Sri Sivasubramaniya Nadar College of Engineering

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Rajiv Gandhi Salai (OMR), Kalavakkam – 603110

Regulations 2021

Curriculum and Syllabi for

Bachelor of Engineering

Electronics and Communication Engineering

Vision and Mission of the Department

Vision:

To be in a position of enhanced national and global reputation as a department offering excellent educational programmes and undertaking internationally recognized research and development activities in electronics and communication engineering

Mission:

- Continued focus on excellence in teaching and learning by investing in faculty and staff development and resources.
- Promoting an all-round development of our students through curricular and co-curricular activities that instill a spirit of social responsibility, innovation, creativity and entrepreneurship.
- Attracting a larger number of the best students at both the graduate and undergraduate level
- Promoting high-quality research leading to publications in reputed journals and patents.
- Building partnerships with leading academic institutions and industries.
- Nurturing a learning and work environment that makes the department one of the best ECE communities for students, faculty and staff.

Programme Educational Objectives

PEO1 (Core Knowledge Development): Be competent in applying electronics and communication engineering principles to develop socially and environmentally acceptable engineering solutions

PEO2 (Professional development): Find fulfilling career in electronic and communication engineering or associated industries or higher education and research, or as entrepreneurs

PEO3 (Attitude towards lifelong-learning): Develop the ability and attitude to adapt to evolving technological and social challenges

Programme Outcomes

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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.

Programme Specific Outcomes

PSO1: Design, develop and analyze electronic systems through application of relevant mathematics and engineering principles

PSO2: Design, develop and analyze communication systems through application of fundamentals from wireless communication network, signal processing, and RF & electromagnetics

PSO3: Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems

Mapping of Programme Educational Objectives with Programme Outcomes:

The correlation between the defined POs and the PEOs is given in Table

Correlation between the defined POs and the PEOs

PEOs	Graduate Attributes/POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PEO01	3	3	3	3	3	1	1	1	1	2	1	1	3	3	1
PEO02	1	1	1	2	1	2	2	3	3	3	3	3	1	1	2
PEO03	1	2	2	2	1	2	2	3	3	3	3	3	1	1	3

Mapping Criterion: Strong - 3 Significant - 2 Reasonable - 1

Mapping of Programme Outcomes with Graduate Attributes

Table 2: Mapping of Programme outcomes with NBA Graduate Attributes

Programme Outcomes		NBA's GAs
PO1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	**GA1**
PO2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	**GA2**
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.	**GA3**
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.	**GA4**
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.	**GA5**
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.	**GA6**
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.	**GA7**
PO8:	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**GA8**
PO9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	**GA9**
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.	**GA10**
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.	**GA11**
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.	**GA12**

MAPPING OF COURSES WITH POs AND PSOs

	COURSE OUTCOMES	PROGRAMME OUTCOMES												PSOs		
Sem	**Course Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I	Technical English									2	3		2			
	Matrices and Calculus	3	2										1	1		
	Engineering Physics	3	2	1												
	Engineering Chemistry	3	2	1												
	Problem Solving and Programming in Python	2	2	2	1											
	Engineering Graphics	3	2	2			2				3					
	Programming in Python Laboratory	3	3		1				1	3	2					
	Physics and Chemistry Laboratory	3	3													
II	Complex Functions and Laplace Transforms	3	2										1	1		
	Basic Electrical and Instrumentation Engineering	3	2	1			2	1								
	Fundamentals of Electronic Devices and Circuits	3	3	2	2	2	1		2	3	3	3	2	2		1
	Environmental Science	3	2	1												
	Humanities I-Elective															
	Circuit and Network Analysis	2	3	2	3	3					1		1	3		1
	Design Thinking and Workshop Practices Laboratory	3	2								1	1	1			
	Circuits and Devices Laboratory	3	3	2	3					3	2		1	3		1
III	Linear Algebra and Numerical Methods	3	3			1							1	1		
	Humanities II -Universal Human Values: Understanding Harmony						2		3	3	2		3			
	Analog Circuits	3	3	3	3	2							2	3		1
	Digital System Design	3	3	3	3	2	2		1	3	3		1	3		2
	OOPS and Data Structures	1	2	3	2						1		1	1		
	Signals and Systems	3	3	2	3	3	2	1		2			2	3	3	2
	Analog Circuits Laboratory	3	3	3	3	3				3	2	2	3	3		2
	OOPS and Data Structures Laboratory	2	2	3	3				1	1	2		1	1		
	Microcontrollers	3	3	2	2								1	3		1
	Indian Constitution															
	Digital Signal Processing	3	2	3	3	3		2	2	3			3	3	3	3

	COURSE OUTCOMES		PROGRAMME OUTCOMES												PSOs		
Sem	**Course Name**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
IV	Control Systems Engineering		3	3	3	2	2										
	Electromagnetic Fields		3	3								2		1	1	3	1
	Principles of Communication Systems		3	3	2	3	3			1		3		1		3	
	Microcontrollers Laboratory		3	3	2	3	3			3	2	1	1	3	3		3
	Digital Signal Processing Laboratory		3	3	3	3	3	1	2		3	2		1		3	2
V	Digital Communication		3	2	3	3	3			1	2	3		2		3	1
	Transmission Lines and Waveguides		3	3								2		1	3	3	1
	Communication Networks		2	3	2	2	2	1	1	2	2	2	1	2	2	2	2
	Principles of VLSI Design		3	3	3	3	2				1	1		2	3		2
	Management Elective																
	Professional Elective I	Information Theory and Coding	3	3	2	2	2	1						1	2	3	2
		Advanced Digital Signal Processing	3	3		3	3							1		3	1
		Computer Architecture and Organization	2	3	3	1	2			1	2	2		1	2		
		MEMS & NEMS	2	2	3	2	2	2	2		1	1		1	2	2	2
	Analog and Digital Communication Laboratory		3	3		3	3				3	2	1	1		3	
	VLSI Design Laboratory		3	3	3	3	3				3	2		1	3		3
VI	Wireless Communication		3	3		2	2			1				1	3	2	2
	System Design for IoT		3	3	3	3	2							2	2	3	3
	Microwave and Antenna Engineering		2	3	2	3	3	1		1	2	2		3		2	2
	Machine Learning		3	3	3	3	2	1	1	2	3	3	2	2	3	1	3
	Open Elective - I																
	Professional Elective – II	Introduction to Radar and Satellite	2	2	3	1	3							1	1	2	1
		Digital Image & Video Processing	2	2	1	1								1	3	2	1
		Advanced Microcontrollers	3	2	2	2								2	2	2	3
		Nano Electronics	3	2	2	3	1		1	1	1		1	1	2	1	3

	COURSE OUTCOMES		PROGRAMME OUTCOMES												PSOs		
Sem	**Course Name**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Microwave and Antennas Laboratory		2	2	3	3	3							2		3	2
	System Design for IoT Laboratory		3	3	3	2	3				2			1	3	3	3
VII	High Frequency Communication Systems		2	2	2	2	1	1						1	2	1	1
	Professional Elective – III	Underwater Acoustic System	3	3	2		3		3					1	2	2	2
		Speech Technology	3			3	3				3			3		3	3
		Embedded and Real Time Operating Systems	2	1	2	2	3	1	1	1	2	1	2	2	2	2	1
		MIC and RF Systems Design	3	3	3	2								2	2	3	2
	Professional Elective – IV	Wireless Adhoc and Sensor Networks	3	2	2	1	1							1		2	2
		Optimization in Wireless Communication	2	2	2	2								2	1	2	1
		ASIC and FPGA Based Design	3	3	3	3	1					2		2	3		2
		Electromagnetic Interference and Compatibility	3	3			1	2		2				2	2	2	3
	Professional Elective – V	Wireless Technologies	2	2	1	1	2			1				1	2	2	2
		Communication Network Security	3	3	2	2	2	2	1		1	2		2	1	3	3
		Mixed Signal Design	1	3	1	1	1					1		1	3	1	1
		Digital Signal Integrity	2	3	3	2			3		1	2	1	1	3		1
	High Frequency Communication Laboratory		2	1	1	3	3			2	2	2		1		2	
	Project Phase I		2	2	2	2	3	2	3	3	3	2	2	3	2	2	2
	Industrial Training / Internship																
VIII	Professional Elective – VI	Cognitive Radio	2	3	3		3	3						1	3	3	2
		Computer Vision	2	2	1	1								1	3	2	1
		CMOS Analog IC Design	1	3	1	1	1					1		1	3	1	1
		Sensors, Actuators and Interfaces	3	3	3	2	3	2	2		1	1		1	2	2	3
	Open Elective – II																

	COURSE OUTCOMES	PROGRAMME OUTCOMES												PSOs		
Sem	**Course Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Project Work Stage – II	2	2	2	2	3	2	3	3	3	2	2	3	2	2	2

SUSTAINABLE DEVELOPMENT GOALS (SDG)

SDG		Description
SDG1	No Poverty	End poverty in all its forms everywhere
SDG 2	Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
SDG 3	Good health and well being	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 5	Gender Equality	Achieve gender equality and empower all women and girls
SDG 6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all
SDG 8	Decent work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9	Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
SDG 10	Reducing Inequality	Reduce income inequality within and among countries
SDG 11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable
SDG 12	Responsible consumption and production	Ensure sustainable consumption and production patterns
SDG 13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
SDG 14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG 15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 16	Peace, justice and string Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG 17	Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

MAPPING OF SUBJECTS RELEVANT TO SDG

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Technical English				✓													
Matrices and Calculus				✓													
Engineering Physics				✓													
Engineering Chemistry				✓													
Problem Solving and Programming in Python				✓													
Engineering Graphics				✓													
Programming in Python Laboratory				✓													
Physics and Chemistry Laboratory				✓													
Complex Functions and Laplace Transforms				✓													
Basic Electrical and Instrumentation Engineering				✓													
Fundamentals of Electronic Devices and Circuits				✓													
Environmental Science (Non-credit)			✓	✓		✓	✓						✓	✓	✓		
Design Thinking and Engineering Practices Laboratory				✓													
Circuits and Devices Laboratory				✓													
Linear Algebra and Numerical Methods				✓													
Universal Human Values – Understanding Harmony			✓	✓													

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Analog Circuits				✓													
Digital System Design				✓													
OOPS and Data Structures				✓													
Signals and Systems				✓													
Analog Circuits Laboratory				✓													
OOPS and Data Structures Laboratory				✓													
Microcontrollers				✓													
Indian Constitution (Non-credit)				✓													
Digital Signal Processing				✓													
Control Systems Engineering				✓													
Electromagnetic Fields				✓													
Principles of Communication Systems				✓													
Microcontrollers Laboratory				✓													
Digital Signal Processing Laboratory				✓													
Digital Communication				✓													
Transmission Lines and Waveguides				✓													
Communication Networks				✓													
Principles of VLSI Design				✓													
Analog and Digital Communication Laboratory				✓													

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
VLSI Design Laboratory				✓													
Wireless Communication				✓													
System Design for IoT				✓													
Microwave and Antenna Engineering				✓													
Machine Learning				✓													
Microwave and Antennas Laboratory				✓													
System Design for IoT Laboratory				✓													
High Frequency Communication Systems				✓													
High Frequency Communication Laboratory				✓													
Project Work Phase I				✓				✓	✓								
Industrial Training /Internship*				✓				✓	✓								
Project Work Phase II				✓				✓	✓								
Information Theory and Coding				✓													
Advanced Digital Signal Processing				✓													
Computer Architecture and Organization				✓													
MEMS & NEMS				✓													
Introduction to Radar and Satellite Communication				✓													
Digital Image & Video Processing				✓													

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Advanced Microcontrollers				✓													
Nano Electronics				✓													
Underwater Acoustic System				✓													
Speech Technology				✓													
Embedded and Real Time Operating Systems				✓													
MIC and RF Systems Design				✓													
Wireless Adhoc and Sensor Networks				✓													
Optimization in Wireless Communication				✓													
ASIC and FPGA Based Design				✓													
Electromagnetic Interference and Compatibility				✓													
Wireless Technologies				✓													
Communication Network Security				✓													
Mixed Signal Design				✓													
Digital Signal Integrity				✓													
Cognitive Radio				✓													
Introduction to Computer Vision				✓													
CMOS Analog IC Design				✓													
Sensors, Actuators and Interfaces				✓													

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Language and Communication				✓				✓									
Fundamentals of Linguistics				✓				✓									
Film Appreciation																	
Human relations at work				✓	✓			✓			✓						
Applications of Psychology in everyday life				✓							✓						
Understanding Society and Culture through Literature				✓							✓						
Principles of Management			✓	✓	✓												
Total quality Management			✓	✓	✓				✓								
Work ethics, Corporate social responsibility and Governance	✓	✓	✓	✓	✓			✓		✓							

I to VIII semesters Curriculum

SEMESTER I								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEN2176	Technical English	HS	4	2	0	2	3
2	UMA2176	Matrices and Calculus	BS	4	3	1	0	4
3	UPH2176	Engineering Physics	BS	3	3	0	0	3
4	UCY2176	Engineering Chemistry	BS	3	3	0	0	3
5	UGE2176	Problem Solving and Programming in Python	ES	3	3	0	0	3
6	UGE2177	Engineering Graphics	ES	5	1	0	4	3
7	UGA2176	Heritage of Tamils	HS	1	1	0	0	1
PRACTICALS								
8	UGE2197	Programming in Python Laboratory	ES	3	0	0	3	1.5
9	UGS2197	Physics and Chemistry Laboratory	BS	3	0	0	3	1.5
			TOTAL	**29**	**16**	**1**	**12**	**23**

SEMESTER II									
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**EL**	**C**
	THEORY								
1	UMA2276	Complex Functions and Laplace Transforms	BS	4	3	1	0	0	4
2	UEE2251	Basic Electrical and Instrumentation Engineering	ES	3	3	0	0	0	3
3	UEC2201	Fundamentals of Electronic Devices and Circuits	ES	4	3	0	1	3	4.5
4	ACY2276	Environmental Science	MC*	3	3	0	0	0	0
5		Humanities I-Elective	HS	4	2	0	2	0	3
6	UEC2202	Circuit and Network Analysis	ES	4	3	1	0	0	4
7	UGA2276	Tamils and Technology	HS	1	1	0	0	0	1
	PRACTICALS								
8	UGE2297	Design Thinking and Engineering Practices Laboratory	ES	3	0	0	3	0	1.5

9	UEC2211	Circuits and Devices Laboratory	ES	2	0	0	2	0	1
			TOTAL	**28**	**18**	**2**	**8**	**3**	**22**

*Non-credit

SEMESTER III								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UMA2353	Linear Algebra and Numerical Methods	BS	4	3	1	0	4
2	UHS2376	Universal Human Values 2: Understanding Harmony	HS	4	2	0	2	3
3	UEC2301	Analog Circuits	PC	3	3	0	0	3
4	UEC2302	Digital System Design	PC	5	3	0	2	4
5	UEC2304	OOPS and Data Structures	ES	3	3	0	0	3
6	UEC2376	Signals and Systems	ES	3	3	0	0	3
PRACTICALS								
7	UEC2311	Analog Circuits Laboratory	PC	3	0	0	3	1.5
8	UEC2312	OOPS and Data Structures Laboratory	ES	3	0	0	3	1.5
			TOTAL	**28**	**17**	**1**	**10**	**23**

