctance - Leakage Factor - Reluctances in Series and Parallel (Series and Parallel Magnetic Circuits) - Electromagnetic Induction - Fleming's Rule - Lenz's Law - Faraday's laws - statically and dynamically induced EMF - Self and mutual inductance - Analogy of Electric and Magnetic Circuits.

UNIT II TRANSFORMERS (9 Hrs)

Construction and Principle of operation of Single Phase Transformer - EMF Equation - Phasor Diagram on No Load and Loaded Transformer –load test - Open Circuit and Short Circuit Test on Transformer- Equivalent Circuit - Regulation and Efficiency - Introduction to auto transformers- copper savings in auto transformers- 3-phase transformer – Types of connections

UNIT III D.C MACHINES (Qualitative Analysis Only) (9 Hrs)

Construction, Principles of operation of DC Generators - Types –EMF Equation - Performance Characteristics of Series and Shunt Generators - Armature Reaction. DC Motor - Torque Equation- Speed - Torque Characteristics of Series and Shunt Motors –Load Test – No Load Test -Speed Control methods and Applications. Need for starter – types.

UNIT IV INDUCTION MOTORS (Qualitative Treatment Only) (9 Hrs)

Constructional Details of Three Phase Induction Motor - Slip Ring and Squirrel Cage Rotor- Principle of operation- Torque Equation - Torque / Slip Characteristics - Starters - Applications Introduction to Single Phase Induction Motors - Capacitor Start Capacitor Run Motor -Shaded Pole Motor.

UNIT V SYNCHRONOUS MACHINES AND SPECIAL MACHINES (9 Hrs)
(Qualitative Treatment Only)

Principles of Alternator - Construction Details - Types Special Machines: Stepper motor- AC and DC Servomotor -Universal Motor - Hysteresis Motor -Permanent Magnet Synchronous Motor - Switched Reluctance Motor - Brushless D.C Motor - Construction, Working And Applications. **Utilization:** Domestic wiring – principle of electrical heating –laws of illumination – Electric lamps – Photometers – Electroplating – Electric Traction – Air conditioning – Earthing.

Text Books

1. J.B. Gupta, “Theory and Performance of Electrical Machines”, S.K. Kataria & Sons, 4th Edition, 2013.
2. B.L.Theraja and A.K.Theraja, “A Text Book of Electrical Technology, Vol.II”, S. Chand & Company Ltd., 2009.
3. R.K. Rajput, “Electrical Engineering” Lakshmi Publications Pvt Limited, 4th Edition, 2008.

Reference Books

1. S.K. Bhattacharya, “Electrical Machines”, Tata Mc Graw Hill Company Ltd, 4th Edition, 2014.
2. D P Kothari and I.J Nagarath, “Electrical Machines”, McGraw Hill Education(India) Private Limited, Fifth edition, 2017.
3. Edward Hughes “Electrical and Electronic Technology”, Pearson Education, 10thEdition,2011.
4. R.K. Rajput, “Utilization of electrical power”, First edition, Lakshmi publications, 2006
5. Venkataratnam K., “Special Electrical Machines”, Universities Press Private Limited, 1stEdition, 2009.

Web References

1. https://www.electricaltechnology.org/
2. https://nptel.ac.in/courses/108105053/
3. https://www.youtube.com/watch?v=FAjM4C7dssM

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

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

U20EST103	FUNDAMENTALS OF CIVIL AND MECHANICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

(Common to ECE, ICE, BME)

Course Objectives

- To be able to differentiate the type of buildings and construction materials.
- To understand about various building components and its function
- To understand the various infrastructure facilities and their importance
- To familiarize the working principles of IC engines and automobile systems
- To understand about the power generation systems and its components.
- To acquire knowledge about the various machining process such as lathe, drilling and boring machines.

Course Outcomes

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

CO1 -Gain knowledge on types of buildings and about various construction materials. **(K2)**

CO2 - To study about the components of buildings **(K2)**

CO3 -To identify the various infrastructure facilities **(K2)**

CO4 - Summarize the working principle of IC engines and energy systems. **(K2)**

CO5 - Explain the basic concepts and fundamentals of power generation, Refrigeration and Air Conditioning Systems **(K1)**

CO6 -To study the various machining process with tool materials. **(K2)**

Part A - CIVIL ENGINEERING

UNIT I BUILDINGS, BUILDING MATERIALS (8 Hrs)

Buildings – Definition –Classification According to NBC-plinth area, Floor area, carpet area, floor space index - Green building, Benefits from green building, Green rating system; Development of Smart cities - Construction Materials - stone, brick , cement, cement-mortar, concrete, steel - their properties and uses.

UNIT II BUILDINGS COMPONENTS AND FOUNDATION (8 Hrs)

Various Buildings Components and their functions. Soils and their classification - Foundation: function and types. Masonry: function and types - Floors: definition and types of floors - Roofs: definition and types.

UNIT III BASIC INFRASTRUCTURE (6 Hrs)

Surveying: Classification-Chain Survey-Ranging-Compass Survey-exhibition of different survey equipment-Roads - types: components, types and their advantage and disadvantages – Bridges- components and types of bridges -Sources of Water - Water Supply-Quality of Water-Wastewater Treatment – Sea Water Intrusion – Recharge of Ground Water – Dams- site selection for dam construction, types of dams

Part B - MECHANICAL ENGINEERING

UNIT IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS (8 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 V POWER GENERATION SYSTEMS, REFRIGERATION AND AIR CONDITIONING SYSTEM (8 Hrs)

Power plants: Thermal – Nuclear, Hydraulic, Solar, Wind, Geothermal, Wave, Tidal and Ocean Thermal Energy Conversion systems - Functions, Applications- Schemes and layouts (Description only).

Refrigeration and Air Conditioning System: Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator–Window and Split type room Air conditioner

UNIT VI MACHINING PROCESS (7 Hrs)

Lathe - types, Specifications, Operations of a centre lathe. Casting- Pattern making, Allowances, Green sand and dry sand moulding, casting defects. Welding - Arc and Gas welding process, brazing and soldering (process description only).

Text Books

1. G Shanmugam, MS Palanichamy, Basic Civil and Mechanical Engineering,1st Edition, McGraw Hill Education, 2018.
2. R. Vaishnavi, M. Prabhakaran, V. Vijayan, Basic Civil and Mechanical Engineering, S. Chand Publisher, 2013.
3. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.

Reference Books

1. M.P. Poonia, S.C. Sharma & T.R. Banga, Basic Mechanical Engineering, Khanna Publishing House 2018.
2. V. Rameshbabu, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
3. SeropeKalpakjian, Steven Schmid, Manufacturing Engineering and Technology,7th Edition, Pearson Publication, 2014.
4. S.S.Bhavikatti, Basic Civil engineering, New Age International Ltd. 2018.
5. GopiSatheesh, Basic Civil engineering, Pearson Publications, 3rd Edition, 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/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	3	3	3	-	3	-	2	3	-	-	-
2	3	2	3	2	2	3	3	-	3	-	2	3	-	-	-
3	3	2	3	2	3	3	3	-	3	-	2	3	-	-	-
4	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
5	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
6	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-

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

U20ESP114	BASIC ELECTRONICS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To give a basic introduction to electronic components
- To provide students knowledge about semiconductor diodes.
- To determine the V-I characteristics of transistor configurations.
- To determine the characteristics of thyristor circuits
- To explain the importance of transistors as switch

Course Outcomes

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

CO1 - Understand the basic circuit concepts. **(K2)**
CO2 - Analyze the functioning and characteristics of transistors. **(K3)**
CO3 - Demonstrate the understanding of special semiconductor diodes and its applications. **(K2)**
CO4 - Analyze the V-I characteristics of thyristors. **(K3)**
CO5 - Analyze the Switching characteristics of transistors. **(K3)**

List of Experiments

1. Study of circuit components and equipment (Component identification, Characteristics of Passive Circuit elements, Color coding, checking diode, BJT, FET, study of CRO, Function Generator, Multimeter, LCR meter).
2. Characteristics of Semiconductor diode
3. Characteristics of Zener diode
4. Characteristics of LED/ LDR.
5. Characteristics of CE configuration
6. Characteristics of CB configuration
7. Characteristics of FET
8. Characteristics of SCR.
9. Characteristics of TRIAC.
10. Simulation using PSpice / Multisim.

Reference Books

1. Ravi kumar “Basic Electronics Engineering Handbook”;1st edition, June 27, 2019
2. Paul Scherz, Dr. Simon Monk “Practical Electronics”, McGraw-Hill Education TAB; 4th edition (March24, 2016)
3. Sedra and Smith, “Microelectronic Circuits”, Oxford University Press, 5th Edition, 2012
4. Schultz, Mitchel, “Grob's basic electronics”, McGraw-Hill, 2019.
5. Robert L. Boylestad, “Electronic Devices and Circuit Theory”, 11th Edition, 2015

Web Resources

1. https://www.makerspaces.com/basic-electronics/
2. https://www.electronics-tutorials.ws/
3. www.allaboutcircuits.com
4. www.circuitstoday.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	1	2	3	2	-	1	-	2	1	-	1	3	3	2	**3**
2	2	2	3	1	1	1	-	2	2	-	2	3	3	2	**3**
3	3	2	3	1	1	1	-	2	2	-	2	3	3	2	**3**
4	3	2	3	1	1	1	-	2	2	-	2	3	3	2	**3**
5	3	2	3	1	1	1	-	2	2	-	2	3	3	2	**3**

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

U20ESP116	ELECTRICAL TECHNOLOGY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce practical knowledge on domestic wiring and analysis of electrical circuits.
- To provide the methods to test and evaluate the performance of electrical machines.
- To evaluate the open circuit and short circuit test on single phase transformer.
- To impart knowledge on speed control of DC shunts motor.
- To observe the performance of load test on single phase induction motor, three phase squirrel cage induction motor and single-phase alternator.

Course Outcomes

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

CO1 - Acquire knowledge on wiring electrical circuits such as domestic, Go-Down wiring and Doctor's Wiring. **(K2)**

CO2 - Apply proper measurement techniques for the calculation of power and calibration of meters. **(K2)**

CO3 - Estimate the performance of DC and induction motor by conducting load and no-load tests. **(K3)**

CO4 - Acquire hands on experience of conducting various tests on induction machines and obtaining their performance indices using standard analytical as well as graphical methods. **(K3)**

CO5 - Acquire hands on experience of conducting various tests on alternators. **(K3)**

List of Experiments
(Any 10 Experiments)

1. Wiring circuits for
   - A. Calling bell
   - B. Staircase
   - C. Ceiling fan and fluorescent lamp wiring
2. Load test on single phase transformer
3. Load test on three phase transformer
4. Open circuit and short circuit test on single phase transformer
5. Load characteristics of dc shunt motor
6. Speed control of dc shunt motor.
7. Load characteristics of dc series motor
8. Open circuit characteristics of separately excited dc shunt generator
9. Load test on single phase Induction motor
10. Load test on three phase squirrel cage induction motor
11. Load test on single phase Alternator

Reference Books

1. Umesh Agarwal, "Laboratory Manual Basic Electrical Engineering, 2019",Notion Press, 1st Edition, 2019.
2. P. Tiwari & S. Sairola S.K. Kataria & Sons,"Electrical Engineering Laboratory Practice ",Reprint 2010 Edition 2010.
3. TarnekarS.G. & et Al, "Laboratory Courses in Electrical Engineering", S Chand & Company, Rep. Edition 2006.
4. R.K.Rajput, " Utilization of electrical power", First edition, Lakshmi publications, 2006
5. Venkataratnam K., "Special Electrical Machines", Universities Press Private Limited, 1st Edition, 2009.

Web References

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://nptel.ac.in/courses/108/105/108105017/
3. http://www.cittumkur.org/eee/em.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	3	2	-	1	-	2	1	-	1	3	3	2	3
2	3	2	3	1	1	1	-	2	2	-	2	3	3	2	3
3	3	2	3	1	1	1	-	2	2	-	2	3	3	2	3
4	3	2	3	1	1	1	-	2	2	-	2	3	3	2	3
5	3	2	3	1	1	1	-	2	2	-	2	3	3	2	3

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

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

(Common to ECE, IT, CSE,ICE,Mech, BME,CSBS, CCE, Mechatronics)

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

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

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

CO2 - Perform freehand sketching of basic geometrical constructions and multiple views of objects. **(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 and cone. **(K4)**

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, PearsonEducation 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, Vikas Publishing House Pvt Ltd., 7th Edition, 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 References

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

COs/POs/PSOs Mapping

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

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

U20ICC1XX	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.

U20ICM101 **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, VivekanandKendras, 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.

U20BST215	ENGINEERING MATHEMATICS II MULTIPLE INTEGRALS AND TRANSFORMS	L	T	P	C	Hrs
		2	2	0	3	60

(Common to all branches except CSBS)

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-Find Laplace transform and inverse transform of simple functions. **(K5)**
CO3 - convert a periodic function into series form. **(K3)**
CO4 - Compute Fourier transforms of various functions. **(K3)**
CO5 - To 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)

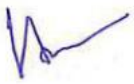
Fourier Integral theorem Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, Convolution and Parseval's identity.

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. Sivaramakrishna Das P. and Vijayakumar C., “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	-	-	1
2	3	2	1	1	-	1	-	-	-	-	-	1	-	-	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

U20EST201	PROGRAMMING IN C	L	T	P	C	Hrs
	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME,Mechatronics, CCE)	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 programs using looping and arrays.
- To understand the concepts ofFunctions 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 ANDARRAYS (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 pre-processor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. Balagurusamy.E, “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. PradipDev, ManasGhoush, “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	2
2	2	1	-	-	3	-	-	-	-	-	-	-	-	2	2
3	3	2	1	1	3	-	-	-	-	-	-	-	-	2	2
4	3	2	1	1	3	-	-	-	-	-	-	-	-	2	2
5	3	2	1	1	3	-	-	-	-	-	-	-	-	2	2

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

U20ICT201	CIRCUIT THEORY	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To impart knowledge on the fundamental principles of Electrical circuits.
- To analyse circuits using various network theorems.
- To acquire knowledge about steady state analysis.
- To introduce the concepts of transient response Analysis.
- To acquaint about the resonance and Coupled Circuits.

Course Outcomes

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

CO1 - Analyse D.C and A.C. Circuits. **(K4)**
CO2 - Apply the Network Theorems. **(K3)**
CO3 - Analyse the steady state analysis of circuits. **(K3)**
CO4 - Analyse the transient Circuits with respect to its Switching Conditions. **(K4)**
CO5 - Analyse the Resonance Conditions and analyse coupled circuits. **(K3)**

UNIT I DC AND AC CIRCUITS (12 Hrs)

Electrical Quantities, Ohm's Law, Resistors -Series and parallel Combinations - voltage and current division, Kirchhoff's Laws. Mesh and node Analysis - A.C. circuits- Average and RMS value - Power, Power Factor and Energy.

UNIT II NETWORK REDUCTION AND THEOREMS (BOTH DCAND AC) (12 Hrs)

Network reduction- source transformation – star delta conversion. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer Theorem, Reciprocity Theorem.

UNIT III STEADY STATE ANALYSIS (12 Hrs)

Sinusoidal Excitation applied to Purely Resistive - Inductive and Capacitive Circuits- RL, RC and RLC Series Circuits.

UNIT IV TRANSIENT RESPONSE ANALYSIS (12 Hrs)

Time Domain Analysis - Transient response of RL, RC & RLC Networks with DC Input - Solution using Laplace transforms.

UNIT V RESONANCE AND COUPLED CIRCUITS (12 Hrs)

Series and Parallel resonance - Quality factor and Bandwidth. Coupled circuits – Faraday's laws of electromagnetic induction - Self and mutual inductance – Dot convention - Coefficient of coupling – Tuned circuits – Single tuned circuits.

Text Books

1. Sudhakar and Shyam Mohan Palli, "Circuits and Networks; Analysis and Synthesis", 3rd Edition, Tata McGraw Hill, 2008
2. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, Seventh Edition, 2019.
3. M.E.Van Valkenburg "Network Analysis", Third Edition, Prentice-Hall, 2019.

Reference Books

1. Joseph Ed minister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Fourth Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.

2. P. Ramesh Babu, “Circuit theory” Second Edition, Scitech Publications Pvt. Ltd, 2014.
3. N.C. Jagan & C.Lakshminarayana, ‘Network Theory’ B.S Publications, 2006.
4. Kuriakose, “Circuit Theory”, PHI Learning, 2005.
5. Allan. H. Robbins, Wilhelm C.Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India,2013.

Web References

1. http://bookboon.com/en/textbooks/electrical-electronics-engineering
2. http://www.freebookcentre.net/electronics-ebooks-download/Circuit-Theory-Lecture-Handouts.html
3. https://nptel.ac.in/courses/108/102/108102042/

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

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

U20ICT202	ELECTRONIC CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the operations of BJT and FET.
- To familiarize the students with the analysis and design of basic transistor Amplifier circuits.
- To acquire the knowledge of feedback amplifiers and Oscillators.
- To understand the frequency response of amplifiers
- To understand the operations of Tuned amplifiers and Blocking oscillators.

Course Outcomes

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

CO1 - Understand the working principles, Frequency response characteristics of BJT and FET. **(K2)**
CO2 - Analyze the classification of amplifiers. **(K4)**
CO3 - Design and analyze the Feedback amplifiers. **(K4)**
CO4 - Analyze the frequency response of Wave shaping circuits and Multivibrators. **(K4)**
CO5 - Analyze the performance of Tuned Amplifiers. **(K4)**

UNIT I SMALL SIGNAL AMPLIFIERS (9 Hrs)

BJT amplifiers: CE, CB and CC amplifiers - multistage amplifiers - differential amplifier - designing BJT amplifier networks(analysis using hybrid -π model) FET amplifiers: CS, CG and CD amplifiers -designing FET amplifier networks Frequency response: low frequency response and high frequency response of BJT and FET amplifiers.

UNIT II LARGE SIGNAL AMPLIFIERS (9 Hrs)

Class A, B, C, AB and D type of operation - efficiency of class A amplifier with resistive and transformer coupled load, efficiency class B, complementary symmetry amplifiers - distortion in power amplifiers - Thermal stability of power amplifier.

UNIT III FEEDBACK AMPLIFIERS AND OSCILLATORS (Qualitative analysis) (9 Hrs)

Feedback Amplifiers: Classification, General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics, feedback topologies.

Oscillators: Barkhausen criteria, RC and LC oscillators using BJT – RC phase shift, Wien bridge oscillators, Hartley and Colpitt's oscillators. Frequency stability of oscillators. Crystal oscillators.

UNIT IV WAVE SHAPING CIRCUITS AND MULTIVIBRATORS (9 Hrs)

High Pass and Low Pass RC Circuits and their Response for Sine, Step, Pulse, Square, Ramp and Exponential Input. Multivibrators – Astable Multivibrators - Emitter and Collector Coupled - Monostable, Bistable Multivibrators, and Schmitt Trigger Circuits.

UNIT V TUNED AMPLIFIERS AND BLOCKING OSCILLATORS (9 Hrs)
(Qualitative analysis)

Single tuned amplifier - Double tuned amplifier.- Bandwidth, Applications of tuned amplifier -Tuned Class C amplifiers - Stagger Tuned Amplifier- Blocking oscillator –Monostable and Astable blocking oscillator.

Text Books

1. J. Millman and C.C. Halkias, Integrated Electronics, McGraw-Hill, 2017.
2. S.Salivahanan, N. Suresh Kumar, A. Vallavaraj, "Electronic Devices and Circuits", TMH, 2nd Edition, 2017.
3. Theodore F. Bogart Jr., J.S. Beasley and G. Rico, Electronic Devices and Circuits, Pearson Edition, 6th Edition, 2004.

Reference Books

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson/ Prentice Hall, 9th Edition, 2013.
2. Microelectronic Circuits – Sedra A.S. and K.C. Smith, Oxford University Press, 5th ed.,2013
3. Kumar and Jain, “Electronic devices and Circuits” PHI learning, 2016.
4. Bakshi, U. A., & Godse, A. P., “Electronic Devices and Circuits”, Technical Publications,2008
5. Boylestad, R. L., & Nashelsky, L., “Electronic devices and circuits”, Prentice-Hall,2013

Web References

1. https://lecturenotes.in/subject/509/electronic-devices-and-circuits-edc
2. https://nptel.ac.in/courses/108108122/
3. https://www.electronics-tutorials.ws/

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

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

U20ICT203	SIGNALS AND SYSTEMS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To study about the basic concepts of signals
- To know about continuous time signals like Laplace transform
- To study about the continuous time laplace transform
- To learn about the discrete time signals
- To Learn about the LTI systems and Z-Transforms

Course Outcomes

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

CO1 -Recall about the basic concepts of signals and systems. **(K1)**
CO2 - Illustrate the different types of relativity of fourier transform. **(K2)**
CO3- Knowing the linear invariant systems. **(K2)**
CO4 - Analyzing the discrete time signals. **(K3)**
CO5 - Knowing the Convolution sum and frequency response. **(K3)**

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS (12 Hrs)

Continuous time signals (CT Signals) and Discrete time signals (DT Signals)- Step, Ramp, Pulse, Impulse, Exponential - Classification of CT and DT signals - Periodic, aperiodic and Random signals - Energy and power signals – Representation of signals Continuous time and discrete time systems: Classification of systems – Properties of systems.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS (12 Hrs)

Definition - Continuous time Fourier transform and Laplace transform analysis with examples - Decaying exponential - Rising exponential - Double exponential - Basic properties - Linearity - Convolution in time and frequency domain - Time shifting & Time reversal - Relation between Fourier transform and Laplace transform

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS (12 Hrs)

CT systems - Linear time invariant systems - Basic properties of continuous time systems - Linearity, Causality, Time invariance, Stability - Frequency response of LTI systems - Analysis and characterization of LTI systems using Laplace transform - computation of impulse response and transfer function using Laplace transform.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS (12 Hrs)

Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT) - Z-Transform definition - Region of convergence - Properties of Z Transform - Inverse Z-Transform using - power series expansion and Partial fraction expansion.

UNIT V LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS (12 Hrs)

LTI-DT systems - Characterization using difference equation - properties of convolution and interconnection of LTI systems - Causality and Stability of LTI Systems - Impulse response, convolution sum and Frequency Response - Computation of Impulse response and Transfer function using Z-Transform.

Text Books

1. Allan V.Oppenheim, Alan.S.Willsky,“Signals and systems”, Prentice Hall of India, 2013.
2. Roger E.Ziemer, “Signals and Systems Continuous and discrete”, McMillan, 2008.
3. Signals and Systems-Anandkumar, Ph Publications,2015

Reference Books

1. P.Ramesh Babu et al, 'Signals and Systems', 4th Edition, Scitech publishers, 2014.
2. Signals and Systems- Narayan Iyer and K Satya Prasad, Cenage Learning, 2011.
3. Signals and systems-Alan V.Oppenheim, AlanS. Willsky, Pearsen 2015
4. Barry Van Veen Simon Haykin, "Signals And Systems" by,2012
5. Dr. J S Chitode, "Signals and Systems", Pearson pubilications,2013

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2. https://lecturenotes.in/subject/36/signals-and-systems-ss
3. http://www.ktunotes.in/ktu-s4-ece-signals-systems-notes/
4. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/
5. https://www.khanacademy.org/science/electrical-engineering/ee-signals

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

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

U20ICT204	TRANSDUCER ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

- Get exposed to basic concepts of measurement.
- To acquire knowledge on different types of resistive transducer and their applications.
- To gain knowledge on capacitive and inductive transducer.
- To get introduced to miscellaneous transducer.
- To acquaint various sensors.

Course Outcomes

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

CO1 - Understand the basic concepts of measurement. **(K2)**
CO2 - Understand the concepts of Resistive transducers. **(K2)**
CO3 - Get familiar with various types of inductive and capacitive transducers. **(K2)**
CO4 - Understand the concept of various types of smart transducers **(K2)**
CO5 - Be familiar with the concept of Smart Sensor **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Generalized scheme of a measurement system – Errors in measurements–types of errors- probability of errors –probable error, limiting errors. Reliability of measurement systems – failure rate–reliability improvement, Availability, redundancy. Difference between Sensors and Transducers, Classification, Active and Passive transducers, Different types of noises in measurements and its Suppression methods.

UNIT II RESISTIVE TRANSDUCERS (9 Hrs)

Resistive transducers: Potentiometers, loading effect – strain gauges – gauge factor – types of strain gauges – rosettes – semiconductor strain gauges, Resistance thermometers, materials, construction, characteristics – Thermistors and photo resistors (LDR) – hot wire anemometer – constant current and constant temperature operation – humidity sensors.

UNIT IIIINDUCTIVE AND CAPACITIVE TRANSDUCERS (9 Hrs)

Self and mutual inductive transducers, eddy current transducers, proximity sensors, tacho-generators and stroboscope. Capacitive transducers – variable area type – variable air gap type – variable permittivity type – signal conditioning circuit– Capacitor microphone – frequency response.

UNIT IV MISCELLANEOUS TRANSDUCERS (9 Hrs)

Piezoelectric transducers, photoelectric transducers, Hall effect transducers, Magnetostrictive transducers. Optical sensors, IC sensor for temperature – signal conditioning circuits, Introduction to Fiber optic sensors – Temperature, pressure, flow and level measurement using fiber optic sensors.

UNIT V SMART SENSORS (9 Hrs)

Introduction to Smart Sensors and Semiconductor sensors, MEMS, MOEMS, Nano-sensors, SQUID Sensors,- Environmental Monitoring sensors (Water Quality & Air Pollution)- Sensor for Motion and Position Measurement, GPS, INS, Doppler, SONAR, Thermal Sensors .

Text Books

1. S.Vijayachitra, Transducers engineering, 2nd edition, Prentice Hall of India, 2016. E.A.
2. D. Patranabis, Instrumentation and control, PHI, 2011
3. Murthy D.V.S., “Transducer and Instrumentation”, PHI, 2nd Edition, 2012.

Reference Books

1. Jacob Fraden "Handbook of modern sensors physics, designs and applications", 5th edition, Springer, 2015.
2. PavelRipka "Modern sensors handbook", ISTE Ltd, 1st edition, 2007.
3. Sensors and transducers by Patranabis, 2nd Edition, 2003.
4. John G.Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition, 2008
5. Renganathan S., “Transducer Engineering” -Allied Publishers Limited, 2003

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1. https://lecturenotes.in/subject/30/sensors-and-transducers-st
2. https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty
3. https://www.electronicshub.org/sensors-and-transducers-introduction/
4. https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty

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

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

U20ESP202	PROGRAMMING IN C LAB (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME, Mechatronics, CCE)	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 - Implement logical formulations to solve simple problems leading to specific applications**(K3)**
CO2 - Execute C programs for simple applications making use of basic constructs, arrays and strings **(K3)**
CO3 - Experiment C programs involving functions, recursion, pointers, and structures **(K3)**
CO4 - Demonstrate applications using sequential and random access file processing. **(K3)**
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.

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.

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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/

COs/POs/PSOs Mapping

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

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

U20ICP201	ELECTRONIC CIRCUITS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To design the rectifier circuits
- To design the voltage regulator circuits.
- To construct the amplifier circuits
- To design the oscillator circuits
- To design the circuits using PSPICE

Course Outcomes

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

CO1 - Design different rectifier circuits. **(K3)**
CO2 - Analyze the voltage regulator circuits. **(K4)**
CO3 - Interpret the amplifier circuits. **(K3)**
CO4 - Design the oscillator circuits. **(K3)**
CO5 - Evaluate the analog circuits using PSPICE. **(K3)**

List of Experiments

Hardware Experiments

1. Half wave Rectifier With and Without Filter.
2. Full Wave Rectifier With and Without Filter
3. Clippers and Clampers
4. Design and Testing of Hartley oscillators
5. Design and Testing Colpitts Oscillators
6. Design and Testing of Power Amplifier
7. Design and Testing of RC coupled amplifiers
8. Design and Testing of FET (common source) amplifiers

Software Experiments (PSPICE SIMULATION)

1. Design and Testing of Multivibrators.
2. Design and testing of Tuned amplifier
3. Design and testing of RC phase shift oscillator
4. Design and Testing of Feedback Amplifier
5. Design and Testing of Power Amplifier

Reference Books

1. J. Millman and C.C. Halkias, Integrated Electronics, McGraw-Hill, 2007.
2. Salivahanan, S. Electronic devices and circuits. Tata McGraw-Hill Education, 2011.
3. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits Theory”, Pearson/ Prentice Hall, 9thEdition, 2013.
4. Sedra and Smith,” Microelectronic Circuits”, Oxford University Press, 5thEdition, 2012.
5. JacobMillman,Chritos C Halkias, “Electronic Devices and Circuits”, 4thedition. McGraw Hill Education India Private Ltd., 2015

Web References

1. https://www.electronics-lab.com/
2. http://vlabs.iitkgp.ernet.in/be/#
3. https://nptel.ac.in/courses/122/106/122106025/

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

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

U20ICP202	TRANSDUCER ENGINEERING LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To experimentally verify the principle and characteristics of various transducers
- Obtain the knowledge about various types of Sensors & Transducers and their working principle
- Understand the various types of transducers like Resistive, Capacitive and Inductive
- Learn some of the miscellaneous transducers
- To select and design suitable instruments to meet the requirements of industrial applications.

Course Outcomes

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

CO1 - Know the standards to measure and to compute the statistical error analysis. **(K4)**

CO2 - An ability to analyze and understand various sensors based on its classification and working principle. **(K4)**

CO3 - Demonstrate the performance characteristics of various transducers. **(K3)**

CO4 - Acquire knowledge of analyzing different stages of signal conditioning units. **(K4)**

CO5 - Design a measurement system for an application. **(K3)**

List of Experiments

1. Characteristics of Strain gauge
2. Characteristics of potentiometer.
3. Measurement of force/load using a load cell.
4. Angular displacement Measurement using capacitive transducers.
5. Speed measurement using photoelectric tachometer.
6. Pressure measurement using piezoelectric transducers.
7. Static and Dynamic Characteristics of Hall Effect Sensor
8. Characteristics of LVDT.
9. Static and Dynamic characteristics of thermocouple, Thermistor and RTD
10. Characteristics of I /P Converters.
12. Characteristics of Optical Transducers.
13. Measurement of position using synchro transmitter and Receiver
14. Characteristics of Filled in system thermometer

Reference Books

1. Handbook of Laboratory Measurements and Instrumentation IFSA Publishing (2011)
2. Sawhney. A.K, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18thEdition, Dhanpat Rai & Company Private Limited, 2017.
3. Renganathan. S, “Transducer Engineering”, 4thedition Allied Publishers, Chennai, 2003.
4. Sensors and transducers by Patranabis, 2nd Edition, 2003.
5. John G. Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2ndEdition, 2008

Web References

1. https://lecturenotes.in/subject/30/sensors-and-transducers-st
2. https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.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	-	1	-	-	2	2	-	2	-	2	1	3	3	3
2	3	-	1	-	-	2	2	-	2	-	2	1	3	3	3
3	3	-	1	-	-	2	2	-	2	-	2	1	3	3	3
4	3	-	1	-	-	2	2	-	2	-	2	1	3	3	3
5	3	-	1	-	-	2	2	-	2	-	2	1	3	3	3

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

U20ICC2XX	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.

U20ICS201	SKILL DEVELOPMENT COURSE 1 DEMONSTRATION OF WORKSHOP PRACTICES	L	T	P	C	Hrs
		0	0	2	0	30

(Common to ECE, CSE, IT, ICE, BME, CCE)

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

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

U20ICM202	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 this 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

U20BST320	COMPLEX ANALYSIS AND APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C	Hrs
		2	2	0	3	60

(Common to EEE, ICE, MECH & Mechatronics)

Course Objectives

- To understand the analytic functions of complex variables.
- To apply the analytic function techniques to transform irregular geometry into regular geometry.
- Expose 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 concept 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, sinz, coshz 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, 4th 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.

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

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

U20EST356	DATA STRUCTURES (Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, 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 - 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 and its operations. Types of Queue: Simple Queue - Circular Queue- Priority Queue- Dequeue.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

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

UNIT IVTREES (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, SartajSahni, “Fundamentals of Data Structures”, Illustrated Edition, Computer Science Press, Second Edition, 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. Balagurusamy, “Data Structures”, Tata McGraw-Hill Education, 2019.
2. D.Samanta, “Classic Data Structures, Prentice-Hall of India, Second Edition, 2012.
3. Robert Kruse, C.L. Tondo and Bruce Leung, “Data Structures and Program Design in c”, Prentice-Hall of India, Second Edition, 2007.
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, Second Edition, 2006.
5. Mark Allen Weiss, “Algorithms, Data Structures and Problem Solving with C++”, Addison-Wesley Publishing Company, Illustrated Edition, 1995.

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

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

U20EST361	SOLID AND FLUID MECHANICS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objective

- To learn fundamental concepts of Stress, Strain and deformation of solids with applications.
- To know the method of finding slope and deflection of beams.
- To understand the effect of torsion on shafts.
- To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyse and appreciate the complexities involved in solving the fluid flow problems.
- To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

Course outcome

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

CO1 - Analyze the state of stress and strain at any point in a member. **(K2)**
CO2 - Identify, formulate, and solve structural engineering problems. **(K2)**
CO3 - Calibrate flow discharge measuring device used in pipes channels and tanks. **(K3)**
CO4 - Apply Hagen Poisueille's equation to solve numerical Problems. **(K3)**
CO5 - Characterize laminar and turbulent flows. **(K3)**

UNIT I DEFORMATION OF SOLIDS AND BENDING OF BEAMS (12 Hrs)

Concept of stress and strain– Normal and shear stresses – Simple and compound Stresses - Elasticity and elastic moduli –Poisson's ratio – Concept of Shear Force and Bending Moment – Bending moment and shear force diagrams for simply supported, cantilever and overhanging beams.

UNIT II SHAFTS AND SPRINGS (12 Hrs)

Torsion – Shear stresses in circular solid and hollow shafts -Torque and power – Helical and leaf springs – Load, deflection, stress and stiffness relationships.

UNIT III FLUID PROPERTY AND FLOW CHARACTERISTICS (12 Hrs)

Fluid Property - Newton's law of Viscosity – Fluid pressure and its measurement – Types of Flow– Reynolds number –Continuity equation - Euler's Equation of Motion.

UNIT IV FLOW DYNAMICS AND PIPE FLOW (12 Hrs)

Bernoulli's Equations –Venturi meter and orifice meter - Pressure losses along the flow –Major and minor losses - Flow through circular pipes –Friction factor – Pipes in series and parallel - Hydraulic gradient.

UNIT V TURBINES AND PUMPS (12 Hrs)

Introduction and Classification of Turbines – Specific Speed –Turbine characteristics, Speed Governance – Classification of Centrifugal Pumps – Pump characteristics – Efficiency – Reciprocating Pumps –Air vessels

Text Books

1. R. K. Rajput, Strength of Materials, S. Chand & Company Ltd., 2018.
2. R.K., Bansal, A text book on Fluid Mechanics & Hydraulic Machinery,- M/s. Lakshmi Publications (P) Ltd, 2018.
3. Junarkar S. B, "Mechanics of Structures", Vol. 2, 24th edition, Charotar Publising House, Anand, India, 2015.

Reference Books

1. WilliamA.Nash, "Theory and problems of strength of materials", Schaum's Outline Series, McGraw-Hill International Editions, Sixth Edition(Paperback), 2013
2. Streeter, V.L., and Wylie, E.B."Fluid Mechanics", McGraw-Hill, Ninth Edition (Paperback), 2017

3. White, F.M.,"Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
4. Som, S.K., and Biswas, G. "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition (Paperback), 2010
5. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi (Reprint edition), 2010.