SEMESTER IV								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEC2401	Microcontrollers	PC	3	3	0	0	3
2	AHS2476	Indian Constitution	MC*	3	3	0	0	0
3	UEC2402	Digital Signal Processing	PC	3	3	0	0	3
4	UEE2476	Control Systems Engineering	PC	3	3	0	0	3
5	UEC2403	Electromagnetic Fields	PC	4	3	1	0	4
6	UEC2404	Principles of Communication Systems	PC	3	3	0	0	3
PRACTICALS								
7	UEC2411	Microcontrollers Laboratory	PC	3	0	0	3	1.5

8	UEC2412	Digital Signal Processing Laboratory	PC	3	0	0	3	1.5
			TOTAL	**25**	**18**	**1**	**6**	**19**

* Non-credit

SEMESTER V								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEC2501	Digital Communication	PC	3	3	0	0	3
2	UEC2502	Transmission Lines and Waveguides	PC	3	3	0	0	3
3	UEC2503	Communication Networks	PC	5	3	0	2	4
4	UEC2504	Principles of VLSI Design	PC	3	3	0	0	3
5		Management –Elective	HS	3	3	0	0	3
6		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
7	UEC2511	Analog and Digital Communication Laboratory	PC	3	0	0	3	1.5
8	UEC2512	VLSI Design Laboratory	PC	3	0	0	3	1.5
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VI								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEC2601	Wireless Communication	PC	3	3	0	0	3
2	UEC2602	System Design for IoT	PC	3	3	0	0	3
3	UEC2603	Microwave and Antenna Engineering	PC	3	3	0	0	3
4	UEC2604	Machine Learning	PC	5	3	0	2	4
5		Professional Elective II	PE	3	3	0	0	3
6		Open Elective I	OE	3	3	0	0	3
PRACTICALS								
7	UEC2611	Microwave and Antennas Laboratory	PC	3	0	0	3	1.5

8	UEC2612	System Design for IoT Laboratory	PC	3	0	0	3	1.5
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VII								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEC2701	High Frequency Communication Systems	PC	3	3	0	0	3
2		Professional Elective III	PE	3	3	0	0	3
3		Professional Elective IV	PE	3	3	0	0	3
4		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
5	UEC2711	High Frequency Communication Laboratory	PC	4	0	0	4	2
6	UEC2718	Project Work Phase I	EEC	6	0	0	6	3
7	UEC2716	Industrial Training /Internship*	EEC	0	0	0	0	2
			TOTAL	**22**	**12**	**0**	**10**	**19**

* The students will undergo 4 weeks Industrial training / Internship during previous vacation

SEMESTER VIII								
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1		Professional Elective VI	PE	3	3	0	0	3
2		Open Elective II	OE	3	3	0	0	3
PRACTICALS								
3	UEC2818	Project Work Phase II	EEC	16	0	0	16	8
			TOTAL	**22**	**6**	**0**	**16**	**14**

Total No of Credits: 16

Honours Degree Specialization: “Internet of Things”

CATEGORY WISE LISTING OF COURSES

HUMANITIES AND SOCIAL SCIENCES (HS)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEN2176	Technical English	HS	4	2	0	2	3
2	UGA2176	Heritage of Tamils	HS	1	1	0	0	1
3		Humanities I-Elective	HS	4	2	0	2	3
4	UGA2276	Tamils and Technology	HS	1	1	0	0	1
5	UHS2376	Universal Human Values 2: Understanding Harmony	HS	4	2	0	2	3
6		Management – Elective	HS	3	3	0	0	3

BASIC SCIENCES (BS)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UMA2176	Matrices and Calculus	BS	4	3	1	0	4
2	UPH2176	Engineering Physics	BS	3	3	0	0	3
3	UCY2176	Engineering Chemistry	BS	3	3	0	0	3
4	UGS2197	Physics and Chemistry Laboratory	BS	3	0	0	3	1.5
5	UMA2276	Complex Functions and Laplace Transforms	BS	4	3	1	0	4
6	UMA2353	Linear Algebra and Numerical Methods	BS	4	3	1	0	4

ENGINEERING SCIENCES (ES)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	EL	C
1	UGE2176	Problem Solving and Programming in Python	ES	3	3	0	0	0	3

2	UGE2177	Engineering Graphics	ES	5	1	0	4	0	3
3	UGE2197	Programming in Python Laboratory	ES	3	0	0	3	0	1.5
4	UEE2251	Basic Electrical and Instrumentation Engineering	ES	3	3	0	0	0	3
5	UEC2201	Fundamentals of Electronic Devices and Circuits	ES	4	3	0	1	3	4.5
6	UEC2202	Circuit and Network Analysis	ES	4	3	1	0	0	4
7	UGE2297	Design Thinking and Engineering Practices Laboratory	ES	3	0	0	3	0	1.5
8	UEC2211	Circuits and Devices Laboratory	ES	2	0	0	2	0	1
9	UEC2304	OOPS and Data Structures	ES	3	3	0	0	0	3
10	UEC2376	Signals and Systems	ES	3	3	0	0	0	3
11	UEC2312	OOPS and Data Structures Laboratory	ES	3	0	0	3	0	1.5

PROFESSIONAL CORE (PC)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2301	Analog Circuits	PC	3	3	0	0	3
2	UEC2302	Digital System Design	PC	5	3	0	2	4
3	UEC2311	Analog Circuits Laboratory	PC	3	0	0	3	1.5
4	UEC2401	Microcontrollers	PC	3	3	0	0	3
5	UEC2402	Digital Signal Processing	PC	3	3	0	0	3
6	UEE2476	Control Systems Engineering	PC	3	3	0	0	3
7	UEC2403	Electromagnetic Fields	PC	4	3	1	0	4
8	UEC2404	Principles of Communication Systems	PC	3	3	0	0	3
9	UEC2411	Microcontrollers Laboratory	PC	3	0	0	3	1.5
10	UEC2412	Digital Signal Processing Laboratory	PC	3	0	0	3	1.5
11	UEC2501	Digital Communication	PC	3	3	0	0	3
12	UEC2502	Transmission Lines and Waveguides	PC	3	3	0	0	3
13	UEC2503	Communication Networks	PC	5	3	0	2	4
14	UEC2504	Principles of VLSI Design	PC	3	3	0	0	3
15	UEC2511	Analog and Digital Communication Laboratory	PC	3	0	0	3	1.5

16	UEC2512	VLSI Design Laboratory	PC	3	0	0	3	1.5
17	UEC2601	Wireless Communication	PC	3	3	0	0	3
18	UEC2602	System Design for IoT	PC	3	3	0	0	3
19	UEC2603	Microwave and Antenna Engineering	PC	3	3	0	0	3
20	UEC2604	Machine Learning	PC	5	3	0	2	4
21	UEC2611	Microwave and Antennas Laboratory	PC	3	0	0	3	1.5
22	UEC2612	System Design for IoT Laboratory	PC	3	0	0	3	1.5
23	UEC2701	High Frequency Communication Systems	PC	3	3	0	0	3
24	UEC2711	High Frequency Communication Laboratory	PC	4	0	0	4	2

MANDATORY COURSES (MC)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ACY2276	Environmental Science	MC	3	3	0	0	0
2	AHS2476	Indian Constitution	MC	3	3	0	0	0

PROFESSIONAL ELECTIVES (PE)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2521	Information Theory and Coding	PE	3	3	0	0	3
2	UEC2522	Advanced Digital Signal Processing	PE	3	3	0	0	3
3	UEC2523	Computer Architecture and Organization	PE	3	3	0	0	3
4	UEC2524	MEMS & NEMS	PE	3	3	0	0	3
5	UEC2621	Introduction to Radar and Satellite Communication	PE	3	3	0	0	3
6	UEC2622	Digital Image & Video Processing	PE	3	3	0	0	3
7	UEC2623	Advanced Microcontrollers	PE	3	3	0	0	3
8	UEC2624	Nano Electronics	PE	3	3	0	0	3
9	UEC2721	Underwater Acoustic System	PE	3	3	0	0	3

10	UEC2722	Speech Technology	PE	3	3	0	0	3
11	UEC2723	Embedded and Real Time Operating Systems	PE	3	3	0	0	3
12	UEC2724	MIC and RF Systems Design	PE	3	3	0	0	3
13	UEC2725	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3
14	UEC2726	Optimization in Wireless Communication	PE	3	3	0	0	3
15	UEC2727	ASIC and FPGA Based Design	PE	3	3	0	0	3
16	UEC2728	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3
17	UEC2729	Wireless Technologies	PE	3	3	0	0	3
18	UEC2731	Communication Network Security	PE	3	3	0	0	3
19	UEC2732	Mixed Signal Design	PE	3	3	0	0	3
20	UEC2733	Digital Signal Integrity	PE	3	3	0	0	3
21	UEC2821	Cognitive Radio	PE	3	3	0	0	3
22	UEC2824	Introduction to Computer Vision	PE	3	3	0	0	3
23	UEC2822	CMOS Analog IC Design	PE	3	3	0	0	3
24	UEC2823	Sensors, Actuators and Interfaces	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2718	Project Phase I	EEC	6	0	0	6	3
2	UEC2716	Industrial Training /Internship	EEC	0	0	0	0	2
3	UEC2818	Project Phase II	EEC	16	0	0	16	8

HUMANITIES I- ELECTIVE (Semester II)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEN2241	Language and Communication	HS	4	2	0	2	3

2	UEN2242	Fundamentals of Linguistics	HS	4	2	0	2	3
3	UHS2243	Film Appreciation	HS	4	2	0	2	3
4	UHS2241	Human relations at work	HS	4	2	0	2	3
5	UHS2242	Applications of Psychology in everyday life	HS	4	2	0	2	3
6	UEN2243	Understanding Society and Culture through Literature	HS	4	2	0	2	3

MANAGEMENT ELECTIVE (Semester V)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UBA2541	Principles of Management	HS	3	3	0	0	3
2	UBA2542	Total quality Management	HS	3	3	0	0	3
3	UBA2543	Work ethics, Corporate social responsibility and Governance	HS	3	3	0	0	3

PROGRAM ELECTIVES

SEMESTER V

PROFESSIONAL ELECTIVE – I

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2521	Information Theory and Coding	PE	3	3	0	0	3
2	UEC2522	Advanced Digital Signal Processing	PE	3	3	0	0	3
3	UEC2523	Computer Architecture and Organization	PE	3	3	0	0	3
4	UEC2524	MEMS & NEMS	PE	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE – II

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2621	Introduction to Radar and Satellite Communication	PE	3	3	0	0	3
2	UEC2622	Digital Image & Video Processing	PE	3	3	0	0	3
3	UEC2623	Advanced Microcontrollers	PE	3	3	0	0	3

4	UEC2624	Nano Electronics	PE	3	3	0	0	3

SEMESTER VII
PROFESSIONAL ELECTIVE – III

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2721	Underwater Acoustic System	PE	3	3	0	0	3
2	UEC2722	Speech Technology	PE	3	3	0	0	3
3	UEC2723	Embedded and Real Time Operating Systems	PE	3	3	0	0	3
4	UEC2724	MIC and RF Systems Design	PE	3	3	0	0	3

SEMESTER VII
PROFESSIONAL ELECTIVE – IV

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2725	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3
2	UEC2726	Optimization in Wireless Communication	PE	3	3	0	0	3
3	UEC2727	ASIC and FPGA Based Design	PE	3	3	0	0	3
4	UEC2728	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3

SEMESTER VII
PROFESSIONAL ELECTIVE – V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC2729	Wireless Technologies	PE	3	3	0	0	3
2	UEC2731	Communication Network Security	PE	3	3	0	0	3
3	UEC2732	Mixed Signal Design	PE	3	3	0	0	3
4	UEC2733	Digital Signal Integrity	PE	3	3	0	0	3

SEMESTER VIII
PROFESSIONAL ELECTIVE – VI

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C

1	UEC2821	Cognitive Radio	PE	3	3	0	0	3
2	UEC2824	Introduction to Computer Vision	PE	3	3	0	0	3
3	UEC2822	CMOS Analog IC Design	PE	3	3	0	0	3
4	UEC2823	Sensors, Actuators and Interfaces	PE	3	3	0	0	3

Specialization in Communication	Specialization in Signal Processing
Specialization in Circuits, Devices and Systems	Specialization in RF and MEMS

DISTRIBUTION OF CREDITS

Semester	HS	BS	ES	PC	PE	OE	EEC	MC*	TOTAL
I	4	**11.5**	**7.5**						**23**
II	4	**4**	**14**					**0**	**22**
III	**3**	**4**	**7.5**	**8.5**					**23**
IV				**19**				**0**	**19**
V	**3**			**16**	**3**				**22**
VI				**16**	**3**	**3**			**22**
VII				**5**	**9**		**5**		**19**
VIII					**3**	**3**	**8**		**14**
TOTAL	**14**	**19.5**	**29**	**64.5**	**18**	**6**	**13**	**0**	**164**

*Mandatory courses -no credits

Courses for Honours Specialization

Sl. No	Course Code	Course Title	Contact Periods	L	T	P	EL	C
	Embedded Group (Any two)							
1	UEC2623	Advanced Microcontrollers	3	3	0	0	0	3
2	UEC2723	Embedded and Real Time Operating Systems	3	3	0	0	0	3
3	UEC2823	Sensors, Actuators and Interfaces	3	3	0	0	0	3
4	UEC2H61	Embedded Programming	4	2	0	2	0	3
	IoT Group (Any two)							
5	UEC2H21	IoT Architectures	3	3	0	0	0	3

6	UEC2H22	IoT Communication Technologies	3	3	0	0	0	3
7	UEC2H23	Data Science for IoT	3	3	0	0	0	3
8	UEC2H24	Security and Privacy in IoT	3	3	0	0	0	3
	Applications Group (Mandatory)							
9	UEC2H25	Industrial IoT 4.0	3	3	0	0	0	3
10	UEC2417	Project Work in IoT	2	0	0	2	6	3

DETAILED SYLLABI

COURSE CODE	COURSE TITLE	L	T	P	C
UEN2176	**TECHNICAL ENGLISH**	**2**	**0**	**2**	**3**

OBJECTIVES

- To enhance the competence in reading and comprehending texts drawn from engineering and technology.
- To improve the ability of the students to write proposals, reports, and letters.
- To develop speaking skills of the students to make technical presentations, participate in group discussions and take part in public speaking.
- To strengthen the listening skills of the students to enable them to listen and comprehend lectures and talks (online and face to face) and quickly decipher deeper levels of meaning.

UNIT I **9**

Language development:	Subject-Verb agreement, Tenses (simple), Conjunctions, Numerical adjective.
Vocabulary development:	Root words – Prefixes & Suffixes, Standard abbreviations
Reading:	Comprehension of short technical texts - skimming and scanning.
Writing:	Describing an object, the process of an event/experiment and others, Paragraph Writing.
Listening:	Listening for taking notes and seeking clarifications (classroom lectures/ ted talks etc),
Speaking:	Self-introduction and introducing others/short conversations in formal and informal contexts.

UNIT II **9**

Language development:	The pronouns-antecedent agreement, Tenses-continuous, If conditionals, Adverbs
Vocabulary development:	Collocations and fixed expressions, Avoidance of Jargons
Reading:	Comprehension of longer texts – (Interpretative and Critical levels of meaning),
Writing:	Writing definitions (single sentence and extended), Expository and Persuasive Essays,
Listening:	Listening Comprehension Tasks
Speaking:	Making technical presentations

UNIT III **9**

Language development:	Prepositions, Tenses-perfect, Articles, Embedded sentences
Vocabulary development:	Compound words, Formal and informal vocabulary
Reading:	Reading Reviews, advertisements, SOPs for higher studies
Writing:	Writing instruction and recommendations, formal and informal letters/ emails, Writing SOPs
Listening:	Listening to longer technical talks and discussion
Speaking:	Demonstrating working mechanisms

UNIT IV **9**

Language development:	Reported speech, Active and Passive voices, Framing 'Wh' and 'Yes' or 'No' questions
Vocabulary development:	Technical vocabulary, Verbal analogies
Reading:	Reading industrial case studies, interpreting technical text and making notes
Writing:	Interpreting charts and graphs, writing blogs and vlogs
Listening:	Listening to telephonic conversations and online interviews
Speaking:	Participating in group discussions

UNIT V **9**

Language development:	Phrasal verbs, clauses, compound and complex sentences
Vocabulary development:	Single-word substitutes, Vocabulary retention strategies,
Reading:	Reading for IELTS, GER, TOEFL

Writing:	Writing proposals and reports, writing minutes of the meeting,
Listening:	Listening Skils for Proficiency Tests like IELTS
Speaking:	Job Interviews (face to face and online) – basics

TOTAL PERIODS: 45

OUTCOMES

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

CO 1: To read and comprehend texts (technical) effectively.
CO 2: To write proposals, reports, emails, letters, SOPs meeting professional expectations.
CO 3: To Improve Vocabulary (use of right collocations, idioms and phrases etc).
CO 4: To enhance their grammatical competency for writing and speaking.
CO 5: To improve their ability to listen and comprehend at deeper levels.

TEXT BOOK:

1. Praveen Sam, D., and Shoba N, A., Course in Technical English, Cambridge University Press, New Delhi, 2020.

REFERENCE BOOKS:

1. Sudharshana,N.P., and Saveetha, C., English for Technical Communication, CambridgeUniversity Press, New Delhi, 2016.
2. Raman, Meenakshi, Sharma, and Sangeetha, Technical Communication Principles andPractice, Oxford University Press, New Delhi, 2014.
3. Kumar, Suresh, E., Engineering English, Orient Blackswan, Hyderabad, 2015.
4. Booth L. Diana, Project Work, Oxford University Press, 2014.
5. Grussendorf, Marion, English for Presentations, Oxford University Press, 2007.
6. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges, CengageLearning, USA, 2007.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	3	3							2	3		2			
CO2	3	3							2	3		2			
CO3	3	3							2	3		2			
CO4	3	3							2	3		2			
CO5	3	3							2	3		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UMA2176	**MATRICES AND CALCULUS**	**3**	**1**	**0**	**4**

OBJECTIVES

The objective of this course is to enable the student to

- To reduce quadratic form to canonical form of a matrix and identify its nature
- To analyse the convergence of infinite series
- To study the concept of evolute and envelope
- To find the extreme values for a function of two variables
- To compute area of closed surface and volume of solids using multiple integrals

UNIT I MATRICES 12

Characteristic equation - Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors, Cayley-Hamilton Theorem – statement and applications, Diagonalization of matrices – Similarity transformation - Quadratic form - Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II SEQUENCES AND SERIES 12

Sequences - Definition and examples, Series - Types of Convergence, Series of positive terms, Tests of convergence - Comparison test, Integral test and D'Alembert's ratio test, Alternating series – Leibnitz's test, Series of positive and negative terms, Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 12

Curvature, radius of curvature - Cartesian and parametric co-ordinates – Centre of curvature – Circle of curvature in Cartesian form, Evolutes, Envelopes (including two parameter family), Evolute as envelope of normal.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and its properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 12

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

TOTAL PERIODS: 60

OUTCOMES

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

CO1: Identify the nature of quadratic form by reducing it to canonical form
CO2: Analyse the convergence of a given infinite series
CO3: Find evolute of a given curve and envelope of family of curves
CO4: Find the extrema of function of two variables
CO5: Evaluate the double and triple integrals
CO6: Application of extreme points of functions and multiple integrals in engineering problems

TEXT BOOKS:

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2016.

REFERENCE BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Ninth Edition, Laxmi Publications Pvt Ltd., 2016.
2. James Stewart, Calculus: Early Transcendental, Cengage Learning, New Delhi, 7th Edition, 2013.
3. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
4. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes	Program Specific Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2											1		
CO2	3	2											1		
CO3	3	2											1		
CO4	3	2											1		
CO5	3	2											1		
CO6	3	2										1	1		

COURSE CODE	COURSE TITLE	L	T	P	C
UPH2176	ENGINEERING PHYSICS	3	0	0	3

OBJECTIVES

The objective of this course is to enable the student to

- Comprehend and identify different crystal structures and their imperfections.
- Explain the elastic and thermal properties of materials and understand their significance.
- Develop an understanding of quantum mechanical phenomena and their applications.
- Provide an overview of the characteristics of sound, architectural acoustics and the production, detection and applications of ultrasound.
- Explain the origin of laser action, production of laser, fibre optics and their applications.

UNIT I CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials– single crystals - Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal Imperfections – Point, line (Edge and Screw dislocations –Burger vectors) Surface (stacking faults) and Volume defects.

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Properties of matter: Elasticity- Hooke's law - Relationship between three moduli of elasticity– stress -strain diagram– Poisson's ratio –Factors affecting elasticity– Torsional stress & deformations – Twisting couple – Torsion pendulum - theory and experiment–bending of beams-bending moment– cantilever: theory and experiment–uniform and non-uniform bending: theory and experiment-I-shaped girders.
Thermal Physics: Modes of heat transfer – thermal conduction, convection and radiation – Newton's law of cooling - thermal conductivity- Lee's disc method for bad conductor – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel) – Formation of ice on ponds.

UNIT III ACOUSTICS AND ULTRASONICS 9

Acoustics: Classification and characteristics of Sound - decibel - Weber–Fechner law – Sabine's formula - derivation using growth and decay method —factors affecting acoustics of buildings and their remedies - Methods of determination of Absorption Coefficient. Ultrasonics: Production of ultrasonics by Magnetostriction and piezoelectric methods – acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C – scan displays.

UNIT IV QUANTAM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton Effect. Theory and experimental verification – Properties of Matter waves – wave particle duality - Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box and extension to three dimensional box – Degeneracy of electron energy states - Scanning electron microscope - Transmission electron microscope.

UNIT V PHOTONICS AND FIBRE OPTICS 9

Photonics: Spontaneous and stimulated emission- Population inversion -Einstein's A and Bcoefficients –Conditions for Laser action - Types of lasers – Nd: YAG, & CO2 lasers-Basics of diode lasers-Industrial and Medical Applications. Fibre optics: Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) –Losses in fibers - attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors.- pressure and displacement.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Analyze crystal structures and the influence of imperfections on their properties.
CO2: Demonstrate and explain the general concepts of elastic and thermal properties of materials.
CO3: Explain quantum mechanical theories to correlate with experimental results and their applications to material diagnostics.
CO4: Analyze the applications of acoustics and ultrasonics to engineering and medical disciplines.
CO5: Elucidate the principle and working of lasers and optical fibers, and their applications in the field of industry, medicine and telecommunication.

TEXT BOOKS:

1. Gaur, R.K., and Gupta, S.L., Engineering Physics, Dhanpat Rai Publishers, 2012.
2. Serway, R.A., & Jewett, J.W., Physics for Scientists and Engineers, Cengage Learning, 2010.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. Principles of Physics, Wiley, 2015.
2. Tipler, P.A. & Mosca, G. Physics for Scientists and Engineers with Modern Physics, WH Freeman, 2007.
3. Avadhanulu, M. N., Kshirsagar, P. G, A text book of Engineering Physics, S. Chand & Co. Ltd., Ninth Revised Edition, 2012.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2		1	1		2			2					
CO2	3	2		1	1		2			2					
CO3	3	2		1	1		2			2					
CO4	3	2		1	1		2			2					
CO5	3	2		1	1		2			2					

COURSE CODE	COURSE TITLE	L	T	P	C
UCY2176	ENGINEERING CHEMISTRY	3	0	0	3

OBJECTIVES:

- To impart knowledge to the students on the basic concepts of chemistry and properties of materials for various engineering applications

UNIT I ATOMIC AND MOLECULAR NANOCHEMISTRY 9

Atoms- Atomic orbitals, Molecules- Molecular orbitals. Nanoparticles and its uniqueness. Distinction between molecules, nanoparticles and bulk materials. Classification of nanoparticles. Size dependent Properties-Thermal, Optical, Chemical, Electronic and Mechanical. Synthesis of nanomaterials - bottom-up and top-down approaches-Techniques-Colloidal, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation. Objectives of surface modification of nanoparticles. Synthesis and applications - Carbon Nano Tubes (CNT) - Gold nanoparticle

UNIT II ELECTROCHEMISTRY 9

Conductivity of electrolytes - factors influencing conductivity- Conductometric titration and its applications -estimation of strong acid, estimation of mixture of strong and weak acids and estimation of $BaCl_2$. Electrochemical cell-redox reaction-origin of electrode potential, Types of electrode, Measurement of electrode potential and emf of the electrochemical cell -reference electrode- saturated calomel electrode and Ag/AgCl electrode - Ion selective electrode-glass electrode measurement of pH –Potentiometric titrations- estimation of ferrous ion and estimation of strong acid. Problems based on all the above concepts.

UNIT III CORROSION AND ITS CONTROL 9

Corrosion-Definition-Classification of corrosion-Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion

– factors influencing corrosion – corrosion control – selection of materials - sacrificial anode and impressed current cathodic methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

UNIT IV PHASE EQUILIBRIA 9

Phase Rule - Definition and explanation of terms involved with suitable examples- Phase – Components – Degrees of Freedom –Applications and limitations of Phase Rule, One component system - H_2O Two component systems – Construction of phase diagram by Thermal Analysis (or) Cooling curves – Condensed Phase Rule - Simple eutectic systems: Pb-Ag system – System with congruent melting point: Zn-Mg – System with incongruent melting point: Ni-Cd

UNIT V SYNTHESIS AND APPLICATIONS OF INDUSTRIAL POLIMERS 9

Polymers and Polymerization: definition, classification - types of polymerization: addition and condensation –mechanism of addition polymerization (cationic, anionic, free radical and coordination polymerization)-Properties: Glass Transition temperature, Average Molecular weight and its determination by viscosity method. Polymer composites (fibre reinforced plastics)-preparation, properties and application of engineering plastics Epoxy resin, Polyurethans, Nylon 6:6, Polycarbonate, PS, PVC and PET

TOTAL PERIODS: 45

COURSE OUTCOMES:

On successful completion of this course, the students will be able to demonstrate understanding on

CO1: Apply the Principles of Electrochemistry for Qualitative Analysis

CO2: Detect/Identify various types of corrosion under severe to normal corrosive environments and provide appropriate solution.

CO3: Construct phase diagram of one and two component system and analyse its properties for application purposes.

CO4: Explain the synthesis, properties and applications of industrially important engineering materials

TEXT BOOKS:

1. Engineering Chemistry’ by Jain P.C. and Monika Jain, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015
2. Engineering Chemistry by S.S.Dara, S.Chand & Co.Ltd,New Delhi ,2011

REFERENCE BOOKS:

1. Pradeep- NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill Education; 2017(1st edition)
2. Gurdeep Raj, Phase Rule, GOEL Publishing House, Meerut, 2011.
3. R. Gopalan, K. Rangarajan, P.S. Subramanian. “Elements of Analytical Chemistry” Sultan Chand & Sons,2003.

4. F.W. Billmayer, Textbook of Polymer Science, 3rd Edison, Wiley. N.Y. 1991.

CO – PO AND PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3								2					
CO3	3													
CO4	3									2		1		

COURSE CODE	COURSE TITLE	L	T	P	C
UGE2176	**PROBLEM SOLVING AND PROGRAMMING IN PYTHON**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To learn algorithmic problem solving techniques.
- To learn the fundamentals of python programming.
- To compose programs in Python using conditions, iterations and decompose a problem into functions
- To construct programs in Python sequenced data type.
- To develop python programs using advanced constructs like dictionaries and files.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Logical and Algorithmic Thinking: Logical Thinking – Algorithmic Thinking; Problem Solving and Decomposition: Defining the Problem – Devising the Solution – Decomposition; Effective building blocks: Basic Algorithmic Constructs (pseudo code, flow chart, programming language) – Program State.

UNIT II DATA, EXPRESSION, STATEMENT, CONDITIONAL 9

Data and types: int, float, boolean, string, list; variables, expressions, statements, simultaneous assignment, precedence of operators; comments; in-built modules and functions; Conditional: boolean values and operators, conditional (if), alternative (if-else), case analysis (if-elif-else).

UNIT III ITERATION, FUNCTION, STRINGS 9

Iteration: while, for, break, continue, pass; Functions: function definition, function call, flow of execution, parameters and arguments, return values, local and global scope, recursion;

Strings: string slices, immutability, string functions and methods, string module.

UNIT IV LISTS, TUPLES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, nested lists, list comprehension; Tuples: tuple assignment, tuple as return value, tuple operations.

UNIT V DICTIONARIES, FILES 9

Dictionaries: operations and methods, looping and dictionaries, reverse lookup, dictionaries and lists; Files: Text files, reading and writing files, format operator, file names and paths; command line arguments.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Solve programming problems and express solutions in pseudo code.
CO2: Develop simple programs using basic constructs.
CO3: Construct programs using conditions and iterations decompose a problem into functions.
CO4: Make use of strings, lists, tuples and dictionaries data structures.
CO5: Perform Input/Output Operations using files.

TEXT BOOK:

1. Karl Beecher, ``Computational Thinking – A beginner's Guide to Problem Solving and Programming", British Computer Society (BCS), 2017.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist", 2nd edition, Green Tea Press, Shroff/O'Reilly Publishers, 2015 (http://greenteapress.com/wp/think-python/)

REFERENCE BOOKS:

1. John V Guttag, ``Introduction to Computation and Programming Using Python", 3rd edition, MIT Press, 2021.
2. Ashok Namdev Kamthane, Amit Ashok Kamthane, ``Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, 2018.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, ``Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, ``Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, ``Fundamentals of Python: First Programs", 2nd Edition, CENGAGE Learning, 2018.

0

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1													
CO2	2	2													
CO3	2	3	2	1											
CO4	2	3	2	1											
CO5	2	2	2	1											

COURSE CODE	COURSE TITLE	L	T	P	C
UGE2177	ENGINEERING GRAPHICS	1	0	4	3

OBJECTIVES

- To develop the graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings

Concepts and Conventions (Not for Examinations):

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 10

Basic Geometrical constructions, Curves used in engineering practices: Conics –Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection principles - Principal planes - First angle projection - Layout of views - Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal

planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 20

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of truncated solids (simple position only) – Prisms, pyramids, cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

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

TOTAL PERIODS: 75

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Draw Plane curves and perform Free hand sketching of three - dimensional objects.
CO2: Draw the Orthographic projections of points, lines and plane surfaces.
CO3: Draw the Projections of solids.
CO4: Draw the Projections of sectioned solids and Development of surfaces.
CO5: Draw the Isometric and Perspective projections of solids.

TEXT BOOKS:

1. Natarajan, K.V., A Text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020.
2. Venugopal, K. and Prabhu Raja, V., Engineering Graphics, New Age International (P) Limited, 15th Edition, 2018.