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2. https://nptel.ac.in/courses/105/103/105103095/
3. https://nptel.ac.in/courses/103/104/103104043/

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

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

U20ICT305	ANALOG INTEGRATED CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the IC fabrication procedure.
- To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.
- To study the applications of Op-amp.
- To study internal functional blocks and the applications of special ICs like Timers, PLL.
- To study the different applications IC's.

Course Outcomes

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

CO1 - To understand the IC fabrication process. **(K2)**
CO2 - Analyse the characteristics of op-amp its significance. **(K4)**
CO3 - Gain knowledge on various applications of op-amp. **(K3)**
CO4 - Design and analyse the 555 timer and its application. **(K3)**
CO5 - Analyse different application IC's. **(K2)**

UNIT I IC FABRICATION (9 Hrs)

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs

UNIT II INTRODUCTION TO OP- AMP (9 Hrs)

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers-V/I & I/V converters, summer, differentiator and integrator

UNIT III APPLICATIONS OF OP-AMP (9 Hrs)

Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using opamps.

UNIT IV SPECIAL ICs (9 Hrs)

Functional block, characteristics and application circuits with 555 Timer IC-566 voltage controlled oscillator IC; 565-phase lock loop IC, Analog multiplier ICs.

UNIT V APPLICATION ICs (9 Hrs)

IC voltage regulators –LM78XX,79XX Fixed voltage regulators - LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier- ICL 8038 function generator IC

Text Books

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D. Roy Choudhary, Sheil B.Jani, 'Linear Integrated Circuits', II edition, New Age, 2012.
3. Ramakant. Gayakwad, "Op-amps and Linear Integrated Circuits", IV Edition, Pearson Education, 2003 PHI. 2015

Reference Books

1. Fiore, "Op-amps & Linear Integrated Circuits Concepts & Applications", Cengage, 2010.
2. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.

3. Sergio Franco, “Design with operational amplifier and analog integrated circuits”, McGraw Hill, 2017
4. Robert F. Coughlin, Fredrick F. Driscoll, ‘Op-amp and Linear ICs’, PHI Learning, 6thedition, 2012
5. William D Stanely, “Operation Amplifier with integrated Circuits”, Pearson Education, 4th edition, 2001.

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2. https://studentsfocus.com/ec6404-lic-notes-linear-integrated-circuits-lecture-notes-ece-4th-sem-anna university/
3. https://lecturenotes.in/subject/668/linear-integrated-circuits-lic

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

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

U20ICT306	DIGITAL LOGIC CIRCUITS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To gain knowledge on number systems, Boolean expressions and simplifications
- To study analyse and design combinational circuits.
- To study, analyse and design synchronous sequential circuits
- To study, analyse and design asynchronous sequential circuits
- To acquire knowledge about memory and programmable logic devices

Course Outcomes

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

CO1 - Attain knowledge on basic binary systems. **(K3)**
CO2 - Analyse the combinational circuits. **(K4)**
CO3 - Analyse the synchronous sequential circuits**(K4)**
CO4 - Analyse the asynchronous sequential circuits. **(K3)**
CO5 - Acquire information about the memory devices and programmable logic devices. **(K2)**

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES (12 Hrs)

Review of number systems – Arithmetic operations in binary number system – Binary codes – Boolean algebra and rules – Boolean functions: Simplifications: standard / canonical form of SOP and POS, Simplification using Karnaugh Map and Tabulation methods – Basic logic gates – Universal gates. Logic Families and their characteristics - DTL,TTL, CMOS, FAN-IN, FAN-OUT.

UNIT II COMBINATIONAL LOGIC (12 Hrs)

Combinational circuits: Analysis and design procedures – Circuits for arithmetic operations: Full adder, Carry look-ahead adder, binary adder, adder-subtractor, comparators – Code conversion – Decoders and Encoders – Multiplexers and De-multiplexers. Realization of combinational logic circuits using decoders and multiplexers.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC (12 Hrs)

Sequential circuits – Flip flops: Triggering, types, conversions, excitation tables – Analysis and design procedures – State reduction and state assignment – Shift registers – Counters: MOD counters, up-down counter, ring counters – Sequence detectors.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC (12 Hrs)

Analysis and design of asynchronous sequential circuits – Reduction of state and flow tables – Race-free state assignment – Arithmetic State Machines: Introduction, components, features, examples.

UNIT V MEMORY AND PROGRAMMABLE LOGIC DEVICES (12 Hrs)

RAM and ROM types – Memory decoding - Error detection and correction - Programmable logic devices: Programmable Array Logic – Programmable Logic Array –CPLD – FPGA.

Text Books

1. M. Morris Mano and Michael D. Cilette, Digital Design‖, Prentice Hall, Fifth Edition, 2011
2. Thomas L Floyd, “Digital Fundamentals", Prentice Hall, 11th Edition, 2014.
3. R.P. Jain, Modern Digital Electronics, 4th Edition TMH, 2010.

Reference Books

1. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 6th Edition, TMH, 2003.
2. Charles H. Roth, Larry L. Kinney, Raghunandan G.H. Fundamentals of Logic Design, Cengage Learning India Pvt. Ltd.; 1st edition, 1 September 2019
3. William H. Gothmann, Digital Electronics Prentice Hall, 2001
4. John M. Yarbrough, Digital logic: Applications and Design Thomas Vikas Publishing House, 2002.
5. Anand Kumar, Fundamentals of Digital Circuits Prentice Hall of India, Pvt Ltd, New Delhi, Second Edition, 2014.

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3. http://nptel.ac.in/courses/117/106/117106086/

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

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

U20ICT307	ELECTRICAL AND ELECTRONIC MEASUREMENTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To give an overview of current, voltage, power and energy measuring instruments
- To give an overview of measurement of power and energy meters
- To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance
- To give an idea about electronic and digital meters
- To study display devices, waveform generators and analysers.

Course Outcomes

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

CO1 - Understand the principle and working of electrical measuring instruments. **(K2)**
CO2 - Develop knowledge to measure parameters like voltage, current, power, energy. **(K3)**
CO3 - To measure the electrical parameters of various circuits. **(K3)**
CO4 - Evaluate the performance of instruments under various operating conditions. **(K3)**
CO5 - Select instruments suitable for specific applications. **(K3)**

UNIT I ELECTRICAL MEASUREMENTS (9 Hrs)

Basics of Measurements, General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron, dynamometer type, rectifier type, thermal instruments. Errors and compensation, Extension of instrument range: shunt and multipliers, calibration of voltmeter and ammeters, CT and PT.

UNIT II MEASUREMENT OF POWER AND ENERGY (9 Hrs)

Electro-dynamic wattmeter, Low Power Factor (LPF) wattmeter, errors, Single and three phase power measurement, Hall Effect wattmeter, thermal type wattmeter. Energy measurement - Single phase and polyphase induction type energy meter - theory and adjustments - Testing of energy meters - Calibration of wattmeter and energy meter.

UNIT III MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE (9 Hrs)

Measurement of Resistance: Wheatstone's bridge, Sensitivity, Limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger.
Measurement of Inductance and Capacitance: Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Schering bridge.

UNIT IV ELECTRONIC AND DIGITAL MEASUREMENTS (9 Hrs)

Introduction essentials of electronic instruments, Advantages of electronic instruments. True RMS reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter (block diagram treatment), Extra features offered by present day meters and their significance in billing.

UNIT V DISPLAY DEVICES, WAVEFORM GENERATORS AND ANALYZERS (9 Hrs)

DSO, DPO, MSO, Analog Recorders – Strip Chart and X-Y recorders, Digital Recorders Function generators, Signal generators, Waveform analyzers, Spectrum analyzers, Distortion analyzers.

Text Books

1. Golding, E.W. and Widdis, F.C., "Electrical Measurements and Measuring Instruments", A.H. Wheeler and Co, 5th Edition, 2011.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 2013.
3. Shawney A K, "A course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons.19th revised edition, 2014.

Reference Books

1. Kalsi.H.S, "Electronic Instrumentation", Tata McGraw Hill Education Private Limited, 3rd Edition, 2012.
2. Patranabis, Principles of Electronic Instrumentation - PHI, 2008
3. Joseph. J. Carr, Elements of Electronic Instrumentation & Measurements, III edition, Pearson Education, 2003.
4. Electronics Instruments and Instrumentation Technology – Anand, PHI
5. Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition

Web References

1. https://lecturenotes.in/subject/265/electrical-measurement-and-instrumentation-emi
2. http://www.brainkart.com/subject/Measurements-and-Instrumentation_204/
3. https://onlinecourses.nptel.ac.in/noc19_ee44/preview
4. https://www.careerride.com/mcq/electrical-and-electronic-measurements-instrumentation-electrical-engineering-mcq-questions-and-answers-272.aspx

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

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

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

Course Objectives

- To enrich strong vocabulary and decoding skills through comprehension analysis
- To advance communication and leadership skills pragmatically
- To pronounce English sounds in isolation and in connected speech
- To expand effective 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 (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

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 References

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

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

U20ESP357	DATA STRUCTURES LAB (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, CCE)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the basic concepts of Data Structures.
- To learn about the concepts of Searching Techniques.
- To explore about the concepts of Sorting Techniques.
- To know about the linear Data Structures.
- To study about non-linear Data Structures.

Course Outcomes

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

CO1 - Analyze the algorithm's / program's efficiency in terms of time and space complexity. **(K3)**
CO2 - Solve the given problem by identifying the appropriate Data Structure. **(K3)**
CO3 - Solve the problems of searching and sorting techniques. **(K3)**
CO4 - Solve problems in linear Data Structures. **(K4)**
CO5 - Solve problems in non-linear Data Structures. **(K4)**

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) Heapsort.
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, 3rdEdition, 2019.
2. Gav. pai, "Data Structures and Algorithms", McGraw-Hill India, 1stEdition, 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, 1stEdition, 2019.

Web References

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

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

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

U20ESP362	SOLID AND FLUID MECHANICS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- Define the nature of a fluid.
- Show where fluid mechanics concepts are common with those of solid mechanics and indicate some fundamental areas of difference.
- Introduce viscosity
- Define the appropriate physical properties and show how these allow differentiation between solids and fluids
- Gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures

Course Outcomes

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

CO1 - Analyse determinate and indeterminate bars, beams, and determinate trusses to determine axial forces, torques, shear forces, and bending moments. **(K2)**

CO2 - Understand the concepts of stress and strain in mechanics of solids and structures and material Properties. **(K2)**

CO3 - Perform experiments to determine the coefficient of discharge of flow measuring devices. **(K3)**

CO4 - Conduct experiments on hydraulic turbines and pumps to draw characteristics. **(K2)**

CO5 - Test basic performance parameters of hydraulic turbines and pumps **(K3)**

List of Experiments

Part – A: Fluid Mechanics Laboratory

1. Determination of Coefficient of discharge of Venturimeter, Orifice meter, Mouthpiece and Orifice.
2. Determination of Losses through pipes and pipe specials.
3. Determination of metacentric height of floating bodies.
4. Determination of force due to impact of jet on Vanes
5. Characteristic study on turbines.
6. Characteristic study on pumps.

Part – B: Strength of Materials Laboratory

1. Tension test and Young's modulus of steel.
2. Hardness test: Rockwell, Brinell and Vicker's.
3. Torsion test: Rods and Flats.
4. Impact test:Charphy and Izod on metals.
5. Ductility test: Sheet metals (Al,GI and MS)

Reference Books

1. R.K., Bansal, Strength of Materials, M/s. Lakshmi Publications (P) Ltd, 2008.
2. R. K. Rajput, Fluid Mechanics and Hydraulic Machineries, S. Chand & Company Ltd.,2008
3. R.S.Khurmi, Strength of Materials, S.Chand& company, 24th Edition, 2006

Web References

1. https://www.iitk.ac.in/me/fluid-mechanics-laboratory
2. https://fm-nitk.vlabs.ac.in/
3. https://rc.library.uta.edu/uta-ir/bitstream/handle/10106/28623/Applied-Fluid-Mechanics-Lab-Manual-1565646222.pdf?sequence=1&isAllowed=y

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

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

U20ICP303	ANALOG AND DIGITAL CIRCUITS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To design and test the basic application of op-amp
- To design an Filter circuit.
- To design an Oscillator circuit
- To design an 555 timer,PLL and VCO
- To design and test the digital circuits

Course Outcomes

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

CO1 - Design various sequential digital circuits like shift registers, counters. **(K3)**
CO2 - Design asynchronous sequential circuits. **(K3)**
CO3 - Design various applications of op-amp. **(K4)**
CO4 - Able to design signal conditioning circuits necessary for instrumentation, PLL, VCO. **(K3)**
CO5 - Evaluate the analog and digital circuits using PSPICE. **(K2)**

LIST OF EXPERIMENTS

PART A

1. Implementation of Boolean Functions, Adder/ Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa Parity generator and parity checking
3. Encoders and Decoders
4. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
5. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
6. Study of multiplexer and demultiplexer

PART B

7. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
8. Timer IC application: Study of NE/SE 555 timer in Astable, Monostable operation.
9. Study of VCO and PLL ICs:
   i. Voltage to frequency characteristics of NE/ SE 566 IC.
   ii. Frequency multiplication using NE/SE 565 PLL IC.
12. First order active filters (LPF, HPF and BPF).

Reference Books

1. M. Morris Mano and Michael D. Cilette, Digital Design‖, Prentice Hall, Fifth Edition,2012
2. Thomas L Floyd, "Digital Fundamentals", Prentice Hall, 11th Edition,2014.
3. R.P.Jain, "Modern Digital Electronics", 4th Edition, TMH, 2010.
4. Anand Kumar, —Fundamentals of Digital Circuits‖, Prentice Hall of India, Pvt Ltd, New Delhi, 4th Edition, 2016.
5. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 8th Edition, TMH,2016.

Web References

1. https://studentsfocus.com/ec8453-lic-notes-linear-integrated-circuits-notes-ece-4th-sem/

2. https://studentsfocus.com/ec6404-lic-notes-linear-integrated-circuits-lecture-notes-ece-4th-sem-anna university/
3. https://lecturenotes.in/subject/668/linear-integrated-circuits-lic

COs/POs/PSOs Mapping

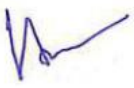
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	-	3	-	-	-	3	1	3
2	3	-	3	-	-	-	-	-	2	-	-	-	3	1	3
3	3	2	3	-	-	-	-	-	2	-	-	-	3	1	3
4	3	-	3	-	-	-	-	-	3	-	-	-	3	1	3
5	3	-	3	-	2	-	-	-	3	-	-	-	3	1	3

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

U20ICC3XX	CERTIFICATION COURSE - III	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.



U20ICS302	SKILL DEVELOPMENT COURSE 2 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. TROUBLESHOOTING OF ELECTRONIC EQUIPMENTS

Course Content:

1. Reliability Aspects of Electronic Equipment.
2. Fundamental Troubleshooting Procedures.
3. Electronic Test Equipment.
4. Tools and Aids for Servicing and Maintenance.
5. PCB Testing and Soldering Techniques.
6. Power Supply and Subsystems Troubleshooting.
7. Mechanical and Electro-mechanical Components.
8. Passive Components and Their Testing.
9. Testing of Semiconductor Devices.
10. Troubleshooting Digital Circuits.
11. Troubleshooting Microprocessor-Based Systems.

(OR)

2. OFFICE AUTOMATION

Course Content:

1. Basics of Computer
2. Operating Systems Ms-Windows & Linux
3. Office Applications –i MsOffice: Ms-Word Open Office: Writer
4. Office Applications - ii MsOffice:Ms-Excel Open Office: Calc& Math
5. Office Applications -iii MsOffice: Ms-Access Open Office: Base
6. Office Applications - iv MsOffice: Ms-Power Point Open Office: Impress
7. Internet & Advanced Communication

(OR)

3. MOBILE PHONE SERVICING

Course Content:

1. How to remove and fix mobile speaker and ringer
2. How to repair and tracing battery connector supply
3. Mobile not charging and charging/discharging problem solution
4. Soldering and disordering of mobile components
5. Mobile phone fingerprint related problem solution
6. Mobile phone assembling & dissembling
7. What is GSM and CDMA generation
8. How to remove and fix headphone jack
9. How to remove damage and fix on/off switch
10. Mobile charging circuit repair
11. Mobile network circuit repair
12. Mobile repair with miracle box
13. Mobile repair with z3x box

U20ICM303	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.

U20BST430	PROBABILITY AND STATISTICS	L	T	P	C	Hrs
		2	2	0	3	60

(Common to EEE & ICE)

Course Objectives

- To acquire skills in handling situation including more than one random variable
- To familiarize the student about the continuous random variables and their Applications.
- To study the basic concepts of Statistics.
- To learn the concept of testing of hypotheses using statistical analysis.
- To learn the concept of Small sampling.

Course Outcomes

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

CO1 - Apply the concept of probability in random variables. **(K3)**
CO2 - Apply the Basic rules of Continuous random variables. **(K3)**
CO3 - Understand the basic concepts of Statistics. **(K2)**
CO4 - Derive the inference for various problems using testing of hypothesis in large samples. **(K3)**
CO5 - Solve the problems related to testing of hypothesis in small samples. **(K3)**

UNIT I DISCRETE RANDOM VARIABLES (12 Hrs)

Random Variables and their event spaces – The probability mass function – Distribution functions – Binomial –Geometric – Negative Binomial and Poisson.

UNIT IICONTINUOUS RANDOM VARIABLES (12 Hrs)

Some important distributions – Exponential distribution –Gamma –Weibull – Gaussian distributions. Application of distribution – Reliability – Failure density and Hazard function.

UNIT III STATISTICS (12 Hrs)

Measures of central tendency – Arithmetic Mean, Median and Mode – Measures of dispersion and Standard deviation –Skewness and Measures of Skewness – Pearson's coefficient of Skewness – Moments – Correlation – Rank correlation and regression.

UNIT IV LARGE SAMPLES (12 Hrs)

Curve fitting by the method of least squares – Fitting of straight lines – Second degree parabolas and more general curves – Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES (12 Hrs)

Test for single mean – Difference of means and correlations of coefficients – Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes.

Text Books

1. B.S.Grewal, "Higher Engineering Mathematics", KHANNA PUBLISHERS - Paperback – 3rd Edition, 2017.
2. Veerarajan. T, "Probability, Statistics and Random Processes", Tata McGraw-Hill Education, 2008.
3. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback – 1 January 2019.

Reference Books

1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", McGraw-Hill, 1stEdition, August 2017.
2. William Mendenhall, Robert J. Beaver, Barbara M. Beaver: "Introduction to Probability & Statistics", Cengage Learning; 15thEdition 2019.

3. Richard .A. Johnson, Irwin Miller and John E. Freund," Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
4. Vijay K. Rohatgi and A.K. Md. EhsanesSaleh, "An Introduction to Probability and Statistics", Wiley 2008.
5. E. Rukmangadachari, "Probability and Statistics",Pearson Education India 2012.

Web References

1. http:// www.stat110.net
2. http://www.nptel.ac.in/courses/111105035 (R.V)
3. http:// www.probabilitycourse.com.
4. www.edx.org/Probability
5. http://www2.aueb.gr/users/demos/pro-stat.pdf

COs/POs/PSOs Mapping

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2	3	2	1	1	-	-	-	-	-	-	-	1	-	-	1
3	2	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

U20EST467	PROGRAMMING IN JAVA (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 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.
- To explore database connectivity

Course Outcomes

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

CO1 - Write a maintainable java Program for a given algorithm and implement the same. **(K2)**

CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**

CO3 - Create java applications using exception handling, thread and generic programming. **(K3)**

CO4 - Build java distributed applications using Collections and IO streams. **(K3)**

CO5 - Exemplify simple graphical user interfaces using GUI components and 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 – SortedSet. 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. Develop real time applications.

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 Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.

Reference Books

1. H.M.Dietel and P.J.Dietel, “Java How to Program”, 11th Edition, Pearson Education/PHI, 2017.
2. Nageshvarrao, “Core Java and Integrated Approach”, 1st Edition, Dreamtech, 2016.
3. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, Prentice Hall,9th Edition, 2013.
4. P.J. Dietel and H.M Dietel, “Java for Programmers”, Pearson Education, 9th Edition, 2011.
5. Cay.S. Horstmann and Gary Cornell, “Core Java 2”, Pearson Education, 8th Edition,2008.

Web References

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
1	2	1	-	-	2	-	-	-	-	-	-	-	-	2	-
2	3	2	1	1	3	-	-	-	-	-	-	-	-	2	-
3	3	2	1	1	3	-	-	-	-	-	-	-	-	2	-
3	3	2	1	1	3	-	-	-	-	-	-	-	-	2	-
3	3	2	1	1	3	-	-	-	-	-	-	-	-	2	-

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

U20ICT408	LINEAR CONTROL SYSTEMS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the methods of representation of systems and their transfer function models.
- To provide adequate knowledge in time response of systems and steady state error analysis.
- To give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To understand the concept of stability of the control system and methods of stability analysis.
- To study the three ways of designing compensators for a control system.

Course Outcomes

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

CO1-Categorize different types of systems and identify a set of algebraic equations to represent and model a complicated system into a more simplified form. **(K2)**

CO2-Analyse the response of any linear time invariant system. **(K4)**

CO3- Perform the analysis of the control system in both time and frequency domains. **(K4)**

CO4-Determine and analyse the stability of the system. **(K2)**

CO5-Design the compensation technique that can be used to stabilize control systems. **(K3)**

UNIT I SYSTEM CONCEPTS (12 Hrs)

Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Electrical Analogy of Mechanical and thermal systems -Transfer function - D.C and A.C Servo Motor - Block Diagram Reduction Techniques - Signal Flow Graphs.

UNIT II TIME RESPONSE ANALYSIS (12 Hrs)

Standard Test Signals -Time Response of First and Second Order System, Time Domain- Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants.

UNIT III FREQUENCY RESPONSE ANALYSIS (12 Hrs)

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin - Bode Plot - Nyquist Plot (Polar Plot).

UNIT IV STABILITY OF CONTROL SYSTEM (12 Hrs)

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion.

UNIT V COMPENSATION NETWORKS. (12 Hrs)

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot - P, PI, PID Controllers design

Text Books

1. Nagrath I J and Gopal M, Control System Engineering, New Age International Pvt Ltd, Sixth Edition, 2017
2. Ogata K, —Modern Control Engineering‖, Prentice-Hall of India Pvt Ltd., New Delhi, Fifth Edition, 2015.
3. Benjamin C Kuo, —Automatic Control Systems ‖, Prentice Hall India Pvt. Ltd, Ninth Edition, 2014.

Reference Books

1. Norman S Nise, Control System Engineering , John Wiley and sons, inc., Seventh Edition, 2015

2. SmarajithGhosh, —Control Systems Theory and Applicationsǁ, Pearson Education, Singapore, Sixth Edition, 2015

3. Richard C. Dorf, Robert H Bishop, —Modern Control Systemsǁ, Pearson Education, Twelfth Edition, 2017.
4. Gopal, M., "Control Systems, Principles and Design", Tata McGraw-Hill Pub. Co.,2nd Edition, New Delhi, 2006.
5. Raymond T. Stefani & Co., 'Design of Feed back Control systems', Oxford University, 2002.

Web References

1. https://lecturenotes.in/notes/6579-note-for-control-system-engineering-cse-by-gyana-ranjan-biswal
2. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs.
3. https://easyengineering.net/control-systems-engineering-by-nagoor-kani/
4. https://civildatas.com/download/control-systems-engineering-by-i-j-nagrath
5. https://www3.nd.edu/~pantsakl/Publications/348A-EEHandbook05.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	1	1
2	3	2	2	-	-	-	-	-	-	-	-	-	3	1	1
3	3	2	2	-	-	-	-	-	-	-	-	-	3	1	1
4	3	-	1	-	-	-	-	-	-	-	-	-	3	1	1
5	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1

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

U20ICT409	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study architecture and programming of 8085 microprocessor
- To study architecture and programming of 8051 microcontroller
- To learn Arduino platform and hardware features
- To study the interfacing of hardware.
- To learn about design of real time microcontroller based systems

Course Outcomes

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

CO1 - Elucidate the architecture and addressing modes of 8-bit microprocessor. **(K2)**
CO2 - Elucidate the architecture and addressing modes of 8051 microcontroller. **(K2)**
CO3 - Gain conceptual understanding of Arduino Platform. **(K3)**
CO4 - Gain knowledge about hardware interfacing. **(K2)**
CO5 - Learn about design of real time microcontroller based systems. **(K4)**

UNIT I 8085 MICROPROCESSOR (9 Hrs)

Evolution of microprocessor, Types of various architectures; Harvard and Von-Neumann, RISC and CISC,8085 microprocessor- Pin Functions, Architecture, Timing Diagrams, Addressing modes, Instruction set Interrupts, Programming Examples, Direct Memory Access, I/O Mapping.

UNIT II 8051 MICROCONTROLLER (9 Hrs)

Architecture – Memory Organization – Structure of Ports – Addressing modes – Instruction set – Timers – Serial Port – Interrupts- Power Saving Modes - Assembly Language Programming.

UNIT III INTRODUCTION TO ARDUINO (9 Hrs)

Introduction to Arduino platform- Hardware features – Types of Arduino boards – Features of Arduino Uno - pin details - Arduino IDE – configuration settings - basic sketch in Arduino – compiling and downloading sketches

UNIT IV HARDWARE INTERFACING (9 Hrs)

I/O Port programming, Bit manipulation, Interfacing to a LED, LCD, Keyboard, ADC, DAC, Stepper Motors, UART, and Sensors (Using 8051).

UNIT V DESIGN OF MICROCONTROLLER BASED SYSTEMS (9 Hrs)

Study of temperature control system – Robotic system using DC motors – Ultrasonic Range system – Security system using sensors – weather monitoring system – Street light control system – GSM based systems – WiFi and Bluetooth based systems – PC based Measurement and Control

Text Books

1. Mohammed Ali Mazidi and Janice Gillispie Mazidi, “The 8051 Microcontroller and Embedded System”, Pearson Education Asia, New Delhi, 2012.
2. Simon Monk, Programming Arduino Next Steps: Going Further with Sketches, McGraw Hill Education-2019.
3. Michael Margolis, Arduino Cook Book, O'reilly-2011.
4. Mark Geddes, Arduino Project Handbook: Volume one: Complete Guide to Creating with the Arduino, Sketch Publishing-2014.

Reference Books

1. N.Senthil Kumar, M.Saravanan and S.Jeevananthan, Microprocessor and Microcontrollers, OXFORD UNIVERSITY PRESS, November, 2010.
2. Jeremy Blum, Exploring Arduino, Wiley-2012.
3. Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, Arduino Programming from Beginning to Advanced, MicroDigital-Ed-2018.
4. David E Simon, "An embedded software primer ", Pearson education Asia, 2001.
5. Raymond J.A. Bhur and Donald L.Bialey, " An Introduction to real time systems: Design to networking with C/C++ "Prentice Hall Inc. New Jersey, 2019

Web References

1. https://www.elprocus.com/8051-microcontroller-architecture-and-applications/
2. https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_architecture.htm
3. https://www.arduino.cc/
4. https://nptel.ac.in/courses/108/105/108105102/

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

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

U20HSP402	GENERAL PROFICIENCY–II (Common to all branches except CSBS)	L	T	P	C	Hrs
		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

- Infer ideas to attend international standardized test by broadening receptive and productive skills **(K2)**
- Interpret the types of writing in different state of affairs **(K2)**
- Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation **(K3)**
- Identify the rules of grammar in academic discourse settings **(K3)**
- 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	-	-	-
4	1	-	-	-	-	-	-	1	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-

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

U20ESP468	PROGRAMMING IN JAVA 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 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.
- To explore database connectivity.

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, multithread. **(K3)**

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 technologies and testing tools.
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.

Reference Books

1. E. Balaguruswamy, “Programming with Java”, TMH Publ, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL & DIETEL.
3. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.
4. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.
5. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018.

Web References

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

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

U20ICP404	MICROCONTROLLER BASED SYSTEM DESIGN LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the students with interfacing of various peripheral devices with 8051 Microcontrollers
- To gain conceptual understanding of using Arduino Uno.
- The students will become knowledgeable about Digital and Analog I/O of Arduino
- The students will gain knowledge about Sensor Interfacing with Arduino.
- The students will learn about design of communication interfaces with Arduino and 8051microntroller.

Course Outcomes

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

CO1 - Gain conceptual understanding of using a8085 microprocessor and 8051 microcontroller. **(K2)**
CO2 - Learn about interfacing of various peripheral devices with 8051 Microcontrollers**. (K3)**
CO3 - Gain conceptual understanding of using Arduino Uno. **(K3)**
CO4 - Gain knowledge about Sensor Interfacing with Arduino. **(K3)**
CO5 - Learn about design of communication interfaces with Arduino and 8051 microcontroller. **(K4)**

List of Experiments

1. Study of 8085 microprocessor Programming
2. Interfacing of switches and display devices using 8051 Microcontrollers
3. Interfacing of interrupt using 8051 Microcontrollers
4. PC interface using 8051 Microcontrollers
5. ADC interface using 8051 Microcontrollers
6. LCD interface using 8051 Microcontrollers
7. UART communication using Arduino PC based control systems
8. Sensor Interfacing with Arduino Design of real world systems.
9. Character and Graphical LCD display interfacing with Arduino.
10. Interfacing DC and Servo motors with Arduino.
11. SPI and I2C communication using Arduino
12. Interfacing GSM and Bluetooth systems with Arduino.
13. Design of Internet of Things (IoT) using Arduino.

Reference Books

1. N.Senthil Kumar, M.Saravanan and S.Jeevananthan, Microprocessor and Microcontrollers, OXFORD UNIVERSITY PRESS, November, 2010
2. Jeremy Blum, Exploring Arduino, Wiley-2012
3. Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, Arduino Programming From Beginning to Advanced, MicroDigital-Ed-2018
4. David E Simon, “An embedded software primer”, Pearson education Asia, 2001
5. Raymond J.A. Bhur and Donald L.Bialey, “An Introduction to real time systems: Design to networking with C/C++” , Prentice Hall Inc. New Jersey, 2019

Web References

1. https://www.elprocus.com/8051-microcontroller-architecture-and-applications/
2. https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_architecture.htm
3. https://www.arduino.cc/
4. https://nptel.ac.in/courses/108/105/108105102/

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

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

U20ICP405	SIMULATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To provide knowledge on design of process control by using MATLAB
- To provide knowledge in process analysis by MATLAB tools.
- To give basic knowledge in describing function analysis
- Get adequate knowledge MATLAB tool sets and Simulink
- Get adequate knowledge MATLAB Data Acquisition

Course Outcomes

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

CO1 - To describe basics of MATALB. **(K2)**
CO2 - Get adequate knowledge on MATLAB tool sets. **(K3)**
CO3 - To determine step and impulse response for first, second order and type 0, 1, 2 systems. **(K4)**
CO4 - To obtain plots using bode, root locus and Nyquist plot. **(K4)**
CO5 - To understand effect of PI and PD controller. **(K3)**

List of Experiments

1. Matrix Manipulation, Numerical solution of differential equations using MATLAB software.
2. Determination of (i)Transfer Functions and (ii) Poles and Zeros of the system.
3. Determination of Step & Impulse Response For A First Order Unity Feedback System
4. Determination of Step & Impulse Response for a Second Order Unity Feedback System.
5. Stability analysis using MATLAB.
6. Compensation of Closed Loop System using MATLAB.
7. Determination of Bode Plot Using Matlab Control System Toolbox For 2nd Order System & Obtain Controller Specification Parameters.
8. Determination of Root Locus Plot Using Matlab Control System Toolbox For 2nd Order System & Obtain Controller Specification Parameters.
9. Determination of Nyquist Plot Using Matlab Control System Toolbox.
10. Study The Effect of Pi & Pd Controller on System Performance.
11. Time domain Analysis using Simulink blocks.
12. Study the Effect of Addition of Poles to the Forward Path Transfer Function of a Closed Loop System.

Reference Books

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson/ Prentice Hall, 9th Edition, 2013.
2. Microelectronic Circuits – Sedra A.S. and K.C. Smith, Oxford University Press, 5th ed.,2013
3. Nagrath I J and Gopal M, Control System Engineering, New Age International Pvt Ltd, Sixth Edition, 2017.
4. DingyüXue, YangQuan Chen, Modeling, Analysis and Design of Control Systems in MATLAB and Simulink,World Scientific Publishing,2014
5. Liuping Wang ,PID Control System Design and Automatic Tuning Using MATLAB/Simulink, Wiley, 2020

Web References

1. https://in.mathworks.com/products/matlab.html
2. https://nptel.ac.in/courses/108108122/
3. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs/

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

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

U20ICC4XX	CERTIFICATION COURSE - IV	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.

U20ICS403	SKILL DEVELOPMENT COURSE 3 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. CALIBRATION OF MEASURINGINSTRUMENTS

Course Content:

1. Parts of the Typical Control Loop
2. Process& Instrument Diagrams (P&ID's).
3. Introduction to Measurement System.
4. Commonly used process control signals.
5. Signal quality terminology (accuracy, linearity, span, etc.)
6. System standards and instrument calibration.
7. Study of measurement errors-zero, span, hysteresis, non-linear, dead-band errors.
8. Sensor/Transducer and Transmitter principles
9. Pressure Instruments – Principle, construction and operation
10. Calibration of low and high Pressure Bourden's Gauges.
11. Principle and operation of Strain gauge Pressure Sensors.
12. Principle and operation of Strain gauge Pressure Transmitters. (2 wire and 4 wire configuration).
13. Operation and calibration of Differential Pressure Switch & Safety Valve.
14. Calibration of Temperature Indicators (RTD & Thermocouple).

(OR)

2. INTRODUCTION TO ROBOTICS

Course Content:

1. Robot kinematics: position analysis, differential motions and velocities.
2. Trajectory planning. Actuators, sensors and simple sensor processing algorithms.
3. Robot programming and control architectures.
4. Selected topics from mobile robotics (localization, mapping, navigation and motion planning).

(OR)

3. LABVIEW IMPLEMENTATION

Course Content:

1. Basics of LABVIEW
2. Data handling instruction

Hardware Interface

3. Process 1: – Acquiring and generation of Digital signals
4. Process 2: – Acquiring analog values in DE and RSE method
5. Process 3: – Generating analog output
6. Process 4: – Integration of DAQ card with embedded devices
7. Embedded device with LABVIEW
8. Matrix
9. Remote panel creation and testing
10. Webserver monitoring with LABVIEW
11. Hardware interfacing with LABVIEW

U20ICM404	NSS	L	T	P	C
		0	0	2	-

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 behaviour. 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

U20BST547	NUMERICAL METHODS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To know the solution of algebraic and transcendental equations.
- To learn the techniques of solving simultaneous equations.
- To introduce the numerical techniques of differentiation and integration.
- To solve ordinary differential equations by using numerical methods.
- To know the solution of partial differential equations by using numerical methods.

Course Outcomes

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

CO1 - Use numerical techniques to solve algebraic and transcendental equations. **(K2)**

CO2 - Find the solution of simultaneous equations. **(K2)**

CO3 - Analyze and apply the knowledge of differentiation and integration by using numerical methods. **(K3)**

CO4 - Solve the solution of ordinary differential equations by Runge Kutta methods. **(K3)**

CO5 - Solve the partial differential equations in iterative methods. **(K3)**

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS ANDEIGEN VALUE PROBLEMS (12 Hrs)

Bisection method - Method of false position - Newton Raphson method (single and system of two equations) -Eigen value and Eigenvector by power method.

UNIT II LINEAR SIMULTANEOUS EQUATIONS (12 Hrs)

Solution of linear simultaneous equations and matrix inversion - Gauss elimination method - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT III INTERPOLATION (12 Hrs)

Finite Differences - Relation between operators - Interpolation by Newton's forward and backward difference formula for equal intervals - Newton's divided difference method and Lagrange's method for unequal intervals - Differentiation based on finite differences - Integrations by Trapezoidal and Simpson's rules.

UNIT IV SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (12 Hrs)

Single step methods -Taylor series method -Picard's method -Euler method and Improved Euler method-RungeKutta method of fourth order only.

UNIT V SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Solution of Laplace and Poisson equations -Leibmann's iterative method -Diffusion equation: Bender-Schmitt method and Crank-Nicholson implicit difference method -Wave equation: Explicit difference method

Text Books

1. Grewal B.S., "Numerical Methods in Engineering and Science", Mercury learning and Information, Kindle Edition, 2018
2. Rajesh Kumar Gupta, "Numerical Methods - Fundamentals and Applications", Cambridge University

Press, 2019
3. M.K. Jain, R.K. Jain, S.R.K. Iyengar, **"**Numerical Methods for Scientific and Engineering Computation, "New Age International Pvt. Ltd., 7th Edition, 2019.

Reference Books

1. Steven C. Chapra, "Applied Numerical Methods W/Mat lab", Tata McGraw Hill, 4thEdition, 2017
2. P. Siva Ramakrishna Das, "Numerical Analysis", Kindle Edition, 2016
3. Timo Heister, Leo G. Rebholz, FeiXue, "Numerical Analysisan Introduction", De Gruyter, 2019.
4. Graham W. Griffiths, "Numerical Analysis using R solutions to ODEs and PDEs", Kindle 1st Edition,Cambridge University Press, 2016
5. K. SankaraRao, "Numerical Methods for Scientists and Engineers", 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2018.
6. C.B. Gupta, Shree Ram Singh, M. Kumar, "Engineering Mathematics for semesters III & IV", Tata McGraw Hill, 1st Edition, 2016.

Web References

1. http://nptel.ac.in/courses/111107063
2. http://nptel.ac.in/courses/122102009
3. https://nptel.ac.in/courses/111/107/111107105/
4. http://www.math.iitb.ac.in/~baskar/book.pdf
5. https://www.math.ust.hk/~machas/numerical-methods.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	3	-	-	-	-	-	-	-	-	-	1	-	-	-
2	1	3	-	-	-	-	-	-	-	-	-	1	-	-	-
3	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
4	1	2	-	-	-	-	-	-	-	-	-	1	-	-	-
5	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-

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

U20ICT510	ANALYTICAL INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the principles of spectrophotometry.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To get knowledge on PH meters and dissolved component analyzers.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

Course Outcomes

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

CO1- Understand the fundamental principle and application of spectrophotometry. **(K3)**
CO2- Assess the chromatographic behaviour of solutes in gas and liquid state. **(K2)**
CO3- Critically evaluate the strengths and limitations of the various pollution monitoring instrumental methods. **(K2)**
CO4- Develop knowledge on PH meters and dissolved component analyzers. **(K1)**
CO5- Understand the working principle, types and applications of NMR and Mass spectroscopy. **(K2)**

UNIT I SPECTROPHOTOMETRY (9 Hrs)

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometer - FTIR spectrophotometer – Atomic absorption spectrophotometer - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

UNIT II CHROMATOGRAPHY (9 Hrs)

General principles – classification – chromatographic behaviour of solutes – quantitative determination – Gas chromatography – Liquid chromatography –High Pressure liquid spectrometry, application.

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORINGINSTRUMENTS (9 Hrs)

Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNITIV PH METERS AND DISSOLVED COMPONENT ANALYZERS (9 Hrs)

Selective ion electrodes - Principle of pH and conductivity measurements – dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY (9 Hrs)

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

Text Books

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., “Instrumental methods of analysis”, CBS publishing & distribution, 7th Edition, 2012.

2. Braun, R.D., “Introduction to Instrumental Analysis”, Pharma Book Syndicate, Singapore, 2nd edition, 2012
3. Robert E. Sherman., “Analytical Instrumentation”, Instruments Society of America, 1996.

Reference Books

1. Khandpur, R.S., “Handbook of Analytical Instruments”, Tata McGraw-Hill publishing Co. Ltd.,2nd Edition 2007.
2. Ewing, G.W., “Instrumental Methods of Chemical Analysis”, McGraw-Hill, 5th Edition reprint 1985.
3. Liptak, B.G., “Process Measurement and Analysis”, CRC Press, 5th Edition, 2015.
4. NPTEL lecture notes on, “Modern Instrumental methods of Analysis” by Dr.J.R. Mudakavi, IISC, Bangalore.

Web References

1. https://www.slideshare.net/ErFarukBinPoyen/analytical-instrumentation-introduction.
2. https://www.youtube.com/watch?v=AkXRYGwlbL4
3. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/IC0309%20Analytical%20Instumentation.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	-	1	-	-	1	-	-	-	-	1	-	2	1	1
2	3	-	1	1	-	1	-	-	-	-	1	-	2	1	1
3	3	-	1	1	-	1	-	-	-	-	1	-	2	1	1
4	3	-	1	-	-	1	-	-	-	-	1	-	2	1	1
5	3	-	1	1	-	1	-	-	-	-	1	-	2	1	1

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

U20ICT511	EMBEDDED SYSTEM DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the basics of the Embedded System.
- To explain the various development tools in the Embedded System.
- To acquire knowledge in Embedded Networking
- To study ARM Processor hardware features and internal peripherals
- To design simple embedded microcontroller based applications

Course Outcomes

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

CO1 -Understand the fundamentals and areas of applications for the Embedded System**(K1)**
CO2 - Analyse the various architectures for embedded software development.**(K2)**
CO3 -Classify and analyze the various standards and protocols used for embedded interfaces.**(K2)**
CO4 - Acquire Knowledge of ARM Processor hardware features and internal peripherals.**(K3)**
CO5 - Design simple embedded microcontroller based applications.**(K4)**

UNIT I INTRODUCTION TO EMBEDDED SYSTEM (9 Hrs)

Embedded system- characteristics of embedded system- categories of embedded system- requirements of embedded systems- challenges and design issues of embedded system- trends in embedded system- system integration- hardware and software partition- applications of embedded system - control system and industrial automation-biomedical-data communication system-network information appliances- IVR systems- GPS systems.

UNIT II EMBEDDED SOFTWARE DEVELOPMENT AND TOOLS (9 Hrs)

Software architectures, Round - Robin, Round-Robin with Interrupts, Function Queue Scheduling architecture, Introduction to assembler - Compiler -Cross compilers, Linker/ Locators, Simulators-Embedded Firmware Design Approaches and Development Languages.

UNIT III EMBEDDED NETWORKING (9 Hrs)

Embedded Networking: Introduction, I/O Device Ports - Serial Bus communication protocols- RS232 standard- RS485 - CAN Bus - RS485 - Serial Peripheral Interface (SPI) - Inter-Integrated Circuits (I2C) - PC Parallel port communication Protocols - Bluetooth-network using ISA, PCI-. Interrupt service mechanism.

UNIT IV INTRODUCTION TO LPC2148 MICROCONTROLLER (9 Hrs)

ARM 7 Architecture –LPC2148 microcontroller introduction – Internal memory map - Peripheral details – Implementation of GPIO, Timer/Counter, UART, Interrupt architecture – ADC and DAC. SPI, I2C and USB features of LPC2148.

UNIT V DESIGN OF SIMPLE EMBEDDED SYSTEMS (9 Hrs)

Design of Simple I/O systems using Switches, LEDs, Buzzers , Current source and sink concepts,Interfacing Character and Graphical LCD Displays , DC Motor Speed Control System, Speed

Measurement, Design of Digital Frequency meter , Stepper Motor Interfacing ,Relays, Keypads ,PC based Control systems. (Using LPC2148)

Text Books

1. Trevor Martin,“The Insider's Guide to the Philips ARM7-Based Microcontrollers”, HitexPubications(UK)
2. KVKK Prasad, “Embedded / Real Time Systems”, Dreamtech Press, 2005.
3. Raj Kamal, “Embedded system-Architecture, Programming, Design”, Tata McGraw Hill, 2011
4. David E Simon, “An embedded software primer ", Pearson education Asia, 2001.

Reference Books

1. Steve Heath, “Embedded Systems Design”, Second Edition, Elsevier India Pvt.Ltd., 2007
2. Wayne Wolf, “Computers as components”, Morgan Kaufmann publishers, 2nd Edition, 2008
3. Jonartthan W. Valvano Brooks/cole “Embedded Microcomputer Systems. Real time Interfacing",Thomson learning 2001.
4. Grehan Moore, and Cyliax, "Real time Programming: A guide to 32 Bit Embedded Development. Reading" Addison Wesley-Longman, 1999.
5. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, Tata McGraw-Hill, 2005.

Web References

1. https://www.tutorialspoint.com/embedded_systems/es_overview.htm
2. https://www.watelectronics.com/classification-of-embedded-systems/
3. https://nptel.ac.in/courses/108/102/108102045/
4. https://nptel.ac.in/courses/106/105/106105193/

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

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

U20ICT512	INDUSTRIAL INSTRUMENTATION- I	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the measurement techniques of force, torque and speed.
- To introduce the measurement techniques of acceleration, Vibration and density
- To equip the students with the knowledge of level measurements.
- To equip the students with the knowledge of temperature measurements.
- To introduce the Measurement techniques of pressure.

Course Outcomes

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

CO1-Understand the measurement techniques of force, torque and speed. **(K1)**
CO2- Explicate the measurement techniques of acceleration, Vibration and density. **(K2)**
CO3- Analyze the various types of level measurement. **(K3)**
CO4-Understand the measurement of temperature. **(K2)**
CO5- Acknowledge the measurement of pressure. **(K1)**

UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED (9 Hrs)

Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells -Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY (9 Hrs)

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer – Vibration sensor - Calibration of vibration pickups - Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

UNIT III LEVEL MEASUREMENT (9 Hrs)

Level measurement: Float gauges - Displacer type – D/P methods -Bubbler system-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method - Solid level measurement.

UNIT IV TEMPERATURE MEASUREMENT (9 Hrs)

Temperature scales, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistors, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT V PRESSURE MEASUREMENT (9 Hrs)

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges -

Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, lionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester

Text Books

1. Doebelin, “Measurement Systems – Application and Design”, Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi,2019.
3. D. Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Company Ltd, 2013.

Reference Books

1. A.K. Sawhney and P. Sawhney, “A Course on Mechanical Measurements, Instrumentation and Control”, DhanpathRai and Co, 2013.
2. S.K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill, 2014.
3. D.P. Eckman, “Industrial Instrumentation”, Wiley Eastern Ltd., 2012.
4. P.Holman, “Experimental Methods for Engineers”, International Student Edition, McGraw Hill Book Company, 2013.
5. Andrew W.G, “Applied Instrumentation in Process Industries – A survey”, Vol. 1 & Vol.2,Gulf Publishing Company, Houston, 2012.

Web References

1. https://lecturenotes.in/subject/42/industrial-instrumentation-ii
2. https://www.scribd.com/presentation/260674587/Industrial-Instrumentation-Notes**.**
3. https://nptel.ac.in/courses/108/105/108105064/.
4. https://www.youtube.com/playlist?list=PLUtfVcb-iqn_Dq6RnkCaOaLjPDu3cmxpo.
5. https://nptel.ac.in/courses/108/106/108106074/

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

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

U20BSP549	NUMERICAL METHODS LAB (Common to ICE & MECH)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn the techniques of non – linear equation.
- To know the techniques of solving simultaneous equations.
- To introduce the numerical techniques of integration.
- To know the applications of Simpsons rule.
- To study about the numerical solution of Laplace equation.

Course Outcomes

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

CO1 - Find out the root of the Algebraic and Transcendental equations. **(K3)**
CO2 - Solve the simultaneous equations. **(K3)**
CO3 -Know the iterative Interpolation formula of integration. **(K3)**
CO4 - Implement Simpsons Rule formula. **(K3)**
CO5 - Solve the Laplace equation using Numerical methods. **(K3)**

List of Experiments

1. Roots of non – linear equation using bisection method.
2. Roots of non – linear equation using Newton's method.
3. Find the largest Eigen value of a matrix by power - method.
4. Solve the system of linear equations using Gauss - Elimination method.
5. Solve the system of linear equations using Gauss - Jordan method.
6. Solve the system of linear equations using Gauss - Seidal iteration method.
7. Find the area by using trapezoidal rule.
8. Find the area by using Simpson's 1/3 rule.
9. Find the area by using Simpson's 3/8 rule
10. Find the numerical solution of heat equation.

Reference Books

1. C. Xavier, "C Language And Numerical Methods", New Age International, 2007.
2. P. Siva Ramakrishna Das, "Numerical Analysis", Kindle Edition, 2016.
3. Timo Heister, Leo G. Rebholz, FeiXue, "Numerical Analysisan Introduction", Publisher De Gruyter, 2019.
4. K. SankaraRao, "Numerical Methods for Scientists and Engineers", 3rd Edition, PHI Learning Pvt.Ltd, New Delhi, 2018.
5. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers" McGraw – Hill Higher Education, 2010.

Web References

1. http://nptel.ac.in/courses/111107063
2. http://nptel.ac.in/courses/122102009
3. http://nptel.ac.in/courses/111/107/111107105
4. http://www.math.iitb.ac.in/~baskar/book.pdf
5. https://www.math.ust.hk/~machas/numerical-methods.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	-	-	-	-	-	1	-	-	1
2	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
3	3	2	1	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

U20ICP506	EMBEDDED SYSTEM DESIGN LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To Design microcontroller based embedded systems.
- To introduce the embedded systems design tools and hardware programming.
- To equip the students skills in both simulation and practical implementation of the basic building blocks of a microcontroller including timers, counters, I/O techniques and requirements, A/D conversion, serial communications
- To develop firmware for the systems and to validate the same through functional simulation and hardware verification.
- To study the peripheral devices interfacing techniques

Course Outcomes

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

CO1 - Get exposure to the system design aspects of Microcontrollers. **(K1)**
CO2 - Design applications for customized requirements. **(K2)**
CO3 - Learn firmware development for microcontrollers. **(K2)**
CO4 -Interface various peripheral devices with ARM processor. **(K3)**
CO5 -Design embedded system based applications. **(K3)**

List of Experiments

1. Implementation of GPIO of ARM LPC2148
2. Interfacing Timer using ARM LPC2148.
3. Implementation of UART features of ARM LPC2148.
4. Implementation of ADC of ARM LPC2148.
5. Implementation of DAC of ARM LPC2148.
6. Seven segment display interface using LPC2148
7. Interfacing 4x4 matrix key with LPC2148
8. Interfacing buzzer with LPC2148
9. Real time clock implementation using LCD in ARM LPC2148

Reference Books

1. Steve Heath, “Embedded Systems Design”, Second Edition, Elsevier India Pvt.Ltd., 2007
2. Wayne Wolf, “Computers as components”, Morgan Kaufmann publishers, 2nd Edition, 2008
3. Jonartthan W. Valvano Brooks/cole “Embedded Microcomputer Systems. Real time Interfacing ",Thomson learning 2001.
4. Grehan Moore, and Cyliax, " Real time Programming: A guide to 32 Bit Embedded Development. Reading " Addison Wesley-Longman, 1999
5. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, Tata McGraw-Hill, 2005

Web References

1. https://www.tutorialspoint.com/embedded_systems/es_overview.html
2. https://www.watelectronics.com/classification-of-embedded-systems/
3. https://nptel.ac.in/courses/108/102/108102045/
4. https://nptel.ac.in/courses/106/105/106105193/

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

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

U20ICP507	INDUSTRIAL INSTRUMENTATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To impart an adequate knowledge and expertise to handle equipment generally available in an industry.
- To make the students aware about calibration of meters and sensors.
- To make the students aware about calibration of transmitters.
- To make the students conscious about the working and operation of different types of analytical Instruments.
- To identify, formulate, and analyze problems regarding sensors and transmitters.

Course Outcomes

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

CO1 -Experimentally measure the flow of the industrial process. **(K1)**
CO2 -Measure the level parameter of the industrial process. **(K2)**
CO3 - Experimentally measure the temperature of industrial process. **(K1)**
CO4 -Measure and analyze pH value of different solutions**. (K2)**
CO5 -Measure and analyze physiological parameters such as BP, ECG, pulse rate. **(K3)**

List of Experiments

1. Measurement of torque, Viscosity and vacuum.
2. Calibration of pressure gauge using dead weight tester.
3. Measurement of level using d/p transmitter.
4. Measurement of flow using
   a) Discharge coefficient of orifice plate
   b) Calibration of manometer.
5. Calibration of Control valves.
6. Calibration of I to P and P to I converters.
7. Calibration of Pressure Switch, RTD and Thermocouple.
8. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer
9. Standardization and measurement of pH values of different solutions
10. Measurement and analysis of ECG and pulse rate.

Reference Books

1. O. Doebelin, “Measurement Systems – Application and Design”, Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 2019.
3. D. Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Company Ltd, 2013.

Web References:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://dl.acm.org/doi/book/10.5555/269184.
3. https://lecturenotes.in/subject/42/industrial-instrumentation-ii
4. https://www.scribd.com/presentation/260674587/Industrial-Instrumentation-Notes**.**
5. https://nptel.ac.in/courses/108/105/108105064/

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

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

U20ICP508	INSTRUMENTATION SYSTEM DESIGN LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn the basics of designing and testing electronic instruments like digital voltmeters, function generators and Power supplies.
- To learn the design, testing and calibration of instruments used in process control industries.
- To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation system.
- To impart design knowledge of controller, control valve and transmitter.
- To provide awareness of industry project, planning and scheduling.

Course Outcomes

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

CO1 - Design, test and calibrate the industrial instruments. **(K1)**
CO2 - Understand design of signal conditioning circuits and instrumentation systems. **(K2)**
CO3 - Calibrate different instruments used in industries. **(K3)**
CO4 - Design the multi-channel data acquisition system and transmitter. **(K3)**
CO5 - Design the advanced measuring circuits**. (K2)**

List of Experiments

1. Design, testing and calibration of Monolithic function Generator using XR 2206
2. Design, testing and calibration of Batch counter using TTL ICs.
3. Design, testing and calibration of Regulator Power supplies.
4. Design, testing and calibration of Electronic P, PI, PID & ON/OFF controllers.
5. Design, testing and calibration of DAC and ADC
6. Design, testing and calibration of Programmable Timers
7. Design, testing and calibration of Cold Junction compensation of a Thermocouple.
8. Design, testing and calibration of Digital Thermometer.
9. Design, testing and calibration of RTD.
10. Design and testing of advanced measuring circuits.

Reference Books

1. Jacob Fraden, “Handbook of Modern Sensors Physics, design and Applications”, springer publication, 4th edition 2010.
2. GanjiVasu, “Design of Controller for Higher Order Discrete Systems”, LAP Lambert Academic Publishing, 26 November 2012.
3. D.Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
4. A.K.Sawhney, “A course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai and Sons, New Delhi, 1999.

Web References

1. https://dl.acm.org/doi/book/10.5555/269184.
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://lecturenotes.in/subject/42/industrial-instrumentation-ii
4. https://www.scribd.com/presentation/260674587/Industrial-Instrumentation-Notes**.**
5. https://nptel.ac.in/courses/108/105/108105064/.

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

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

U20ICC5XX	CERTIFICATION COURSE - V	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 is40-50 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.

U20ICS504	SKILL DEVELOPMENT COURSE 4: Career and Professional Skill Development Program – I	L	T	P	C	Hrs
		0	0	2	-	30

1. BASIC APTITUDE & MATHEMATICAL SKILLS:

- Number System – Basics
- Number System – Advanced
- Surds & Indices
- Ratio & Proportion
- Problem On Ages & Partnership

2. APPLIED APTITUDE & MATHEMATICAL SKILLS:

- Average
- Alligations & Mixtures
- Profit & Loss, Discounts
- Percentage
- Time, Speed & Distance
- Problem On Trains
- Boats & Streams
- Time & Work
- Chain Rule
- Pipes & Cisterns
- Calendars

3. ENGINEERING APTITUDE SKILLS:

- Simple & Compound Interest
- Probability
- Permutation & Combination
- Mensuration
- Data Interpretation

U20ICS505	SKILL DEVELOPMENT COURSE 5: (Presentation Skills using ICT)	L	T	P	C	Hrs
		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 work flow 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 audio visual activities.
- Handle audio visual 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 are port, 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.

U20ICM505	INDIAN CONSTITUTION	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties

Course Outcomes

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

CO1- Understand historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration

CO2 - Understand knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

UNIT I INDIAN CONSTITUTION

Salient Features – Preamble – Fundamental Rights– Directive Principles of State Policy-Fundamental Duties

UNIT II PARLIAMENTRY SYSTEM

Powers and Functions of President and Prime Minister –Council of Ministers-The Legislature Structure and Functions of LokSabha and RajyaSabha –Speaker

UNIT III THE JUDICIARY

Organization and Composition of Judiciary- Powers and Functions of the Supreme Court –Judicial Review– High Courts.

UNIT IV STATE GOVERNMENTS

Powers and Functions of Governor and Chief Minister– Council of Ministers – State Legislature

UNIT V LOCAL GOVERNMENTS

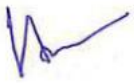
73rd and 74th Constitutional Amendments–Federalism – Center–State Relations

Text Books

1. Basu D.D, “Introduction to Indian Constitution”, Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, “Indian Government and Politics”,Vikas Publishing House, New Delhi, 2010.

Reference Books

1. Pylee M.V,“Introduction to the Constitution of India”,Vikas Publishing House,New Delhi, 2011.
2. Kashyap S,“Our Constitution”, National BookTrust, New Delhi, 2010



U20ICT613	MEDICAL INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study about the basic cell structure and its functions
- To know about the different bio potential electrodes and amplifiers
- To study about the different instruments used for diagnosis
- To become familiarize with therapeutic instruments
- To get basic idea about modern imaging system and telemetry

Course Outcomes

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

CO1 - Recall the structure of cell, physiology of different biological systems and their functions. **(K1)**
CO2 - Illustrate the types of electrodes and measurements of biological parameters. **(K2)**
CO3 - Explain the working of diagnostic instruments. **(K2)**
CO4 - Analyze the measurements of therapeutic instruments. **(K2)**
CO5- Elucidate the working principle of imaging systems. **(K2)**

UNIT I ELECTROPHYSIOLOGY (9 Hrs)

Cell and Its Structure - Electrical, Mechanical and Chemical Activities - Action and Resting Potential- Organization of Nervous System - CNS - PNS - Neurons - Axons- Synapse - Propagation of Electrical Impulses along the Nerve-Sodium Pump - Cardiopulmonary System- Physiology of Heart, Lung, Kidney.

UNIT II BIO POTENTIAL ELECTRODES AND TRANSDUCERS (9 Hrs)

Design of Medical Instruments - Components of Biomedical Instrument System - Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes -Instrumentation amplifier - Biomedical Measurements Like pH, PCO2, PO2 of Blood, Isolation Amplifier, Preamplifier, Current Amplifier, Chopper Amplifier.

UNIT III INSTRUMENTS USED FOR DIAGNOSIS (9 Hrs)

ECG, Einthoven Triangle, Leads, Electrodes, Vector Cardiograph, Measurement of Cardiac Output, EEG, EMG, Plethysmography, Blood Flow Measurements, Holter Monitor- Respiratory Rate Measurement - Oximeter**,** Patient Monitoring System, ICCU, Bone Density Measurement.

UNIT IV RECENT TRENDS & INSTRUMENTS FOR THERAPY (9 Hrs)

Dialysers - Surgical Diathermy - Electro Anaesthetic and Surgical Techniques , Sources of Electric Hazards and Safety Techniques. Single Channel Telemetry, Multi channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications, Stem Cell Therapy.

UNIT V MODERN IMAGING SYSTEM (9 Hrs)

Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis- Pace Makers, Defibrillators, Doppler Monitor(colour), Medical imaging-X-ray generation, DXA, Radiographic & Fluoroscopic Techniques - Image Intensifiers-Computer Aided Tomography, PET, SPECT- Laser Applications- Echocardiography-CT Scan -MRI/ NMR-Endoscopy.

Text Books

1. Khandpur, “Handbook of Biomedical Instrumentation” 2nd Edition, Tata McGraw Hill, 2003.
2. Arumugam M, “Biomedical Instrumentation”, Anuradha Publications, Reprint 2009.

3. Khandpur, Raghbir Singh, “Biomedical instrumentation: Technology and applications”2nd Edition, Mcgraw
Hill, 2005.

Reference Books

1. Anandanatarajan, R, “Biomedical Instrumentation and Measurements”, 2nd Edition, PHI Learning Pvt. Ltd., 2011.
2. Jog, NandiniK., “Electronics in Medicine and Biomedical Instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd., 2013.
3. Singh, Mandeep, “Introduction to biomedical instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd., 2014.

Web References

1. https://wne.libguides.com/bme/websites
2. https://researchguides.dartmouth.edu/c.php?g=877404
3. https://www.google.com/search?client=firefox-b-d&q=nptel+bm

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

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

U20ICT614	INDUSTRIAL INSTRUMENTATION- II	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce variable head type flow meters.
- To introduce quantity meters, air flow meters and mass flow meters.
- To educate on electrical type flow meters.
- To educate on Viscosity, Humidity and Moisture content.
- To educate on smart transmitters.

Course Outcomes

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

CO1 -Understand the working of different variable head type flow meters. **(K1)**

CO2-Understand the working and calibration of quantity flow meters, variable area flow meters and mass flow meters.**(K1)**

CO3 -Understand the working of electrical type flow meters.**(K1)**

CO4 -Gain knowledge about the measurement of viscosity, humidity and moisture.**(K2)**

CO5- Acquire knowledge on smart transmitters.**(K3)**

UNIT I VARIABLE HEAD TYPE FLOWMETERS (9 Hrs)

Expression for flow rate through restriction(compressible and incompressible flow) -Orifice plate: different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube: combined pitot tube, averaging pitot tube – Installation and applications of head flow meters.

UNIT II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS (9 Hrs)

Positive displacement flow meters: Nutating disc, Reciprocating piston and Oval gear flow meters – Inferential meter – Turbine flow meter – Variable Area flow meter: Rotameter –theory, characteristics, installation and applications – Mass flow meter– Angular momentum – Thermal, Coriolis type mass flow meters – Calibration of flow meters: – Dynamic weighing method.

UNIT III ELECTRICAL TYPE FLOW METERS (9 Hrs)

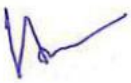
Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

UNIT IV MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE (9 Hrs)

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

UNIT V SMART TRANSMITTERS (9 Hrs)

Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters.



Text Books

1. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi,2019.
3. D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill Publishing Company Ltd, 2013.

Reference Books

1. A.K. Sawhney and P. Sawhney, 'A Course on Mechanical Measurements, Instrumentation and Control', DhanpathRai and Co, 2013.
2. S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2014.
3. D.P. Eckman', Industrial Instrumentation', Wiley Eastern Ltd., 2012.
4. P.Holman, "Experimental Methods for Engineers", International Student Edition, McGraw Hill Book Company, 2013.
5. Andrew W.G, "Applied Instrumentation in Process Industries – A survey", Vol. 1 & Vol.2, Gulf Publishing Company, Houston, 2012.

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1. https://lecturenotes.in/subject/42/industrial-instrumentation-ii
2. https://www.scribd.com/presentation/260674587/Industrial-Instrumentation-Notes.
3. https://nptel.ac.in/courses/108/105/108105064/.
4. https://www.youtube.com/playlist?list=PLUtfVcb-iqn_Dq6RnkCaOaLjPDu3cmxpo.
5. https://nptel.ac.in/courses/108/106/108106074/

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

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

U20ECCM04	INTERNET OF THINGS (Common to ECE, CCE and ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart necessary and practical knowledge of components of Internet of Things.
- To attain the knowledge about different types of Reference modules and architecture of IoT.
- To understand the concepts of Hardware and Software Elements.
- To acquire the knowledge about various Functions with IoT elements.
- To develop skills required to build real-time IoT based Applications.

Course Outcomes

After completion of the course, students will be able to

CO1- Infer internet of Things and its components**.(K2)**
CO2- Describe about Reference modules and Architecture**.(K2)**
CO3- Explain the concepts of Hardware and Software Elements **.(K2)**
CO4- Build and deploy various Functions with IoT elements**.(K3)**
CO5- Develop real-time IoT based Applications**.(K3)**

UNIT – I INTRODUCTION TO INTERNET OF THINGS **(9 Hrs)**

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust.

UNIT - II ARCHITECTURE OF IoT **(9 Hrs)**

State of the Art – Introduction, Architecture Reference Model- IoT reference Model, IoT Reference Architecture, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT - III ELEMENTS OF IoT **(9 Hrs)**

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.
Software Components- Programming APIs (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

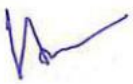
UNIT - IV IoT DEVELOPMENT **(9 Hrs)**

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

UNIT -V IoT APPLICATIONS **(9 Hrs)**

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in Business to Master IoT, IoT for Retailing Industry, IoT for Oil and Gas Industry.

Text Books



1. Vijay Madisetti, Arshdeep Bahga, Internet of Things, “A Hands-on Approach”, University Press,3rd/e, Aug 2018.
2. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill ISBN: 9789352605224, 9789352605224,2nd edition, May 2017
3. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A Practical Approach”, ETI Labs 2014

Reference Books

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi, 2012
2. Adrian McEwen, “Designing the Internet of Things”, Wiley, 2007
3. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill, 2002
4. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press

Web Resources

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2. https://www.theinternetofthings.eu/
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/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	2	2	3	2	-	-	-	-	-	-	-	-	3	3	-
2	3	-	3	2	-	-	-	-	-	-	-	-	3	2	-
3	2	3	2	-	-	-	-	-	-	-	-	-	2	2	-
4	2	2	2	-	-	-	-	-	-	-	3	-	3	3	-
5	2	3	2	-	3	-	-	-	-	-	3	-	3	3	-

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

U20ICT616	PROCESS CONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce technical terms and nomenclature associated with Process control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed forward control and Model Based control schemes.

Course Outcomes

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

CO1 - Introduce the dynamics of various processes. **(K1)**
CO2 - Acquire knowledge on the characteristics, Selection and Sizing of final control elements. **(K2)**
CO3 - Learn the effect of various control actions. **(K2)**
CO4 - Understand the evaluation criteria and tuning techniques of controllers. **(K1)**
CO5 - Understand the concept of multi loop control techniques. **(K1)**

UNIT I PROCESS MODELLING AND DYNAMICS (9 Hrs)

Need for process control – Mathematical Modelling of Processes**:** Level, Flow, Pressure and Thermal processes – Interacting and non-interacting system - Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.

UNIT II FINAL CONTROL ELEMENTS (9 Hrs)

Actuators: Pneumatic and electric actuators –- Control Valves-Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modelling of a Pneumatically Actuated Control Valve – Valve body:-Commercial valve bodies-Control Valve Sizing – Cavitation and flashing.

UNIT III CONTROL ACTIONS (9 Hrs)

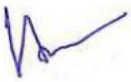
Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues**:** Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action.

UNIT IV PID CONTROLLER TUNING (9 Hrs)

PID Controller Design Specifications**:** Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning**:** Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning- Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio.

UNIT V CONTROL TECHNIQUES AND APPLICATIONS (9 Hrs)

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range and introduction to multivariable control – Applications from distillation column and boiler systems – IMC– Adaptive control – P&ID diagram.



Text Books

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 3rd Edition, 2010.
2.Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2008.
3. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003.

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1.Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill International Education,3rd edition,2013.
2.Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson,2013.
3.Considine, D.M., “Process Instruments and Controls Handbook”, Second Edition, McGraw,5th edition 2009.
4.Bela.G.Liptak., “Process Control and Optimization”, Instrument Engineers’ Handbook, volume 2,CRC Press and ISA, 2005.
2.D. P. Eckman, “Automatic Process control”, 7th Edition, John Wiley, New York, 1990.

Web References

1. http://www.pc-education.mcmaster.ca/
2. https://controlguru.com/
3. https://www.youtube.com/watch?v=eYrZcxOPVPE
4. http://www.instrumentationworld.com/instrumentation_tutorial.htm
5. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm

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

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

U20ICP609	MEDICAL INSTRUMENTATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize students with pulse oximeter, biotelemetry, ECG and EEG instruments.
- To illustrate students with the simulation of ECG signals.
- To impart knowledge on shortwave and ultrasonic diathermy.
- To describe the working of ventilators and pacemakers.
- To analyse the heart lung machine model.

Course Outcomes

After completion of the course, students shall have ability to,

CO1 - Experiment the analysis using pulse oximeter, biotelemetry, ECG and EEG instruments. **(K2)**
CO2 - Simulate ECG signals. **(K1)**
CO3 - Describe shortwave and ultrasonic diathermy **(K3)**
CO4 - Conduct investigation using ventilators and pacemakers **(K3)**
CO5 - Demonstrate the heart lung machine model. **(K2)**

LIST OF EXPERIMENTS

1. Measurement of blood pressure using sphygmomanometer.
2. Measurement of Respiratory system analysis using Pulse oximeter
3. Measurement of various physiological signals using biotelemetry
4. Design a frontal EEG wave analysis using simulator
5. ECG heart rate alarm system with HRV
6. Measurement of Real time monitoring of Echocardiography
7. Galvanic Skin Resistance measurement
8. Design of EOG amplifier to detect eye blink
9. Working of different types of Diathermy equipment's – study

a) Shortwave Diathermy
b) Ultrasound Diathermy
c) Surgical Diathermy

10. Study of Ventilators and pacemaker
11. Study of ultrasound scanners
12. Study of heart lung machine model

Text Books

1. John G. Webster, Bioinstrumentation", John Willey and sons, New York, 2004

Reference Books

1. "Handbook of Biomedical Instrumentation", Khandpur R.S, Tata McGraw- Delhi, 2003.
2. Standard Handbook of Biomedical Engineering and Design – Myer Kutz McGraw-Hill Publisher, 2003

Web Resources

1. https://www.youtube.com/watch?v=pIpGNnKHh1Q
2. https://www.youtube.com/watch?v=PUv7nxFd0XM

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

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

U20ICP610	PROCESS CONTROL LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the process plant and Piping and Instrumentation diagrams.
- To get adequate knowledge about practical issues of various controller modes and methods of tuning of PID controller
- To get adequate knowledge about practical issues of closed loop control of processes.
- To implement tuning in the PID controller for soft processes.
- To impart knowledge on interacting and non-interacting system.

Course Outcomes

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

CO1 -Understand the practical issues of closed loop control of processes.**(K1)**

CO2 -Design process control system components to meet desired needs within realistic constraints.**(K2)**

CO3-Understand tuning of level, flow, temperature and pressure process. **(K1)**

CO4 - Evaluate the dynamic behaviour of Interacting and Non-interacting System**. (K2)**

CO5 - Acquire knowledge on PID enhancements. **(K1)**

List of Experiments

1. Study of Process Control Training System and Piping and Instrumentation diagram of a plant.
2. Study of Inherent and Installed Characteristics of Control Valves.
3. Tuning and Closed loop control of Level Process.
4. Tuning and Closed loop control of Flow Process.
5. Tuning and Closed loop control of Temperature Process.
6. Tuning and Closed loop control of Pressure Process.
7. Design and implementation of ON/OFF Controller for the Temperature Process.
8. Tuning PID Controller for soft processes. (Mathematically described processes).
9. Tuning and closed loop control of Electronic Processes.
10. Design and implementation of Interacting and non-interacting system
11. Simulation study on PID Enhancements

Reference Books

1. N.A.Anderson, Instrumentation for Process Measurement and Control, Chilton Company, 2012.
2. D.M.Considine, Process Instruments and Controls Handbook, McGraw-Hill.reprint 2013.
3. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill InternationalEducation, 3rd edition,2013.
4. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson,2013.
5. D. P. Eckman, “Automatic Process control”, 7th Edition, John Wiley, New York, 1990.