REFERENCE BOOKS:

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House, 53rd Edition, 2014.
2. Basant Agarwal, and Agarwal, C.M., Engineering Drawing, McGraw Hill, 3rd Edition, 2019.
3. Gopalakrishna, K.R., Engineering Drawing (Vol. I & II Combined), Subhas Publications, 27th Edition, 2017.
4. Luzzader J Warren, and Jon M Duff, Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Pearson Education, 11th Edition, 2005.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.

2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2			2				3					
CO2	3	2	2			2				3					
CO3	3	2	2			2				3					
CO4	3	2	2			2				3					
CO5	3	2	2			2				3					

COURSE CODE	COURSE TITLE	L	T	P	C
UGA2176	HERITAGE OF TAMILS	1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

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

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam

Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

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

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V. Subaramanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE2197	PROGRAMMING IN PYTHON LABORATORY	0	0	3	1.5

OBJECTIVES

- To write, test, and debug simple Python programs.
- To apply conditions and loops to solve problems using python.
- To implement programs using functions

- To write programs using different data types such as strings, lists tuples and dictionaries
- To perform read and write operations into the files.

SUGGESTIVE EXERCISES

1. Use Linux shell commands, use Python in interactive mode, and an editor
2. Write simple programs (area of a geometric shape, simple interest, solve quadratic equation, net salary).
3. Write programs using conditional statements (leap year, maximum of 2 numbers, maximum of 3 numbers, simple calculator, grade of the total mark).
4. Develop programs using loops and nested loops (gcd, prime number, integer division, sum of digits of an integer, multiplication table, sum of a series, print patterns, square root using Newton's method).
5. Develop programs using functions (sine and cosine series, Pythagorean triplets).
6. Develop programs using recursion (efficient power of a number, factorial, Fibonacci number).
7. Develop programs using strings (palindrome, finding substring) without using in-built functions.
8. Develop programs using lists and tuples (linear search, binary search, selection sort, insertion sort, quicksort).
9. Develop programs using nested lists (matrix manipulations).
10. Develop simple programs using dictionaries (frequency histogram, nested dictionary).
11. Develop programs using Files (read and write files).
12. Develop programs to perform any task by reading arguments from command line.
13. Implement a simple application using appropriate datatypes and files

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Develop Python programs using conditions, loops and functions (K3)
2. Solve problems using strings, lists and tuples (K3)
3. Construct programs using dictionaries and perform Input/Output operations using files (K3)

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3									2	
CO2	3	2		3									2	
CO3	3	2		3									2	
Score	9	6		9									6	
	3	3		3									2	

COURSE CODE	COURSE TITLE	L	T	P	C
UGS2197	PHYSICS AND CHEMISTRY LABORATORY	0	0	3	1.5

PHYSICS LABORATORY

COURSE OBJECTIVES

The objective of this course is to enable the students to

- Obtain basic Knowledge about physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of the Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of the rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of the wavelength of the mercury spectra using Spectrometer and grating.
4. Determination of the dispersive power of a prism using Spectrometer.
5. Determination of the grating element/wavelength, and particle size/ wavelength using a laser.
6. Determination of the Numerical and the acceptance angle of an optical fiber.
7. Determination of the thickness of a thin wire using interference fringes.
8. Determination of the coefficient of viscosity of the given liquid using Poiseuille's method.
9. Determination of the band gap energy of a semiconductor.
10. Determination of the coefficient of thermal conductivity of the given bad conductor using Lee's disc.

COURSE OUTCOMES

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

CO1: Apply principles of elasticity, optics, viscosity, thermal and band gap determination for engineering applications

CO-PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			2	1										

CHEMISTRY LABORATORY

OBJECTIVES

- To impart hands on training for all the possible concepts learned in Engineering Chemistry Course

LIST OF EXPERIMENTS

(Any 6 to be performed)

1. Estimation of ferrous ion by potentiometric titration
2. Estimation of strong acid using pH meter.
3. Estimation of strong acid by conductometric titration
4. Estimation of mixture of strong and weak acids using conductometer
5. Estimation of BaCl2 by conductometric titration
6. Determination of degree of polymerization of a water soluble polymer by Viscosity method
7. Determination of equivalent conductance of a strong electrolyte at infinite dilution
8. Determination of weak acid using weak base by conductometric titration.
9. Determination of rate of corrosion by weight loss method

TOTAL PERIODS: 45

COURSE OUTCOMES

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

CO2: To understand the principles and procedures of pHmetry, potentiometry and conductometry

TEXT BOOK

Manual Prepared by Faculty of Chemistry Department, SSNCE

REFERENCE BOOK

1. Practical Physical Chemistry,B.Viswanath and P.S.Raghavan, ViVa Books PVT.Ltd,New Delhi, 2012.

CO – PO AND PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO2	2			2										

COURSE CODE	COURSE TITLE	L	T	P	C

UMA2276	COMPLEX FUNCTIONS AND LAPLACE TRANSFORMS	3	1	0	4

OBJECTIVES

The objective of this course is to enable the student to

- Applying C-R equations in the construction of Analytic Functions.
- Study the methods of Complex Integration, finding Taylor's and Laurent's Series expansions.
- Find the Laplace Transforms and inverse transforms for standard functions.
- Solve Differential Equations using different techniques.
- Evaluate Line, Surface and Volume integrals.

UNIT I ANALYTIC FUNCTIONS 12

Analytic functions – necessary and sufficient conditions, Cauchy-Riemann equations in Cartesian and polar form (with proof) – Properties - harmonic functions, Construction of analytic function, conformal mapping - some standard transformations $-w = z + c, cz, \frac{1}{z}, z^2$, bilinear transformation.

UNIT II COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula, Taylor's and Laurent's series, Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour (except the poles on the real axis).

UNIT III LAPLACE TRANSFORM 12

Definition, properties, existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function, shifting theorems, Transforms of derivatives and integrals, Initial and final value theorems, Periodic functions, Inverse transforms – Convolution theorem.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12

Solution of second and higher order linear differential equation with constant coefficients $(f(x) = e^{mx}, sinmx, cosmx, x^n, f(x)e^{mx}, f(x)sinmx)$, Method of variation of parameters, Simultaneous linear equations with constant coefficients of first order, Solving linear second order ordinary differential equations with constant coefficients using Laplace transforms.

UNIT V VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields, Line integral over a plane curve, Surface integral - Area of a curved surface, Volume integral, Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

TOTAL PERIODS: 60

OUTCOMES

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

CO1: Solve problems in Analytic functions and construction of analytic functions using C-R equations.

CO2: Solve problems using integration techniques, find Taylor's and Laurent's Series expansions.

CO3: Obtain the Laplace Transforms and inverse transforms of standard functions.
CO4: Solve Differential Equations using different techniques.
CO5: Evaluate Line, Surface and Volume integrals.
CO6: Application of Complex integration, Laplace transforms, Ordinary differential equations, and vector calculus in engineering problems

TEXT BOOKS:

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2016.

REFERENCE BOOKS:

1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, 11th Edition, Global Edition, Wiley, 2017.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2014.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2012.
5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, 11th Edition, Global Edition, John Wiley & Sons, Inc., 2017.
6. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.
7. Srivastava, A.C., and Srivastava, P.K., Engineering Mathematics Volume I and II, PHI learning Pvt. Ltd, 2011.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2											1		
CO2	3	2											1		
CO3	3	2											1		
CO4	3	2											1		
CO5	3	2											1		
CO6	3	2										1	1		

COURSE CODE	COURSE TITLE	L	T	P	C
UEE2251		3	0	0	3

	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING				

PREAMBLE

It helps in understanding the importance of machines in electrical applications. This course helps in providing adequate knowledge about the different machines governing the basic electrical operations. In addition, this course helps in understanding the basics of three phase circuits and power systems. Finally, this course helps the students in selecting a specific instrument for a particular application by studying the basics of measurement and instrumentation.

OBJECTIVES:

To impart knowledge on

- Operation of Three phase electrical circuits and power measurement
- Working principles of Electrical Machines (Both AC and DC)
- Working principle of various measuring instruments.

UNIT I AC CIRCUITS AND POWER SYSTEMS 9

Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads- Power equation – Star Delta Conversion – Three Phase Power Measurement - Transmission & Distribution of electrical energy – Overhead Vs Underground system – Protection of power system – types of tariff – power factor improvement.

UNIT II TRANSFORMER 9

Introduction - Ideal Transformer – Accounting for Finite Permeability and Core Loss – Circuit Model of Transformer – Per Unit System – Determination of Parameters of Circuit Model of Transformer – Voltage Regulation – Name Plate Rating – Efficiency – Three Phase Transformers - Auto Transformers.

UNIT III DC MACHINES 9

Introduction – Constructional Features– Motoring and generation principle – EMF and Torque equation - Circuit Model – Methods of Excitation and magnetisation characteristics – Starting and Speed Control – Universal Motor.

UNIT IV AC MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit. Single phase Induction motors - Construction and Working – Types–starting and speed control methods. Alternator- working principle– EMF equation. Synchronous motors- working principle-starting methods – Torque equation – Stepper Motors – Brushless DC Motors.

UNIT V MEASUREMENT AND INSTRUMENTATION 9

Type of Electrical and electronic instruments – Classification- Types of indicating Instruments – Principles of Electrical Instruments – Multimeters, Oscilloscopes - Static and Dynamic Characteristics of Measurement – Errors in Measurement – Transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Explain the basic concept of three phase supply
CO2: Understand the basics of power generation, transmission and distribution
CO3: Comprehend the concepts in AC and DC motors, generators and transformers
CO4: Understand the operation and working of special machines
CO5: Choose appropriate measuring instruments for given application

TEXT BOOKS:

1. Kothari D.P and Nagarath, I.J, Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
2. Giorgio Rizzoni, Principles and Applications of Electrical Engineering, McGraw Hill Education (India) Private Limited, 2010.
3. S. Salivahanan, R. Rengaraj and G.R. Venkatakrishnan, " Basic Electrical and Instrumentation Engineering" , McGraw Hill, 2017.

REFERENCE BOOKS:

1. Bhattacharya S.K, Basic Electrical and Electronics Engineering, Pearson India, 2011.
2. Del Toro, Electrical Engineering Fundamentals, Pearson Education, New Delhi, 2015.
3. Leonard S Bobrow, Foundations of Electrical Engineering, Oxford University Press,2013.
4. Rajendra Prasad, Fundamentals of Electrical Engineering, Prentice Hall of India, 2006.
5. Mittle, N, Basic Electrical Engineering, Tata McGraw Hill Edition, 24th Reprint, 2016.
6. Fitzgerald A.E, David E Higginbotham, and Arvin Grabel, Basic Electrical Engineering, McGraw Hill Education (India) Private Limited, 2009.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3				2	1								
CO2	3	2	1			2	1								
CO3	3	2	1			2	1								
CO4	3	2	1			2	1								
CO5	3	2	2			2	1								

COURSE CODE	COURSE TITLE	L	T	P	EL	C
UEC2201		3	0	1	3	4.5

	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS					

PREAMBLE

Fundamentals of Electronic Devices and Circuits is a foundation course on the development of electronic devices and circuits. This course provides a broad overview on the working of various PN devices and the students will have a hands-on experience in designing simple electronic devices using discrete PN devices. Moreover, this course provides a broad overview on the design and development of BJT and FET based amplifier circuits.

OBJECTIVES

- To acquaint the semiconductor properties and formation of PN Junction diode and its characteristics
- To understand the operation and applications of BJT, FET and special PN devices
- To understand the concepts of biasing in BJT, JFET and MOSFET
- To design and analyze single stage and multistage amplifier circuits using equivalent circuit.
- To provide exposure to the students with hands-on experience on various basic electronic devices.

UNIT I PN JUNCTION DIODE AND BJT CHARACTERISTICS 9

Theory of PN junction diode – Energy band structure of open-circuited PN junction – Diode current equation – Temperature dependence of V-I characteristics of diode - Transition and diffusion capacitances - Breakdown in PN junction diodes – Switching Characteristics of diode. BJT: Construction of BJT – Operation of NPN and PNP transistors – Types of configurations – Breakdown in Transistors

UNIT II FIELD EFFECT TRANSISTOR AND SPECIAL PN DEVICES 9

Construction and operation of N-channel JFET – Characteristic parameters of JFET (drain resistance, transconductance, amplification factor) – Expression for saturation drain current - Construction and operation of N-Channel and P-Channel MOSFET – Enhancement and depletion type MOSFET –Characteristics – Threshold voltage – Channel length modulation - Operation and I-V Characteristics of Zener diode – Varactor diode – Photodiode - Operation and I-V Characteristics of UJT – SCR – DIAC.

UNIT III BIASING OF DISCRETE BJT, JFET & MOSFET 9

BJT: Need for biasing - DC load line and bias point - Thermal runaway - Stability factor (S) - Design and analysis of transistor biasing circuits – fixed bias -feedback bias – self bias circuits - JFET: DC load line and bias point - Methods of JFET and MOSFET biasing.

UNIT IV BJT AND FET SINGLE-STAGE AMPLIFIERS 9

General shape of frequency response of amplifiers - Frequency response of transistor amplifiers with circuit capacitors - Small signal hybrid-π equivalent circuit of BJT - Early effect – Mid-band analysis of CE, CC and CB amplifiers using hybrid-π equivalent circuit - Small signal hybrid-π equivalent circuit of FET and MOSFET – Mid-band analysis of CS, CD and CG amplifiers using hybrid-π equivalent circuit.

UNIT V MULTI-STAGE AND DIFFERENTIAL AMPLIFIERS 9

Different coupling schemes used in Amplifiers - Bootstrapping technique - Darlington amplifier - Cascade and cascode amplifier using BJT - BJT Differential amplifier - Small signal analysis and CMRR - FET differential amplifier - Small signal analysis and CMRR.

Theory Periods: 45

LIST OF EXPERIMENTS (any 2)

1. Design an automatic water level indicator and a motor control using bipolar junction transistors.
2. Construct a mobile charging unit using silicon-controlled rectifier (SCR).
3. Using an LDR and relay circuit, construct an automatic street light controller.
4. Design and develop an alarm security system using BJT.
5. Design a fire alarm system using LDR.
6. Construct a LED flash circuit using UJT
7. Design a battery eliminator circuit using Zener diodes.
8. Design a pulse generator using UJT.
9. Design a shadow movement alarm using photodiodes.
10. Design an infrared Alarm system to detect movement of people using photodiodes.
11. Design a RF filter using a variable capacitor.
12. Design a power supply for amplifier circuit.