Web References

1. https://nptel.ac.in/courses/103/103/103103037/
2. http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html
3. https://www.youtube.com/watch?v=J1-tzQtqifU

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

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

U20ICP611	VIRTUAL INSTRUMENTATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To provide knowledge on design of process control by using virtual instrumentation techniques
- To provide knowledge in process analysis by VI tools.
- To give basic knowledge in describing function analysis
- Get adequate knowledge VI tool sets
- Get adequate knowledge VI Data Acquisition.

Course Outcomes

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

CO1 - Get adequate knowledge on VI tool sets **(K1)**
CO2 - Describe the data acquisition. (**K1, K2)**
CO3 - Attain knowledge on VI programming techniques. **(K1, K2, K3)**
CO4 - Understand VI programming techniques. **(K1, K2)**
CO5 - Get an adequate knowledge on application of virtual instrumentation **(K1, K2)**

List of Experiments

1. Creating Virtual Instrumentation for simple applications.
2. Programming exercises for loops and charts
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time sequential control of any batch process.

Reference Books

1. Sanjay Gupta, “Virtual Instrumentation using LABVIEW” Prentice Hall India Learning Private Limited 2010
2. Jeffrey Y Beyon,” Hands-On Exercise Manual for LabVIEW Programming, Data Acquisition and Analysis”, Prentice Hall 2000.
3. Saanjay Gupta and Joseph John,”Virtual Instrumentation using LAbVIEW”,Tata Mc Graw Hill 2006.
4. S.Sumathi,P.Surekha,“LabVIEW Based Advanced Instrumentation Systems”,Springer,2007.
5. JovithaJerome,”Virtual Instrumentation using LAbVIEW”,Prentice Hall India Learning Private Limited 2010

Web Resources

1. https://www.ni.com
2. https://www.sciencedirect.com/topics/engineering/virtual-instrument
3.http://jjackson.eng.ua.edu/courses/ece380/assignments/373363c.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	3	1	2	3	-	-	-	2	2	3	2	1	2
2	2	2	3	2	3	3	-	-	-	2	2	3	3	1	2
3	2	2	3	2	3	2	-	-	-	3	2	3	3	1	2
4	2	3	2	2	2	2	-	-	-	3	2	3	2	1	3
5	3	2	3	3	2	2	-	-	-	2	2	2	2	1	3

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

U20ICC6XX	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 is40-50 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.

U20ICS606	SKILL DEVELOPMENT COURSE 6: Career and Professional Skill Development Program – II	L	T	P	C	Hrs
		0	0	2	-	30

1. LOGICAL REASONING:

- Syllogism
- Coding Inequalities
- Coding & Decoding
- Blood Relationship
- Direction Sense
- Number Series
- Odd Man Out
- Ranking Test
- Logical Analogy

2. ANALYTICAL REASONING & CRITICAL REASONING:

- Analytical Thinking
- Seating Arrangement
- Selection Decision Table – Eligibility Test
- Numerical Puzzles
- Data Sufficiency
- Critical Reasoning

3. NON VERBAL REASONING:

- Cubes & Dices
- Sequence Oriented, Analogy Oriented, Coding Oriented
- Figure & Factual Analysis
- Water & Mirror Image
- Paper Cutting Problems

4. FUNCTIONAL GRAMMAR:

- Naming &Substituting Words - (Noun &Pronoun)
- Qualifying Words - (Adverb)
- Describing Words - (Adjectives)
- Action Words - (Verb)
- Positioning Words - (Preposition)
- Connecting / Linking Words - (Conjunction)
- Articles
- Tenses

5. VERBAL APTITUDE – I:

- Error Correction & Spotting Errors
- Error Detection
- Sentence Correction & Improvement

- Phrases & Idioms
- Sentence Completion
- Cloze Test
- One Word Sunstitute

6. VERBAL APTITUDE – II:

- Reading Comprehension
- Para Jumbled Sentences
- Vocabulary Development
- Essay Writing

U20ICS607	SKILL DEVELOPMENT COURSE 7 (Technical Seminar)	L	T	P	C	Hrs
		0	0	2	-	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.
- Ina session of three periods per week, 8 to10 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.Themarks attained for this course is not considered for CGPA calculation.

U20ICS608	SKILL DEVELOPMENT COURSE 8 (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.

U20ICM606	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, ISBN13:978-8187276333,2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450494-X,200
4. S.Narain,“ExaminationsinancientIndia”,AryaBookDepot,1993
5. SatyaPrakash,“Founders of Sciences in Ancient India”,VijayKumarPublisher,1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990,2014

U20ICT717	COMPUTER CONTROL OF PROCESSES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Introduce state variable form analysis of discrete time systems.
- In order to develop system identification methods.
- To Design Digital Controllers
- To educate on various process loops and its control.
- To Design Multi-loop and Multivariable Controllers for multivariable system

Course Outcomes

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

CO1 - Analyse the discrete time systems. **(K2)**
CO2 - Analyse transient and steady state behaviours of linear discrete time control systems. **(K2)**
CO3 - Design a digital controller. **(K3)**
CO4 - Understand the concept of MIMO Controller. (**K2)**
CO5 - Understand basic principles and importance of Multivariable Control Systems. **(K2)**

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE (9 Hrs)

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system.

UNIT II SYSTEM MODELING AND IDENTIFICATION (9 Hrs)

Mathematical model for processes – first order. Second order processes without and with pure delay higher order systems – process modeling from step test data – pulse testing for process identification – time – domain identification – linear least square algorithm.

UNIT III DIGITAL CONTROLLER DESIGN (9 Hrs)

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat control, Dahlin's control and Kalman's control – Smith predictor – Digital Feed-forward controller - LQG Control

UNIT IV MULTI-LOOP REGULATORY CONTROL (9 Hrs)

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA – Multi – loop PID Controller– Biggest Log Modulus Tuning Method – De coupler

UNIT V MULTIVARIABLE REGULATORY CONTROL (9 Hrs)

Introduction to Multivariable control –Multivariable PID Controller -Multivariable IMC– Multivariable Dynamic Matrix Controller – Multivariable Model Predictive Control – Generalized Predictive Controller – Implementation Issues.

Text Books

1. Gopal,M.,"DigitalControlandStateVariableMethods",TataMcGrawHill,Fourth Edition,2017

2. Bequette,B.W.,“ProcessControlModeling,DesignandSimulation”,PrenticeHallof India,2015
3. M. Chidambaram , Computer control of process, Narosa publishing house,2015

Reference Books

1. Stephanopoulos, G., “Chemical Process Control -An Introduction to Theory and Practice”, Prentice Hall of India, 2015.
2. John Lavigne, Instrumentation Applications for the Pulp and Paper Industry (A Pulp and paper book), Books,1988
3. E. Ikonen and K.Najim, “Advanced Process Identification and Control”, Marcel Dekker, Inc. Newyork, 2002.

Web Resources

1. https://nptel.ac.in/courses/112/105/112105211/
2. https://www.youtube.com/watch?v=ImtSsDLgAaI&feature=emb_logo

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

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

U20ICT718	PROCESS AUTOMATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know about the design of a system using PLC introduced in detail.
- To study about PLC Programming
- To understand the concept of SCADA.
- To have an exposure to a Distributed control system.
- To know about advanced topics in automation.

Course Outcomes

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

CO1 - Understand working of PLC, I/O modules of PLC, automation and applications in industry. **(K1)**

CO2 - Acquire knowledge on the design of systems using PLC and PLC programming. **(K4)**

CO3 - Gain knowledge about the SCADA architecture, communication in SCADA, develop any application based on SCADA along with GUI using SCADA software. **(K3)**

CO4 - Understand the fundamentals of DCS and its importance. **(K1)**

CO5 - Gain knowledge about the foundations of modern automation**. (K1)**

UNIT I PLC ARCHITECTURE AND INTERFACE MODULES (9 Hrs)

Introduction - Principles of operation – PLC Architecture and specifications – PLC hardware components Analog and digital I/O modules, CPU and memory module – Programming devices -comparative study of industrial PLC's.

UNIT II PLC PROGRAMMING (9 Hrs)

Ladder logic -PLC ladder diagram, Converting simple relay ladder diagram into PLC relay ladder diagram. PLC programming Simple instructions - Latching relays - sequential function instruction set-program counter, data manipulation, chart Arithmetic, shift registers and sequencers – Structured Text Programming.

UNIT III APPLICATION OF PLC AND INTRODUCTION OF SCADA (9 Hrs)

Application of PLC –Simple materials handling application, Automatic control of warehouse door, Motor control, Bottle Label detection and process control application. SCADA:- Hardware and software, Remote terminal units, Master station, Communication architectures and Open SCADA protocols.

UNIT IV DISTRIBUTED CONTROL SYSTEM (9 Hrs)

Evolution – Different architecture – Local control unit functions – Operator Interface – LLOI and HLOI - redundancy concepts – Displays – Communication networks and communications standards in DCS – Engineering Interface – Factors to be considered in selecting a DCS.

UNIT V ADVANCED TOPICS IN AUTOMATION (9 Hrs)

Introduction to networked control systems- Plant wide control - Internet of Things- Cloud based Automation- OLE for process control - Safety PLC - Case studies: PLC - SCADA - DCS.

Text Books

1. Frank. D. Petrezuella, Programmable logic controllers, McGrewhill, Third edition, 2010.
2. Lucas. M.P., Distributed control systems, Van Nostrand and Reinhold company, NY,1986.
3. Hughes. T. Programmable controllers, ISA Press, 2000.

Reference Books

1. McMillan, G. K., Process Industrial Instrument and controls handbook, McGraw Hill, Newyork, 1999.
2. Berge.J., Field buses for process control: Engineering, operation and maintenance, ISA Press, 2004.
3. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP 3”, Summit Valley Press; 2nd edition, 2014.
4. Mikel P. Grover, et. Al. “Industrial Robots – Technology Programming and Applications”, McGraw Hill, 1980.
5. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill, 2004.

Web References

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

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

U20HSP703	BUSINESS BASICS FOR ENTREPRENEUR	L	T	P	C	Hrs
		0	0	2	1	30

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., and Zehle, S., "Guide to business planning", Profile Books Limited, 2004.
2. Lasher, W., "The Perfect Business Plan Made Simple: The best guide to writing a plan that will secure financial backing for your business", Broadway Books, 2010
3. Arjun Kakkar., "Small Business Management: Concepts and Techniques for improving Decisions", Global India Publications, 2009.

Reference Books

1. Alexander Osterwalder and Yves Pigneur, “Business Model Generation”, Wiley; Latest edition, 2011.
2. Arthur R. DeThomas, “Writing a Convincing Business Plan”, Barrons Educational Series; Second edition, 2001.
3. Ben Horowitz, “The Hard Thing About Hard Things”, Harper Business, 2014.
4. Guy Kawasaki, “The Art of Start 2.0”, Portfolio, 2015.
5. Hal Shelton, “The Secrets to Writing a Successful Business Plan”, Summit Valley Press; 2nd edition, 2014.

Web References

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

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

U20ICP712	COMPUTER CONTROL OF PROCESSES LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the advanced control strategies
- To get adequate knowledge about practical issues of various digital controllers.
- To get adequate knowledge about practical issues of closed loop control of processes
- Using Digital Controllers
- To impart design knowledge of controller, control valve and transmitter.
- To get adequate knowledge about various complex control.

Course Outcomes

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

CO1 - Design various digital controllers. **(K3)**
CO2 - Understand the concept of process estimation and identification. **(K2)**
CO3 - Design Multivariable control for MIMO Process. **(K3)**
CO4 - Design the multi-channel data acquisition system. **(K3)**
CO5 - Design and implement computer based control schemes for MIMO processes**. (K2)**

List of Experiments

1. Design and simulation of digital controller using Dahlin's algorithm.
2. Design and simulation of digital controller using Dead beat algorithm.
3. Design and simulation of digital controller using Kalman's algorithm.
4. Parameter estimation of process from input output data.
5. Design of PID Controller and Auto tuning of PID Controller.
6. PC based PID Control of 4th order electronic process using C program.
7. Analysis of Multi-input Multi-Output System (Four-tank System).
8. Design of Multi-Loop PID Controller and Multivariable PID Controller.
9. Design of Gain scheduling controller.
10. Design of Self-Tuning Controller.

Reference Books

1. Jacob Fraden, “Handbook of Modern Sensors Physics, design and Applications”, springer publication, 4th edition 2010.
2. Ganji Vasu, “Design of Controller for Higher Order Discrete Systems”, LAP Lambert Academic Publishing, 26 November 2012.
3. D. Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
4. A.K. Sawhney, “A course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai and Sons, New Delhi, 1999.

Web References

1. https://dl.acm.org/doi/book/10.5555/269184.
2. https://nptel.ac.in/courses/108/105/108105064/

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

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

		L	T	P	C	Hrs
U20ICP713	PROCESS AUTOMATION LAB	0	0	2	1	30

Course Objectives

- To understand practical issues of applications of PLC hardware.
- To get adequate knowledge about practical issues of implementations of PLC and DCS.
- To impart practical skills in Programming of PLC.
- To provide practical knowledge of sensor data collection, processing, and visualisation.
- To develop practical skills in interfacing various field equipment with PLCs.

Course Outcomes

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

CO1 - Understand the fundamentals and Programming of PLC. **(K1)**
CO2 - To comprehend the concepts of functional block and instruction set in PLC programming. **(K1)**
CO3 - Design and implement control schemes in PLC. **(K3)**
CO4 - Interface field devices with PLC. **(K2)**
CO5 - Design and implement computer based control schemes for different processes. **(K3)**

List of Experiments

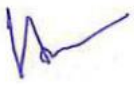
1. Study of PLC field device interface modules (AI,AO,DI,DO modules)
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations, Timer, Counter operation using PLC
4. Programming Jump-to-subroutine and return operations in PLC
5. PLC Exercises: 1. Traffic Light Control and Filling/Draining Control Operation
6. PLC Exercises: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
7. Annunciator design using PLC
8. PLC based control of batch Process.
9. Study of Foundation Field bus /IOT/Wireless HART Enabled Transmitter.
10. Case study SCADA

Reference Books

1. Frank. D.Petruzella , Programmable logic controllers, McGraw hill, Third edition.
2. Lucas. M.P., Distributed control systems, Van Nostrand and Reinhold company, NY,1986.
3. Hughes. T. Programmable controllers, ISA Press, 2000
4. M. Chidambaram, Computer control of process, Narosa publishing house.

Web References

1. https://nptel.ac.in/courses/108/105/108105063/.
2. https://nptel.ac.in/courses/112/102/112102011/.
3. https://www.youtube.com/playlist?list=PL874F91C0180417C3



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

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

		L	T	P	C	Hrs
U20ICP714	**COMPREHENSIVE VIVA VOCE**	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program.

Course Outcomes

CO 1 - The students will be able to attend the various Competitive examinations such as GATE, IES Examination etc. **(K3)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

Description

- The student will be tested for his understanding of basic principles of the core Instrumentation and Control Engineering subjects. 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 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 University.

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	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**

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

U20ICW701	PROJECT PHASE-I	L	T	P	C	Hrs
		0	0	4	2	60

Course Objectives

This course should enable the students to

- Encouraged to get hands on experience to work in various area of Instrumentation and control engineering.

Course Outcomes

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

CO1 - Perceive the problems and to find suitable solutions. **(K5)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

Description

The students to work in groups of not more than four members in each group on a project involving analytical, experimental, design or combination of these in the area of Instrumentation and Control Engineering. Each project shall have an internal guide. The student is required to do literature survey, formulate the problem and form a methodology in arriving at the solution of the problem. The evaluation is based on internal review committee and guide for 50 marks. The End Semester Examination for the project work shall consist of an evaluation of the project report by an external examiner, followed by a viva-voce examination conducted by a committee consisting of the external examiner (25 marks) and an internal examiner (25 marks).

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	2	2	1	3	2	1	2	3	2	2

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

U20ICW702	INTERNSHIP / IN-PLANT TRAINING	L	T	P	C
		0	0	0	2

Course Objectives

This course should enable the students to

- Expose to the industrial environment
- Understand and sharpen the real time technical / managerial skills required in the instrumentation and control engineering job.
- Expose on the current technological developments relevant to instrumentation and control engineering domain.
- Communicate effectively on complex engineering activities
- Create conditions conducive to quest for knowledge and its applicability on the job.

Course Outcomes

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

CO1 - Be a source of highly motivated pre-professionals. **(K3)**
CO2 - Bring new perspectives to problem solving. **(K4)**
CO3 - Implement/Develop Technology solutions which will improve quality of life **(K4)**
CO4 - Develop an ability to communicate effectively (oral and written communication, report writing, presentation skills) **(K4)**
CO5 - Identify and to address their own educational needs in a changing world. **(K4)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

DESCRIPTION

Students may undergo training or internship during summer / winter vacation at Industry/ Research organization / University (after due approval from the Mentor, Class advisor and Departmental Consultative Committee (DCC). In such cases, the internship/training should be undergone continuously (without break) in one organization. Normally no extension of time is allowed. However, DCC may provide relaxation based on the exceptional case. The students are allowed to undergo three to four weeks internship in established industry / Esteemed institution during vacation period.

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

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

U20ICM707	PROFESSIONAL ETHICS	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- 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 SAFETY (6 Hrs)

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.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics –Concepts and Cases”, Cengage Learning, 2009.
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
6. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”,

Oxford University Press, Oxford, 2001
7. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal

Web References

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

U20ICT819	INSTRUMENTATION IN PROCESS INDUSTRIES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the basic operation of various industries.
- To understand the measurement of different process parameters in paper industry.
- To impart knowledge on placing the sensors/transducers in instruments in petrochemical industries.
- To explore the special measuring devices and sensors for the iron and steel industry.
- To provide an exposure to the process and instrumentation and control applications in pharmaceutical industries.

Course Outcomes

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

CO1 - List the basic operation of various industries.
CO2 - Summarize the process parameters with appropriate sensors/transducers in paper industry.
CO3 - Explain the measurement of different process parameters for petrochemical industries.
CO4 - Analyze the working of different Instruments used in specified industries.
CO5 - Compare diverse measurement techniques/control of process parameters.

UNIT I OVERVIEW OF INDUSTRIAL PROCESSES (9 Hrs)

Description of process in Paper Industries Description of process in petrochemical industries: Description of process in iron and steel and cement industries - Description of process in pharmaceutical and nuclear industries.

UNIT II INSTRUMENTATION IN PAPER INDUSTRIES (9 Hrs)

Measurement of Basic weight, thickness, density, Porosity, smoothness, softness, hardness and compressibility; selection of suitable measurement hardware for flow, pressure, level, temperature, density, solids, consistency - moisture analyzers oxidation - reduction potential and pH.

UNIT III INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES (9 Hrs)

P & I diagram of petroleum refinery - measurement and control of absolute pressure, density, conductivity, differential pressure and flow of evaporators. Measurement and control of column pressure, liquid distillate, vapour distillate.

UNIT IV INSTRUMENTATION IN IRON AND STEEL INDUSTRIES (9 Hrs)

Iron and steel: Selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning - special gauges for measurement of thickness and shape.

UNIT V INSTRUMENTATION IN PHARMACEUTICAL INDUSTRIES (9 Hrs)

Pharmaceutical Industries: Flow measurement - pressure measurement - smoke detector.

Text Books

1. B.G. Liptak, “Instrumentation Engineers Handbook (Measurement)”, Fourth Edition, Volume 1, CRC press, 2011.
2. Gregory K. McMillan's Considine D. M., “Process/Industrial Instruments and Control Handbook”, McGraw Hill, 5th edition 2009.
3. Norman A. Anderson, “Instrumentation for Process Measurement and Control”, Routledge, Third Edition, 2017.

Reference Books

1. Liptak B G, “Instrument Engineer’s Handbook, Vol. 2: Process Control and Optimization”, CRC Press, 2006.
2. BhaskaraRao, “a text on petrochemicals”, Trendy paper, 2004.
3. Liptak B.G, “Process Measurement and Analysis”, Third Edition, Chilton Book Co., 2003.

Web References

1. https://www.branom.com/instruments-type.html
2. https://www.controlengeurope.com/features/132/Process-instrumentation/
3. https://new.siemens.com/global/en/products/automation/process-instrumentation.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	3	2	3	2	-	3	1	-	-	3	3	3	3
2	3	2	3	2	3	2	-	3	1	-	-	3	3	3	3
3	3	2	3	2	3	2	-	3	1	-	-	3	3	3	3
4	3	2	3	2	3	2	-	3	1	-	-	3	3	3	3
5	3	2	3	3	3	2	-	3	1	-	-	3	3	3	3

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

U20HSP804	ENTREPRENEURSHIP MANAGEMENT	L	T	P	C	Hrs
		0	0	2	1	30

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 ENTREPRENEURIAL 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., and Greene, F. J., "Small business and entrepreneurship", Financial Times/Prentice Hall, 2010.
2. Scarborough, N. M., "Essentials of entrepreneurship and small business management", Prentice Hall, 2011.
3. Gupta C.B., and Srinivasan N.P., "Entrepreneurial Development", Sultan Chand and Sons, 2020.

Reference Books

1. Brian Tracy, "The Psychology of Selling" HarperCollins Leadership, 2022.
2. Dale Carnegie, "How to Win Friends and Influence People", 1998.

3. Robert Kiyosaki and Sharon Lechter – Rich Dad, Poor Dad, Hachette Book Group USA; 1st edition, 2000.
4. Reid Hoffman – The Startup of You: Adapt to the Future, Invest in Yourself, and Transform Your Career, RHUK, 2013.
5. Michael E. Gerber – The E-Myth Revisited, Harper Business; Updated, Subsequent edition, 2004.
6. Chris Guillebeau – The Art of Non-Conformity, Penguin USA, 2010.
7. Eric Ries, “The Lean Startup, Currency”, 1st Edition, 2011.
8. Kevin D. Johnson, “The Entrepreneur Mind”, Lightning Source Inc, 2012.

Web References

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

U20ICW803	PROJECT PHASE II	L	T	P	C
		0	0	16	8

Course Objectives

This course should enable the students to

- Expose students to design problem related to various disciplines of instrumentation and control engineering.

Course Outcomes

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

CO1 - Take up any challenging practical problems and find solution by formulating proper methodology. **(K5)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

DESCRIPTION

The students will be encouraged to handle the problems independently in Project work phase II with the extension of the project work Phase-I started in the seventh semester. On completion of the work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal review committee for 40 marks. The End Semester Examination for the project work shall consist of an evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted by a committee consisting of the external examiner (25 marks), an internal examiner (25 marks). Based on the Publication of paper / Prototypes / Patents 10 marks will be awarded.

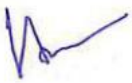
COs/POs/PSOs Mapping

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	2	2	1	3	2	1	2	3	2	2

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

U20ICS809	SKILL DEVELOPMENT COURSE 9: (NPTEL/MOOC-II)	L	T	P	C	Hrs
		0	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.



Professional Electives

R-2020

U20ICE401	DIGITAL SIGNAL PROCESSING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge on the discrete-time system for different inputs
- To provide the concepts of DTFT and Z-Transform
- To familiarize and impart knowledge on DFT and FFT
- To design the digital filters
- To impart knowledge on digital control techniques.

Course Outcomes

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

CO1 – Analyse the response of a discrete-time system for different inputs. **(K3)**

CO2 – Plot the frequency response of a discrete time system and analyse the discrete-time systems using Z-transform. **(K3)**

CO3 – Analyze the frequency spectrum of discrete-time signals using FFT. **(K3)**

CO4 – Design IIR and FIR digital filters for the given application. **(K3)**

CO5 – Analyse finite word length effects in digital filter. **(K3)**

UNIT I Discrete-Time Signals and Linear Systems (9 Hrs)

Classification of signals: continuous and discrete, energy and power -representation of discrete-time signals, elementary discrete-time signals, classification of discrete-time signals, Classification of systems, Representation of a system with difference equation, impulse response and step response, FIR and IIR systems, Convolution sum and correlation, sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect, reconstruction of analog signal from its samples

UNIT II DTFT and Z-Transform (9 Hrs)

Discrete-time Fourier series, Frequency range, Discrete-time Fourier transform-properties, Frequency response, ideal filters, Z-transform and its properties- inverse z-transforms- system function- stability criterion- Solving difference equations using Z-transform.

Realization of IIR systems- direct form-I, direct form –II, cascade form and parallel forms. Realization of FIR systems-direct form, linear phase realization, cascade and parallel forms.

UNIT III DFT and FFT (9 Hrs)

Discrete Fourier Transform, Relationship of the DFT to other transforms, Properties of DFT, circular convolution, filtering long duration sequences, parameter selection to calculate DFT. Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure- FFT applications.

UNIT IV Design of Digital Filters (9 Hrs)

FIR filter design: Linear phase characteristics- Windowing technique of designing FIR filter–Need and choice of windows, frequency sampling method.

IIR filter design: Analog filter design - Butterworth and Chebyshev filters, digital design usingimpulse invariant and bilinear transformation – War ping effect, prewarping.

UNIT V Finite Word Length Effects in Digital Filters (9 Hrs)

Number representation, quantization, rounding truncation. Input quantization error, Product quantization error, Coefficient quantization error, Overflow limit cycle oscillations, Zero input limit cycle oscillation, Scaling. Finite word length effects in computation of DFT using direct evaluation and FFT algorithms.

Text Books

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.

3. Willliam K Pratt, “Digital Image Processing”, John Willey, 2002.

Reference Books

1. P. Ramesh Babu, Digital Signal Processing, Seventh edition, Scitech publications, 2017.
2. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, Discrete – Time Signal Processing, Pearson Education, New Delhi, 2003.
3. Johny R. Johnson : Introduction to Digital Signal Processing, Prentice Hall, 2004.
4. J.GProakis and D.G.Manolakis, Digital Signal Processing Principles, Algorithms and Applications, Pearson Education/ PHI, New Delhi, 2011.
5. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.

Web References

1. http://eeweb.poly.edu/~onur/lectures/lectures.html.
2. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3. https://nptel.ac.in/courses/117/105/117105079/

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

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

U20ICE402	ELECTRIC AND HYBRID VEHICLES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To expose the working of different configurations of electric vehicles
- To incorporate different energy storage technologies used for hybrid electric vehicles and their control
- To provide a comprehensive overview of a electric and hybrid electric vehicle
- To impart knowledge on the sources utilized for hybrid electric vehicle.
- To impart knowledge on the electric propulsion system

Course Outcomes

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

CO1 - Understand the architecture of electric vehicles. **(K2)**
CO2 - Understand the basic concept of Hybrid electric vehicles **(K2)**
CO3 - Critically evaluate the strength and limitations of electric propulsion systems.**(K3)**
CO4 - Examine various storage technologies and sizing of storage for independent systems. **(K2)**
CO5 - Design and develop a solar based vehicle with suitable techniques and ability to acknowledge the society about the need of hybrid vehicle system. **(K3)**

UNIT I ELECTRIC VEHICLES (9 Hrs)

Architecture of an electric vehicle, impact of modern drive, essentials and performance of electric vehicles – Traction motor characteristics, attractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations.

UNIT II HYBRID VEHICLES (9 Hrs)

Hybrid electric drive trains – Basic concepts of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, fuel efficiency analysis, Merits and Demerits.

UNIT III ELECTRIC PROPULSION SYSTEMS (9 Hrs)

DC motor drives, induction motor drives, permanent magnet motor drives and switched reluctance motor drives. Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis

UNIT IV ENERGY STORAGE DEVICES (9 Hrs)

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles -Electrochemical batteries – Reactions, thermodynamic voltage, lead-acid batteries, nickel-based batteries, lithium-based batteries, flywheel and ultra-capacitors, Battery management systems.

UNIT V HYBRID SOLAR VEHICLES (9 Hrs)

Impact on hybrid Solar vehicles, Fuel cell thermodynamics, operating principle, fuel cell technologies, fuel reforming, hydrogen production and storage. Photovoltaic cell, maximum power point tracking, solar powered accessories, hybrid solar vehicles.

Text Books

1. MehrdadEhsani, Yimin Gao, sebastien E. Gay and Ali Emadi, —Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design‖, CRC Press, second edition,2010.
2. Iqbal Husain, —Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011.
3. Chris Mi, M. AbulMasrur, David WenzhongGao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2011.

Reference Books

1. Seref Soylu —Electric Vehicles - The Benefits and Barriers ll, InTech Publishers, Croatia, 2011.
2. Aulice Scibioh M. and Viswanathan B., —Fuel Cells – Principles and Applicationsll, University Press, India, 2007
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
4. Mehrdad Ehsani, Yimi Gao, Senastian E. Gay, Ali Emandi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
5. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2005

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1. https://nptel.ac.in/courses/108103009/
2. http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric%2C%20Hybrid%20Electric%20%26%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf
3. https://www.youtube.com/watch?v=uoBuOQn9XAQ

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

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

U20ICE403	COMMUNICATION SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce different methods of analog communication and their significance
- To introduce Digital Communication methods for high bit rate transmission.
- To impart knowledge on the concepts of source and line coding techniques for enhancing rating of transmission of minimizing the errors in transmission.
- To enhance knowledge on Fiber optical communications
- To enhance the knowledge on mobile communication.

Course Outcomes

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

CO1 - Ability to understand and analyze, linear and digital electronic circuits. **(K2)**
CO2 - Understand the Pulse and digital modulation systems. **(K2)**
CO3 - Use data and pulse communication techniques in microwave and satellite communication systems. **(K1)**
CO4 - Understand the importance of fiber optic technics in communication field. **(K2)**
CO5 - Apply the concepts and techniques in real time applications. **(K3)**

UNIT I ANALOG MODULATION SYSTEMS (9 Hrs)

Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM – Power relation –Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.

UNIT II PULSE AND DIGITAL MODULATION SYSTEMS (9 Hrs)

Principles of pulse modulation – sampling theorem, PAM – PWM – PPM– Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction to digital modulation systems – PCM, ASK, FSK and PSK.

UNIT III MICROWAVE AND SATELLITE COMMUNICATION SYSTEMS (9 Hrs)

Microwave communication systems: advantage, block diagram of a microwave radio system, microwave radio stations-Terminal station and repeater station. Satellite Communication system: Satellite Orbits, launch vehicles, look angles, satellite parameters, satellite link model, personal communication systems- GPS services

UNIT IV FIBER OPTICAL COMMUNICATION SYSTEMS (9 Hrs)

Need for fiber optics, introduction to optical fiber, principle of light transmission through a fiber, fiber characteristics and classification, various fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system- Power budget analysis for a optical link-Recent applications of fiber optics

UNIT V CELLULAR MOBILE COMMUNICATION (9 Hrs)

Cellular concept, basic cellular concept and its operation, uniqueness of mobile radio environment- Performance metrics in cellular system-Elements of cellular mobile radio-Handoff- Frequency management and channel assignment- Introduction to various cellular standards like AMPS, GSM, GPRS, IS-95A, IS-95B, CDMA-2000 and WCDMA

Text Books

1. Kennedy Davis, “Electronic Communication Systems”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1999.
2. Wayne Tomasi, “Electronic Communication Systems”, Pearson education Private Limited, Delhi, 2004.

3. Taub & Schiling “Principles of Communication Systems” Tata McGraw Hill 2007.

Reference Books

1. Roddy D and Coolen J, “Electronic Communications”, Prentice Hall of India Private Limited, fourth edition, 2007.
2. William C.Y. Lee, “Mobile Cellular Telecommunication Systems”, McGraw Hill International Edition, Second edition, 2006.
3. Gerd Keiser, “Optical fiber Communications”, McGraw Hill International Edition, Fourth edition, 2006
4. Sklar “Digital Communication Fundamentals and Applications” Pearson Education, 2001.
5. Bary le, Memuschmidt, Digital Communication, Kluwer Publication, 2004.

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

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

U20ICE404	ELECTRIC DRIVES AND CONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart basic knowledge on the development of drives and the types of control
- To expose students to the operation, application electric drives to cater the industrial needs.
- To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications
- To provide a strong foundation to assess performance of different industrial drives considering issues such as, energy efficiency, power quality, economic justification, environmental issues, and practical viabilities.
- To impart knowledge on digital control techniques.

Course Outcomes

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

CO1 - Understand the basics of electric drive to handle it in industrial areas where use of electric drives is essential. **(K2)**

CO2 - Examine the induction motor and DC drives in the aspects of control techniques.**(K5)**

CO3 - Understand the operation of synchronous and BLDC motor drives **(K2)**

CO4 - Elucidate the principle and working of Reluctance Motor drives **(K2)**

CO5 - Acquaintance knowledge on digital control and drive applications.**(K3**)

UNIT I INTRODUCTION TO ELECTRIC DRIVES (9 Hrs)

History and development of electric drives, Characteristics of Electrical & mechanical loads, Classification of electric drives, Basic elements & advantages of variable speed drives. Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation.

UNIT II DC Drives and INDUCTION MOTOR DRIVES (9 Hrs)

DC Drives: Speed control of DC motors - Chopper fed DC drives - Single, two and four quadrant operations

Induction Motor Drives**:** Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Krammer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives.

UNIT III SYNCHRONOUS MOTOR AND BLDC MOTOR DRIVES (9 Hrs)

Speed control of 3 phase Synchronous Motors - True synchronous and self-controlled modes of operation - PMSM: principle-flux density distribution-Types. BLDC motor: Principle-drive scheme - converter topologies.

UNIT IV RELUCTANCE MOTOR DRIVES (9 Hrs)

DC servo drives -principle of operation - AC servo drives- principle of operation - Stepper motor –principle of operation –SRM drives - principle of operation - drives. Introduction to synRM drives.

UNIT V DIGITAL CONTROL AND DRIVE APPLICATIONS (9 Hrs)

Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes. Solar and battery powered drives.

Text Books

1. Dubey G K, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2012.
2. Bose B K, —Modern Power Electronics and AC Drives", Pearson Education, New Delhi, 2009.

3. Nagrath .I.J. and Kothari .D.P, Electrical Machines, Tata McGraw-Hill, 2006

Reference Books

1. Ion Boldea and Nasar S All, Electric Drives ll, CRC Press LLC, New York, 2005.
2. Krishnan R, —Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall of India, New Delhi, 2010.
3. Frank D. Petruzella, Industrial Electronics, McGraw Hill International Editions, 1996
4. S.K. Bhattacharya and S. Chatterjee, Industrial electronics and control, Tata Me Graw Hill 1995
5. Pillai. S.K A First Course on Electric Drives, Wiley Eastern Limited, 2012

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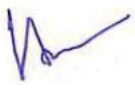
2. https://easyengineering.net/ee6351-electrical-drives-and-controls/
3. https://lecturenotes.in/subject/655/electrical-drives-and-controls-edc

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

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



U20ICE405	MECHATRONICS AND INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of mechatronics.
- To create a strong base on the various sensors and transducers in mechanical system.
- To learn interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems.
- To design control system for computer application like CNC.
- To create a base for recent advancement in various fields.

Course Outcomes

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

CO1 - Illustrate the approach of Mechatronics to engineering concepts. **(K2)**
CO2 - Classify the different types of sensors, transducers. **(K2)**
CO3 - Select an actuator and use of robot kinematics. **(K2)**
CO4 - Distinguish the different control and interfacing techniques. **(K2)**
CO5 - Compare the applications of mechatronics in the fields of automobile, robotics, medicine, manufacturing, office automation through case studies and also to formulate the design for mechatronics for industrial application. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Mechatronics: Definition & Key Issues - Evolution - Elements - Mechatronics Approach to Modern Engineering, Industrial design and safety Design

UNIT II SENSORS AND TRANSDUCERS (9 Hrs)

Introduction and background, difference between transducer and sensor, transducers types, transduction principle, photoelectric transducers- thermistors, thermodevices, thermocouple, inductive transducers capacitive transducers, piezoelectric transducers, piezoelectric transducers. Hall Effect transducers, Fiber optic transducers, Signal Processing - Data Display.