TOTAL PERIODS: 60

OUTCOMES

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

CO1 : Explain the basics of device physics and working principle of PN Junction diode
CO2 : Describe the construction, operation and applications of BJT, FET and special PN devices.
CO3 : Apply the knowledge of biasing on BJT and FET circuits
CO4 : Analyze the performance of small-signal BJT and FET in single stage and multi-stage amplifiers.
CO5 : Design and evaluate electronic systems using semiconductor devices and analyze its characteristics.
CO6 : Communicate effectively through reflections, reports and presentations

TEXT BOOK:

1. Salivahanan S and Suresh Kumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017. (Unit I to V)

REFERENCE BOOKS:

1. Donald A. Neamen, Electronic Circuits Analysis and Design, McGraw Hill Education (India) Private Ltd., Third Edition, 2017.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Eleventh Edition, 2016.
3. Millman J, Halkias C and Sathyabrada Jit, Electronic Devices and Circuits, McGraw Hill Education (India) Private Ltd., Fourth Edition, 2015.
4. Thomas L. Floyd, Electronic Devices, Pearson Education, Ninth Edition, 2017.
5. David A. Bell, Electronic Devices and Circuits, Oxford University Press, Fifth Edition, 2017.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	1							2	3		
CO2	3	3	2	2	1							2	3		
CO3	3	3	3	2	2							2	2		1
CO4	3	3	2	2	2							2	2		1
CO5	3	3	3	2	3	1		1	3	3	2	3	2		2
CO6								3	3	3	3	2	1		1

COURSE CODE	COURSE TITLE	L	T	P	C
ACY2276	ENVIRONMENTAL SCIENCE	3	0	0	0

OBJECTIVES

- The students of Engineering undergoing this Course would develop a better understanding of human relationships, perceptions and policies towards the environment and focus on design and technology for improving environmental quality

UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 9

Definition, scope and importance of environment– concept, structure and function of an ecosystem – energy flow- food chains, food webs and ecological pyramids – ecological succession Introduction to biodiversity definition and types– values of biodiversity- India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity-endangered and endemic species of India -conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II NATURAL RESOURCES 9

Uses, over-exploitation of natural resources: Forest, Water, Mineral, Food, Energy and Land. Case studies on over exploitation of natural resources -Role of an individual in conservation of natural resources- Equitable use of resources for sustainable lifestyles.

UNIT III CURRENT ENVIRONMENTAL ISSUES 9

Environmental issues– causes, effects and control measures of Pollution of (a) Air (Smog, acid rain, climate change and global warming, ozone layer depletion) (b) Water (rain water harvesting, watershed management and waste water treatment) (c) Soil (solid waste management, wasteland reclamation) (d)Electronic waste.
Population explosion, Resettlement and rehabilitation of people and Disaster management.

UNIT IV ENGINEERING INTERVENTIONS TO REDUCE ENVIRONMENTAL STRESSES 9

Role of information technology in environment- Remote Sensing- satellites and sensors- Geographical Information Systems(GIS)-Applications. Environment data base management system.
Green chemistry-Principles - Green buildings-Advantages of green buildings over conventional buildings-Electric and Hybrid Electric Vehicles (HEV)

UNIT V ENVIRONMENTAL REGULATIONS 9

Environmental Ethics for sustainable development- Human rights- Environmental Impact Assessment– Ecomark-role of NGO- Central and state pollution control boards- Air (Prevention and Control of Pollution) act 1981– Water (Prevention and control of Pollution) act 1974– Wildlife protection act 1972 – Forest conservation act 1980- The National Green Tribunal Act 2010

TOTAL PERIODS: 45

OUTCOMES

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

CO1: To understand the fundamentals of ecosystem and importance of biodiversity

CO2: To comprehend the importance of natural resources, the social issues arising due to over exploitation of natural resources and equitable use of resources

CO3: A knowledge on the causes, effects and control measures of various types of environmental pollution and disaster management.

CO4: To understand the role of information technology and application of principles of green chemistry in environment and human health.

CO5: To know the role of enforcement machinery, individuals, NGOs in preventing environmental degradation and in sustainable development.

CO6: To analyse the current environmental issues considering the ethical and sustainable component.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik, Environmental Science and Engineering, New Age International Publishers,14thEdition, 2014.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2006.

REFERENCE BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition,Pearson Education, 2004.
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1							3								
CO2							3								
CO3							3								
CO4							2								
CO5						3	2								
CO6								1		1		1			

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2202	CIRCUIT AND NETWORK ANALYSIS	3	1	0	4

PREAMBLE

The analysis of the circuits is the basic foundation to understand all electrical phenomena. Circuit and network analysis is connected with technologies that involves electricity, such as medical, automotive, computer, energy and aerospace industries. In this course, the fundamental laws governing the circuits are studied by developing the mathematical representation and the analysis of the circuits.

OBJECTIVES

- To learn the basic concepts and behaviour of DC and AC circuits.
- To understand various methods of circuit/ network analysis using network theorems.
- To learn the concept of resonance and coupling in tuned circuits.
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.
- To characterize two port networks in terms of Z, Y, ABCD and h parameters.

UNIT I BASIC CIRCUITS ANALYSIS 12

Ohm's law – Kirchhoff's laws – DC and AC Circuits – Resistors, inductors and capacitors in series and parallel circuits – voltage and current division, source transformation – star delta

conversion – Mesh current and node voltage method of analysis for DC and AC circuits – Phasor Diagram

.

UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS 12

Superposition theorem – Thevenin's and Norton's theorems – Maximum power transfer theorem – Reciprocity theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Resonance – Series and Parallel resonance – frequency response – Quality factor and Bandwidth – Self and Mutual inductance – Coefficient of coupling – Dot convention – Modeling of coupled circuits – Coupled inductors in series and parallel – Tuned circuits – Single tuned and Double tuned coupled circuits.

UNIT IV TRANSIENT ANALYSIS 12

Natural and Forced Response, Damping, damping coefficient, Transient response of RL, RC and RLC circuits using Laplace transform for DC excitations and AC with sinusoidal excitations

UNIT V TWO PORT NETWORKS 12

Two port networks, Characterization of two port networks in terms of Z, Y, ABCD and h-parameters, Representation of one parameter in terms of other, Interconnection of two port networks – Symmetry and Reciprocity.

TOTAL PERIODS: 60

OUTCOMES

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

CO1: Apply the basic concepts of circuit analysis such as Kirchoff's laws, mesh current and node voltage method for analysis of DC and AC circuits.
CO2: Apply the basic circuit analysis concepts and network theorems such as, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, and Maximum power transfer theorem to DC and AC circuits.
CO3: Analyze the frequency response of parallel and series resonance circuits, the concept of inductance, coupling and apply it to single and double tuned circuits.
CO4: Analyse transient response for any RC, RL and RLC circuits.
CO5: Analyze two port networks in terms of Z, Y, ABCD and h parameters.

TEXT BOOK:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill Higher Education, Eighth Edition, 11th Reprint 2016. (Unit I to V)

REFERENCE BOOKS:

1. Joseph A. Edminister, Mahmood Nahvi, Electric circuits, Schaum's outline series, Tata McGraw-Hill Publishing Company, 6th edition, 2016.

2. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, McGraw Hill, 6th edition, 2017.
3. J. David Irwin, R. Mark Nelms, Basic Engineering Circuit Analysis, John Wiley & Sons, 11th edition, 2015.
4. S. Salivahanan, "Circuit Theory: Analysis and Synthesis", Pearson Education, First edition, 2021.
5. Bruce A. Carlson, Circuits, Cengage Learning, India Edition, 2008.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	3					1		1	3		1
CO2	3	3	2	3	3					1		1	3		1
CO3	2	3	2	3	3					1		1	3		1
CO4	2	3	2	3	3					1		1	3		1
CO5	2	3	2	3	3					1		1	3		1

COURSE CODE	COURSE TITLE	L	T	P	C
UGA2276	TAMILS AND TECHNOLOGY	1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V. Subaramanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Title	L	T	P	C
UGE2297	**DESIGN THINKING AND ENGINEERING PRACTICES LABORATORY**	**0**	**0**	**3**	**1.5**

Objectives:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering
- To train the students to dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model, and to assemble the different engineering components

List of Experiments:

GROUP A (CIVIL & MECHANICAL ENGINEERING PRACTICE)

I - CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings - Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.

(b) Preparation of plumbing line sketches for water supply and sewage works.

(c) Hands-on-exercise:

- Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
- Plumbing with basic connections for washing basin and sink

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise: Wood work, joints by sawing, planning and cutting.

- Fabrication of different models of pencil box and pen stand.
- Fabrication of wooden wall shelf

(c) Demonstration of wood working machinery

II - MECHANICAL ENGINEERING PRACTICE

Basic Machining:

(a) Drilling Practice (holes of various diameters - steel sheet metal, wood, hylam/plywood sheet)

Sheet Metal Work

(a) Forming & Bending

(b) Different type of joints.

- Fabrication of mobile phone metal stand
- Fabrication of electrical control panel box

Design thinking practices

To dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model, and to assemble the following components.

- Pedestal Fan head swing mechanism - Reserve mechanism (Two wheeler) - Hot Glue gun - Paper clips - Flush tank container mechanism - Hand pump – washer Mechanism

GROUP B (ELECTRICAL & ELECTRONICS ENGINEERING PRACTICE)

1. Residential house wiring, staircase wiring and tube light wiring with single phase AC two wire system.
2. Energy measurement with RLC Load.
3. Earth resistance measurement.
4. Measurement of AC parameters using CRO and half wave and Full wave rectifier.
5. Study of logic gates AND, OR, EX-OR & NOT.
6. Soldering practice – Components Devices and Circuits – Using PCB.

Design thinking practices

1. Assemble a single phase 3 wire circuit for connecting household appliances and explain through schematic diagram
2. Measure the energy consumed by the household appliances and verify it theoretically
3. Analyze the fault occurring in electrical appliances
4. Design, assemble and test a cell phone charger
5. Design, assemble and test a relay logic to control electrical appliances.

6. Design, assemble and test a dc power supply using PCB **Total Periods:45**
Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Draw pipeline plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household woodwork (K2)
CO2: Practice machining to make holes on different materials; fabricate sheet metal components (K2)
CO3: Dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model of various components (K2)
CO4: Construct domestic electrical circuits and verify their output parameters (K3)
CO5: Construct electronics circuits and verify their output (K3)
References: 1. Willis H. Wagner, Howard "Bud" Smith, and Mark W. Huth Modern Carpentry, 12th Edition, 2015 2. P.C.Sharma, Production Technology (Manufacturing Process): Manufacturing Process, S.Chand publisher, 2006 3. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, McGraw-Hill Education, 2014 4. David W Rongey , A Complete Guide to Home Electrical Wiring, 2013 5. K.Jeyachandran, S.Natarajan & S, Balasubramanian, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).

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

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
UEC2211	**CIRCUITS AND DEVICES LABORATORY**	**0**	**0**	**2**	**1**

PREAMBLE

This Laboratory is designed to provide hands on training for students undergoing course on Electric Circuits and Electronic Devices. The experiments provide deeper understanding about the theorems and working of semiconductor devices.

OBJECTIVES

- To gain hands on experience in selected network theorems
- To understand the working of resonant circuits

- To learn the VI characteristics of basic semiconductor electronic devices.

LIST OF EXPERIMENTS

Part I: Circuit Experiments

1. Verification of Kirchhoff's Voltage Law and Kirchhoff's Current Law
2. Verification of Thevenin and Norton theorem
3. Verification of Superposition theorem
4. Verification of Maximum Power Transfer and Reciprocity theorem
5. Determination of Resonance Frequency of Series and Parallel RLC Circuits

Part II: Electronic Devices Experiments

1. VI Characteristics of PN Junction diode
2. Zener diode Characteristics & voltage Regulation using Zener diode
3. Input and Output Characteristics of BJT in CE configuration
4. VI Characteristics of JFET
5. VI characteristics of SCR

TOTAL PERIODS: 30

OUTCOMES

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

CO1: Verify network theorems and estimate the resonant behaviour of RLC circuits.
CO2: Analyse the characteristics of basic electronic devices

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Semiconductor devices (Diodes, BJT, FET and SCR) and resistors	As required
2	Decade inductance and capacitance box	2 boxes each
3	DC Ammeter, Voltmeter and Multi-meters	As required
4	Bread-boards and connecting wires	As required

CO – PO/PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		3					3	2		1	2		
CO2	3	2	2	3					3	2		1	3		1

COURSE CODE	COURSE TITLE	L	T	P	C
UMA2353	LINEAR ALGEBRA AND NUMERICAL METHODS	3	1	0	4

OBJECTIVES

The objective of this course is to enable the student to

- To study the basics of vector spaces, subspaces and linear transformations
- To apply the linear transformation concepts in diagonalization of a matrix
- To study inner product and norms and apply it in Gram-Schmidt procedure and least square approximation
- To evaluate the linear system of equations by using different numerical methods
- To find the numerical solution of Eigen values problems and generalized inverses

UNIT I VECTOR SPACES 12

Vector spaces –Subspaces –Linear combinations and system of Linear equations –Linear independence and Linear dependence –Bases and Dimensions

UNIT II LINEAR TRANSFORMATIONS 12

Linear transformations –Null and Range spaces -Matrix representation of linear transformation – Eigen values, Eigenvectors and Diagonalization.

UNIT III INNER PRODUCT SPACES 12

Inner product and norms -Gram Schmidt orthonormalization process -Orthogonal Complement – Least square approximation.

UNIT IV NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS 12

Solution of linear system of equations–Direct methods – Gauss elimination method, Pivoting, Gauss-Jordan method -Cholesky decomposition method -Iterative methods – Gauss-Jacobi and Gauss-Seidel methods.

UNIT V NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS AND GENERALISED INVERSES 12

Eigen value Problems – Power method, Jacobi’s rotation method– QR decomposition, Generalized inverse of a matrix,Singular value decomposition.

TOTAL PERIODS: 60

OUTCOMES

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

CO1 : Solve the problems using the concepts of vector spaces, subspaces and linear transformation

CO2 : Apply linear transformation to diagonalize a given matrix and hence to find the eigen values of the given matrix

CO3 : Apply Gram-Schmidt's orthogonalization process to diagonalize a given matrix and to solve the given system of equations by least square approximations

CO4 : Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to the linear system of equations

CO5 : Decompose the matrix using different methods such as QR and singular value Decomposition

CO6: Application of inner product space and numerical methods in engineering problems

TEXT BOOKS:

1. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Prentice Hall of India, 4th Edition, New Delhi, 2004.
2. Faires J.D. and Burden R., Numerical Methods, 7th Edition, Brooks/Cole (Thomson Publications), New Delhi, 2002.

REFERENCE BOOKS:

1. Kumaresan S, Linear Algebra – A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
2. Strang G, Linear Algebra and its applications, 4th Edition, Brooks/Cole (Thomson Publications), New Delhi, 2006.
3. Gerald C.F, and Wheatley P.O, Applied Numerical Analysis, 7th Edition, Pearson Education, New Delhi, 2004.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Education, New Delhi, 8th Edition, 2005.
6. Richard Branson, Matrix Operations, Schaum's outline series, McGraw Hill, 1989.
7. M. Tamban Nair and Arindama Singh, Linear Algebra, Springer, 2018.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2											1		
CO2	3	2											1		
CO3	3	2											1		
CO4	3	3											1		

CO5	3	3											1		
CO6	3	3			1							1	1		

COURSE CODE	COURSE TITLE	L	T	P	C
UHS2376	Universal Human Values 2: Understanding Harmony	**2**	**0**	**2**	**3**

OBJECTIVES

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- To help students initiate a process of dialogue within themselves to know what they ‘want to be in their life and profession
- To help students understand the meaning of happiness and prosperity for a human being.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life Course

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Value Education - Need, Basic Guidelines, Content and Process, Self-Exploration - meaning, importance and process, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities - the basic requirements, Understanding Happiness and Prosperity - A critical appraisal of the current scenario, Method to fulfil the above human aspirations - understanding and living in harmony at various levels.

UNIT II HARMONY IN THE HUMAN BEING 9

An understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’, Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT III HARMONY IN THE FAMILY AND SOCIETY 9

Understanding harmony in the Family- the basic unit of human interaction, understanding values in a human-to-human relationship; Understanding Trust - the foundational value in relationship, Difference between intention and competence, Understanding Respect – as the right evaluation, Difference between respect and differentiation; the other salient values in a

relationship, Understanding the harmony in the society - comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order - from family to world family!

UNIT IV HARMONY IN NATURE AND EXISTENCE 9

Understanding the harmony in Nature, Interconnectedness, self-regulation and mutual fulfilment among the four orders of nature- recyclability, Understanding Existence as Coexistence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 9

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics - augmenting universal human order, the scope and characteristics of people-friendly and eco-friendly, Holistic Technologies, production systems and management models - Case studies, Strategy for the transition from the present state to Universal Human Order - At the level of individual: as socially and ecologically responsible engineers, technologists and managers, At the level of society: as mutually enriching institutions and organizations.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.

CO2: Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.

CO3: Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.

CO4: Understand the harmony in nature and existence, and work out their mutually fulfilling participation in nature.

CO5: Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

TEXT BOOK:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2nd Revised Edition, 2019.

REFERENCE BOOKS:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. The economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1						2		3	3	2		3			
CO2						2		3	3	2		3			
CO3						2		3	3	2		3			
CO4						2		3	3	2		3			
CO5						2		3	3	2		3			

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2301	ANALOG CIRCUITS	3	0	0	3

PREAMBLE:

Analog Circuits is the fundamental course offered to discuss the construction and working of various amplifier topologies and signal generators using transistors. Also, this course provides the foundation for integrated circuits, the associated basic building blocks and the linear/non-linear electronic applications using OPAMP. Using this knowledge, the students can construct circuits for use in a variety of applications such as communication systems.

OBJECTIVES:

- To introduce the concept of feedback amplifiers and power amplifiers
- To study the construction and operation of transistor-based waveform generators
- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the concepts of waveform generation and some special function ICs

UNIT I TRANSISTOR AMPLIFIERS 9

Classification of amplifiers - Concept of feedback in amplifiers - General Characteristics of feedback - Analysis of feedback amplifiers - Power Amplifiers: Class A, Class B, Class C, Class AB Amplifiers.

UNIT II TRANSISTOR SIGNAL GENERATORS 9

Basic principles of sinusoidal oscillators - RC phase shift oscillator, Wien Bridge Oscillator - Hartley, Colpitts and Clapp Oscillators - Crystal Oscillators - Multivibrators: Bistable, Monostable and Astable multivibrators.

UNIT III BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources - Voltage sources - Voltage References - Basic information about op-amps - Ideal Operational Amplifier - General operational amplifier stages of IC 741 - DC and AC performance characteristics - slew rate - Open and closed loop configurations.

UNIT IV APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer - Scale Changer - Phase Shift Circuits - Voltage Follower - V-to-I and I-to-V converters - Adder - subtractor - Instrumentation amplifier - Integrator, Differentiator - Logarithmic amplifier, Antilogarithmic amplifier – Comparators - Schmitt trigger - Precision rectifier - peak detector - clippers and clampers - Low-pass, high-pass and band-pass Butterworth filters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs 9

Sine wave generators - Multivibrators and Triangular wave generator - Sawtooth wave generator - ICL8038 function generator - Timer IC 555 - IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Frequency to Voltage and Voltage to Frequency converters.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Classify feedback amplifiers and power amplifiers.
CO2: Design transistor based sinusoidal and non-sinusoidal signal generators.
CO3: Implement linear and nonlinear applications using OP-AMPS
CO4: Demonstrate waveform generation using OP-AMP Circuits

TEXT BOOKS:

1. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Oxford University Press, Seventh Edition, 2016. (Unit I & II)
2. D.Roy Choudhry and Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., Fifth Edition, 2018. (Unit III to V)

REFERENCE BOOKS:

1. Millman J, Halkias C and Chetan D. Parikh, Integrated Electronics, McGraw Hill Education (India) Pvt. Ltd., Second Edition, 2015.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory Pearson Education, Eleventh Edition, 2016.
3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata McGraw Hill, Fourth Edition 2016.
4. Salivahanan S and Kanchana Bhaskaran V S, Linear Integrated Circuits, Tata McGraw Hill, Second Edition, 4th Reprint, 2016.
5. William D. Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, Fourth Edition, 2001.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2							2	3		1
CO2	3	3	3	3	2							2	3		1
CO3	3	3	3	3	2							2	3		1
CO4	3	3	3	3	2							2	3		1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2302	DIGITAL SYSTEM DESIGN	3	0	2	4

PREAMBLE:

The digital system design is the basic foundation to understand the building blocks involved in designing any digital system. Digital systems find its applications in various areas such as Communication, Business transactions, Traffic control, Space guidance, Medical treatment, Weather monitoring, Internet, and many other commercial, industrial, and scientific enterprises. In this course, the functioning of basic building blocks for digital systems are studied and designed.

OBJECTIVES:

- To introduce the important basic parameters and theoretical aspects of Boolean algebra
- To design combinational & sequential logic circuits and verify its functionality using VHDL

UNIT I DIGITAL FUNDAMENTALS 9

Analog versus Digital, Fan-In, Fan-Out, propagation delay, power dissipation, Noise Margin, Number systems: Binary, Octal, Decimal, Hexadecimal, Number-Base Conversions, Complements of Number, Binary Codes, Boolean Algebra: Switching algebra, axioms and

theorems, Logic gates: AND, OR, NOT, NAND, NOR, EXOR, EXNOR, Canonical and Standard Forms.

UNIT II COMBINATIONAL CIRCUIT DESIGN 9

Logic minimization using Karnaugh's map: 3 variables, 4 variables and 5 variables, Logic minimization using Quine Mc-Cluskey method, Arithmetic operations: Half adder, full adder, ripple carry adder, lookahead adder, subtractor, binary multiplier, Selection logic: Multiplexer, De-multiplexer, decoder, encoder, priority encoder, magnitude comparator.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Latches and Flip flops: SR, JK, T and D, excitation tables and excitation equations, Counters: Ripple counters, ring counters, modulo counters, Shift registers: SISO, SIPO, PISO, PIPO, Universal shift registers, Analysis of clocked sequential circuits, Synchronous FSM: Mealy and Moore Models, Design procedure, Design of sequence detector, counters.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Asynchronous FSM: Analysis Procedure, Circuit with Latches, cycles and race conditions, Design procedure, Reduction of Flow tables, Race free assignment, Hazards, Design examples.

UNIT V HARDWARE DESCRIPTIVE LANGUAGE: VHDL 9

Introduction to VHDL, Design entry in VHDL: Entity, architecture, coding style (behavioral and structural), Coding syntax: sequential statement, case, if statement, sensitivity list, Behavioral design of combinational logic blocks: multibit adder, selection logic, encoder, decoder, comparator, Behavioral design of sequential logic blocks: counters, shift registers, finite state machines and sequence detector, Introduction to test bench.

LIST OF EXPERIMENTS 30

1. Design and implement an arithmetic unit which does atleast two operations using combinational logic.
2. Design and implement combinational logic circuits that compare two numbers.
3. Design and implement an adder which adds two numbers of any lengths with minimal components.
4. Design and implement a sequential circuit to detect the given sequence.
5. Design a 3-bit counter which counts in ascending order when mode control input is zero and in gray code sequence otherwise.
6. Design and implement a finite string recognizer which has one input (X) and one output (Z). The output is asserted whenever the input sequence …010… has been observed, as long as the sequence 100 has never been seen.
7. Design and implement a BCD to Excess-3 code converter.
8. Design and implement a traffic light controller.
9. Design and implement a digital combinational lock.
10. Design and implement a vending machine

Note: Students have to do four experiments by choosing one from 1 to 3; two from 4 to 7 and one from 8 to 10. Students should not repeat the same set of experiments in the coming years

TOTAL PERIODS: 75

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Apply the knowledge of Boolean algebra and simplification of Boolean expressions to deduce the digital circuits
CO2: Design combinatorial logic circuits including arithmetic logic, selection logic and code conversion
CO3: Design synchronous and asynchronous sequential logic circuits
CO4: Design combinational and sequential logic circuits using VHDL
CO5: Evaluate relevance and use of engineering fundamentals in digital system design to advanced industrial/societal applications or products
CO6: Communicate effectively through reflections, reports and presentations

TEXT BOOK:

1. M.Morris Mano and Michael D.Ciletti, Digital Design Pearson, 6th Edition, 2018. (Unit I to V)

REFERENCE BOOKS:

1. Salivahanan S and Arivazhagan S, Digital Circuits and Design, Oxford University Press, Fifth Edition, 2017.
2. John F. Wakerly, Digital Design Principles and Practices, Prentice Hall, Fourth Edition, 2012.
3. Charles H. Roth and Larry L. Kenney Fundamentals of Logic Design, Cengage learning, Seventh Edition, 2018.
4. Donald D. Givone, "Digital Principles and Design", Tata Mcgraw Hill, 2003.
5. Kenneth L. Short, VHDL for Engineers, Prentice Hall, 2009.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2									3		1
CO2	3	3	3	3	1								3		2
CO3	3	3	3	3	1								3		2
CO4	3	3	3	3	3								3		2
CO5	3	3	3	3	3	2		1	3	2		1	3		2
CO6									3	3		1	2		1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2304	OOPS AND DATA STRUCTURES	3	0	0	3

OBJECTIVES

- To understand the object oriented programming concepts, using C++.
- To apply object oriented programming principles in data structures.
- To use linear and non-linear data structures in various applications

UNIT I BASICS 8

Getting Started: Simple C++ program – Input/Output; Variables and Basic Types: Primitive built-in types – Variables – Compound types; Expressions: arithmetic – logical and relational – Assignment – Increment and decrement operators; Statements: Conditional – Iterative – Jump; Strings, Vectors and Arrays: Library string type – Library vector type – Iterators – Arrays.

UNIT II OOP CONCEPTS 11

Functions: Basics – Argument passing – Return types and return statements – Overloaded functions; Classes: Defining abstract data types – Access control and encapsulation – Constructors – Static class members; Exception handling; Overloaded Operations: Arithmetic and relational operators; Object Oriented Programming: Defining base and derived classes – Access control and inheritance.

UNIT III LINEAR DATA STRUCTURES 9

List ADT: Array implementation of list – Linked list – Applications: Polynomial addition; Stack ADT: Stack model – Implementation of stacks – Applications: Postfix expressions – Infix to postfix conversion; Queue ADT: Queue model – Array implementation of queue – Applications of queues.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees: Preliminaries – Binary trees – Traversals – Binary search tree ADT; Graphs: Definitions – Representation of graphs – Shortest-Path Algorithm: Dijkstra's algorithm; Minimum Spanning Tree: Prim's algorithm.

UNIT V PRIORITY QUEUE, SORTING 8

Priority Queues: Model, Binary heap; Sorting: Insertion sort – Heapsort – Mergesort – External sorting: Multiway merge – Polyphase merge.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Make use of the control structures of C++ in different applications.
CO2: Apply the concepts of data abstraction, encapsulation and inheritance for problem solutions.
CO3: Select suitable linear data structures for different problem solutions.
CO4: Apply non-linear data structures to various problems.
CO5: Demonstrate the use of various sorting algorithms.

TEXT BOOKS:

1. Stanley B. Lippman, Jose Lajoie, and Barbara E. Moo. 2012. C++ Primer, 5th edition. Addison-Wesley Professional.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3rd Edition, Pearson Education, 2007

REFERENCE BOOKS:

1. Deitel and Deitel, "C++, How To Program", Fifth Edition, Pearson Education, 2005.
2. Bhushan Trivedi, "Programming with ANSI C++, A Step – By - Step approach", Oxford University Press, 2010.
3. Bjarne Stroustrup, "The C++ Programming Language", 3rd Edition, Pearson Education, 2007.
4. Herb Schildt. 2002. *C++:* The Complete Reference, 4th Edition (4 ed.). McGraw-Hill, Inc., New York, NY, USA
5. Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 7th Edition, Wiley. 2004.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	2	2						1					
CO2	1	2	3	2						1		1	1		
CO3	2	2	3	3						1		1	1		
CO4	2	2	3	3						1		1	1		
CO5	1	2	2	2						1					

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2376	**SIGNALS AND SYSTEMS**	**3**	**0**	**0**	**3**

PREAMBLE:

Signals and Systems play a vital role in the many fields such as communication systems, speech & image processing, aeronautics, biomedical systems etc., Signals are mostly continuous in nature and can be converted to discrete. Systems respond to signals, processes them to provide required outputs. This course provides the basic knowledge required for further processing and analysis of signals and systems for any application.

OBJECTIVES:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and systems in the Fourier and Laplace domain

- To analyze discrete time signals and systems in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Continuous-Time signals (CT), Discrete-Time signals (DT) - Step, Ramp, Pulse, Real and complex exponentials, Sinc, Impulse, Exponential, Classification of CT and DT signals - periodic and aperiodic signals, Energy and Power signals, Random signals- Continuous-time and Discrete-time sinusoids and its properties – Operations on signals-Dependent and Independent Variables-CT systems and DT systems - Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Static and Dynamic and Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNAL 9

Fourier series analysis (Exponential only)- Properties of Fourier series -Time shifting, Frequency shifting and Parseval's Theorem in Fourier series, Gibb's phenomenon. Fourier Transform and its properties - Linearity, Time shift, Time scaling, Frequency shift, Duality, Differentiation in time and frequency, Convolution, Multiplication and Parseval's Theorem. Review of Laplace transform- Pole-Zero diagram in s-domain, Region of Convergence (ROC)- Properties of ROC-Inverse Laplace transform.

UNIT III LINEAR TIME-INVARIANT CONTINUOUS TIME SYSTEMS 9

Differential equation, Representing CT system using differential equations – Application of Laplace transform to RL, RC and RLC circuits- Impulse response- Causality and Stability, Convolution integral- Properties of convolution integral (Statement only)- Transfer function of CT systems-Analysis of CT systems using Fourier and Laplace transform- Interconnection of system –Cascade and Parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Sampling of CT signals, Frequency domain representation of sampling, Reconstruction of a band-limited signals from its samples- Z-transform, Pole – Zero diagram in z-domain, properties of Z-transform -Linearity, Time shift, Time scaling, Time Reversal, Frequency shift, Convolution, and Correlation, Inverse Z-transform- Partial fraction method. Discrete-Time Fourier Transform (DTFT) and Inverse DTFT- Properties- Periodicity and Parseval's theorem.

UNIT V LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS 9

Difference equations, Impulse response, Convolution sum, Z-transform and DTFT Analysis of Recursive & Non-recursive systems. Block diagram representation, Direct Form-I and Direct Form-II - Cascade and Parallel forms, Interconnection of DT systems – Cascade and Parallel

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Analyze the properties of signals & systems.
CO2: Apply Fourier series, Laplace transform, Fourier transform, Z-transform and DTFT in signal analysis.
CO3: Analyze continuous time LTI systems using Fourier and Laplace Transforms.
CO4: Analyze discrete time LTI systems using Z-transform and DTFT.