UNIT III ACTUATION SYSTEMS (9 Hrs)

Introduction to Mechanical Types and Electrical Types - Pneumatic & Hydraulic Systems - Applications - Selection of Actuators, Kinematics of robot manipulator links.

UNIT IV DIGITAL AND CONTROL SYSTEMS (9 Hrs)

Digital logic neuron system, Types of Controllers - Programmable Logic Controllers - applications - ladder diagrams - Microprocessor Applications in Mechatronics: Temperature measurement system, Domestic washing machine - Programming Interfacing - Computer Applications: CNC drilling machine.

UNIT V RECENT ADVANCES (9 Hrs)

Manufacturing Mechatronics - Automobile Mechatronics - Medical Mechatronics - Office Automation – Case Studies.

Text Books

1. Paul P.L. Regtien, Edwin Dertien, "Sensors for Mechatronics", Second edition, Elsevier, 2018.
2. Robert H. Bishop, "Mechatronic Systems, Sensors, and Actuators: Fundamentals and Modeling
3. The Mechatronics Handbook", Second Edition, CRC Press, 2017.
4. Bolton W., "Mechatronics", 2nd Edition, Pearson education, 5th Indian Reprint, 2003.

Reference Books

1. Clarence W. de Silva, FarbodKhoshnoud, Maoqing Li, Saman K. Halgamuge, “Mechatronics: Fundamentals and Applications”, CRC press, 2016..
2. TeodorPiatek, “Mechatronic Systems Applications”, Scitus Academics LLC, 2016.
3. Ganesh S. Hegde, “Mechatronics Engineering series Infinity Science Series”, Jones & Bartlett Learning, 2010.
4. Rajput R.K., “A Textbook of Mechatronics”, S. Chand & Co, 2007.

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2. http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html
3. https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.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	-	-	-	2	-	-	-	-	2	-	-	1	-	1
2	2	-	-	-	2	-	-	-	-	2	-	-	1	-	1
3	2	1	1	-	2	-	-	-	-	2	-	-	1	-	1
4	2	-	-	-	2	-	-	-	-	2	-	-	1	-	1
5	2	1	1	-	2	-	-	-	-	2	-	-	1	-	1

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

U20ICE506	TELEMETRY AND TELECONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To enable the students to study the fundamentals of Telemetry & Tele control systems.
- To impart knowledge on landline Telemetry systems.
- To impart knowledge on various multiplexing techniques.
- To impart knowledge on satellite telemetry and optical fibres.
- To impart knowledge on various Telemetry Control techniques.

Course Outcomes

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

CO1 - Understand about the telemetry principles and methods. **(K1)**
CO2 - Understand about the landline telemetry systems. **(K2)**
CO3 - Study about different multiplexing techniques. **(K2)**
CO4 - Analyze the satellite and optical telemetry systems. **(K1)**
CO5 - Acknowledge the various telecontrol Methods. **(K2)**

UNIT I TELEMETRY PRINCIPLES (9 Hrs)

Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency, and Power Line Carrier Communication.

UNIT II LAND LINE TELEMETRY (9 Hrs)

Electrical Telemetry-Current Systems – Voltage Systems – Synchro Systems – Frequency systems – Position and Pulse systems – Example of a landline telemetry system.

UNIT III FREQUENCY DIVISION AND TIME DIVISION MULTIPLEXING (9 Hrs)

FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL. TDM- PAM systems, PAM /PM and TDM–PCM Systems. PCM reception. Differential PCM. Modems-Introduction, QAM, Modem Protocols.

UNIT IV SATELLITE AND OPTICAL TELEMETRY (9 Hrs)

General considerations, TT&C Service, Digital Transmission systems, TT&C Subsystems, satellite Telemetry and Communications. Optical fibers Cable – dispersion, losses, connectors and splicers, Sources and detectors, Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System, WDM.

UNIT V TELECONTROL METHODS (9 Hrs)

Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance and regulation – Telecontrol using information theory – Example of a Telecontrol System.

Text Books

1. D. Patranabis, Telemetry Principles, Tata McGraw2013
2. Swoboda G., Telecontrol Methods and Applications of Telemetry and Remote Control, Reinhold Publishing Corp. 2007.
3. Modern Digital and Analog Communication Systems - B. P. Lathi, Oxford University Press

Reference Books

1. Gruenberg L., Handbook of Telemetry and Remote Control, McGraw Hill, New York, 2016
2. Young R.E., Telemetry Engineering, Little Books Ltd., London, 2012.
3. Housley T., Data Communication and Teleprocessing System, PH Intl., Englewood Cliffs, New Jersey, 2012.

4. Principles of Electronics Communication Systems - Louise Frenzel TMH2008 3rd edition
5. Frank Carden, Russell P.Jedicka, Robert Henry, “Telemetry System Engineering”, Artech house, 2002.

Web References

1. https://new.siemens.com/global/en/products/automation/industrial-communication/industrial-remote-communication/telecontrol.html
2. https://www.youtube.com/watch?v=9ZDP-NffdXQ.
3. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-851-satellite-engineering-fall-2003/lecture-notes/l20_satellitettc.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	-	1	-	-	2	-	-	-	-	-	-	2	-	1
2	3	-	1	-	-	2	-	-	-	-	-	-	2	-	1
3	3	-	1	-	-	1	-	-	-	-	-	-	2	-	-
4	3	-	1	-	-	2	-	-	-	-	-	-	2	-	1
5	3	-	1	-	-	1	-	-	-	-	-	-	3	-	-

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

U20ICE507	NON-LINEAR CONTROL SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide knowledge on design in state space analysis.
- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To provide knowledge in stability concept.

Course Outcomes

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

CO1 - Apply advanced control theory to practical engineering problems. **(K1)**
CO2 - Design in state space analysis. **(K2)**
CO3 - Study the stability of linear and nonlinear systems by Lyapunov method. **(K1)**
CO4 - Design of digital controller. **(K2)**
CO5 - Study of discrete system design stability concept**. (K1)**

UNIT I STATE SPACE MODEL (9 Hrs)

Introduction to State Space, State Variables, Physical Variables, Phase Variables-Matrices, Eigen Values and Eigen vectors - Diagonalization, Canonical and Jordan forms - State Space Models from Differential Equations - Conversion of State Variable Models to Transfer Function.

UNIT II MATHEMATICAL ANALYSIS (9 Hrs)

Computation of State Transition Matrix - Laplace Transformation Method, Canonical Transformation - Cayley Hamilton Theorem- Solution of State Equation. Concepts of Controllability and Observability.

UNIT III PHASE PLANE ANALYSIS (9 Hrs)

Features of linear and non-linear systems - Common physical non-linearity – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT IV DESCRIBING FUNCTION ANALYSIS (9 Hrs)

General Properties of Non-Linear Systems - Describing Function Method - On / Off, Dead Zone, Saturation and Hysteresis Non Linearity - Determination of Limit Cycle by Describing Function. Stability of oscillations.

UNIT V STABILITY ANALYSIS (9 Hrs)

Stability concepts - Equilibrium points - BIBO and asymptotic stability, Lyapunov Theory, Definitions (Stability and Functions). Direct method of Lyapunov, Application to non-linear problems.Stability analysis by describing function method –jump resonance. Frequency domain stability criteria

Text Books

1. Benjamin C. Kuo, ‘Digital Control Systems’, Oxford University Press, Tenth Edition 2018.
2. George J. Thaler, ‘Automatic Control Systems’, Jaico Publishers, 2013.
3. Jain R.K., “Mechanical and Industrial Measurements”, Khanna Publishers, 11th edition, Reprint 2005.

Reference Books

1. Nagrath I J and Gopal M, Control System Engineering, New Age International Pvt Ltd, Sixth Edition, 2017. Murthy D.V.S., “Transducers and Instrumentation”, Prentice Hall of India, 13th printing, 2006.
2. Benjamin C Kuo, —Automatic Control Systemsǁ, Prentice Hall India Pvt. Ltd, Ninth Edition, 2015.

3. Smarajith Ghosh, —Control Systems Theory and Applications‖, Pearson Education, Singapore, Sixth Edition, 2015.

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1. https://lecturenotes.in/subject/111/advanced-control-systems-acs
2. https://nptel.ac.in/courses/108103007/
3. https://freevideolectures.com/course/3488/advanced-control-systems

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

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

U20ICE508	INDUSTRIAL ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide knowledge on regulated power supplies.
- To educate on higher power rating devices.
- To learn operation of DC motor control using SCR.
- To introduce industrial timers for sequential tasks.
- To understand the principle and working operation of industrial heating applications.

Course Outcomes

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

CO1 - Understand the principle and operation of regulated supplies and types of SCR. **(K1)**
CO2 - Elucidate the applications of SCR in various circuitry operation. **(K2)**
CO3 - Examine the Role of SCR in DC motor control circuit. **(K1)**
CO4 - Acquaintance the knowledge on industrial timers. **(K2)**
CO5 - Understand the concept of industrial Heating applications. **(K1)**

UNIT I REGULATED SUPPLIES AND SCRS (9 Hrs)

Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3- terminal Voltage regulators, Current boosting .Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors, Ratings of SCR.

UNIT II APPLICATIONS OF SCRS-I (9 Hrs)

Static circuit breaker, Protection of SCR, Inverters, Classification, Single Phase inverters, Converters, single phase Half wave and Full wave. Chopper circuits, Principle, methods and Configurations, Diac and Triac, Triacs, Triggering modes, Firing Circuits, Commutation.

UNIT III APPLICATIONS OF SCRS-II (9 Hrs)

Voltage compensator – solid state DC voltage regulation – DC shunt motor – armature control and field control of motor speed – electronic control of DC motor – speed regulator action – full wave motor speed regulation by one SCR.

UNIT IV INDUSTRIAL TIMERS (9 Hrs)

Industrial timers -Classification, types, Electronic Timers, Classification, RC and Digital timers, Time base Generators. Electric Welding, Classification, types and methods of Resistance and ARC wielding

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UNIT V INDUSTRIAL HEATING APPLICATIONS (9 Hrs)

High Frequency heating, principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating, principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics, Generation and Applications.

Text Books

1. Industrial and Power Electronics, G.K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003
2. Integrated Electronics, J. Millman and C.C Halkias, McGraw Hill, 2017.

Reference Books

1. Industrial electronics and control, S.K. Bhattacharya and S.chatterjee, Tata Me Graw Hill, 2017.
2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.
3. Frank D. Petruzella, Industrial Electronics, McGraw Hill International Editions, 1996.

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1. https://nptel.ac.in/courses/108/105/108105066/
2. https://swayam.gov.in/nd1_noc19_ee37/

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

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

U20ICE509	MEMS AND NEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the concepts of micro and nano electromechanical devices
- To know the fabrication process of Microsystems
- To know the design concepts of micro sensors
- To introduce the concepts of micro actuators
- To Design and learn about the nono devices

Course Outcomes

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

CO1 - Interpret the basics of micro/nano electromechanical systems **(K2)**
CO2 - Recognize the use of materials in micro fabrication and describe the fabrication **(K2)**
CO3 - Analyze the key performance aspects of electromechanical transducers **(K3)**
CO4 - Comprehend the theoretical foundations of micro actuators **(K2)**
CO5 - Analyze the efforts of Nano Devices **(K3)**

UNIT I INTRODUCTION TO MEMS AND NEMS (9 Hrs)

Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES (9 Hrs)

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

UNIT III MICRO SENSORS (9 Hrs)

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester

UNIT IV MICRO ACTUATORS (9 Hrs)

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.

UNIT V NANO DEVICES (9 Hrs)

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnOnanorods based NEMS device: Gas sensor.

Text Books

1. Marc Madou, “Fundamentals of Micro fabrication”, CRC press 2009
2. Stephen D. Senturia, “Micro system Design”, Kluwer Academic Publishers,2001
3. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2012

Reference Books

1. Chang Liu, —Foundations of MEMS, Pearson education India limited, 2006
2. Sergey Edward Lyshevski, —MEMS and NEMS: Systems, Devices, and Structures‖ CRC Press, 2002

Web References

1. https://ieeexplore.ieee.org/document/8352606
2. https://www.theiet.org/publishing/inspec/researching-hot-topics/mems-to-nems/

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

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

U20ICE510	INDUSTRIAL UNIT OPERATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge on pertaining to overview of unit operations.
- To give an idea about unit operations in transport of solids, liquids & gases
- To understand the various unit operations involved in chemical reactors, steam boilers, furnaces.
- To Gain knowledge about the operations of evaporators, crystallizers and dryers.
- To Gain knowledge on the operation of Pumps, compressors, and centrifuges.

Course Outcomes

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

CO1 - Define unit operations, unit process and types of reactions involved in different industries. **(K2)**

CO2 - Understand the unit operations in transportation of solids, liquids and gases. **(K2)**

CO3 - Develop knowledge on the unit operations in different processes of distillation. **(K2)**

CO4 - Outline the working principle and operation of different processes of Dryers, Crystallizers and Evaporators. **(K2)**

CO5 - Analyze the unit operation in pumps compressors with case studies. **(K3)**

UNIT I OVERVIEW OF UNIT OPERATIONS (9 Hrs)

Introduction to industrial processes - Concepts of unit operations and unit processes - Material balance and energy balance -Types of reactions - General idea of controlling operations.

UNIT II TRANSPORT OF SOLIDS, LIQUIDS AND GASES (9 Hrs)

Study of Unit operation in Transport of Solids, liquids and gases - Different crushers and grinders - Adjusting of particle size, Mixing- Separation- Leaching and extraction.

UNIT III DISTILLATION, CHEMICAL REACTORS, STEAM BOILERS, FURNACES (9 Hrs)

Study of Unit operation in Distillation: Flash distillation - Batch distillation- Continuous distillation- Operational features- construction and working principle of Chemical reactors- Steam boilers- Furnaces

UNIT IV DRYERS, CRYSTALLIZERS, EVAPORATOR (9 Hrs)

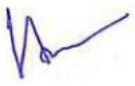
Study of Unit operation in Dryers, Crystallization, Evaporators, Heat exchangers, Humidification, De-humidification - Different types - operational features, construction and working principle.

UNIT V PUMPS, COMPRESSORS,EXTRUDERS, BLOWERS, CENTRIFUGES (9 Hrs)

Study of Unit operation in Pumps, Compressors, Extruders, Blowers, Centrifuges - operational features, construction and working principle. **Case studies:** Unit Operations and Control schemes applied to Thermal Power plant, Paper and Pulp Industry.

Text Books

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York,1988.
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, Sixth Edition,2001.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment Selection and Design", Gulf Professional Publishing,2010.



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1. Waddams, A.L., “Chemicals from petroleum”, Butler and Taner Ltd., UK,1969.
2. Liptak, B.G., “Process measurement and analysis”, Chilton Book Company, USA,1995
3. Luyben W.C., “Process Modeling, Simulation and Control for Chemical Engineers”, McGraw- Hill.
4. McCabe, W.L., J.C. Smith and P. Harriot, “Unit Operations of Chemical Engineering”. McGraw Hill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001 ,
5. Geankoplis C.J.1999. Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi.

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1. https://www.youtube.com/watch?v=9M0HqQEFL6k
2. https://nptel.ac.in/courses/103107127/
3. https://www.docsity.com/en/ontroductions-unit-operations-lecture-slides/394376/

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

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

U20BMCM01	SOFT COMPUTING (Common to ECE, ICE, BME, CCE) -	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge in the basics of fuzzy set.
- To learn the concepts of Optimization algorithms.
- To get familiarized with the learning schemes of neural networks.
- To understand with the design of fuzzy interface systems.
- To get exposed to neuro-fuzzy hybrid systems and its applications

Course Outcomes

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

CO1 - Gain knowledge in the basics of fuzzy set. **(K2)**
CO2 - Understand the concepts of optimization algorithms. **(K2)**
CO3 - Explain the terminologies and various learning schemes of Neural Networks. **(K3)**
CO4 - Gain knowledge in fuzzy interface systems. **(K3)**
CO5 - Familiarize with the neuro-fuzzy hybrid systems and its applications. **(K3)**

UNIT- I Introduction to Fuzzy Set **(9 Hrs)**

Fuzzy Sets – Basic Definition and Terminolo/7gy – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT- II Optimization **(9 Hrs)**

Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT- III Neural Networks **(9 Hrs)**

Introduction to Neural Networks - Supervised Learning Neural Networks – Perceptrons - Adaline – Back propagation Multilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT- IV Fuzzy Interface Systems **(9 Hrs)**

Type of fuzzy interface-Adaptive networks based Fuzzy interface systems – structure and parameters of a fuzzy system-Classification and Regression Trees - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation.

UNIT- V Applications of Hybrid Systems **(9 Hrs)**

Hybrid Systems -Neural Networks, Fuzzy Logic - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy Art Map: A Brief Introduction - Soft Computing Tools - Fuzzy Logic Controller.

Text Books

1. Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd. 2017.
2. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley Publications, 2nd Edition, 2011
3. Ross T. J., "Fuzzy Logic with Engineering Applications", McGraw Hill, 2016.

Reference Books

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education 2004
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw- Hill, 2011.
3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2002.
4. Martin T. Hagam Howard B. Deruth and Mark Beale, “Neural Network Design”, Thompson Learning, 2002.
5. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

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2. https://www.elprocus.com/soft-computing/
3. https://nptel.ac.in/courses/108/104/108104049/
4. http://www.myreaders.info/html/soft_computing.html
5. https://nptel.ac.in/courses/106/105/106105173/

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

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

U20ICCM02	VIRTUAL INSTRUMENTATION	L	T	P	C	Hrs
	(Common to EEE and ICE)	3	0	0	3	45

Course Objectives

- To Introduce the evolution, block diagram and architecture of VI.
- To get knowledge on basic Programming by using virtual instrumentation.
- To provide knowledge in programming Structure by VI tools.
- To provide knowledge in Different types of Arrays and Clusters by VI tools.
- To provide knowledge in Hardware Interfacing by VI tools.

Course Outcomes

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

CO1 - Understand the evolution, architecture, applications of visual instrumentation. **(K1)**
CO2 - Study about the basics of Programming by using virtual instrumentation. **(K1, K2)**
CO3 - Acquiring knowledge on VI programming Structure by VI tools. **(K1, K3)**
CO4 - Study about the different types of Arrays and Clusters by VI tools. **(K1)**
CO5 - Understanding the concept of instrument interfacing by VI tools. **(K1, K2)**

UNIT I INTRODUCTION (9 Hrs)

Evolutions of VI, advantages, block diagram and architecture of a virtual instrument-Graphical programming, and comparison with conventional programming.

UNIT II VI PROGRAMMING (9 Hrs)

Controls and indicators- Labels and Text –Shape, size and color- – Data type, Format, Precision and representation – Data types – Data flow programming-Editing – Debugging and Running a Virtual Instrument –Concept of sub VI.

UNIT III PROGRAMMING STRUCTURE (9 Hrs)

FOR Loops, WHILE Loops, CASE Structure, Formula nodes, Sequence structures- Attribute modes Local and Global variables.

UNIT IV ARRAYS AND CLUSTERS (9 Hrs)

Arrays and Clusters– Array Operations – Bundle – Bundle/Unbundle by name, graphs and charts – String and file I/O.

UNIT V HARDWARE INTERFACING (9 Hrs)

DAQ – Block diagram – Description - basic system components of a signal conditioning system- Interfacing with LabVIEW- Introduction to my RIO

Text Books

1. Gupta , Virtual Instrumentation Using Lab view 2nd Edition, Tata McGraw-Hill Education, 2010
2. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI Learning Pvt. Ltd., 2010

Reference Books

1. Gary Jonson, “Labview Graphical Programming”, Fourth Edition, McGraw Hill, New York, 2012
2. Gupta.S., Gupta.J.P., “PC interfacing for Data Acquisition and Process Control”, Second Edition, Instrument Society of America, 2012.
3. Sokoloff; “Basic concepts of Labview 4”, Prentice Hall Inc., New Jersey 2013.

Web References

1. https://www.ni.com/
2. https://www.youtube.com/user/Labview/playlists

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

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

U20ECCM02	ROBOTICS AND AUTOMATION (Common to ECE,EEE and ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce basic components required for Robot
- To analyze different control mechanism applied for Robotics
- To understand the concept of path planning in Robotics
- To Manipulate forward and inverse kinematics
- To understand application of robots in various fields

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 – Describe the components required for robotics **(K2)**

CO2 - Demonstrate control mechanism required for Robotics**(K3)**

CO3 - Explain path planning of Robotics**(K2)**

CO4 - Demonstrate forward and inverse kinematics**(K3)**

CO5 - Demonstrate application of Robots in industrial and other application**(K3)**

UNIT- I INTRODUCTION (9 Hrs)

Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horse power calculation, magnetostrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors – ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems – Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT - II ROBOT CONTROL (9 Hrs)

Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control.

UNIT - III END EFFECTORS (9 Hrs)

End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation-continuous path motion interpolated motion- straight line motion.

UNIT - IV ROBOT MOTION ANALYSIS (9 Hrs)

Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates- Homogeneous transformations and rotations and Robot dynamics.

UNIT - V ROBOT APPLICATIONS (9 Hrs)

Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

Text Books

1. Mikel P. Grover, 'Industrial Robots – Technology Programming and Applications', second edition, McGraw Hill, 2012
2. Robert J.Schilling 'Fundamentals of Robotics-Analysis and Control', PHI, 2015,
3 R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

Reference Books

1. K.S.Fu,R.C.Gonzalez, CSG. Lee, "Robotics, Control sensing vision and Intelligence", Tata Mcgraw-Hill, Indian edition, 2008.
2. JohnJ.Craig, "Introduction to Robotics Mechanics and Control", Third edition, Pearson Education 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, "Industrial Robotics", McGraw-Hill, Singapore, 2007

4. Ashitava Ghoshal, “Robotics-Fundamental Concepts and Analysis”, Oxford University Press, Sixth impression, 2010
5. B.K.Ghosh, “Control in Robotics and Automation: Sensor Based Integration”, Allied Publishers, Chennai,

Web References

1. https://robotics.nasa.gov/links/resources.php
2. https://hackernoon.com/16-best-resources-to-learn-robotics-and-iot-development-in-2019- 847bb93c9bd9
3. https://www.robotics.org/Online-Store
4. https://nptel.ac.in/courses/112/107/112107289/
5. https://www.mheducation.co.in/robotics-and-control-9780070482937-india

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	3	2	1
2	3	2	1	-	-	-	-	-	-	-	-	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

		L	T	P	C	Hrs.
U20EECM01	**RENEWABLE ENERGY SOURCES** (Common to EEE and ICE)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To impart knowledge on renewable energy sources and technologies.
- To gain adequate knowledge on variety of issues in harnessing renewable energy sources.
- To outline about the alternate renewable energy sources for both domestics and industrial applications.
- To provide knowledge about grid connectivity in renewable energy systems.
- To provide in-depth knowledge in the key concepts of energy policies.

Course Outcomes

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

CO1 - Analyze the national and international energy scenario of renewable energy Sources. **(K2)**
CO2 - Design the aerodynamics of wind turbines and calculate their energy production. **(K3)**
CO3 - Analyze electrical power generation from biomass, geothermal, tidal, wave etc. **(K2)**
CO4 - Analyze technical and sustainability issues involved in the integration of renewable energy systems. **(K2)**
CO5 - Compare the cost economics of using renewable energy sources with non-renewable energy sources. **(K2)**

UNIT I SOLAR ENERGY (9 Hrs)

Overview - Limitations of conventional energy resource - Importance of renewable sources - Types - Present Indian and international energy scenario. Solar Energy: solar thermal power and its energy conversion - solar collectors - types and applications. Photovoltaic (PV) technology - photovoltaic effect - efficiency of solar cells - Design Concept of solar PV system - standards and applications.

UNIT II WIND AND HYDRO POWER ENERGY (9 Hrs)

Wind Energy: wind data – properties - speed and power relation - wind turbines and electric generators - horizontal and vertical wind mills - wind energy farms - off-shore plants- Selection factors. Hydro Energy: small, mini and micro hydro power plants and their resource assessment - plant layout with major components -selection factors-application.

UNIT III ALTERNATE ENERGY SOURCES (9 Hrs)

Biomass: Photosynthesis and origin of biomass energy – terms and definitions – pyrolysis, thermo-chemical biomass conversion to energy, Geothermal: resources, hot spring, steam system, site selection, challenges. Ocean and Tidal energy: principle of OTEC – wave energy conversion machines – fundamentals of tidal power, conversion systems and limitations – Introduction to fuel cells.

UNIT IV GRID INTEGRATION (9 Hrs)

Wind power interconnection requirement - low-voltage ride through (LVRT), ramp-rate limitations, supply of ancillary services for frequency and voltage control - load and reserve requirement – issues in interconnection - steady - state and dynamic performance of power system – interfacing solar system with grid - protective relaying, islanding, Power quality issues.

UNIT V RENEWABLE ENERGY POLICY (9 Hrs)

Renewable energy policies: Five Year Plan programmes - Feed-in tariffs - portfolio standards - policy targets, tax incentives – bio-fuels mandates - International policies for climate change and energy security - Economic analysis and comparisons - Life cycle analysis - financial analysis - cost of conserved energy and externalities - Cost assessment of supply technologies versus energy – Efficiency - Renewable Energy Certification – Carbon contents.

Text Books

1. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Resources: Basic Principle and Application”, Alpha Science International Ltd, New Edition, 2005.
2. B. H. Khan, “Non-Conventional Energy Resources”, Tata McGraw Hill, 2nd Edition, 2009.
3. R. Loulou, P. R. Shukla and A. Kanudia, “Energy and Environment Policies for a sustainable Future”, Allied Publishers Ltd, New Delhi, 1997.

Reference Books

1. Solanki Chetan Singh, “Solar Photovoltaic - Fundamentals, Technologies and Applications”, PHI, New Delhi, 3rd Edition, 2015.
2. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, New York, 2nd Edition, 2011.
3. D. P. Kothari, K. C Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Learning Pvt. Ltd, New Delhi, 2nd Edition, 2013.
4. John Twidell and Tony Weir, “Renewable Energy Resources”, Routledge publication, 3rd Edition, 2015.
5. Godfrey Boyle, “Renewable Energy: Power for a Sustainable Future”, Oxford University Press, 3rd Edition, 2014.
6. A. K. Mukerjee and Nivedita Thakur, “Photovoltaic Systems: Analysis and Design”, PHI Learning Private Limited, New Delhi, 2011.
7. Ali Keyhani, “Design of Smart Power Grid Renewable Energy Systems”, Wiley Publication, 1st Edition, 2011.

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1. https://nptel.ac.in/courses/103/107/103107157/
2. www.renewableenergyworld.com/rea/tech/home
3. www.eschooltoday.com/energy/renewable-energy
4. https://www.chetansinghsolanki.in/course.php
5. https://nptel.ac.in/courses/108/108/108108078/

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

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

U20ICE615	DIGITAL CONTROL SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand digital feedback control systems.
- To develop a knowledge of constructing discrete-time mathematical model system
- To develop a knowledge of analysing the system behaviour using discrete-time model and evaluating the system performance.
- To develop knowledge to use controller design techniques.
- To make the system behaviour satisfies specified design objectives.

Course Outcomes

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

CO1 - Learn the digital feedback control systems. **(K1)**
CO2 - Acquire knowledge on discrete-time systems. **(K2)**
CO3 - Gain knowledge of digital control design. **(K1)**
CO4 - Evaluate and test the system performance using digital simulations. **(K2)**
CO5 - Acquire knowledge of State feedback design. **(K1)**

UNIT I INTRODUCTION TO DIGITAL CONTROL (9 Hrs)

Introduction-Discrete time system representation -Mathematical modelling of sampling process Data reconstruction -Modelling discrete-time systems by pulse transfer function, Revisiting Z-transform, Mapping of splane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system Sampled signal flow graph Stability analysis of discrete time systems, Jury stability test, Stability analysis using bi-linear transformation.

UNIT II RESPONSE OF DISCRETE TIME SYSTEMS (9 Hrs)

Time response of discrete systems, Transient and steady state responses, Time response parameters of a prototype second order system, Deadbeat response design, Design of digital control systems with deadbeat response , Practical issues with deadbeat response design, Sampled data control systems with deadbeat response.

UNIT III DIGITAL CONTROL SYSTEM DESIGN (9 Hrs)

Design of sampled data control systems, Root locus method, Controller design using root locus, Root locus based controller design using MATLAB, Nyquist stability criteria, Bode plot, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain.

UNIT IV DISCRETE STATE SPACE MODEL (9 Hrs)

Introduction to state variable model Various canonical forms Characteristic equation, state transition matrix Solution to discrete state equation, Controllability, observability and stability of discrete state space models Controllability and observability, Stability : Lyapunov stability theorem

UNIT V STATE FEEDBACK DESIGN (9 Hrs)

State feedback design, Pole placement by state feedback, Set point tracking controller, Full order observer, Reduced order observer, Output feedback design, Theory Examples, Introduction to optimal control, Basics of optimal control , Performance indices, Linear Quadratic Regulator (LQR) design.

Text Books

1. B. C. Kuo, Digital Control Systems, Oxford University Press, 2nd Indian Edition, 2007.
2. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, 2/e, 2003

Reference Books

1. K. Ogata, Discrete Time Control Systems, Prentice Hall, 2nd edition, 1995.
2. G. F. Franklin, J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems.
3. Addison Wesley, 1998, Pearson Education, Asia, 3rd edition, 2000.
4. K. J. Astroms and B. Witten mark, Computer Controlled Systems - Theory and Design, Prentice Hall, 3rd edition,1997.

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2. http://www.ece.mtu.edu/faculty/shiyan/EE4262Spring17/DigitalControlTextBook.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	2	2	-	-	-	-	-	-	-	-	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	-	2	2	3
3	3	3	3	3	-	-	-	-	-	-	-	-	2	2	3
4	3	2	3	2	-	-	-	-	-	-	-	-	2	2	3
5	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3

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

U20ICE716	POWER PLANT INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide an overview on power generation through various methods.
- To educate on the important power plant measurements and devices.
- To educate on basic Boiler control techniques.
- To Learn about Piping and Instrumentation diagrams and various instruments in Nuclear Power
- To study about the monitoring and control of turbines.

Course Outcomes

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

CO1 - Understand and analyze about the various Power Generation Methods. (K2)
CO2 - Analyze basic measurement in power plants. (K2)
CO3 - Recognize various analyzers for monitoring feed water impurity, flue gas etc. (K2)
CO4 - Learn about various Instruments used in nuclear power plants. (K2)
CO5 - Apply the knowledge to control and monitor the turbines. (K1)

UNIT I OVERVIEW OF POWERGENERATION (9 Hrs)

Survey of methods of power generation:– hydro, thermal, nuclear, solar and wind power– Importance of instrumentation in power generation – Thermal power plant – Building blocks - Combined Cycle System – Combined Heat and Power System – sub critical and supercritical boilers.

UNIT II MEASUREMENTS IN POWER PLANTS (9 Hrs)

Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement – Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.

UNIT III BOILER CONTROL (9 Hrs)

Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Control of deaerator – Drum level control – Single, two and three element control – Furnace draft control – implosion - flue gas dew point control – Trimming of combustion air – Soot blowing.

UNIT IV INSTRUMENTATION IN NUCLEAR POWER PLANT (9 Hrs)

Piping and instrumentation diagram of different types of nuclear power plants-radiation detection instruments-process sensors for nuclear power plants-spectrum analyzers-nuclear reactor control systems and allied instrumentation.

UNIT V TURBINE MONITORING AND CONTROL (9 Hrs)

Speed, vibration, shell temperature monitoring and control – Steam pressure control – Lubricant oil temperature control – Cooling system.

Text Books

1. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company,2013.
2. P.K.Nag, Powerplant Engineering, Tata McGraw-Hill Education, 3rd edition,2011.
3. Power-plant Control and Instrumentation, The Control of Boilers and HRSG Systems, By David Lindsley, 2000.

Reference Books

1. Sam Dukelow, Control of Boilers, Instrument Society of America, 2012.
2. Jain R.K., Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 2012.
3. Power plant instrumentation, by k. Krishnaswamy, m. Ponnibala · 2013

Web References

1. www.ignou.ac.in/upload/Unit-2-58.pdf
2. http://www.powerplantinstrumentationcontrol.yolasite.com/
3.https://electrical-engineering-portal.com/download-center/books-and-guides/power-substations/power-plant-control

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

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

U20ICE717	AUTOMOTIVE INSTRUMENTATION SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge on the automobile system, its subsystems and components.
- To expose the students to the concepts of various sensors used in automobile systems.
- To teach the basic and advanced controls in automotive systems.
- To learn the active and passive safety systems.
- To impart knowledge about the electronics and protocol involved in automotive systems.

Course Outcomes

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

CO1 - Identify the automotive system and its components. **(K1)**
CO2 - Attain knowledge of various sensors and conditioning circuits used in automotive systems. **(K1, K2)**
CO3 - Gain knowledge about various control strategies. **(K1, K2)**
CO4 - Acquaint the types of active and passive safety systems. **(K1)**
CO5 - Understand the automotive standards and protocols in the system. **(K1, K2)**

UNIT I INTRODUCTION OF AUTOMOBILE SYSTEM (9 Hrs)

Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.

UNIT II ENGINE MANAGEMENT SYSTEMS (9 Hrs)

Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.

UNIT III VEHICLE POWERTRAIN AND MOTION CONTROL (9 Hrs)

Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.

UNIT IV ACTIVE AND PASSIVE SAFETY SYSTEM (9 Hrs)

Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags.

UNIT V AUTOMOTIVE STANDARDS AND PROTOCOLS (9 Hrs)

Automotive standards like CAN protocol, LIN protocol, FLEX RAY, Head-Up Display (HUD), OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262).
System design and energy management: BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotives and instrumentation systems.

Text Books

1. William B. Ribbens, “Understanding Automotive Electronics”, Butterworth-Heinemann publications, 7th Edition, 2012.

Reference Books

1. Young A.P., Griffiths L., “Automotive Electrical Equipment”, ELBS and New Press, 2010.
2. Tom Weather Jr., Cland C. Hunter, “Automotive computers and control system”, Prentice Hall Inc., New Jersey,2009.
3. Crouse W.H., “Automobile Electrical Equipment”, McGraw Hill Co. Inc., New York, 2005.
4. Bechtold, “Understanding Automotive Electronic”, SAE, 2010.
5. BOSCH, “Automotive Hand Book”, Bentely Publishers, Germany, 9th Edition, 2014.

Web References:

1. https://www.globalspec.com/reference/40076/203279/chapter-9-automotive-instrumentation-and-telematics
2. https://sites.google.com/site/sjredu/subje/instru-auto
3. https://www.gtvinc.com/advances-automotive-instrumentation/
4. https://www.kacsik.com/industries/automotive

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

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

U20ICE718	INDUSTRY 4.0	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide the basic knowledge of Industry 4.0
- To learn a Conceptual Framework for Industry 4.0
- To learn the Technology Roadmap for Industry 4.0
- To get knowledge of Advances in Robotics in the Era of Industry 4.0
- To provide the knowledge of Obstacles and Framework Conditions for Industry 4.0

Course Outcomes

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

CO1 - Know the Industry 4.0. **(K1)**
CO2 - Demonstrate conceptual framework and road map of Industry 4.0 **(K2)**
CO3 - Demonstrate road map of Industry 4.0 **(K3)**
CO4 - Describe Robotic technology and Augmented reality for Industry 4.0. **(K2)**
CO5 - Demonstrate obstacle and framework conditions for Industry 4.0 **(K3)**

UNIT I INTRODUCTION TO INDUSTRY 4.0 **(9 Hrs)**

Introduction, core idea of Industry 4.0, origin concept of industry 4.0, Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0

UNIT II A CONCEPTUAL FRAMEWORK FOR INDUSTRY 4.0 **(9 Hrs)**

Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.