TEXT BOOK:

1. Oppenheim A.V, Wilsky S and Nawab S.H, Signals and Systems, Prentice-Hall International, Second Edition, 2011 (Unit I to V)

REFERENCE BOOKS:

1. Lathi B.P, Principles of Linear Systems and Signals, Oxford, Second Edition, 2009.
2. Zeimer R.E, Tranter W.H and Fannin R.D, Signals & Systems-Continuous and Discrete,Prentice-Hall, Fourth Edition, 1998.
3. Oktay Alkin**,** Signals and Systems: A MATLABORATORY® Integrated Approach, CRC Press,First Edition, 2017.
4. Roberts M.J, Signals & Systems Analysis using Transform Methods & MATLABORATORY, Tata-McGraw Hill, First Edition, 2003.
5. Luis Chaparro and Aydin Akan, Signals and Systems using MATLABORATORY, Elsevier, Third.Edition, 2018

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		2	3				2			2	3	3	2
CO2	3	3		2	3				2			2	3	3	2
CO3	3	3	2	3	3	2	1		2			2	2	3	2
CO4	3	3	2	3	3	2	1		2			2	3	3	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2311	**ANALOG CIRCUITS LABORATORY**	**0**	**0**	**3**	**1.5**

PREAMBLE

Analog Circuits Laboratory is designed to provide hands-on experience to students to work with electronic circuits constructed using BJT and OPAMP. The Laboratory enables the students to apply the knowledge and skills in analysing the electronic circuits and IC related problems using both hardware and software.

OBJECTIVES

- To gain hands on experience in designing electronic circuits like amplifiers and oscillators
- To apply operational amplifiers in linear and nonlinear applications
- To acquire the basic knowledge of special function ICs
- To use PSpice software for transistor and OP AMP based circuit design

LIST OF EXPERIMENTS

1. Design and analysis of Common Emitter Amplifier with and without Emitter Bypass Capacitor
2. Design and analyse the frequency response of Common Source amplifier using JFET

3. Determination of the effect of feedback on the gain and bandwidth of Shunt-Shunt feedback amplifier
4. Design of RC phase shift oscillator
5. Design of Hartley and Colpitts oscillator
6. Design of Inverting and Non-inverting amplifiers using Op-amp
7. Design of Integrator and Differentiator Circuits using Op-amp
8. Design of Schmitt Trigger using Op-amp.
9. Design of Astable and Monostable multivibrators using NE555
10. Design of Voltage Regulator circuit using LM723
11. Determination of Frequency response of Wien bridge oscillator using PSPICE
12. Design and Analysis of Instrumentation Amplifier using PSPICE

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Experiment various types of amplifiers and oscillators using BJT.
CO2: Demonstrate amplifiers and oscillators using operational amplifiers.
CO3: Implement multivibrators and voltage regulators using Ics.
CO4: Examine the performance of electronic circuits using PSpice.

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Cathode Ray Oscilloscope (20 MHz)	15
2	Function Generators (3 MHz)	15
3	Pulse Generators	02
4	Dual Regulated Power Supplies (0 – 30 V)	15
5	Multimeter	15
6	Transistors (BC107/BC547/BFW10)	50 each
7	Resistors, Capacitors, Inductors, PN-Junction diodes, Zener diodes, Power transistors, Potentiometer, and wires	As required
8	Op-Amps: uA741, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM555, and LM565.	As required
9	Standalone PCs with PSPICE	15
10	Breadboard	As required

CO – PO & PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3				3	2	2	3	3		2
CO2	3	3	3	3	3				3	2	2	3	3		2
CO3	3	3	3	3	3				3	2	2	3	3		2
CO4	3	3	3	3	3				3	2	2	3	3		2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2312	OOPS AND DATA STRUCTURES LABORATORY	0	0	3	1.5

OBJECTIVES

- To write programs using object oriented programming features in C++
- To implement linear and non-linear data structures
- To apply suitable data structure for various problems

LIST OF EXPERIMENTS

1. Basic programs using control structures in C++
2. Programs using arrays and vectors
3. Programs using classes
4. Programs using function & operator overloading
5. Programs using exception handling
6. Programs using inheritance
7. Linked list implementation
8. Application of Stack ADT
9. Queue ADT implementation
10. Implementation of Binary Search Tree and its traversals
11. Implementation of Dijkstra's algorithm
12. Implementation of Binary heaps
13. Sorting algorithms

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Apply object oriented programming features in program development.
CO2: Implement linked list, stack and queue.
CO3: Implement trees and graphs.
CO4: Apply suitable data structures for solving problems.

LABORATORY EQUIPMENT FOR A BATCH OF 35 STUDENTS:

1. Standalone desktops with C++ Compiler - 35 Nos.

   (or)

   Server with C++ compiler supporting 35 terminals or more.

CO – PO & PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	3				1		2		1	1		
CO2	1	2	3	3				1		2		1			
CO3	1	2	3	3				1		2		1			
CO4	2	2	3	3				1	1	2		1	1		

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2401	**MICROCONTROLLERS**	**3**	**0**	**0**	**3**

PREAMBLE:

Microcontrollers have become important building blocks in embedded system design. It is important for student to understand the architecture of a microcontroller and its interfacing with various modules. 8051 microcontroller architecture, programming, and interfacing is dealt in detail in this course. Architecture, instruction set and assembly language programming of ARM microcontroller are also covered in this course.

OBJECTIVES:

- To understand the architecture of 8051 microcontroller.
- To learn the development of assembly language programming of 8051.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To understand the architecture of ARM microcontroller.
- To learn the development of assembly language programming with ARM microcontroller and interface memory.

UNIT I THE 8051 MICROCONTROLLER ARCHITECTURE 9

8051 Microcontroller Architecture – Memory organization – Register Banks- Bit addressable area in memory - SFR – working registers - Addressing modes - Instruction set - Instruction timing, Data transfer - Arithmetic – logic - compare - rotate instructions - Assembly language programming.

UNIT II 8051 TIMER, SERIAL PORT and I/O PORT PROGRAMMING 9

Time delay for various 8051 chips - machine cycle - delay calculation - Timer module - Programming 8051 timers and counters - Serial port architecture - basics of serial communication - serial port programming - memory address decoding - Interfacing 8051 with external memory.

UNIT III 8051 INTERRUPTS AND INTERFACING 9

8051 Interrupt structure - Programming timer interrupts, external hardware interrupts, serial communication interrupt - LCD interfacing – Keyboard Interfacing – ADC, DAC and sensor Interfacing – Stepper Motor Interfacing - DC motor interfacing and PWM.

UNIT IV ARM MICROCONTROLLER – ARCHITECTURE 9

The Acorn RISC Machine – Architectural inheritance – The ARM Programmer's model – ARM development tools - Instruction set - Data transfer instructions – Data processing instructions – control flow instructions – Assembly Language programming – 3 stage pipeline- 5 stage pipeline – ARM Instruction execution.

UNIT V ARM MICROCONTROLLER – INTERFACING 9

Thumb bit in the CPSR – thumb programmer's model – thumb data processing, branch, Software interrupt instructions - ARM memory interface – Advanced Microcontroller Bus Architecture (AMBA) – ARM processor cores – ARM7TDMi (LPC 2148).

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Apply programming techniques in developing the ALP for 8051 microcontrollers
CO2: Develop ALP to interface timers, serial port and I/O ports with 8051 microcontroller.
CO3: Interface different peripheral devices with 8051 microcontroller.
CO4: Comprehend the architecture of ARM microcontroller.
CO5: Apply programming techniques in developing the assembly language program for ARM microcontroller and interface memory / peripherals

TEXT BOOK:

1 Mohamed Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson education, Second Edition, 2013. (Unit I to III)
2. Steve Furber, ‘’ARM System - On - Chip architecture” Addision Wesley, 2000. (Unit IV & V)

REFERENCE BOOKS:

1. Kenneth J.Ayala, the 8051 Microcontroller, Architecture, Programming and Applications, West Publishing Company, Third Edition, 2007.
2. Scott MacKenzie, Raphael Chung-Wei Phan, the 8051 Microcontroller, Pearson Education, Fourth Edition, 2007.
3. Han-Way Huang, Using the MCS-51 Microcontroller, Oxford University Press, Firs, Edition, 2009.
4. Joseph Yiu, the Definitive Guide to the ARM Cortex-M3, Second Edition, Newnes, (Elsevier), 2010.
6. Raj Kamal, Microcontrollers, Pearson, Second Edition, 2012.

CO – PO & PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2								1	3		1
CO2	3	3	2	1								1	3		1
CO3	3	3	1	2								1	3		2
CO4	2	3	1	1									2		2
CO5	3	3	2	2								1	3		1

COURSE CODE	COURSE TITLE	L	T	P	C
AHS2476	INDIAN CONSTITUTION	3	0	0	0

OBJECTIVES:

- To teach history and philosophy of Indian constitution.
- To summarize powers and functions of Indian government.
- To explain structure and functions of local administration.
- To demonstrate the organization and working of the Judiciary.
- To discuss financial power and emergency provisions.

UNIT I INTRODUCTION` 9

Historical background–Government of India act – Indian councils act–Making of the constitution - Philosophy of the Indian constitution – Preamble.

UNIT II GOVERNMENT OF THE UNION 9

Powers and Functions of President and Prime Minister - Council of Ministers–President in relation to his council - Legislature structure and functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III GOVERNMENTS OF THE STATES AND LOCAL GOVERNMENT 9

The state executive: General structure – Governor – Council of ministers –State legislature. Local government - Panchayat – Municipality – Power authority and responsibilities municipalities.

UNIT IV THE JUDICATURE 9

Organization and Composition of Judiciary – Constitution – Appointment - Qualifications - Powers and functions of the supreme court – High courts–Control over subordinate courts.

UNIT V THE FEDERAL SYSTEM 9

Distribution of financial powers: Need, principles - Under laying distribution of tax revenues- Distribution of legislative power–Interstate relation-Emergency provisions.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Understand history and philosophy of Indian constitution
CO2: Realize powers and functions of Indian government
CO3: Acquire awareness on structure and functions of local administration
CO4: Enhance knowledge about organization and composition of judiciary
CO5: Explore the distribution of financial powers and emergency provisions

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 Book Trust, New Delhi, 2010.
3. The Constitution of India, 1950 (Bare Act), Government Publication.
4. Jain MP, Indian Constitution Law, 7th Edition., Lexis Nexis,2014.
5. Busi SN, Ambedkar BR Framing of Indian Constitution, 1st Edition, 2015.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1						2		2	2	2		2			
CO2						2		2	2	2		2			
CO3						2		2	2	2		2			
CO4						2		2	2	2		2			
CO5						2		2	2	2		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2402	DIGITAL SIGNAL PROCESSING	3	0	0	3

PREAMBLE:

Digital signal processing is one of the fundamental and essential courses for Electronics and Communication Engineers. Prerequisites for this course are knowledge on signals & systems, and exposure to fundamental concepts of probability theory.

This course is focused to introduce the concepts of processing of digital deterministic signals in general and random signals as an extended concept. Processing of deterministic signals mainly involves filtering the signals using various frequency selective components, the design criteria, design methodology and issues in the choice of filtering techniques. Further, as an introductory aspect, the multirate signal processing, characteristics and applications of filters that can handle random signals, the adaptive filters, are introduced to the students. This course is a foundation to other elective courses such as advanced digital signal processing, Speech Processing, Image processing, etc.

OBJECTIVES:

- To learn the fundamentals of Discrete Fourier transform and its properties.
- To understand the design aspects of frequency selective digital filters.
- To interpret the implementation issues in designing digital filters.
- To understand the concepts of adaptive filters.

UNIT I DISCRETE FOURIER TRANSFORM 9

The concept of frequency in discrete time signals. Frequency-domain sampling, the discrete Fourier transform (DFT), DFT as a linear transformation. Properties of DFT - periodicity, linearity, time-reversal, symmetry properties, multiplication property - circular convolution. Linear filtering using DFT - filtering long data sequences - overlap save and overlap add method. Computation of DFT using DIF-FFT and DIT-FFT.

UNIT II DESIGN OF FIR FILTERS 9

Ideal filter characteristics, causality and its implications, characteristics of practical frequency selective filters. Design of FIR filters - Symmetric FIR filters, design of linear-phase FIR filters using windows: rectangular window, Hamming window. Frequency sampling method.

UNIT III DESIGN OF IIR FILTERS 9

Design of analog filters - Chebyshev filter – Type I, Butterworth filter. Design of digital IIR low-pass filter from analog filters - impulse invariance method and bilinear transformation.

UNIT IV IMPLEMENTATION OF DISCRETE-TIME SYSTEMS 9

Structures for the realization of discrete-time systems: structures for FIR systems - direct-form, cascade-form, Effects of quantization of FIR filter coefficients. Review of structures for IIR systems. Round-off effects in IIR filters - limit cycle oscillations, scaling to prevent overflow. Statistical characterization of quantization effects in realization of digital filters.

UNIT V MULTI-RATE PROCESSING & ADAPTIVE FILTERS 9

Multi-rate processing – decimation, interpolation, sampling rate conversion by rational factor Wiener filter - Discrete Wiener Hoff equations. Basics of adaptive filters, FIR Adaptive filters, Adaptive filters based on steepest descent method, the LMS algorithm

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Apply discrete Fourier transform for the analysis of digital signals and systems.
CO2: Design and realize a frequency selective digital IIR filters
CO3: Design and realize FIR filters
CO4: Characterize quantization effects in digital filters.
CO5: Apply, analyse and evaluate the multi-rate processing and adaptive filtering in engineering applications

TEXT BOOK:

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing - principles, algorithms and applications, Pearson Education, Fourth Edition, 2007(Unit I to V)

REFERENCE BOOKS:

1. Alan V. Oppenheim, Ronald W. Schaffer and John R. Buck, Discrete time signal Processing, Prentice Hall, Third Edition, 2009
2. Vinay K. Ingle and John G. Proakis, Digital Signal Processing using MATLABORATORY,
Cengage learning, Third Edition, 2011
3. Sanjit K. Mitra, Digital Signal Processing: A computer based approach, McGraw Hill, Second Edition, 2000
4. Ashok Ambardar, Digital Signal Processing: A modern introduction, Cengage Learning First Edition, 2006
Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley Publishers, 2011.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2		2	3				2				3	3	
CO2	3	2		3	3				2			3	3	3	
CO3	3	2		3	3				2			3	3	3	
CO4	3	2		3	3				2				3	3	
CO5	3	2	3	2	3			2	2	3		3	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEE2476	CONTROL SYSTEMS ENGINEERING	3	0	0	3

PREAMBLE:

It helps in understanding the importance of transfer function models in analysing any physical systems. This course helps in providing adequate knowledge about the control system components. In addition, this course helps in analysing the given system both in time domain and frequency domain. Moreover, this course introduces the stability analysis and design of compensators technique for the given system. Finally, a state variable representation of physical systems and its effect is introduced to analyse the multi input multi output system.

OBJECTIVES:

- To explain the importance of transfer function in modelling physical systems
- To analyse any system with respect to time domain and frequency domain
- To explain the stability of the system
- To Design and analyse a compensator system and PID Controller to meet the desired specifications and to improve the stability of the system.

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis - Implementation using MATLABORATORY

UNIT III FREQUENCY RESPONSE 9

Frequency response – Bode plot – Polar plot – Nyquist plot- Constant M - N circles - Nichols Chart- Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Implementation using MATLABORATORY

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion – Performance criteria – Lag, lead and lag-lead networks – Effect of Lag, lead and lag-lead compensation on frequency response analysis - Design of compensator network using Bode plot.- Implementation using MATLABORATORY

UNIT V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Implementation using MATLABORATORY

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Explain the importance of transfer function in modelling physical systems.
CO2: Analyse any system with respect to time domain.
CO3: Analyse any system with respect to frequency domain
CO4: Explain the stability of the system.
CO5: Design and analyse a compensator system to meet the desired specifications.
CO6: Design a PID controller to improve the stability of the system.