UNIT III TECHNOLOGY ROADMAP FOR INDUSTRY 4.0 **(9 Hrs)**

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

UNIT IV ADVANCES IN ROBOTICS IN THE ERA OF INDUSTRY 4.0 **(9 Hrs)**

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. Introduction, Augmented Reality Hardware and Software Technology, Industrial Applications of AR.

UNIT V OBSTACLES AND FRAMEWORK CONDITIONS FOR INDUSTRY 4.0 **(9 Hrs)**

Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, state support, legal framework, protection of corporate data, liability, handling personal data.

Text Books

1. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer; 1st edition 2018.
2. Bartodziej, Christoph Jan, “The Concept Industry 4.0”, Springer Gabler; 1st ed. 2017 edition 2016.
3. Klaus Schwab, “The Fourth Industrial Revolution”, Currency 2017.
4. Christian Schröder, “The Challenges of Industry 4.0 for Small and Medium-sized Enterprises”, 2017.

Reference Books

1. Klaus Schwab, “Fourth Industrial Revolution”, Random House USA Inc, New York, USA, 2017.
2. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies”, Study lab Publications, 2016.
3. Alasdair Gilchrist, “INDUSTRY 4.0: Industrial Internet of Things”, Apress, 2016.
4. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, “Applied Cyber-Physical Systems”, Springer Publications, New York, 2013.

Web References

1. https://nptel.ac.in/courses/106/105/106105195/
2. https://www.ibm.com/in-en/topics/industry-4-0

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

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

		L	T	P	C	Hrs
U20ICE719	MODERN ELECTRONIC INSTRUMENTATION	3	0	0	3	45

Course Objectives

- To introduce the digital methods of measurements.
- To get knowledge on basic current trends in digital instrumentation.
- To provide knowledge in programming Structure by VI tools.
- To provide knowledge in Data Acquisition and VI Chassis Requirements by VI tools.
- To provide knowledge in VI Toolsets, Distributed I/O Modules.

Course Outcomes

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

CO1 - Understand the digital methods of measurements. **(K1)**
CO2 - Study about the basics current trends in digital instrumentation. **(K1)**
CO3 - Acquiring knowledge on programming Structure by VI tools. **(K1,K2)**
CO4 - Study about the Data Acquisition and VI Chassis Requirements by VI tools. **(K1)**
CO5 - Understanding the concept of instrument interfacing by VI tools. **(K1,K3)**

UNIT I DIGITAL METHODS OF MEASUREMENTS (9 Hrs)

Review of A/D, D/A techniques – F/V and V/F conversion techniques – Digital voltmeters and multimeters – Automation and accuracy of digital voltmeters and multimeters – Digital phase meters – Digital tachometers – Digital frequency, period and time measurements – Low frequency measurements – Automatic time and frequency scaling – Sources of error – Noise – Inherent error in digital meters, hidden errors in conventional ac measurements – RMS detector in digital multimeters – Mathematical aspects of RMS - Digital storage Oscilloscope.

UNIT II CURRENT TRENDS IN DIGITAL INSTRUMENTATION (9 Hrs)

Introduction to special function add on cards – Resistance card – Input and output cards –Digital equipment construction with modular designing; interfacing to microprocessor, micro controllers and computers - Computer aided software engineering tools (CASE) – Use of CASE tools in design and development of automated measuring systems – Interfacing IEEE cards – design of GPIB Systems - Intelligent and programmable instruments using computers-Data networks-CAN Bus, SMART/HART protocols

UNIT III VIRTUAL INSTRUMENTATION (9 Hrs)

Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI. VI programming techniques: 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, Instrument Drivers, Publishing measurement data in the web.

UNIT IV DATA ACQUISITION AND VI CHASSIS REQUIREMENTS (9 Hrs)

Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.

UNIT V VI TOOLSETS, DISTRIBUTED I/O MODULES (9 Hrs)

Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Textbooks

1. Bouwens, A.J., “Digital Instrumentation”, McGraw Hill, 2006.
2. Albert D. Helfrick & William D. Cooper, ‘Modern Electronic Instrumentation & Measurement Techniques’, Pearson India Education, 2016.
3. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 2001.
4. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI Publishers, New Delhi, Second Edition,2010.

References

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
2. Doebelin, ‘Measurement System, Application and Design’, IV Ed, McGraw-Hill, 1990.

Textbooks

1. Bouwens, A.J., “Digital Instrumentation”, McGraw Hill, 2006.
2. Albert D. Helfrick & William D. Cooper, ‘Modern Electronic Instrumentation & Measurement Techniques’, Pearson India Education, 2016.
3. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 2001.
4. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI Publishers, New Delhi, Second edition,2010.

References

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
2. Doebelin, ‘Measurement System, Application and Design’, IV Ed, McGraw-Hill, 1990.

Web Resources

1. https://www.ni.com/
2. https://www.youtube.com/user/Labview/playlists

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

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

U20ICE720	FIBER OPTICS AND LASER INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study in detail about optical fiber properties.
- To study in detail about optical fiber applications
- To study about lasers fundamentals and its properties.
- To study in detail about industrial applications of laser.
- To study about hologram and medical application of laser

Course Outcomes

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

CO1 - Understand the optical fiber and their properties **(K1)**
CO2 - Acquired knowledge of industrial application of optical fibres. **(K1)**
CO3 - Understand the laser fundamentals. **(K1)**
CO4 - Acquired knowledge of industrial application of lasers. **(K1, K2, K3)**
CO5 - Understand hologram and its medical applications. **(K1, K2, K3)**

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES (9 Hrs)

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics -Absorption losses - Scattering losses - Dispersion - Connectors and Splices - Optical Sources - Optical detectors.

UNIT II INDUSTRIAL APPLICATIONS OF OPTICAL FIBRES (9 Hrs)

Fibre Optic Sensors - Fibre Optic Instrumentation System – Electro optic, Acousto-optic and Travelling Wave Modulators - Interferometric Method of Measurement of Length – Moire fringes – Measurement of Pressure, Temperature, Current, Voltage, Liquid level and Strain.

UNIT III LASER FUNDAMENTALS (9 Hrs)

Fundamental Characteristics of Lasers – Three level and Four level Lasers - Properties of Lasers - Laser Modes -Resonator Configuration – Q-Switching and Mode locking – Cavity dumping - Types of Lasers – Gas lasers, Solid lasers, Liquid lasers, Semiconductor lasers

UNIT IV INDUSTRIAL APPLICATIONS OF LASERS (9 Hrs)

Laser for measurement of Distance, Length, Velocity, Acceleration, Current, Voltage and Atmospheric Effect - Material Processing - Laser heating, Welding, Melting and Trimming of Material - Removal and Vaporization

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS (9 Hrs)

Holography - Basic Principle - Methods - Holographic interferometry and applications, Holography for non-destructive Testing - Medical Applications of Lasers, Lasers and Tissue interaction - Laser Instrumentations for surgery, Removal of Tumours of Vocal cords, Brain surgery, Plastic surgery.

Text Books

1. G.Keiser, Optical Fibre Communication, McGraw Hill, 2013.
2. Ajoyghatak K. Thyagarajan, Optical Electronics, Cambrige University Press, 2010.

Reference Books

1. J.M.Senior, OFC – Principles and Practice,PH1,2009
2. J.Wilson and J.F.Bhawkes, Introduction to Optical Electronics, PH1, 2001
3. Dr.Manjeet Singh, Lasers – Theory, Principles and Applications, VEI, Vayn Education India, 2011

4. Mr.Gupta, Fibre Optics Communication, PH1, 2004.
5. R.P. Khare, —Fiber Optics and Optoelectronicsǁ, Oxford University Press, 2008.

Web References

1. https://nptel.ac.in/courses/108101093/
2. http://www.brainkart.com/subject/Fiber-optics-and-Laser-instruments_190
3. https://sites.google.com/site/smartice2015/my-forms/applied-soft-computing

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

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

U20ICE821	INDUSTRIAL SAFETY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide the concept of Industrial Safety and provide knowledge for workplace safety.
- To acquire knowledge in identification, evaluation and control of all the hazards.
- To prevent wear, corrosion and the prevention methods.
- To conduct the fault tracing in machineries.
- To conduct periodic and preventive maintenance.

Course Outcomes

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

CO1 - Identify hazard and potential hazard areas. **(K1)**
CO2 - Develop safety programs to prevent or mitigate damage or losses. **(K2)**
CO3 - Acquire knowledge on wear, corrosion and its preventive methods. **(K2)**
CO4 - Understand the fault tracing in machineries. **(K2)**
CO5 - Develop knowledge on periodic and preventive maintenance. **(K2)**

UNIT I INDUSTRIAL SAFETY (9 Hrs)

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, 103 cleanliness, fire, guarding, pressure vessels, etc., Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING (9 Hrs)

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost and its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION (9 Hrs)

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING (9 Hrs)

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE (9 Hrs)

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Text Books

1. Keith Mobley, “Maintenance Engineering Handbook”, McGraw-hill education, eighth edition, 2014.
2. Sushil Kumar Srivastava, Maintenance Engineering and Management, S. Chand and Company Ltd, 2006.

Reference Books

1. M.P.Poonia, S.C.Sharma, “Industrial Safety Maintenance Management”, Khanna Publication, 2018.
2. C.Ray Asfahl, David W.Rieske, “Industrial Safety and health Management”, 5th Edition, Prentice Hall, London,2010.

Web References

1. https://www.safeopedia.com/definition/1052/industrial-safety
2. https://www.nistinstitute.com/blog/industrial-safety-scope-significance/
3. https://labour.gov.in/industrial-safety-health

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

COs/POs/PSOs Mapping

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

U20ICE822	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Introduce Non parametric methods.
- To impart knowledge on parameter estimation methods.
- To impart knowledge on Recursive identification methods.
- To impart knowledge on Adaptive control schemes.
- To introduce stability, Robustness and Applications of adaptive control methods.

Course Outcomes

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

CO1 - Apply advanced control theory to practical engineering problems **(K1)**
CO2 - Define basic concepts of parameter estimation methods. **(K2)**
CO3 - Understand the recursive least square method. **(K2)**
CO4 - Acquaint the various adaptive control schemes. **(K3)**
CO5 - Illustrate issues in adaptive control and applications **(K1)**

UNIT I NON-PARAMETRIC METHODS (9 Hrs)

Non parametric methods: Transient analysis–frequency analysis–Correlation analysis–Spectral analysis.

UNIT II PARAMETERIC ESTIMATION METHODS (9 Hrs)

Least square estimation – best linear unbiased estimation under linear constraints – updating the parameter estimates for linear regression models–prediction error methods: description of prediction methods – optimal prediction – relation between prediction error methods and other identification methods – theoretical analysis - Instrumental variable methods: Description of instrumental variable methods – Input signal design for identification.

UNIT III RECURSIVE IDENTIFICATION METHODS (9 Hrs)

The recursive least square method – the recursive instrumental variable methods- the recursive prediction error methods – Maximum likelihood. Identification of systems operating in closed loop: Identification considerations – direct identification – indirect identification

UNIT IV ADAPTIVE CONTROL SCHEMES (9 Hrs)

Introduction – Types of adaptive control–Gain scheduling controller–Model reference adaptive control schemes– Self tuning controller–MRAC and STC: Approaches–The Gradient approach – Lyapunov functions – Passivity theory – pole placement method – Minimum variance control – Predictive control.

UNIT V ISSUES IN ADAPTIVE CONTROL AND APPLICATIONS (9 Hrs)

State feedback design, Pole placement by state feedback, Set point tracking controller, Full order observer, Reduced order observer, Output feedback design, Theory Examples, Introduction to optimal control, Basics of optimal control, Performance indices, Linear Quadratic Regulator (LQR) design.

Text Books

1. Arun K. Tangirala, Principles of System Identification – Theory and Practice, CRC Press,2015.
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Pearson Education, Second edition, Fifth impression, 2009.
3. Kannan Moudgalya, Digital Control, JohnWiley & Sons, Ltd, 2007.

4. Sastry,S. and Bodson, M., Adaptive Control– Stability, Convergence and Robustness, Prentice Hall inc., New Jersey, 1989.
5. Soder storm T and Peter Stoica, System Identification, Prentice Hall International, 1989.

Reference Books

1. Bela. G. Liptak., “Process Control and Optimization, Instrument Engineers’ Handbook”, volume 2, CRC press and ISA, 2005.
2. William S. Levine, “Control Systems Advanced Methods, The Control Handbook”, CRC Press 2011.
3. Ljung L, “System Identification: Theory for the user”, Prentice Hall, Engle wood Cliffs,1987.

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2. https://nptel.ac.in/courses/108/102/108102113/
3. http://www.personal.reading.ac.uk/~shshawin/LN/SI2018.pdf.
4. https://uotechnology.edu.iq/dep-cse/lectures%202017/control/st4/Adaptive%20Control_5.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	1	1	2	1	-	-	-	-	-	-	2	2	1	2
2	3	3	3	2	2	-	-	-	-	-	-	2	2	2	2
3	3	2	3	2	2	-	-	-	-	-	-	2	2	2	3
4	2	1	1	2	1	-	-	-	-	-	-	2	2	3	3
5	3	2	3	2	2	-	-	-	-	-	-	2	2	1	3

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

U20ICE823	ADVANCED INSTRUMENTATION SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
- To explore the various types of analyzers used in industrial applications.
- To understand the requirement of safety instrumentation and risk analysis techniques.
- To familiarize with instrumentation standards.
- To familiarize with instrumentation symbols, process flow and piping diagrams.

Course Outcomes

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

CO1 - Understand the instrumentation behind flow, level, temperature and pressure measurement **(K1)**
CO2 - Acquire knowledge on various types of analyzers used in typical industries. **(K2)**
CO3 - Understand the role of safety instrumented systems in the industry. **(K1)**
CO4 - Explore the standards for applying instrumentation in hazardous locations. **(K2)**
CO5 - Design, develop and interpret the documents used to define instruments and control systems. **(K3)**

UNIT I MEASUREMENT OF PROCESS PARAMETERS (9 Hrs)

Review the various measurement techniques of temperature, pressure, flow and level- application- selection of sensors- calibration methods

UNIT II INSTRUMENTS FOR ANALYSIS (9 Hrs)

Ion selective electrodes: Gas and liquid chromatography- Oxygen analyzers for gas and liquid – CO, CO2, NO and SO Analyzers – Hydrocarbon and HS analyzers – Dust Analyzers, smoke analyzers, toxic gas analyzers and radiation monitoring.

UNIT III SAFETY INSTRUMENTATION (9 Hrs)

Introduction to safety instrumented systems – Hazards and Risk- Process Hazards Analysis (PHA) – Safety life cycle – Control and Safety Systems – Safety Instrumented function – Safety Integrity Level (SIL) – Selection, Verification and Validation.

UNIT IV INSTRUMENTATION STANDARDS (9 Hrs)

Instrumentation Standards – Significance of codes and standards – Overview of various types – Introduction of various Instrumentation Standards – review, interpretation and significance of specific standards – examples of usage of standards on specific applications.

UNIT V DOCUMENTATION IN PROCESS INDUSTRIES (9 Hrs)

Block Diagram of a typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems – Process flow diagram (PFD) – Piping and Instrumentation Diagram (P and ID) – Instrument Lists and specification – Logic Diagrams – Instrument Loop Diagrams – Instrument Hookup Diagrams – Location Plans for instruments – Cable Routing Diagrams – Typical Control / Rack Rooms Layout – Vendors Documents and Drawings.

Text Books

1. B. G. Liptak, “Instrumentation Engineers Handbook (Process Measurement and Analysis)”, Fourth Edition, Chilton Book Co, CRC Press, 2005.
2. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA 2006.

Reference Books

1. SwapanBasu, “Plant Hazard analysis and Safety Instrumentation Systems” Academic Press, 2016.
2. AI. Sutko, Jerry. D. Faulk, “Industrial Instrumentation”, Delmer Publishers, 1996.

Web References

1. https://www.eolss.net/Sample-Chapters/C05/E6-39A-04-08.pdf
2. https://www.nap.edu/read/11520/chapter/4

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

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

U20ICE824 **INDUSTRIAL DATA NETWORKS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To educate on the basic concepts of data networks
- To give an overview of the Field bus
- To gain knowledge on instrumentation network design and upgrade.
- To impart knowledge in PROFIBUS protocol.
- To introduce industrial Ethernet and wireless communication

Course Outcomes

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

CO1 - Understand and analyse Instrumentation systems and their applications to various industries. **(K1)**
CO2 - Illustrate Field bus used in process digital communication. **(K2)**
CO3 - Impart knowledge on the instrumentation network design and upgrade. **(K3)**
CO4 - Summarize the operation of MODBUS, PROFIBUS protocol and its applications. **(K2)**
CO5 - Explain and adopt the different Industrial Ethernet protocol and usage of wireless communication in process applications. **(K1)**

UNIT I DATA NETWORK FUNDAMENTALS (9 Hrs)

Networks hierarchy and switching – Open System Interconnection model of ISO - Types of network Topology -Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP

UNIT II FIELD BUS (9 Hrs)

Use of fieldbuses in industrial plants, functions, international standards, performance, use of Ethernet networks, fieldbus advantages and disadvantages. Fieldbus design, installation, economics and documentation.

UNIT III INSTRUMENTATION NETWORK DESIGN AND UPGRADE (9 Hrs)

Instrumentation design goals, cost optimal and accurate sensor networks. Global system architectures, advantages and limitations of open networks, HART network and Foundation fieldbus network.

UNIT IV PROFIBUS-PA: (9 Hrs)

Basics, architecture, model, network design and system configuration. Designing PROFIBUS-PA and Foundation Fieldbus segments: general considerations, network design.

UNIT V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION (9 Hrs)

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100

Text Books

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data, Newnes; 1st edition 2004.
2. Steve Mackay, Edwin Wright, Deon Reynders, John Park Networks Design, Installation and Troubleshooting" Newnes Publication, Elsevier 1st edition, 2004.
3. William Buchanan, "Computer Buses", CRC press, 2000.
4. B.G. Liptak, Process software and digital networks, CRC press, Florida, 3rd Edition 2011.

5. Noltingk B.E., Instrumentation Reference Book, Butterworth Heinemann, 2nd Edition, 1995.

Reference Books

1. Behrouz Forouzan, Data Communications and Networking, Tata McGraw Hill Education, New Delhi, 2010.
2. Steve Mackay, Edwin Wright, Deon Reynders, John Park, “Practical Industrial Data”, Newnes 1st edition 2004.
3. Networks: Design, “Installation and Troubleshooting”, Newnes, An imprint of Elsevier, 2004.
4. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Prentice Hall of India Pvt. Ltd., 5th Edition, 2011

Web References

1. https://nptel.ac.in/courses/106/105/106105082/.
2. https://lecturenotes.in/subject/903/industrial-data-networks-idn.

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

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

U20ICE825	FIELD INSTRUMENTATION AND CABLING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To review the IC technologies.
- To obtain knowledge on foundation field bus networks.
- To get adequate Knowledge on the model and design of profibus networks.
- To understand and acquaint fiber optic networks.
- To enable the students to understand the network installation and security.

Course Outcomes

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

CO1 - Impart knowledge on IC technologies. **(K1)**
CO2 - Describe working of foundation fieldbus. **(K2)**
CO3 - Understand and outline profibus networks. **(K1)**
CO4 - Understand and explore fiber optic networks. **(K1)**
CO5 - Interpret and to specify use of network installation and security. **(K3)**

UNIT I REVIEW OF IC TECHNOLOGIES (9 Hrs)

Proprietary and open networks- Hardware selection for Field bus systems -Sorting the protocols. Field bus trends-Advantages and Disadvantages- Design- installation-economics and documentation. Hart Networks-Hart protocol, field Devices- calibration- Hart applications, installing Hart Networks, Device Descriptions and Applications. Wireless transmitters and their architecture, Wireless Hart.

UNIT II FOUNDATION FIELDBUS NETWORKS (9 Hrs)

Standards, field bus Architecture and user Layer, H1 and HSE specifications, Segment design.

UNIT III PROFIBUS NETWORKS (9 Hrs)

Basics, Block Model, Applications, Network Design-system configuration and Developments. Profibus PA and DP specifications. Segment design.

UNIT IV FIBER-OPTIC NETWORKS (9 Hrs)

Principles- Types of Cables- Network Design-installation finishing- inspection and Testing, Modulation/Demodulation techniques.

UNIT V NETWORK INSTALLATION AND SECURITY (9 Hrs)

Network components, Configuring routers and switches. Physical security, security policies, Encryption, Identity verification, OS security, Login and password security, protection from viruses, preventive measures, internet access, Digital certificates, Network security with Firewalls.

Text Books

1. Instrument Engineers Handbook ‘Process software and Digital Networks’: Bela Liptak, CRC process. 2012.
2. Sunit Kumar Sen, “Fieldbus and Networking in Process Automation”, CRC Press,2021.
3. Jonas Berge, “Fieldbuses for Process Control”, ISA Publisher, 2004.

Reference Books

1. Samuel M. Herb, “Understanding Distributed Process system for control”, ISA,2016.
2. Rich Mcmahon, “Introduction to Networking”, McGraw Hill Education, 2014.
3. Terry L. M. Bartelt, “Instrumentation and Process Control”, Delmar Cengage Learning, 1st edition, 2010.

Web References

1. https://www.youtube.com/watch?v=IVzANPsrEOs
2. https://www.specialcables.co.in/instrumentation-cables/

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

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

U20ICE826	DESIGN OF PROCESS CONTROL SYSTEM COMPONENTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the working of process control systems.
- To impart knowledge measurement of instrumentation systems.
- To understand about the control valves types and its characteristics.
- To make the students to understand about the types of pumps and its characteristics
- To obtain knowledge on Interlocks and alarms and its types

Course Outcomes

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

CO1 - Interpret and formulate design specifications for instrumentation systems that meet accuracy and sampling speed requirements. **(K1)**

CO2 - Design, construct, and verify an instrumentation system to meet desired Specifications. **(K3)**

CO3 - Get familiar with control valves, types and its characteristics. **(K2)**

CO4 - Acquaint with the concept Pumps and its characteristics and types. **(K1)**

CO5 - Understand and interpret the concept of Interlocks and alarms. **(K3)**

UNIT I INTRODUCTION TO PROCESS CONTROL COMPONENTS (9 Hrs)

Orifice meter - design of orifice for given flow condition - design of rotameter - design of RTD measuring circuit - design of cold junction compensation circuit for thermocouple using RTD - Transmitters – zero and span adjustment in D/P transmitters and temperature transmitters

UNIT II MEASUREMENTS OF INSTRUMENTATION SYSTEMS (9 Hrs)

Bourdon gauges - factors affecting sensitivity - design aspect of Bourdon tube -design of Air purge system for level measurement. Electronic P+I+D controllers - design - adjustment of set point, bias and controller settings.

UNIT III CONTROL VALVES (9 Hrs)

Control valves - characteristics of control valves - types of valve bodies - valve characteristics - materials for body and trim - sizing of control valves - cavitations, flashing in control valves- selection of body materials and characteristics of control valves for typical applications

UNIT IV TYPES OF PUMPS (9 Hrs)

Types of pumps - pump performance - Different types of pump systems- characteristics of pump system- pressure, friction and flow - pump operation - maintenance - instruments used in pumping practice - pump noise and vibration - selection of pumps.

UNIT V INTERLOCKS AND ALARMS (9 Hrs)

Interlocks and alarms: Interlock design principles, fail-safe design - alarms and their types. Design of logic circuits for alarm and annunciator circuits, interlocks design

Text Books

1. N.A. Anderson, Instrumentation for Process Measurement and Control, Chilton Company,2012.
2. D.M. Considine, Process Instruments and Controls Handbook, McGraw-Hill, reprint 2013.

Reference Books

1. R.H. Warring, Pumping Manual, Gulf Publishing Co., 2011.
2. P. Bentley, Principles of Measurement Systems, Longman Inc., 2008.

3. Dr. R.K. Bansal, ”Fluid Mechanics”,Laxmi Publications Private limited, 2015.

Web References

1. https://www.youtube.com/watch?v=sF88DdDCrRA
2. https://www.youtube.com/watch?v=1rO9nJriVR0

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

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

U20ICE827	WEB BASED INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn Internet and web concepts.
- To learn various application of Internet.
- To learn the language constructs of the programming language.
- To understand the various advanced concepts of java.
- To develop understanding about various applications of java

Course outcomes

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

CO1 - Explore the internet and web concepts**. (K2)**
CO2 - Develop internet-based instrumentation and Control applications**. (K1)**
CO3 - Acquire the basics of JAVA programming**. (K1)**
CO4 - Develop the advance concepts in java language**. (K1)**
CO5 - Explicate the application of internet measurement and control**. (K1)**

UNIT I BASIC INTERNET CONCEPTS (9 Hrs)

Packet Switching - Internet: A Network of Networks-ISPs: Broadband and Wireless Access – Software to Create a Virtual Network -TCP: Software for Reliable Communication - Clients + Servers =Distributed Computing - Names for Computers- NAT: Sharing an Internet Connection.

UNIT II INTERNET APPLICATION (9 Hrs)

Electronic Mail- Bulleting Board Service (Newsgroups)-Browsing the World Wide Web- World Wide Web Documents (HTML)-Advanced Web Technologies (Forms, Frames, Plugins, Java, JavaScript, Flash)-Group and Personal Web Pages (Wikis and Blogs)-Automated Web Search (Search Engines)-Text, Audio, and Video Communication (IM, VolP)-Faxes, File Transfer, and File Sharing (FTP)-Remote Login and Remote Desktops (TELNET)-Facilities for Secure Communication-Secure Access from a Distance (VPNs)-Internet Economics and Electronic Commerce-The Global Digital Library

UNIT III BASICS OF JAVA LANGUAGE (9 Hrs)

Java Evolution-Overview of Java Language - Constants, Variables, and Data Types - Operators and Expressions - Classes, Objects and Methods- Arrays and Strings.

UNIT IV ADVANCE CONCEPTS IN JAVA LANGUAGE (9 Hrs)

Interfaces: Multiple Inheritance - Packages: Putting Classes Together- Multithreaded Programming Managing Errors and Exceptions- Applet Programming.

UNIT V APPLICATION OF INTERNET MEASUREMENT AND CONTROL (9 Hrs)

Measurements through Internet: Web based data acquisition – Monitoring of plant parameters through Internet – Calibration of measuring instruments through Internet.
Internet based Control: Virtual laboratory – Web based Control – Tuning of controllers through Internet.
Case Study: Internet based Measurement and Control case studies using Java, JVM and security –Over view of class library: I/O, AWT and NET – JDBC, Object serialisation – remote method invocation – Java script – Java vs C++.

Text Books

1. Balagurusamy, “Object Oriented Programming Using C++ and JAVA , McGraw Hill Education 2017.
2. Ouglas E. Comer,” The Internet Book” 4th Edition, 2009 Princtice Hall.

Reference Books

1. Itel and Deitel, “Java: How to Program”, 9 th Edition Printice Hall 2012
2. Nenbaum, “Computer Networks” 2012 5th Edition, DORLING KINDERSLEY (RS) Publication
3. HTML, JavaScript, and Advanced Internet Technologies BASICS, By Karl Barksdale, E. Shane Turner · 2005

Web References

1. https://link.springer.com/chapter/10.1007/978-3-319-46407-7_1
2. https://nptel.ac.in/courses/105/103/105103095/
3. https://nptel.ac.in/courses/103/104/103104043/

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

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

U20ICE828	INSTRUMENTATION FOR AGRICULTURAL AND FOOD PROCESSING INDUSTRIES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide an understanding on the need of instrumentation in agriculture and food processing sector.
- To impart knowledge on food quality assessment.
- To acquaint knowledge on agriculture associated activities and instruments.
- To impart knowledge on green houses and instrumentation.
- To provide design knowledge in food processing equipment.

Course Outcomes

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

CO1 - Understand the necessity of instrumentation in agriculture and food processing. **(K2)**
CO2 - Understand the usage of instrumentation for food quality assurance. **(K2)**
CO3 - Familiarize with instrumentation requirement in agriculture and food processing. **(K2)**
CO4 - Understand the green houses and instrumentation. **(K3)**
CO5 - Design equipment for agriculture and food processing. **(K4)**

UNIT I INTRODUCTION TO FOOD PROCESSING AND AGRICULTURE SENSOR (9 Hrs)

Introduction: Necessity of instrumentation and control for food processing and agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for food quality.

UNIT II INSTRUMENTATION FOR FOOD QUALITY ASSURANCE (9 Hrs)

Instrumentation for food quality assurance: Instrumental measurements and sensory parameters. Inline measurement for the control of food processing operations: colour measurements of food, food composition analysis using infrared, microwave measurements of product variables, pressure and temperature measurement in food process control, level and flow measurement in food process control, ultrasonic instrumentation in food industry.

UNIT III INSTRUMENTATION FOR AGRICULTURE (9 Hrs)

Instrumentation for Agriculture: Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems & it's performance, comparison of different irrigation systems, soil moisture measurement methods. Major Processes: Application of SCADA for DAM parameters and control, Water distribution and management control, Auto-Drip irrigation systems, Irrigation Canal management, upstream and downstream control concepts, supervisory control.

UNIT IV GREEN HOUSES AND INSTRUMENTATION (9 Hrs)

Green houses and Instrumentation: Ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control.

UNIT V DESIGN CONSIDERATIONS OF AGRICULTURAL AND FOOD PROCESSING EQUIPMENTS (9 Hrs)

Design considerations of agricultural and food Processing Equipments: Design of Food Processing equipments, dryers, design of dryers PHTC, RPEC, LSU and Drum Dryer, determination of heat and air requirement for drying grains.

Text Books

1. Erika Kress-Rogers, Christopher J.B. Brimelow., "Instrumentation and Sensors for the Food Industry", Woodhead Publishing, 2001.

2. Manabendra Bhuyan., “Measurement and control in food processing”, CRC/Taylor & Francis Publications, 2007.
3. P.J. Fellows, “Food Processing Technology Principles and Practice”, Woodhead Publishing, 3rd edition, 2009.
4. Semioh Otles, “Methods of analysis of food components and additives”, CRC Press, Taylor and Francis group, 2nd edition, 2012.

Reference Books

1. McMillan G. K., Considine D. M., “Process/Industrial Instruments and Controls Handbook”, McGraw Hill International, 5th edition,1999.
2. Liptak B. G., “Instrument Engineers Handbook”, Process Measurement Volume I and Process Control Volume II, CRC press, 4th Edition,2005.
3. Hall C. W., Olsen W. C, “The literature of Agriculture Engineering”, Cornell University Press, 1992.
4. Sahu J. K., “Fundamentals of Food Process Engineering”, Alpha Science Intl Ltd, 2016.
5. G.E. Meyer and Yufeng Ge., “Instrumentation and Controls for Agricultural and Biological Engineering Applications, using LabVIEW® and other Modern tools as Support Systems”, Semantic Scholar, 2008.

Web References

1. https://www.linkedin.com/pulse/importance-instrumentation-agriculture-shamitha-kr
2. https://www.branom.com/instruments-industry-food-beverage
3. https://www.foodengineeringmag.com/keywords/instrumentation
4. https://www.nuvisioninstrumentation.com/instrumentation-food-and-beverage-industry/

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

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

U20ICE829	CYBER SECURITY IN INDUSTRIAL AUTOMATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get adequate knowledge on the security process for Industrial Control System.
- To learn about the threats in Industrial Control System
- To gain more idea and to apply Industrial Control System vulnerabilities
- To develop critical thinking for Cyber security in SCADA system
- To make the students to understand and to apply Industrial Sectors Cyber Security

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Learn detail about cyber security for Industrial Control System. **(K1)**
CO2 - Describe about threats in Industrial Control System. **(K2)**
CO3 - Achieve basic idea and to apply Industrial Control System vulnerabilities. **(K3)**
CO4 - Attain critical thinking for Cyber security in SCADA system. **(K3)**
CO5 - Understand and apply Industrial Sectors Cyber Security. **(K3)**

UNIT I CYBER SECURITY FOR INDUSTRIAL CONTROL SYSTEM (9 Hrs)

Industrial Control System-Industrial control system security different than regular IT security-ICS-ICS compare to safety instrument system-Components of Typical ICS/SCADA systems-SCADA system-Supervisory Control and Data Acquisition-Remote Terminal Unit (RTU)-Distributed Control System (DCS)-Programmable Logic Controller.

UNIT II THREATS TO ICS (9 Hrs)

Threats to ICS: Threat treatment in ICS and IT-Threats to ICS-Threat –to and threat-from-most series treat to ICS-Hi-jacking malware-The reproductive cycle of modern malware- A socks 4/sock 5/HTTP connect proxy-SMTP spam engine-porn dialers.

UNIT III ICS VULNERABILITIES (9 Hrs)

ICS Vulnerability versus IT vulnerability-Availability, Integrity and Confidentiality-Purdue Enterprise Reference Architecture-PERA levels-Levels 5- level 4-level 3-level 2-level1-level 0- an ironic comment on PERA.

UNIT IV CYBER SECURITY FOR SCADA SYSTEMS (9 Hrs)

SCADA security architecture: Commercial hardware and software vulnerabilities - Operating system-TCP/IP Firewalls-Traditional security feature of SCADA system-Eliminating the vulnerabilities of SCADA system reporting and investigation – measuring safety performance – workman compensation rules.

UNIT V INDUSTRIAL SECTORS CYBER SECURITY (9 Hrs)

ICS Application security: Application security-Application security testing_ ICS application patching-ICS secure SDLC-Case Studies: Water/waste water industry specific cyber security-Piping Industry-specific cyber security issues-Emerging cyber threat to SCADA system

Text Books

1. K S Manoj, “Cyber Security: In Industrial Automation”, India: Notion Press, 2020.
2. Pascal Ackerman, “Industrial Cyber Security Efficiently secure critical infrastructure systems”, Packt Publisher, 2017.
3. William T. Shaw, “Cyber security for SCADA systems”, Pennwel publisher, 2006.

Reference Books

1. Culp. A. W, “Principles of Energy Conservation”, McGraw Hill Book Co., 2012.
2. R.A. Kisner, W.W. Manges, “Cyber security through Real-time Distributed Control Systems”, UT-Battelle, publisher, 2010.

Web References

1. https://www.assetguardian.com/cyber-security-management-of-industrial-automation-and-control-systems-iacs/
2. https://www.youtube.com/watch?v=SCzdtXDus7A

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

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

U20ICE830	SAFETY INSTRUMENTED SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get adequate knowledge on the safety instrumented system.
- To learn about protection layers and safety requirements
- To gain more idea of the safety integrity level for an application.
- To Develop critical thinking for system evaluation
- To make the students to understand and to apply safety instrument system case studies

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Analyse the role of safety instrumented systems in the industry. **(K3)**
CO2 - Identify and analyse the hazards. **(K2)**
CO3 - Determine the safety integrity level for an application. **(K3)**
CO4 - Analyse the failure modes, failure rates and MTBF using various reliability engineering tools. **(K3)**
CO5 - Apply the design, installation and maintenance procedures for SIS applied to industrial processes. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions - Standards and Regulation – HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle - Process Control vs. Safety Control.

UNIT II PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS (9 Hrs)

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards.

UNIT III SAFETY INTEGRITY LEVEL (SIL) (9 Hrs)

Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low as Reasonably Practicable (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.

UNIT IV SYSTEM EVALUATION (9 Hrs)

Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modeling Accuracy, Modeling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities.

UNIT V CASE STUDY (9 Hrs)

SIS Design checklist - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Lifecycle Cost Analysis, verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-start-up Tests, Operation and Maintenance Procedures.

Text Books

1. Lucchini, S., Gruhn, P. “Safety Instrumented Systems: A Life-cycle Approach”, United States: International Society of Automation, 2019.
2. Paul Gruhn and Harry L. Cheddie, “Safety Instrumented systems: Design, Analysis and Justification”, ISA, 2nd edition, 2018.
3. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, “Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle, exida” 2nd edition 2016.

Reference Books

1. William M. Goble and Harry Cheddie, “Safety Instrumented Systems Verification: Practical Probabilistic Calculations ISA”, 2005.
2. Edward Marszal, Eric W. Scharpf, “Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis”, ISA, 2002.

Web References

1. https://instrumentationtools.com/category/safety-instrumented-system/
2. https://www.safeopedia.com/definition/5011/safety-instrumented-systems-sis
3. https://www.aiche.org/sites/default/files/2009-07-Beacon-English.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	1	1	-	1	-	-	-	-	3	-	2	1	1	2
2	3	2	1	-	1	2	2	-	-	3	-	2	2	2	2
3	3	2	2	-	2	2	1	-	-	3	-	2	2	2	2
4	2	2	2	-	2	2	1	-	-	3	-	2	2	2	2
5	3	2	3	-	2	2	2	-	-	3	-	2	2	3	2

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

Open Electives

R-2020

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 References

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

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

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

		L	T	P	C	Hrs
U20EEO402	**ELECTRICAL SAFETY** (Common to ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE)	**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 References

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

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

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

		L	T	P	C	Hrs
U20ECO401	**ENGINEERING COMPUTATION WITH MATLAB** (Common to ICE, EEE, MECH, CIVIL, BME, Mechatronics)	**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 I INTRODUCTION TO MATLAB (9 Hrs)

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 II LOOPS& CONTROL STATEMENTS (9 Hrs)

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 III PLOTS IN MATLAB & GUI (9 Hrs)

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 IV 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 V SIMULINK & APPLICATIONS **(9 Hrs)**

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

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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

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

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

	CONSUMER ELECTRONICS	L	T	P	C	Hrs
U20ECO402	(Common to EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To enable the troubleshoot of different types of microphones and loudspeakers
- To make the students to analyze 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 I AUDIO FUNDAMENTALS AND DEVICES (9 Hrs)

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 (9 Hrs)

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 (9 Hrs)

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 (9 Hrs)

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 (9 Hrs)

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

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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

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

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

		L	T	P	C	Hrs
U20CSO401	**WEB DEVELOPMENT** (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	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. Uttam K. 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.

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5. http://Oriel.ly/learning-web-app

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

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

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, 3rdEdition, 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 References

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

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

U20ITO401 DATABASE SYSTEM: DESIGN & DEVELOPMENT

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the various data models, conceptualize E-R diagram and depict using relational model
- Gain knowledge about database languages and frame query using Relational Algebra and SQL
- Understand and design an efficient database schema using the various normal forms
- Impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- Explore knowledge on tools and practice case studies

Course Outcomes

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

CO1 - Explain the concepts of Database Management System and develop Entity Relationship model and Relational Models for a given application**(K2)**

CO2 - Manipulate and build database queries using Structured Query Language and relational algebra**(K2)**

CO3 - Apply data normalization principles to develop a normalized database for a given application.**(K3)**

CO4 - Explain various storage & indexing techniques, transactions and recovery techniques**(K2)**

CO5 - Apply tools like NoSQL, MongoDB, Cassandra on real time applications**(K3)**

UNIT I INTRODUCTION (9 Hrs)

Database Systems– Data Models – Database System Architecture - Entity-Relationship Model - ER Diagram-Extended ER Model –ER into Relational Model - **Relational Model**: Structure of Relational Databases, Database Schema,Keys,Tables

UNIT II DATABASE LANGUAGES (9 Hrs)

Relational Algebra – Extended-Relational Algebra Operations –**SQL**: Introduction – DDL – DML –Integrity Constraints-Set Operations-Joins – Nested Queries -View- Trigger - Stored Procedures

UNIT III RELATIONAL-DATABASE DESIGN (9 Hrs)

Introduction to Schema Refinement – Decomposition – Lossless Decomposition – Functional Dependencies – Normal Forms - First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form.

UNIT IV DATA STORAGE (9 Hrs)

RAID - File Organization - Indexing, Ordered Index, Index files, Hashing - Static and dynamic hashing.
Transactions: Transaction concepts and states– Concurrent Execution-Serializability-Concurrency Control: Lock based Protocol - Timestamp based Protocol - **Recovery System**: – Log-Based Recovery – Shadow Paging

UNIT V CASE STUDY (9 Hrs)

NoSQL – Document Database : MongoDB - Multi-dimensional: Cassandra

Text Books

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, 7thEdition – McGraw-Hill Higher Education, International Edition, 2019.
2. RamezElmasri, and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), Publisher: Pearson,2016

Reference Books

1. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
2. Date C J, Kannan A and Swamynathan S, —An Introduction to Database Systems‖, 8th Edition, Pearson Education, New Delhi, 2006.
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, O'Reilly,2009
4. Kristina Chodorow; Shannon Bradshaw MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc., 2018.
5. Pramod J. Sadalage (Author), Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1stEdition, Kindle Edition

Web References

1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.com/

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

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

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 References

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

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

U20MEO401	RAPID PROTOYPING (Common to EEE, ECE, ICE, CIVIL, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the development of RP systems
- To learn the classification of liquid based and solid based rapid prototyping systems
- To understand the powder based rapid prototyping systems
- To learn about the materials for rapid prototyping systems
- To discuss about the reverse engineering and new technologies

Course Outcomes

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

CO1 - Acquire knowledge about the product development **(K1)**
CO2 - Analyse the classification of liquid based and solid based rapid prototyping systems **(K4)**
CO3 - Analyse the powder based rapid prototyping systems **(K4)**
CO4 - Acquire knowledge about the materials for rapid prototyping systems **(K1)**
CO5 - Acquire knowledge about reverse engineering and new technologies **(K1)**

UNIT I INTRODUCTION (9 Hrs)

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format– Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS (9 Hrs)

Classification – Liquid based system – Stereo lithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system- Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS (9 Hrs)

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS (9 Hrs)

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES(9 Hrs)

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

Text Books

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons, 2006.

2. 2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003.
3. Amitav Ghosh Introduction to Rapid Prototyping, North West Publication, New Delhi, 2008.

Reference Books

1. Hopkinson N, R.J.M, Hauge, P M, Dickens, “Rapid Manufacturing – An Industrial revolution for the digital age”, Wiley, 2006
2. Ian gibson, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying”, Wiley, 2006
3. Paul F. Jacobs, Rapid Prototyping and Manufacturing, “Fundamentals of Stereolithography”, McGraw Hill 1993.
4. Pham D.T and Dimov, “Rapid Manufacturing”, Springer Verlog 2001.
5. Liou W. Liou, Frank W. Liou ,”Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2007.

Web References

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://www.digimat.in/nptel/courses/video/112104265/L01.html
3. https://nptel.ac.in/courses/112/107/112107078/
4. https://www.youtube.com/watch?v=oDdOqLblmVQ
5. https://www.youtube.com/watch?v=OhNnKTaciVI

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

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

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

After completion of the course the students 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 - Illustratethe basic material handling system, selection.**(K1)**
CO5 - Define theergonomics related to material handling equipment.**(K1)**

UNIT I MATERIAL HANDLING EQUIPMENTS (9 Hrs)

Types of intraplant 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, AroraVikas, 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 References

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

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

		L	T	P	C	Hrs
U20BMO401	**MEDICAL ELECTRONICS** (Common to EEE, ECE, CSE, IT, ICE, MECH, Mechatronics)	**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 References

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/medicinenet.com/script/main/art.asp?articlekey=6414
4. 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	-	-	-	-	2	-	1
2	3	2	-	2	2	2	-	1	-	-	-	-	2	-	1
3	3	-	-	2	3	3	-	1	-	-	-	-	2	-	1
4	3	-	2	2	3	2	-	1	-	-	-	-	2	-	1
5	3	2	2	3	3	2	-	1	-	-	-	-	2	-	1

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

U20BMO402	TELEMEDICINE (Common to EEE, ECE, CSE, IT, ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To understand the classification of telemetry.
- To gain knowledge about biotelemetry principles
- To know about the applications of telemetry in various fields
- To provide the idea about the value of telemedicine
- To know the various applications in telemedicine.

Course Outcomes:

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

CO1 - Categorize the telemetry systems **(K2)**
CO2 - Understand the principles of biotelemetry in transmission of biological signals **(K3)**
CO3 - Apply the various Biotelemetry applications for diagnostics **(K3)**
CO4 - Acquire clear idea about the fundamentals of telemedicine **(K2)**
CO5 - Know about various applications of telemedicine **(K3)**

UNIT I INTRODUCTION TO TELEMETRY (9 Hrs)

Basic system, Classification, Non electrical telemetry systems, Mechanical and Pneumatic type, Voltage and Current telemetry systems, Local transmitters and Converters, Frequency telemetry system, Power Line carrier communication (PLCC).

UNIT II BIOTELEMETRY (9 Hrs)

Radio Telemetry principles, FM, AM, PCM, Transmission of biological data through radio telemetry.

UNIT III APPLICATION OF BIOTELEMETRY (9 Hrs)

Wireless Telemetry - Single Channel and Multi-channel Telemetry systems, Multi Patient Telemetry, Implantable Telemetry Systems, Ambulatory patient monitoring.

UNIT IV FUNDAMENTALS OF TELEMEDICINE (9 Hrs)

History and advancements in telemedicine, Benefits of telemedicine, Functional Block of a telemedicine system, Use of computers in distance mode of healthcare delivery, Familiarizing with technology of telemedicine, scanner, electro stethoscope, data reception equipment, Scope for telemedicine, Limitations of telemedicine.

UNIT V APPLICATIONS OF TELEMEDICINE (9 Hrs)

Telemedicine in Neuroscience, Telecardiology, Telepathology, Telepediatrics, Telepharmacy, Telepsychiatry and mental health, Veterinary.

Text Books

1. Marilyn J. Field , “A Guide to Assessing Telecommunications in Health Care”, Fourth Edition, Academy Press,2011.
2. Bashshur , R. L. , Sanders, J. H and Shannon, G, “Telemedicine: Theory and Practice”, Eight Edition, Springer,2014.
3. Olga (EDT), Ferre Roca, M. Sosa, “Handbook of Telemedicine”, Third Edition, IOS press 2009.

Reference Books

1. Bemmel, J.H. van, Musen, M.A. (Eds.), “Handbook of Medical Informatics”, Second Edition, Springer, 2010.
2. Simpson, W, “Video over IP. A practical guide to technology and applications’”, Ninth Edition, Focal Press, Elsevier, 2009.
3. Ferrer-Roca, O., Sosa-Iudicissa, , “Handbook of Telemedicine”, IOS Press, 2012
4. Norris, A.C, “Essentials of Telemedicine and Telecare”, Eight Edition, Wiley, 2017
5. Wotton, R., Craig, J., Patterson, V. (Eds.), “Introduction to Telemedicine”, Fifth Edition, Royal Society of Medicine Press Ltd., 2014.

Web References

1. https://en.wikipedia.org/wiki/Biotelemetry
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731/

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

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

	BASIC DBMS	L	T	P	C	Hrs
U20CCO401	(Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	**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.

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

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

		L	T	P	C	Hrs
U20CCO402	**INTRODUCTION TO COMMUNICATION SYSTEMS** (Common to EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics)	**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 References

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

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

U20ADO401	KNOWLEDGE REPRESENTATIONS AND REASONING	L	T	P	C	Hrs
		3	0	0	3	45

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

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 KR techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes

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

CO1 - Analyse and design knowledge based systems intended for computer implementation.**(K3)**

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 production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge. **(K3)**

CO5 - Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making.**(K2)**

UNIT I **(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 **(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 **(9 Hrs)**

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation.

UNIT IV INDUSTRIALIZATION, OPPURTUNITIES AND APPLICATIONS **(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 ETHICS AND RECENT TRENDS (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; 1991st edition, 1991.

Reference Books

1. Trevor Bench-Capon, "Knowledge representation: an approach to artificial intelligence", Academic Press, 2014.
2. YuliaKahl, 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. SanidaOmerović, GregaJakus, V. Milutinovic, SašoTomažič "Concepts, Ontologies, and Knowledge Representation" Springer; 2013.
5. Bernhard Nebel, Gerhard Lakemeyer "Foundations of Knowledge Representation and Reasoning" Springer, 1994.

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

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

U20ADO402	INTRODUCTION TO DATA SCIENCE	L	T	P	C	Hrs
		3	0	0	3	45

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

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. Logarithms: Logarithms and Multiplying Probabilities – Logarithms and Ratios – Logarithms and Normalizing Skewed Distributions.

UNIT IIIDATA 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, OPPURTUNITIES 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. McOwan, "The Power of Computational Thinking", World Scientific Publishing, 2017.
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 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	3	2	2	-	-	-	-	-	-	-	-	-	-
2	2	2	2	1	1	-	-	-	-	-	-	-	-	-	-
3	2	1	3	2	3	-	-	-	-	-	-	-	-	2	-
4	1	2	2	1	1	-	-	-	-	-	-	-	-	-	1
5	2	1	1	2	1	-	-	1	-	-	-	-	-	-	-

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

U20HSO501	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 References

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

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

U20HSO502	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: To disseminate 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 References

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
6. 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	-	-	-
2	1	-	3	-	2	-	2	2	-	-	-	2	-	-	-
3	-	-	2	-	1	-	3	3	-	-	-	2	-	-	-
4	2	-	3	-	2	-	2	2	-	-	-	2	-	-	-
5	1	-	1	-	2	-	1	2	-	-	-	2	-	-	-

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

U20HSO503	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

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

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

U20HSO504	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	-	2	1	-	-	1	-	-	1	1	1	1	-	-	-
3	-	1	3	-	-	-	-	-	-	-	1	-	-	-	-
4	3	1	1	-	-	1	1	-	-	1	1	3	-	-	-
5	3	-	3	-	-	-	-	3	3	2	3	2	-	-	-

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

U20HSO505	FINANCE FOR ENGINEERS	L	T	P	C
		3	0	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)

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

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

		L	T	P	C	Hrs
U20EEO603	**CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES** (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT)	**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 (09 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 (09 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 (09 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 (09 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 (09Hrs)

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. 4thEdition, 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 References

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

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

U20EEO604	INDUSTRIAL DRIVES AND CONTROL (Common to ECE, ICE, MECH, Mechatronics, AI&DS)	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. Kok Kiong Tan & Andi Sudjana Putra, “Drives and Control for Industrial AutomationAdvances 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.

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

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

		L	T	P	C	Hrs
U20ECO603	**ELECTRONIC PRODUCT DESIGN AND PACKAGING** (Common to EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics)	**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:

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,

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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/

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

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

U20ECO604	AUTOMOTIVE ELECTRONICS (Common to EEE, ICE, MECH)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge about Autotronics
- To introduce and discuss the fundamentals of Automotive Electronics
- To get clear idea about various Sensors and Actuators for automobiles.
- To acquire depth knowledge about the Microcontrollers/Microprocessors in Automotive Domain.
- To study the Current Trends in Automotive Electronics.5

Course Outcomes

After completion of the course, students are able to

CO1 - Explain the basics of Autotronics. **(K2)**
CO2 - Infer the fundamentals of Automotive Electronics**. (K2)**
CO3 - Summarize the clear idea about Sensors and Actuators **(K2)**
CO4 - Demonstrate the role of Microcontrollers/Microprocessors in Automotive Domain **(K3)**
CO5 - Use Current Trends in Automotive Electronic Engine Management System **(K3)**

UNIT-I INTRODUCTION TO AUTOTRONICS (9 Hrs)

Autotronics- Definition- need, Field effect transistor-construction and working-applications, Silicon controlled rectifiers-construction and working-applications, logic gates-concept-AND-OR-NOT gates-working with truth tables, Flip flops-concept-applications, registers-concept, Integrated circuits-concept-types, Binary number system- need- conversion process, analog and digital signals-signal conditioning-need-steps, analog to digital conversion-steps

UNIT - II FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS (9 Hrs)

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile

UNIT - III SENSORS AND ACTUATORS (9 Hrs)

Types of Sensors: Sensor for Speed- Throttle Position- Exhaust Oxygen Level- Manifold Pressure- Crankshaft Position- Coolant Temperature- Exhaust Temperature- Air Mass Flow for Engine Application. Solenoids- Stepper Motors- Relay.

UNIT - IV MICROCONTROLLERS/MICROPROCESSORS IN AUTOMOTIVE DOMAIN (9 Hrs)

Critical review and overview of development within the automotive context of microprocessors, microcontrollers and digital signal processors (architecture of 8/16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts, Watchdog timers and PWM). Criteria to choose the right microcontroller/processor for various automotive applications. Understanding various architectural attributes relevant to automotive applications. Automotive grade processors viz. Renesas, Quorivva, Infineon.

UNIT - V ELECTRONICS SYSTEMS (9 Hrs)

Current Trends in Automotive Electronic Engine Management System- Types of EMS Electromagnetic Interference Suppression- Electromagnetic Compatibility- Electronic Dashboard Instruments- Onboard Diagnostic System- Security - Warning System infotainment and Telematics

Text Books

1. William Ribben Butterworth-Heinemann, “Understanding Automotive Electronics” 5th edition, Elsevier, 1998
2. Jack Erjavec, “A Systems Approach to Automotive Technology”, Cengage Learning, 5th edition, 2009
3. Steve.V.Hatch, “Electronic Engine Controls”, Cengage Learning, 2012

References

1. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications", Springer, 2009.
2. Mehrdad Ebsani, Ali Emadi & Yimin Gao: "Modern Electronic Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2 nd Edition, CRC Press, 2009.
3. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill
4. Bennett , "Truck engines Fuel & computerized management systems Sean", Cengage Learning, 2016

Web Reference

1. http://www.diffen.com/difference/Analog vs Digital
2. https://www.youtube.com/watch?v=AiQpYO5E-go
3. https://en.wikipedia.org/wiki/Signal_conditioning
4. https://en.wikibooks.org/wiki/Electronics/Digital to Analog %26
5. http://www.allaboutcircuits.com/textbook/digital/chpt-13/delta-sigma-adc/

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

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

U20CSO603	PLATFORM TECHNOLOGY	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, MECH, CIVIL & BME)	3	0	0	3	45

Course Objectives

- To understand the fundamentals of developing modular application by using object oriented concepts.
- To utilize the C# and .NET framework to build distributed enterprise applications.
- To develop Console Application, Windows Application and Web Applications.
- To connect to multiple data sources and managing them effectively.
- To develop the Enterprise kind of applications

Course Outcomes

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

CO1-Understand the concept of .NET Framework.**(K2)**

CO2 -Develop, implement and creating Applications with C#.**(K4)**

CO3 -Evaluate various graphics and window forms.**(K5)**

CO4 - Integrating front end applications with Database connectivity.**(K3)**

CO5- Classifying various Enterprise applications into real world problems.**(K3)**

UNIT I INTRODUCTION TO .NET FRAMEWORK (9 Hrs)

.NET Framework - Common language Runtime (CLR) – Common Type System (CTS) – Common language Specification (CLS) – Compilation process – Assemblies – Namespaces – Command line compiler.

UNIT II C# FUNDAMENTALS (9 Hrs)

C# class - object - string formatting - Types - scope - Constants - C# iteration - Control flow - Operators - Array - String - Enumerations - Structures - Custom namespaces. Programming constructs – value types and reference types – object oriented concepts – Encapsulation – Inheritance – polymorphism – Interfaces – collections – Multithreading.

UNIT III GRAPHICS AND WINDOWS FORMS (9 Hrs)

Tool box controls – Container control – Menu – Tool bar – Tool tip Controls during design time – Run time – Graphics programming GDI+.

UNIT IV DATABASE PROGRAMMING (9 Hrs)

Data Access with ADO.NET – Architecture – Data reader – Data Adapter – Command – Connection – Data set – Data binding – Data Grid Control – XML based Data sets.

UNIT V J2EE (9 Hrs)

Enterprise Edition Overview – Multi-Tier Architecture – Best Practices – Comparison between J2EE and .NET.

Text Books

1. David Chappell, “Understanding .NET – A Tutorial and Analysis”, Addison Wesley, 2002.
2. Herbert Schildt, “C# 3.0 The Complete Reference”, McGraw-Hill Professional, Third Edition, 2008.
3. Keogh, “J2EE The Complete Reference”, Tata McGraw-Hill, 2008.

Reference Books

1. Andrew Troelsen, “Pro C# 5.0 and the .NET 4.5 Framework”, Sixth edition, A Press, 2012.
2. Joh Skeet, “C# in depth, Manning publications”, Third Edition, 2014.
3. AdrewStellman and Jennifer Greene, “Head First C#”, Third Edition, O’Reilly, 2013.
4. Rod Johnson, “J2EE Design and Development”, Wrox, 2002
5. Michael Schmalz, “C# Database Basics”, O'Reilly Media, January 2012.

Web Resources

1. https://www. nptel.ac.in/
2. https://www.c-sharpcorner.com/csharp-tutorials
3. https://www.guru99.com/c-sharp-tutorial.html

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

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

U20CSO604	GRAPHICS DESIGNING	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, MECH, CIVIL & BME)	3	0	0	3	45

Course Objectives

- To develop basic skills using graphics and theory used in design process.
- Create computer-based projects using Adobe Photoshop.
- Understand, develop and employ visual hierarchy using images and text
- Use a computer to create and manipulate images and layers for use in various print and digital mediums.
- To acquire the knowledge of Animation

Course Outcomes

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

CO1 – Develop the basic design elements of graphics. **(K3)**
CO2 – Apply the various photoshop tools. **(K3)**
CO3 – Modify the image size, selection and grids using tools. **(k3)**
CO4 – Create and Work with colored layers. **(K4)**
CO5 – Apply different methods for Animation & Panoramic Picture creation. **(K5)**

UNIT I BASIC CONCEPTS (9 Hrs)

Basic Concepts of Designing - Design Principles – Basics of design elements – Typography – Color theory - Introduction to Graphics - Introduction to Photoshop - Bitmap and Vector Images - Understanding Image Size and Resolution

UNIT II INTRODUCTION TO PHOTOSHOP (9 Hrs)

Introduction to Tools - Environment - layout of Photoshop - Design layout setup - color - resolution setting - using basic marquee - selection tools Usage of lasso tools - Using brushes - using and filling colors - layers Using text tool - free transform tool - Exercise: Designing Greeting card / Advertisement

UNIT III IMAGE SIZE, SELECTION, GRID AND GUIDES (9 Hrs)

Modifying Image Size - Resolution, Marquee - Lasso - Magic Wand - Selection Tools – Selecting – Saving - Crop tool - Coping Selection And Image - Grid and Guide Options – Masks – Channel - Painting and editing - Working with quick masks - Painting (Brush, and its effects) - Blending Modes, Color palettes – Editing - Background - Color - Touchup - Cleanup - Gradient tools - layer blending modes - all types of text tools - shape tools Exercise : Designing Magazine cover - Poster - Brochure

UNIT IV LAYERS (9 Hrs)

The layer Palette - Changing and controlling layer order - Editing layers - Adjustment layers - Layer Effects Filters - Actions - Automation - Extract - Filter Gallery - Liquefy , Pattern making - Vanishing point - Built in Bitmap Filters - 3rd party Plug-ins - Using predefined Actions - Creating and Recording Actions - Using built in automation - Learning Filter effects - managing the files with layers and layer effects - plugins Manipulation tools - Image control options – HUE - Levels - brightness control Using image – modifying - changing color Exercise : Converting black and white photo to color - designing a photo album

UNIT V ANIMATION & PANORAMIC PICTURE CREATION (9 Hrs)

Creating product Packaging designs - CD cover - Book and magazine front cover - Envelope - Visiting card - Color correction and color channel management - Design automation theory and Practical's Samples and demos - guidelines for freelance work - website links - resource sharing - Preparing Image For Print and Web -

Calculating Image size and Resolution, Changing Image Dimensions - Layout Preview - Color Separation - Optimizing Images for Web - File Formats - Creating Webpages - web photo galleries

Text Books

1. Adobe Creative Team, "Adobe Photoshop – Classroom in a Book", Adobe system incorporation, Adobe Press, 2010.
2. Katherine A.Hughes, "Graphic Design", Learn It,Do It,CRC Press 2019.
3. Ken Pender, "Digital color in Graphics Design", CRC Press 2012.

Reference Books

1. Mike Wooldridge , "Teach Yourself Visually Adobe Photoshop CS 5", Wiley Publishing , 2010
2. Lesa Snider, "Photoshop the missing Manual", O'Reilly Media, Inc, 2010.
3. Poppy Evans, Aaris Sherin, Irina Lee, "The Graphic Design", Rockport, 2013.
4. Peter Bauer, "Photoshop CC for Dummies", Wiley, 2013.
5. Scott Onstott, "Enhancing CAD Drawings with Photoshop", Wiley,2006

Web Resources

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/lecture-notes/MIT6_831S11_lec18.pdfhttp://www.moshplant.com/direct-or/bezier/
2. https://www.cs.montana.edu/courses/spring2004/352/lectures/CS351-GUIDesign.pdf
3. https://www.university.youth4work.com/study-material/graphic-design-lecture
4. https://kmayeunhia.wordpress.com/lecture-notes/
5. https://nptel.ac.in/courses/106/106/106106090/

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

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

U20CCO603	NETWORK ESSENTIALS (Common to EEE, MECH, 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 LINKCONTROLANDMEDIUMACCESS (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 Vsin direct delivery- Forwarding-Unicast and Multicast routing protocols-Different Routing Algorithms-Internetworking-Routers and gateways.

UNIT IV TRANSPORTANDCONGESTION (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. DouglasE.Comer,"InternetworkingwithTCP/IP(VolumeI)Principles,ProtocolsandArchitecture",6th Edition, Pearson Education,2013.
2. NaderF.Mir,"ComputerandCommunicationNetworks",2nd Edition, Prentice Hall, 2014.
3. Ying-DarLin,Ren-HungHwangandFredBaker,"ComputerNetworks:AnOpenSourceApproach",Mc Graw HillPublisher, 2011
4. BehrouzA.ForouzanandFirouzMosharraf,"ComputerNetworksaTopDownApproach",TataMcGraw-Hill, 2017.
5. RichSeifert,JamesEdwards,"TheAllNewSwitchBook:TheCompleteGuidetoLANSwitching Technology", 2nd Edition, Wiley Publishing Inc,2011

Web References

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

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

U20CCO604	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 ofJavaScript 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 developmenttools, the web browser, Whatis server, dynamic IP, Web Design: Web site designprinciples, 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, usingCSS, 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, 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. HirdeshBhardwaj,, “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 References

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

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

U20ITO603	ESSENTIALS OF DATA SCIENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the concepts involved in data analytics.
- To discover insights in data using R programming.
- To summarize the operations involved in Hadoop Map Reduce.
- To make use of algorithms related to regression and classification.
- To examine data using time series analysis and text analysis

Course Outcomes

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

CO1 - Experiment with data analytics using R language**.(K3)**

CO2 - Demonstrate clustering algorithms and association rules.**(K3)**

CO3 - Use algorithms related to regression and classification. **(K3)**

CO4- Explore data using time series analysis and text analysis.**(K2)**

CO5 - SummarizeHadoop platform to solve map reduce problems.**(K2)**

UNIT I DATA ANALYTICS USING R (9 Hrs)

Big Data Overview-Examples of Big Data Analytics-Data Analytics Lifecycle overview-Phases in the lifecycle-GINA Case Study-Introduction to R programming-Exploratory Data Analysis-Statistical Methods for Evaluation.

UNIT II CLUSTERING AND ASSOCIATION RULES (9 Hrs)

Overview of clustering-Scope of Clustering Techniques- K Means clustering- Additional Algorithms-Clustering in practise: Fake news identification-Overview of Association rules-Apriori Algorithm-Evaluation of Candidate Rules-Applications of Association Rules-An Example: Transactions in a grocery store-Validation and Testing-Diagnosis

UNIT III REGRESSION AND CLASSIFICATION (9 Hrs)

Scope of Regression Techniques-Linear Regression-Logistic Regression-Additional Regression models-Scope of Classification Techniques-Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional Classification Methods-Applications: Prediction of crop yield

UNIT IV TIME SERIES ANALYSIS AND TEXT ANALYSIS (9 Hrs)

Overview of Time Series Analysis-ARIMA Model-Additional Methods-Text Analysis Steps-A Text Analysis Example-Collecting Raw Text-Representing Texts-TFIDF-Categorizing documents by topics-Determining Sentiments-Gaining Insights.

UNIT V HADOOP MAP REDUCE AND DATA ANALYTICS (9 Hrs)

Installing and Understanding Hadoop-HDFS and Map Reduce Architecture-Hadoop Map Reduce Example-Hadoop Map Reduce in R-Data Analytics Problems: Exploring web pages categorization - Computing the frequency of stock market change-Real Time Recommender model using Apache Spark.

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.

2. VigneshPrajapathi, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013, Birmingham, Mumbai.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding opportunities in Huge DataStreams with Advanced Analytics”, John Wiley & sons, 2012.

Reference Books

1. Roger D. Peng, “R Programming for Data Science”, LeanPub, 2015.
2. Bart Baesens , “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications“, Wiley Publishers, 2014.

Web References

1. www.ibm.com/Data Analytics/
2. https://www.ijser.org/researchpaper/Importance-of-Clustering-in-Data-Mining.pdf
3. https://datafloq.com/read/7-innovative-uses-of-clustering-algorithms/6224
4. https://publications.waset.org/10011058/improving-fake-news-detection-using-k-means-and-support-vector-machine-approaches
5. https://statisticsbyjim.com/regression/when-use-regression-analysis/

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

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

U20ITO604	MOBILE APP 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 IINTRODUCTION (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

1. Dharma PrakashAgarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
2. William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition,TataMcGraw Hill Edition ,2006.
3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

Web References

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

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

U20CEO603	DISASTER MANAGEMENT (EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI &DS, FT)	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Understand the basic conceptual understanding of disasters
- Understand approaches of Disaster Management
- Build skills to respond to disaster
- Understand the safety precaution
- Understand the basic planning and policy act of the disaster

Course Outcomes

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

CO1 - Understanding Disasters, man-made Hazards and Vulnerabilities**(K2)**
CO2 - Understanding the flood management studies **(K2)**
CO3 - Understanding disaster mitigation and management mechanism **(K1)**
CO4 - Understanding the disaster safety precaution **(K2)**
CO5 - Understanding the disaster plan and act **(K3)**

UNIT I DEFINITION AND TYPES (9 Hrs)

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

UNIT II STUDY OF IMPORTANT DISASTERS (9 Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

UNIT III MITIGATION AND MANAGEMENT (9 Hrs)

Concepts of risk management and crisis management - Disaster managementcycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness- Planning for relief.

UNIT IV SAFETY PROCESS (9 Hrs)

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT V PLANNING AND ACT (9 Hrs)

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Text Books

1. Dr. Mrinalini Pandey, Disaster Management, Wiley India Pvt. Ltd
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd.
3. Jagbir Singh, Disaster Management : Future Challenges and Opportunities, K W Publishers Pvt. Ltd.

4. J. P. Singhal, Disaster Management, Laxmi Publications
5. C. K. Rajan, NavalePandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication

Reference Books

1. Disaster Management by Mrinalini Pandey Wiley 2014.
2. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
3. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India
5. Manual on Disaster Management, National Disaster Management, Agency Govt of India.

Web References

1. http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf
2. http://nidm.gov.in/pdf/guidelines/new/sdmp.pdf
3. http://sdmassam.nic.in/pdf/publication/undp/disaster_management_in_india.pdf

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	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
CO2	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
CO3	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
CO4	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
CO5	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3

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

U20CEO604	AIR POLLUTION AND SOLID WASTE MANAGEMENT (EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI &DS, FT)	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Provide general understanding of air pollution, air pollutants, their sources and their effects
- Provide knowledge about meteorological parameters, air sampling and measurement of pollutants.
- Provide knowledge of air pollution controlling technologies, air pollution due to automobiles and general Idea of noise pollution.
- Study the importance of solid waste management by processing, treatment, disposal and reuse of solid waste.
- Study about the equipment used for waste collection and transportation of solids waste.

Course Outcome

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

CO1 - Understand the type, sources & effect of air pollutants (**K2)**
CO2 - Know the parameters affecting air pollution and various methods of measurement and estimation of pollutants **(K3)**
CO3 - Gain knowledge of basics of noise pollution **(K2)**
CO4 - Understand various air pollution control equipment's & pollution caused due to automobile exhaust **(K4)**
CO5 - Understand the concepts of solid waste management **(K2)**

UNIT I INTRODUCTION TO AIR POLLUTION (8 Hrs)

Introduction to air pollution: Air pollution episodes, Atmosphere and its zones, classification and sources of air pollutants, effects of air pollutants on man, plants animal & materials

UNIT II METEOROLOGICAL ASPECTS (8 Hrs)

Meteorological Aspects: Atmospheric stability, plume behavior, Ambient air sampling and stack sampling, collection of particulates and gaseous pollutants, methods of estimation.

UNIT III AIR POLLUTION CONTROL METHODS (9 Hrs)

Air pollution control methods and equipment: Principle of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters cyclones, wet scrubbers, automobile exhaust: Pollution due to diesel and petrol engines, exhaust treatment and abatement, noise Pollution: Sources, ill effects, control measures.

UNIT IV SOLID WASTE MANAGEMENT (8 Hrs)

Introduction to solid waste management, sources, quantification and characterisation, classification and components, sampling and analysis, Method of collection

UNIT VEQUIPMENT (12 Hrs)

Equipment used for collection and transportation, transfer stations, solid waste processing and management. Treatment and disposal methods: composting, sanitary landfills, Incineration – concept, components and applications, leachate management.

Text Books

1. M.N. Rao & H.V.N. Rao, 1988, Air Pollution, Tata McGraw Hill Publishing Co. Ltd.
2. C.S. RAO, 2007, Environmental Pollution Control Engineering, New Age International, Wiley Estern Ltd. New Delhi.
3. Stern A. C., 1973, Air pollution, Academic Press.
4. A.D. Bhide & Sunderesan B.B., 1983, Solid Waste Management in Developing countries, INSDOC, New Delhi.
5. Tohobanoglous, 1993, Intgrated Solid Waste Management Engineering Principle and Management Issues, McGraw-Hill publication Ltd.

Reference books

1. P. Aarne Vesilind, William Worrell & Debra Reinhart, 2002, Solid Waste Engineering, Cengage Learning India pvt. Ltd.
2. Dr. Y Anjaneyulu, 2002, Air Pollution and Control Technologies, Allied Publisher pvt. Ltd.
3. Waste Management: A Reference Handbook. Contributors: Jacqueline Vaughn - Author. Publisher: ABC-Clio
4. K. V. S. G. Murlikrishna, 1995, Air Pollution, Kaushal & Company.

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1. https://nptel.ac.in/courses/120108005/
2. http://cpheeo.gov.in/upload/uploadfiles/files/Part1
3. https://nptel.ac.in/content/storage2/courses/104103022

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	2	3	2	3	2	3	3	3	3	3	2	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2	2	3	3	3	3
CO3	3	3	3	2	2	2	3	3	3	3	2	3	3	3	2
CO4	2	3	2	3	2	3	2	3	3	2	2	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3

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

U20MEO604	HEATING VENTILATION AND AIR CONDITIONING SYSTEM (HVAC)	L	T	P	C	Hrs
		3	0	0	3	45

(Common to EEE, ECE, ICE, CIVIL)

Course Objectives

- To understand the principles of heating ventilation and air conditioning, refrigerant properties, selection
- To learn about the heating and cooling load estimation
- To understand about air distribution systems, industrial ventilation
- To impart knowledge of the psychrometric properties, processes and air-conditioning systems
- To provide knowledge on different components and parameters involved in design of air conditioning systems using cooling load calculations

Course Outcomes

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

CO1 - Describe the principles of heating ventilation and refrigerant properties. **(K1)**
CO2 - Analyse the factors affecting the load estimate. **(K4)**
CO3 - Explainthe air distribution classification, types of air flow and types of cross section. **(K1)**
CO4 - Appraise the psychrometric processes and air conditioning system performance. **(K5)**
CO5 - Design the Air-conditioning systems with available resources as cost effective. **(K5)**

UNIT I INTRODUCTION TO HVAC (9 Hrs)

Definition – Principles of HVAC –Scope of HVAC Industry with overview of consulting & construction Industry-market size – Growth – Penetration – opportunities- challenges – Energy usage and saving of HVAC - Terminologies – Heat and its types – Psychometric chart – Properties of Air – Codes & Standards used in HVAC-Refrigerants - Desirable properties – classification – refrigerants used – nomenclature – Selection of refrigerants - ozone depletion – global warming–ASHRAE – Recent substitute for refrigerants.

UNIT II VENTILATION, HEATING AND COOLING LOAD (9 Hrs)

Basics of Heat transfer in a building envelop – Understanding of Outdoor & Indoor condition – Factors affecting the loads estimate Sources of Heat gain – External: Sun gain through Glass/Window/Roof/Wall – Partition gain – Internal: People/Lights/Electrical Equipments/motors/Kitchen Appliances – Heat gain through Infiltration air – Ventilation, air quantity and loads –Need, threshold limits of contaminants, estimation of ventilation rate, decay equation, air flow around buildings – Methods of Ventilation – Infiltration load calculation – Heating and cooling load estimation – Calculating ESHF, GTH, ADP, Dehumidified CFM – Cold storage design

UNIT III DESIGN OF AIR DISTRIBUTION SYSTEM (9 Hrs)

Air Distribution – Classification – Types of Air flow – Types of Cross section – Types of Velocity & pressure duct – Types of material – Types of Insulations – Duct Accessories – SMACNA standard – Duct designing methods: Velocity reduction method, Equal friction method, Static regain method - Duct designing Software – Duct sheet metal calculation: GI sheet, Gauge of duct & thickness of Gauge, Hanger spacing,Hanger Rod Diameter and Angle support Size –Air terminal selection – Industrial ventilation: Steel plants, car parks, plant rooms and mines

UNIT IV INTRODUCTION TO PSYCHROMETRIC AND HUMAN COMFORT (9 Hrs)

Principle and psychrometric properties of air – Psychrometric Chart – Psychrometric relations; Dalton's law of partial pressures –Wet bulb temperature and measurement – Adiabatic saturation temperature –

Psychrometric processes – mixing of air stream - sensible heat factor – HVAC systems: Unitary, Semi-central, Central, Air-cooled systems, Water cooled systems–Human Comfort – Heat transfer from body, convection, radiation, conduction, evaporation, clothing resistance, activity level - Concept of human comfort – Thermal response – comfort factors– Environmental indices - Indoor air quality(IQA) - Effective temperature and comfort chart – Heat production and regulation of human body.

UNIT V DESIGN OF AIR CONDITIONING SYSTEMS COMPONENTS (9 Hrs)

Air conditioning loads - Sources of heat load – Sensible load – Latent load - Conduction load – Sun load – Load from occupants – Equipment load – Infiltration air load- Load from moisture gain – Fresh air load-ASHARE standards - concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature - Requirements of industrial air conditioning – Calculation of load on air-conditioning system – Design of space cooling load - Air-conditioning devices and components:Air filters, types, efficiency – Humidifiers and Dehumidifiers – selection of humidifier and design – Fans, types &selection - Coil, Characteristics, types & Coil Accessories - condensate control-blowers – Cooling towers and spray ponds – Air distribution system –precision air conditioning - Automotive air conditioning - Heat pump – heat sources – different heat pump circuits – Commissioning and Maintenance.

Text Books

1. Arora, C.P.," Refrigeration and Air conditioning", TataMcGraw-Hill, New Delhi, Third edition, 2017.
2. McQuiston, F.C., Parker, J.D and Spilter, J.D.," Heating Ventilating and Air Conditioning", John Wiley & Sons Inc., 2001.
3. Stocker W.F and Jones J.W, "Refrigeration and Air Conditioning ", McGraw-Hill, 1995.

reference Books

1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International Publisher, New Delhi, 2015.
2. Arora.S.C and Domkundwar.S, "A course in refrigeration and Air conditioning", DhanpatRai(P) Ltd, New Delhi, 2016.
3. Legg, R.C., "Air Conditioning System - Design, Commissioning and maintenance", Batsford Ltd, London 1991.
4. Haines, W.R, and Wilso, C.L," HVAC systems Design Handbook", Mcgraw Hill, 2nd Edition, New Delhi, 1994
5. Sapali S.N, "Refrigeration and air Conditioning", PHI, second edition, 2014.

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2. Httpp://ocw.mit.edu/courses/mechanical engineering/
3. http://www.nptelvideos.in/2012/12/refrigeration-and-airconditioning.html
4. https://www.youtube.com/watch?v=ScVBPAitibQ
5. https://www.youtube.com/watch?v=z8ZStRCacdM

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

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

U20MEO605	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.

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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

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

		L	T	P	C	Hrs
U20BMO603	**BIOMETRIC SYSTEMS** (Common to EEE, ECE, ICE)	**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 - Describethe 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 KarthikNandakumar“ 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, DavideMaltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”,Springer,2005
5.Nikolaos V. Boulgouris,Konstantinos N. Plataniotis ,EvangeliaMicheli-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

		L	T	P	C	Hrs
U20BMO604	**MEDICAL ROBOTICS** (Common to EEE, ECE, ICE,CIVIL)	**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 MEDICAL APPLICATIONS (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, f*irst edition,* 2009

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

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

U20ADO603	PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand basic principles of Artificial Intelligence
- To learn and design Knowledge representation
- To understand the concept of reasoning
- Tomasterthefundamentalsofmachinelearning,mathematicalframeworkandlearningalgorithms
- To understand the reinforcement and statistical learning.

Course Outcomes

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

CO1- Understand foundational principles of artificial intelligence. **(K2)**

CO2- Understand formal methods of knowledge representation. **(K2)**

CO3-Understandthefundamentalissuesandchallengesof Reasoning. **(K2)**

CO4-Analyzetheunderlyingmathematicalrelationshipswith Machine Learning algorithms. **(K3)**

CO5-Applyvarious models for Artificial Intelligence programming techniques.**(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to Artificial Intelligence- Artificial Intelligence Problems-Timelines of Artificial Intelligence-Production Systems-State Space Representation- Branches of Artificial Intelligence-Application of Artificial Intelligence.

UNIT II KNOWLEDGE REPRESENTATION (9 Hrs)

Knowledge Management-Types of Knowledge-Knowledge representation-Approaches to Knowledge representation-Issues in Knowledge representation-Knowledge base.First order Logic – Frames — Conceptual Dependency.

UNIT III REASONING (9 Hrs)

Types of reasoning-reasoning with Fuzzy Logic- Rule based Reasoning-Diagnosis Reasoning.

UNIT IV LEARNING (9 Hrs)

Types of Learning-Machine Learning-Intelligent agents- Association Learning: Apriori Algorithm- Case Study: Customer Sequence and SCADA Application – k-Means Clustering-Fuzzy Clustering-Cluster Similarity

UNIT V REINFORCEMENT AND STATISTICAL LEARNING (9 Hrs)

Markov Decision Problem- Hidden Markov Model-Linear Classifier-decision Trees: Random forest - Bayesian Network – ANN- ANN Learning process-Types of Network – Perceptron-RBF Network-Case studies: Character recognition.

Text Books

1. Anand Hareendran S., Anand Hareendran, And Vinod Chandra S.S. “Artificial Intelligence and Machine Learning” PHI Publication, 2014.

2. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Science, 1997.
3. Peter Harrington, “Machine Learning in action”, Manning Publication, 2012.

Reference Books

1. Charu C. Aggarwal “Data Classification Algorithms and Applications”, Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, “Introduction to Machine Learning with Python”, O’Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos “Machine Learning Refined Foundations, Algorithms, and Applications”, Cambridge University Press, 2016.
4. ShaiShalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2014.

Web References

1. https://www.coursera.org/learn/machine-learning
2. https://ml-cheatsheet.readthedocs.io/en/latest/regression_algos.html
3. https://machinelearningmastery.com/a-tour-of-machine-learning-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	2	2	2	–	1	-	-	-	-	-	-	-	2	2	2
2	1	2	2	–	–	-	-	-	-	-	-	-	1	1	-
3	2	2	1	2	–	-	-	-	-	-	-	-	-	1	1
4	3	2	2	2	1	-	-	-	-	-	-	-	1	-	1
5	2	2	2	2	1	-	-	-	-	-	-	-	1	1	2

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

U20ADO604	DATA SCIENCE APPLICATION OF VISION (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Tounderstandthecapabilityofamachinetogetandanalyzevisualinformationandmakedecisions
- 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 data sets invision. **(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 IVIMAGE 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 ActivitiesforVideoSurveillance”,IGIGlobal,2014.
2. Ying-liTian,ArunHampapur,LisaBrown,RogerioFeris,MaxLu,AndrewSenior,“ EventDetection,Query ,andRetrievalforVideoSurveillance”,IGIGlobal,2009.
3. MatthewTurk,GangHua,“ Vision-basedInteraction”,FirstE dition,Morgan Claypool,2013.
4. IanGoodfellow,YoshuoBengio,AaronCourville,“DeepLearning(AdaptiveComputationandMachineLearningseries)”,MITPress,2017.
5. FanJiang,“ AnomalousEventDetectionfromSurveillanceVideo”,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

U20EEO706	ELECTRICAL ENERGY CONSERVATION AND AUDITING	L	T	P	C	Hrs
	(Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS)	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, 1stEdition, 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 References

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

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

U20ECO705	IoT AND ITS APPLICATIONS (Common to EEE, ICE, CSE MECH, IT, CIVIL, CCE, FT)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart necessary and practical knowledge of components of Internet of Things.
- To attain the knowledge about different types of architecture and their elements of IoT.
- To understand the concepts of integration of devices and data's.
- To acquire the knowledge about remotely monitor data and control devices.
- To develop skills required to build real-time IoT based projects.

Course Outcomes

After completion of the course, students will be able to

CO1 - Understand internet of Things and its hardware and software components. (K2)
CO2 - Demonstrate the Interfacing of I/O devices, sensors & communication modules. (K3)
CO3 - Understand the concepts of remotely monitor data and control devices. (K2)
CO4 - Build and deploy an various architecture with their elements. (K3)
CO5 - Can develop real time IoT based projects. (K3)

UNIT I INTRODUCTION TO INTERNET OF THINGS (9 Hrs)

The technology of the internet of things, making the internet of things, Elements of an IoT ecosystem, design principles for connected devices, Web thinking for connected devices.

UNIT II ARCHITECTURE OF 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 III 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 IV IoT APPLICATION DEVELOPMENT (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

UNIT V IoT APPLICATIONS (9 Hrs)

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in Business to Master IoT, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Text Books

1. Vijay Madisetti, ArshdeepBahga, "Ïnternet of Things, A Hands on Approach", University Press ,3rd/e ,Aug 2018.

2. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill ISBN: 9789352605224, 9789352605224,2nd edition, May 2017
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs 2014.

Reference Books

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi, 2012
2. Adrian McEwen, “Designing the Internet of Things”, Wiley, 2007
3. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013
4. CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press

Web Resources

1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.theinternetofthings.eu/
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/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	2	2	3	2	-	-	-	-	-	-	-	-	2	2	3
2	3	-	3	2	-	-	-	-	-	-	-	-	2	2	3
3	2	3	2	-	-	-	-	-	-	-	-	-	2	2	3
4	2	2	2	-	-	-	-	-	-	-	3	-	2	2	3
5	2	3	2	-	3	-	-	-	-	-	3	-	2	2	3

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

U20ECO706 SENSORS FOR INDUSTRIAL APPLICATIONS

L	T	P	C	Hrs
3	0	0	3	45

(Common to EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics)

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–Tactilesensors,Temperature–IC,Thermistor,RTD,Thermocouple.AcousticSensors – flow and level measurement. Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V 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 I, 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 References

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

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

U20CSO705	ARTIFICIAL INTELLIGENCE	L	T	P	C	Hrs
	(Common to EEE, ICE, CIVIL, MECH,CCE, FT)	3	0	0	3	45

Course Objectives

- To cover fundamentals of Artificial Intelligence,
- To understand various knowledge representation techniques.
- To provide knowledge of AI systems and its variants
- To understand the planning and different learning.
- To understand the communication process of language translator.

Course Outcomes

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

CO1 - Understand the basics of Artificial Intelligence. **(K1)**

CO2 - Apply AI problem solving techniques, knowledge representation, and reasoning methods in Knowledge based systems **(K3)**

CO3 - Develop simple intelligent / expert system using available tools and techniques of AI to analyze and interpret domain knowledge. **(K3)**

CO4 - Become familiar with planning and different learning methods. **(K3)**

CO5 - Understanding the human language to Machine language and Robotics. **(K1)**

UNIT I INTRODUCTION (9 Hrs)

Introduction - Foundations of AI – History of AI –Structure of AI agents, Problem solving - Informed and uninformed search techniques.

UNIT II KNOWLEDGE REPRESENTATION AND REASONING (9 Hrs)

Logical Agents –Propositional logic - First-Order Logic - Forward and backward chaining - Knowledge Representation

UNIT III UNCERTAIN KNOWLEDGE AND REASONING (9 Hrs)

Basic probability notations - Bayes rule – Wumpus world revisited - Bayesian network.

UNIT IV PLANNING AND LEARNING (9 Hrs)

Introduction to planning, Planning in situational calculus - Representation for planning – Partial order planning algorithm- Learning from examples- Knowledge in Learning - Statistical Learning Methods - Reinforcement Learning.

UNIT V COMMUNICATING, PERCEIVING AND ACTING (9 Hrs)

Natural Language Processing – Natural Language for communication – Perception - Robotics.

Text Books

1. Kevin Night, Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, McGraw Hill2008.
2. Stuart Russel, Peter Norvig “AI – A Modern Approach”, 2nd Edition, Pearson Education 2007.
3. Patrick Henry Winston,” Artificial Intelligence”, Addison Wesley, Books Third edition, 2000.

Reference Books

1. George F Luger, Artificial Intelligence, Pearson Education, 6th edition, 2009.
2. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.
3. EngeneCharniak and Drew Mc Dermott,” Introduction to Artificial intelligence, Addison Wesley

2000.
4. Patrick Henry Winston, “Artificial Intelligence”, Addison Wesley, Books Third edition, 2000.
5. Nils J. Nilsson, “Principles of Artificial Intelligence”, Narosa Publishing House, 2000.

Web Resources

1. https://www.tutorialspoint.com/artificial_intelligence/index.htm
2. https://www.javatpoint.com/artificial-intelligence-tutorial
3. https://www.w3schools.com/ai/
4. https://www.mygreatlearning.com/blog/artificial-intelligence-tutorial/
5. https://nptel.ac.in/courses/112/103/112103280/

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

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

U20CSO706	CLOUD TECHNOLOGY AND ITS APPLICATIONS (Common to EEE, ICE, MECH, CIVIL, BME, CCE, Mechatronics)	L	T	P	C	Hrs
		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 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 ,& quot; Cloud Computing & quot;,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

U20ITO705	AUTOMATION TECHNIQUES & TOOLS - DEVOPS (common to EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics)	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

U20ITO706	AUGMENTED AND VIRTUAL REALITY	L	T	P	C	Hrs
	(common to EEE, ICE, MECH, CICIL, BME)	3	0	0	3	45

Course Objectives

- To learn basics of VR and AR systems
- To know about basic Augment reality functions
- To know about basic Virtual reality functions
- To know about Virtual reality environment and steps to work on it
- To learn various application on AR and VR

Course Outcomes

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

CO1 - Understand the concepts of VR **(K2)**
CO2 - Summarize different VR modelling Process **(K2)**
CO3 - Identify applications of virtual reality environment **(K2)**
CO4 - Explore and work on Augmented Reality environment **(K2)**
CO5 - Illustrate applications related to VR and AR **(K3)**

UNIT I VIRTUAL REALITY AND 3D COMPUTER GRAPHICS (9 Hrs)

Introduction - Benefits of virtual reality - The Virtual world space – Positioning the virtual observer – Stereo perspective projection – 3D clipping – Color Theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms

UNIT II VR MODELLING PROCESS (9 Hrs)

Geometric modeling – kinematics modeling- physical modeling – behaviour modeling – model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR (9 Hrs)

Methodology and terminology - user performance studies - VR health and safety issues – Usability of virtual reality system - cyber sickness -side effects of exposures to virtual reality environment

UNIT IV AUGMENTED REALITY (AR) (9 Hrs)

Introduction – Benefits of AR – Key players of AR technology - Understanding Augmented reality - Working with AR and System structure

UNIT -V APPLICATIONS ON VR (9 Hrs)

Medical applications- robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations

Text Books

1. Kelly S. Hale , Kay M. Stanney, “Handbook of Virtual Environments: Design, Implementation, and Applications”, Human Factors and Ergonomics ,Second Edition , 2014.
2. C. Burdea and Philippe Coiffet, “Virtual Reality Technology”, Gregory, John Wiley and Sons, Inc., Second Edition, 2008.
3. Jason Jerald, “The VR Book: Human-Centred Design for Virtual Reality”. Association for Computing Machinery and Morgan and Claypool, New York, 2015.

Reference Books

1. Dieter Schmalstieg and Tobias Hollerer , “Augmented Reality: Principles and Practice (Usability)”, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
2. Steve Aukstakalnis, “Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)”, Addison-Wesley Professional; 1 edition, 2016.
3. Tony Parisi , “Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile”, OReilly Media, 1st edition, 2015.
4. Tony Parisi , “Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages”, OReilly Media, 1st edition, 2014.

Web References

1. https://www.coursera.org/courses?query=augmented%20reality
2. https://nptel.ac.in/courses/106/106/106106138/
3. http://www.vrmedia.it/en/xvr.html
4. http://www.hitl.washington.edu/artoolkit/

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

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

U20MEO706	PRINCIPLES OF HYDRAULIC AND PNEUMATIC SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

(Common to EEE, ECE, ICE, CIVIL)

Course Objectives

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of Hydraulic system design and industrial applications.
- To provide fundamental knowledge of components forming pneumatic systems.
- To design pneumatic circuits.
- To understand the PLC programming and its applications in Hydro mechanical servo systems.

Course Outcomes

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

CO1 - Identify the components of a typical hydraulic systems. **(K2)**
CO2 - Design and predict simple pressure and direction flow circuits. **(K3)**
CO3 - Understand the pneumatic components (Cylinders, valves, etc.), their use, symbols, and their constructional details. **(K2)**
CO4 - Design Industrial Pneumatics automatic control circuits. **(K3)**
CO5 - Develop circuits for controlling hydraulic and pneumatic system using PLC. **(K3)**

UNIT I ELEMENTS OF HYDRAULIC SYSTEMS (9 Hrs)

Introduction to fluid power, Power unit and accessories, Types of power units –elements. Design properties - Hydraulic fluids, Selection of hydraulic fluid, comparison of hydraulics and pneumatics. Types of cylinders, cylinder cushioning, Pipes- material, pipe fittings. Seals and packing. Filter arrangement, maintenance of hydraulic systems. Selection criteria for cylinders, pipes, Heat generation in hydraulic system.

UNIT II HYDRAULIC SYSTEM DESIGN AND INDUSTRIAL APPLICATIONS (9 Hrs)

Pressure, flow and direction control valves – types & constructional details, circuit symbols. Flow, Pressure and direction control circuits. Regenerative circuits, differential circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits. Design of hydraulic circuits.

UNIT III ELEMENTS OF PNEUMATIC SYSTEMS (9 Hrs)

Compressors- types, selection. Symbols of pneumatic elements. Cylinders - types, typical construction details. Valves – Types, typical construction details.

UNIT IV PNEUMATIC SYSTEMS DESIGN AND INDUSTRIAL APPLICATIONS (9 Hrs)

General approach, travel step diagram. Types - sequence control, cascade, step counter method. K..Mapping for minimization of logic equation. Metal working, handling, clamping, application with counters. Design of pneumatic circuits.

UNIT V ADVANCES IN HYDRAULICS AND PNEUMATICS (9 Hrs)

Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming.

Text Books

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2005.
2. Srinivasan R. ‘‘Hydraulic and Pneumatic Controls’, Vijay Nicole Imprints Private Ltd, 2005.
3. Yeaple F.D ,‘‘Hydraulic and Pneumatic Power and Control: Design’, McGraw-Hill, USA, 2007.
4. S.Sameer, ‘‘Hydraulic And Pneumatic’’,R.K.Publications, 2010.
5. Turner I C, ‘‘Engineering Applications Of Pneumatics And Hydraulics’’, Taylor & Francis, 2020.

Reference Books

1. Majumdar, S.R, ‘‘Oil Hydraulic Systems: Principles and Maintenance’, Tata McGraw- Hill, New Delhi, 2003.
2. Sundaram K.Shanmuga, ‘‘Hydraulic and Pneumatic Controls’’, S. Chand,2006.
3. Pippenger J.J Tyler G Hicks, ‘‘Industrial Hydraulics’’, McGraw-Hill, USA, 2007.
4. Jarosław Stryczek, ‘‘Advances in Hydraulic and Pneumatic Drives and Controls’’, Springer, 2020.
5. Joji Parambath, ‘‘Hydraulics Accumulators and Circuits’’ 2020.

Web References

1. https://nptel.ac.in/courses/112/106/112106300/
2. https://nptel.ac.in/courses/112/105/112105046/
3. https://nptel.ac.in/courses/112/102/112102011/
4. https://nptel.ac.in/courses/112/106/112106175/
5. https://www.hydraulicspneumatics.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	3	1	1	-	2	1	-	1	-	1	-	2	1	2	1
2	3	2	2	1	2	1	-	1	-	1	-	2	2	1	2
3	3	1	2	-	1	-	-	1	-	1	-	1	2	2	1
4	3	2	2	2	1	1	-	1	-	1	-	3	2	1	2
5	3	1	2	1	2	1	-	1	1	1	-	3	2	2	2

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

U20CEO706	GLOBAL WARMING AND CLIMATE CHANGE (common to EEE, ECE, CSE, IT, ICE, MECH, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the basics and importance of global warming.
- Gain adequate knowledge about the characteristic of atmosphere components.
- Gain knowledge about impart of climate change.
- Gain knowledge about the Changes in Climate and Environment
- Impart knowledge about the mitigation measures

Course Outcomes

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

CO1 - Understand the concept and effects of global warming**(K2)**
CO2 - Understand Climate system, earth's atmosphere and its components**.(K2)**
CO3 - Analyze the Impacts of Climate Change on various sectors**(K4)**
CO4 - Assess the concept about carbon credit and clean development mechanism.**(K3)**
CO5 - Understand climate changes, its impact and mitigation activities.**(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I EARTH'S CLIMATE SYSTEM (9 Hrs)

Ozone layer-Role of ozone in environment-ozone depleting -Green House gases- Effects of Greenhouse Gases- Global Warming -Hydrological Cycle – Radiative Effects and Carbon Cycle.

UNIT II ATMOSPHERE AND ITS COMPONENTS (9 Hrs)

Importance of Atmosphere-Physical Chemical Characteristics of Atmosphere- Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability-Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.

UNIT III IMPACTS OF CLIMATE CHANGE (9 Hrs)

Causes of Climate change : Change of Temperature in the environment-Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV OBSERVED CHANGES AND ITS CAUSES (9 Hrs)

Climate change and Carbon credits- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks –The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India .

UNIT V CLIMATE CHANGE AND MITIGATION MEASURES (9 Hrs)

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels –Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices–Carbon sequestration – Carbon capture and storage (CCS) – International and Regional cooperation-Remedial measures.

Text Books

1. Joan Fitzgerald “Greenovation: Urban Leadership on Climate Change,Oxford University Press 2020.
2. J. David Neelin” Climate change and climate modelling” Cambridge University press (2011).
3. Robin Moilveen “Fundamentals of weather and climate” Oxford University Press (2nd Edition) (2010),
4. Andrew Dessler and Edward A. Parson “The Science and Politics of Global Climate Change”2009
5. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.

Reference Books

1. Bill Mc Kibben (2012), The Global Warming Reader: A Century of Writing About Climate Change, Penguin.
2. Jason Smerdon (2009) Climate Change: The Science of Global Warming and Our Energy Future, Columbia University
3. Adaptation (2006) and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge.
4. J.M. Wallace and P.V. Hobbs (2006) Atmospheric Science, Elsevier / Academic Press.
5. Jan C. van Dam, (2003) Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press.

Web References

1. https://nptel.ac.in/courses/105102089/
2. https://www.warmheartworldwide
3. https://nptel.ac.in/content/storage

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	2	2	3	3	3	3	3	3	3	3	3	3	-	-	-
CO2	3	3	2	3	3	3	3	3	3	2	3	3	-	-	-
CO3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO4	2	3	3	2	3	3	3	3	3	3	3	3	-	-	1
CO5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	1

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

U20BMO705	INTERNET OF THINGS FOR HEALTH CARE	L	T	P	C	Hrs
		3	0	0	3	45

(common to EEE, ECE, ICE)

Course Objectives

- To understand the architecture of IoT and its associated protocols
- To gain knowledge on interfacing IoT and cloud
- To analyse the designand development of IoT.
- To get trained with m-IoT components and equipments
- To understand wearable technologies and applications of m-IoT

Course Outcomes

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

CO1 - Understand the architecture of IoT and its associated protocols **(K2)**
CO2 - Gain knowledge on interfacing IoT and cloud. **(K2)**
CO3 - Analyse the design and development of IoT. **(K3)**
CO4 - Understand m-IOT components andequipments **(K2)**
CO5 - Gain knowledge in wearable technologies and applications of m-IoT **(K2)**

UNIT I INTRODUCTION TO IoT (9 Hrs)

Brief History of IoT, Architectural Layers of IoT, Bluetooth, ZigBee, Wi-Fi, IP-Based Protocols, UPnP, CoAP, MQTT, XMPP. SCADA, Authentication protocols, IEEE 802.15.4.

UNIT II IOT IN THE CLOUD (9 Hrs)

Network layer, Cloud, Network Technologies, Types of Networks, BAN, Cloud and Virtualization, Cloud terminologies, Types of Cloud, Service Models, Fog and edge customization

UNIT III DESIGN & DEVELOPMENT (9 Hrs)

Design Methodology – Embedded computing logic – Microcontroller, System on Chips – IoT system building blocks – Arduino board details – IDE programming – Raspberry Pi – Introduction and Interfacing

UNIT IV M-IoT (9 Hrs)

Perception Layer, RFIDs, cameras, Sensors, Introduction to ASICs, pulse oximeters, instrumentation amplifiers, surgical equipment and dependencies, Surgery and its types, role of IoT in surgery.

UNIT V APPLICATION OF IoT in HEALTH CARE (9 Hrs)

Ventilators, Wearable Technologies, smart watches, Computer Assisted Anthropology, Smart Health Organizations

Text Books

1. Aboul Ella Hassanien, Nilanjan, Dey, Surekha Borra, “Medical Big Data and Internet of Medical Things”, CRC Press, 1st edition, 2018.
2. Pankajavalli, P. B., Karthick, G. S. “Incorporating the Internet of Things in Healthcare Applications and Wearable Devices,”IGI Global, 1st edition, 2019.
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015

Reference Books

1. Valentia E.Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar “Internet of Things in Biomedical Engineering”, , Academic Press, 2019

2. Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends, Yole Development Copyrights ,2014
3. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad “A Handbook of Internet of Things in Biomedical and Cyber Physical System” Springer International Publishing,2019
4. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues “Internet of Medical Things for Smart Healthcare” Springer Singapore,2019
5. Subhas Chandra Mukhopadhyay “Intelligent IoT Systems in Personalized Health Care” Elsevier SciencePublishing,2020

Web References

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2. https://www.digimat.in/nptel/courses/video/108105091/L01.html
3. https://youtu.be/ZIBBZnGjFCg
4. https://youtu.be/UrwbeOIlc68
5. https://youtu.be/gGNz-SduPnM

COs/POs/PSOs Mapping

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

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

U20BMO706	TELEHEALTH TECHNOLOGY	L	T	P	C	Hrs
	(common to EEE, ECE, ICE)	3	0	0	3	45

Course Objectives

- To Learn the key principles for telehealth technologies
- To understand communication networks and services.
- To know telemedicine system deployment
- To know the technology for alternative medicine
- To get an adequate knowledge of telemedicine applications.

Course Outcomes

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

CO1 - Understand fundamentals of telemedicine **(K2)**

CO2 - Gain knowledge in Communication networks and services (**K2)**

CO3 - Explain telemedicine system deployment and apply safeguard technologies in telemedicine **(K3)**

CO4 - Gain knowledge in technology for alternative medicine (**K2)**

CO5 - Explain telemedicine applications. **(K2)**

UNIT I FUNDAMENTALS OF TELEMEDICINE (9 Hrs)

Information Technology and Healthcare Professionals- Providing Healthcare to Patients- Technical Perspective - Healthcare Providers - Healthcare Informatics Developments - Different Definitions of Telemedicine - The Growth of the Internet: Information Flooding in E-Health.

UNIT II COMMUNICATION NETWORKSAND SERVICES (9 Hrs)

Wireless Communications Basics - Types of Wireless Networks - Wireless Technology in Patient Monitoring - Body Area Networks - Remote Recovery, General Health Assessments. Technologies in Medical Information Processing - Collecting Data from Patients - Bio-signal Transmission and Processing - Patient Records and Data Mining - Knowledge Management for Clinical Applications - Electronic Drug Store.

UNIT III TELEMEDICINE SYSTEM DEPLOYMENT AND SECURITY (9 Hrs)

Planning and Deployment Considerations - OSI Model - Scalability to Support Future Growth - Integration with Existing IT Infrastructure – Database - Evaluating IT Service and Solution Provider - Technologies for Safeguarding Medical Data and Privacy - Information Security Overview – Safeguarding Patient Medical History.

UNIT IV TECHNOLOGY FOR ALTERNATIVE MEDICINE (9 Hrs)

Technology for Natural Healing and Preventive Care - Consumer Electronics in Healthcare- Telehealth in General Healthcare and Fitness - Telemedicine in Physiotherapy -Healthcare Technology and the Environment.

UNIT V APPLICATIONS OF TELEMEDICINE (9 Hrs)

Teleradiology- Telepathology -Telecardiology- Tele oncology- Tele dermatology- Telesurgery-e-Health and Cyber Medicine - Future Trends in Healthcare Technology.

Text Books

1. Norris A C, Essentials of Telemedicine and Telecare, John Wiley, New York, 2002.
2. Bernard Fong, A. C. M. Fong, C. K. Li, “Telemedicine Technologies: Information Technologies in Medicine and Telehealth”, John Wiley & Sons, Ltd, 2010.
3. Khandpur R S, “Telemedicine Technology and Applications”, PHI Learning Pvt Ltd, 2017.

Reference Books

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, Handbook of Telemedicine, IOS Press, Netherland, 2002.
2. Wootton, R., Craig, J., Patterson, V. (Eds.), “Introduction to Telemedicine” Taylor & Francis 2017
3. Carroll, P.W. Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), “Public Health Informatics and Information Systems”, Springer, 2003.
4. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), “Handbook of Telemedicine,Studies in Health Technology and Informatics”, IOS Press, 2002
5. R. Latifi,” Current Principles and Practices of Telemedicine and e-Health, IOS Press; 2008

Web References

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2. https://youtu.be/AMyTpsG86Pk
3. https://youtu.be/ZfDheAo4nCo
4. https://youtu.be/d87Iyj4rCNg
5. https://youtu.be/QfAoYUsTvtk

COs/POs/PSOs Mapping

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

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

U20CCO705	DATA SCIENCE USING PYTHON (Common to EEE, ECE, MECH, CIVIL, ICE, 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 (9 Hrs)

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.

UNIT III INTRODUCTION TO NUMPY (9 Hrs)

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 (9 Hrs)

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 (9 Hrs)

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. Jake Vander Plas, “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. Rajendra Akerkar, PritiSrinivas 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.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	2
2	2	2	2	2	2	-	-	-	-	-	-	-	-	1	2
3	2	2	2	2	2	-	-	-	-	-	-	-	-	1	2
4	3	3	3	3	3	-	-	-	-	-	-	-	-	1	2
5	3	2	2	2	2	-	-	-	-	-	-	-	-	1	2

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

U20CCO706	MOBILE APPLICATION DEVELOPMENT USING ANDROID	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 INTRODUCTION (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 (9 Hrs)

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

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

U20ADO705	DATA SCIENCE APPLICATION OF NLP	L	T	P	C	Hrs
	(Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	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 ANDLANGUAGE 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. EmilyBender,“LinguisticsFundamentalsforNLP”,MorganClaypoolPublishers,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

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	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.

U20ADO706	ARTIFICIAL INTELLIGENCE APPLICATIONS (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the basic design concept of AI.
- To understand the Machine learning concepts.
- To learn the concept of Deep learning and its applications
- To learn the concept of RPA.
- To acquire the skill to design a chatbot using NLP.

Course Outcomes

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

CO1 - Apply the concept of data science. **(K4)**

CO2 - Understand the concept of Machine learning. **(K2)**

CO3 - Understand the concept of Deep Learning. **(K2)**

CO4 - Apply the design ideas in RPA. **(K4)**

CO5 - Make use of NLP concepts to create chatbot. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction – Alan Turing and Turing test - The rise and fall of expert system - technological drivers of modern AI -Structure of AI-Data: types of Data - Big Data - Database and other tools - Data Process - Ethics and Governance -Data terms.

UNIT II MACHINE LEARNING (9 Hrs)

Machine learning - Standard deviation - the normal distribution - Naive Bayes Classifier - K-Nearest Neighbor - Linear regression - K-Means Clustering.

UNIT III DEEP LEARNING (9 Hrs)

Deep Learning - Difference between Deep Learning and Machine learning – ANN – Backpropagation – RNN – CNN – GAN - Deep Learning Applications - Use Case: detecting Alzheimer's Disease - Deep Learning Hardware - When to use Deep Leaning? - Drawbacks of deep learning.

UNIT IV ROBOTIC PROCESS AUTOMATION (9 Hrs)

RPA - pros and cons of RPA - Determine the right function to automate - assess the processes - RAP and AI - RPA in the real world.

UNIT V NATURAL LANGUAGE PROCESSING (9 Hrs)

Challenges of NLP - Understanding How AI translated Language - NLP in real World - Voice Commerce - Virtual assistants – Chatbot - Future of NLP - The Future of AI.

Text Books

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing" Third Edition. 2000.
2. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva,"Artificial Intelligence (AI)Recent Trends and Applications" CRC Press, 2021.
3. Navin Sabharwal; Amit Agrawal, "Cognitive Virtual Assistants Using Google Dialogflow"Apress,2020.

Reference Books

1. Durkin, J., “Expert systems Design and Development”, Macmillan, 1994.
2. Peter Jackson, “Introduction to Expert Systems”, Addison Wesley Longman, 1999.
3. Amir Shevat,” Designing Bots: Creating Conversational Experiences” O'Reilly,2017.
4. Anik Das and Rashid Khan,“Build Better Chatbots: A Complete Guide to Getting Started with Chatbots” Apress,2017.
5. Akhil Mittal “Getting Started with Chatbots: Learn and create your own chatbot with deep understanding of Artificial Intelligence and Machine Learning” BPB Publications,2019

Web Resources

1. https://www.javatpoint.com/application-of-ai
2. https://pytorch.org/tutorials/beginner/chatbot_tutorial.html
3. https://www.mygreatlearning.com/blog/basics-of-building-an-artificial-intelligence-chatbot/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/lecture-3-reasoning-goal-trees-and-rule-based-expert-systems/
5. http://www.umsl.edu/~joshik/msis480/chapt11.htm

COs/POs/PSOs Mapping

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

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