TEXT BOOKS:

1. 1. S.Salivahanan, R.Rengaraj, and G.R.Venkatakrishnan, Control systems Engineering, Pearson India Education, 2015.
2. Nagarath, I.J. and Gopal, M., Control Systems Engineering, New Age International Publishers, 2017.
3. Benjamin C. Kuo, Automatic Control Systems, Wiley, 2014

REFERENCE BOOKS:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson India Education, 2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson India Education,2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLABORATORY", CRC Taylor& Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3				1										
CO2	3	3		2											
CO3	3	3		2											
CO4	3	3		2											
CO5	3	3	3	2	3										
CO6	3	3	3	2	3										

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2403	ELECTROMAGNETIC FIELDS	3	1	0	4

PREAMBLE:

Electromagnetic fields is one of the most essential subjects for electronics and communication engineering students. It is the study of the physical behavior of electric and magnetic fields produced by charges and currents, the laws that govern these behaviors, and the mathematical methods for using and applying these laws. The main topics covered are electrostatics, magnetostatics, time-varying fields and plane waves. This course is the foundation for antenna engineering, microwave engineering and optical communication.

OBJECTIVES:

- To understand and apply vector-analysis techniques in electromagnetics.
- To gain conceptual and basic mathematical understanding of electric and magnetic Fields in free space and in materials.
- To understand the coupling between electric and magnetic fields through Faraday's Law, displacement current and Maxwell's equations.
- To understand wave propagation in lossless and in lossy media.

UNIT I VECTOR ANALYSIS 12

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem.

UNIT II ELECTROSTATICS 12

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatic energy, Poisson's and Laplace's equations, Capacitance of various geometries (parallel plate, cylindrical and spherical) using Laplace's equations, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT III MAGNETOSTATICS 12

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors (toroid and solenoid), Magnetic energy, Magnetic forces and torques (Hall effect, infinitely long parallel conductors, rectangular loop)

UNIT IV TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS 12

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields.

UNIT V PLANE ELECTROMAGNETIC WAVES 12

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.

TOTAL PERIODS: 60

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Demonstrate knowledge and understanding of fundamental electromagnetic laws and concepts
CO2: Discuss the understanding of the effect of materials on electric and magnetic fields.
CO3: Analyze electric and magnetic field quantities from simple charge and current Distributions
CO4: Analyze electric and magnetic field from a plane wave normally incident on a Metallic dielectric material.

TEXT BOOK:

1. Cheng D.K., Field and wave electromagnetics, Pearson Education, Second Edition 1989. (Unit I to V)

REFERENCE BOOKS:

1. Griffiths D.J, Introduction to Electrodynamics, Pearson Education, Fourth Edition 2013.
2. Notaros B.M, Electromagnetics, Pearson, New Jersey, 2011
3. Hayt W.H and Buck J.A, Engineering electromagnetics, McGraw-Hill (India), seventh Edition, 2006.
4. Sadiku M.N.O and Kulkarni S.V, Principles of electromagnetics, Oxford (Asian Edition), Sixth Edition, 2015.
5. Salivahanan S and Karthie S, Electromagnetic Field Theory, McGraw Hill Education Second Edition, 2018.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3								2		1	1	3	
CO2		3								2				3	
CO3	3	3										1	1	3	1
CO4	3	3										1		3	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2404	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3

PREAMBLE:

Analysis and design of analog communication systems forms the basis for understanding digital, wireless and several other personal communication systems. The signals are modulated, transmitted through a variety of communication media and recovered at the destination. The analysis includes the possible noise sources too. This course provides the basic knowledge required for designing and analyzing the analog communication system in presence of noise.

OBJECTIVES:

- To introduce the concepts of analog modulation techniques and their spectral characteristics.
- To understand the properties of random processes.
- To know the effect of noise on communication systems.
- To study the limits set by Information Theory.

UNIT I AMPLITUDE MODULATION 9

Amplitude Modulation- Double-Sideband Suppressed-Carrier AM, Conventional AM, Single-Sideband AM, Vestigial Side-band AM – Implementation of AM Modulators and Demodulators – Power Law Modulation, Balance Modulator, Envelope Detector, Demodulation of DSBSC, SSB signals - Superheterodyne Receiver.

UNIT II ANGLE MODULATION 9

Angle Modulation - Representation of FM and PM signals, Spectral Characteristics of Angle Modulated Signals - Angle Modulation by a sinusoidal signal - Angle Modulation by an arbitrary message signal – Implementation of Angle Modulators and Demodulators - Varactor diode modulation – Indirect generation - balanced discrimination of angle modulation.

UNIT III RANDOM PROCESS 9

Random Variables - Random Process – Basic Concepts, Statistical Averages, Wide Sense Stationary Processes, Multiple Random Processes, Transmission of Random Process through a Linear System, Power Spectral Density of Stationary Processes, Power Spectra in LTI Systems, Gaussian and White Processes, Filtered Noise Processes.

UNIT IV EFFECT OF NOISE ON ANALOG COMMUNICATION 9

Effect of Transmission Losses and Noise in Analog Modulation – Characterization of Thermal Noise Sources, Effective Noise Temperature and Noise Figure - Transmission Losses. Effect of Noise on Amplitude Modulation Systems – Baseband System, DSB-SC AM, SSB-AM, Conventional AM, Effect of Noise on Angle Modulation - Threshold effect, Pre-emphasis and de-emphasis, Comparison of Analog Modulation Systems.

UNIT V INTRODUCTION TO INFORMATION THEORY 9

Modelling Information Sources, Measure of Information, Joint and Conditional Entropy, Mutual Information, Differential Entropy, Source Coding Theorem, Source Coding Algorithms – The Huffman Source Coding Algorithm, the Lempel-Ziv Source Coding Algorithm, Modelling of Communication Channels – Channel Coding Theorem.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Demonstrate an understanding of Analog Modulation Principles.
CO2: Comprehend and use the concepts of Random Process to the design of Communication system.
CO3: Analyze the noise performance the noise performance of Analog Modulation systems
CO4: Apply the concepts of source coding techniques for the design of systems

TEXT BOOK:

1. Proakis.J.G, Salehi.M, Fundamentals of Communication Systems, Pearson Education Second edition, 2006. (Unit I to V)

REFERENCE BOOKS:

1. Haykin.S, Communication Systems, John Wiley, Second Edition, 2005
2. Lathi B.P, Modern Digital and Analog Communication Systems, Oxford University Press, Third Edition, 2007.
3. Roody D, Coolen.J, Electronic Communications, PHI, Fourth Edition, 2006
4. Berbard Sklar and Fredric J. Harris, Digital Communications: Fundamentals and Applications - Prentice Hall Communications, Third Edition, Pearson, 2020.
5. Hsu.H.P, Schaum Outline Series - Analog and Digital Communications, TMH, 2006

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2											3	
CO2	2	3	1											3	
CO3	3	3	3											3	
CO4	3	3	3	3	3			1		3		1		3	

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2411	MICROCONTROLLERS LABORATORY	0	0	3	1.5

PREAMBLE

Microcontrollers Laboratory course helps the students to develop their knowledge on processor architecture and the programming skills. This Laboratory course provides hands-on experience to interface I/O devices, perform A/D and D/A conversions, design traffic light etc. The skills acquired through the experiments help the students to do their projects and enhance their knowledge on the latest trends and technologies.

OBJECTIVES

- To introduce assembly language programming concepts and features oscillators.
- To write assembly language program for 8051.
- To interface I/O interfaces with 8051 microcontroller.
- To interface I/O interfaces with ARM (LPC2148).

LIST OF EXPERIMENTS

8051 PROGRAMS USING KITS AND EDSIM51

1. Arithmetic instructions – Program to perform Addition, Subtraction, Multiplication and Division operations, program to find square and cube
2. Boolean and Logical instructions – Program to compute the logical instructions
3. Data transfer – Program for block data movement, exchange a block of data
4. Searching and sorting – sorting, exchanging, finding largest element in an array
5. Code Conversions – Program to convert HEX to Decimal number and Decimal to HEX number
6. Programs to generate delay, Programs using serial port and on-chip timer / counters
7. Matrix Operations

8051 PERIPHERALS AND INTERFACING EXPERIMENTS

1. Interfacing Stepper motor control interface.
2. Interfacing DAC to generate waveforms of particular frequency
3. Automatic Traffic light control system using 8051

ARM (LPC2148) INTERFACING EXPERIMENTS

1. Develop an embedded C program to verify the interfacing of ADC and DAC with ARM Microcontroller
2. Develop an embedded C program to verify the interfacing of keyboard with ARM Microcontroller.
3. Develop an embedded C program to verify the interfacing of Pulse Width Modulation (PWM) kit with ARM microcontroller.

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Develop and test simple assembly language programs using 8051 instruction sets

CO2 : Design and interface various peripheral devices with 8051
CO3 : Develop ALP to interface different peripherals with ARM (LPC2148)

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Interfacing Units - ADC interface, DAC interface, Traffic light interface, stepper motor control interface, Keyboard interface	3 Each
2	8051 Trainer kits	15
3	Desktop Computers with Edsim51 Simulators (8051)	15
4	ARM Trainer kit (LPC2148)	15
5	Keil µVision	15

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	0	3	3			3	2	1	1	3	3		3
CO2	3	3	3	3	3			3	2	1	1	3	3		3
CO3	3	3	3	3	3			3	2	1	1	3	3		3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2412	DIGITAL SIGNAL PROCESSING LABORATORY	0	0	3	1.5

PREAMBLE

Digital Signal Processing (DSP) is one of the basic requirement in many engineering and non-engineering fields such as communication systems, speech & image processing, artificial intelligence and robotics, biomedical systems, medical and finance etc., This Laboratory course is intended to provide the basic knowledge required to record a signal in real-time and how to analyze its frequency content to perform various signal processing operation. It also intended to provide a practical knowledge on how to design both conventional and adaptive filters to eliminate the background correlated and non-correlated noises.

OBJECTIVES

- To generate/record a signal in real-time and apply various signal processing algorithm

- To implement DFT and analyze the frequency content of deterministic and random signals
- To implement FIR & IIR filters and understand the impact of finite word length effects
- To design an Adaptive filter to eliminate the correlated noise in the communication signal

LIST OF EXPERIMENTS

1. Generate various discrete-time (DT) sequences and random noise
2. Record a signal with background noise in real-time using a microphone and perform sectioned convolution with a Sinc function
3. Analyse the spectrum of the generated/recorded signal using DFT
4. Design a Butterworth and Chebyshev IIR filters to eliminate the background noise in the generated/recorded signal
5. Design a Linear phase FIR filter to eliminate the background noise in the recorded signal
6. Demonstrate the impact of finite word length on the performance of FIR/IIR filters
7. Design and demonstrate an Adaptive filter to eliminate the correlated noise in the generated/recorded signal
8. Design an N-Band Audio Equalizer and demonstrate its effects for an audio signal

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Generate/record a signal and apply various signal processing algorithm
CO2: Implement DFT/FFT to analyse the frequency spectrum of the DT signals
CO3: Design FIR/IIR filters to eliminate the background noise and analyse the impact of finite word length in the designed filters
CO4: Analyze discrete time LTI systems using Z-transform and DTFT

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	PC Loaded with MATLABORATORY/Simulink or Other Equivalent Software	30
2	Microphone and Speakers	15 each

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	3	1	1		3	2		1		2	2
CO2	3	3	3	3	3	1	1		3	2		1		3	3
CO3	3	3	3	3	3	1	2		3	2		1		3	1
CO4	3	3	3	3	3	1	2		3	2		1		3	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2501	DIGITAL COMMUNICATION	3	0	0	3

PREAMBLE:

Analysis and design of digital communication systems forms the basis for understanding advanced digital modulation techniques, wireless and several other personal communication systems. This course aims at covering the main topics such as digitization methods, waveform coding techniques, and spread spectrum. It emphasizes the baseband and passband signal transmission strategies. It also provides an in-depth analysis of error control coding. Hence enables the students to get a better insight into the existing custom communications.

OBJECTIVES:

- To represent the analog signals in digital form using waveform coding techniques.
- To understand the ISI, pulse shaping and correlative coding.
- To comprehend the fundamentals of channel coding.
- To learn the principles of spread spectrum modulation schemes.

UNIT I WAVEFORM CODING TECHNIQUES 9

Sampling - Quantization, Quantization noise, Robust Quantization - Pulse Code Modulation - Linear Prediction, Differential Pulse Code Modulation - Delta modulation - Adaptive Differential Pulse Code Modulation, Adaptive Delta Modulation.

UNIT II BASEBAND SIGNALLING 9

Line codes and PSD of line codes - Inter Symbol Interference, Nyquist criterion for distortion less transmission - Pulse shaping - Correlative level coding schemes - Eye pattern – Equalization - Correlation receiver.

UNIT III BANDPASS MODULATION SCHEMES 9

Signal space representation – M-ary systems - Generation, detection, Power Spectral Density & Bit Error Rate of coherent Binary Phase Shift Keying, Binary Frequency Shift Keying, Quadrature Phase Shift Keying and Differential Phase Shift Keying - Quadrature Amplitude Modulation – BER analysis.

UNIT IV ERROR CONTROL CODING 9

Channel coding theorem - Linear block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.

UNIT V SPREAD SPECTRUM MODULATION 9

Pseudo noise sequences, Properties - Generation of Pseudo Noise sequences - Direct sequence spread spectrum, Processing gain, Jamming Margin, Slow and Fast frequency hop spread spectrum.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Represent and analyze analog signals through different waveform coding technique.
CO2: Comprehend the properties and performance of Line codes
CO3: Apply the knowledge of ISI problems to understand the related combating Solutions.
CO4: Compare the error probability of different digital modulation schemes
CO5: Apply various error control coding schemes over information bits
CO6. Describe spread spectrum modulation scheme and illustrate both DS and FH Systems

TEXT BOOK:

1**.** Haykin S, Digital Communications, John Wiley, 2005. (Unit I to V)

REFERENCE BOOKS:

1. Proakis J.G, Digital Communication, Tata Mc Graw Hill Company, Fifth Edition,
2. Bernard Sklar and Fredrick.J.Harris, Digital Communications: Fundamentals and Applications, Third Edition, 2020
3. Lathi B. P, Modern Digital and Analog Communication Systems, Oxford University Press, Third Edition, 2007
4. Hsu H.P, Schaum's Outline Series – Analog and Digital Communications, Tata Mc Graw Hill Company, Third Edition, 2006.
5. Roody D, Coolen J, Electronic Communications, PHI, Fourth Edition, 2006.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2												3	
CO2	3	2												3	
CO3	3	2												3	
CO4	3	3	3	3	3			1	2	3		3		3	
CO5	3	3	3	3	3			1	2	3		3		3	
CO6	3	2										1			1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2502	TRANSMISSION LINES AND WAVEGUIDES	3	0	0	3

PREAMBLE:

This course aims to provide students with the technological skills needed in understanding the behaviour of parallel-wire transmission lines, parallel planes, and waveguides. Having obtained a better understanding on the electromagnetic field theory in the fourth semester, this course will enable the students to learn about the types of fields and field propagation in parallel planes, rectangular and circular waveguides. This course also provides a broad overview on the impedance matching in high frequency transmission lines.

OBJECTIVES:

- To impart knowledge on the passive filter theory.
- To introduce the types of transmission lines and discuss the associated losses.
- To provide thorough understanding about impedance transformation and matching
- To utilize the Smith chart in transmission line problem solving.
- To give insight about the field concepts of parallel planes and waveguides

UNIT I PASSIVE FILTERS 9

Symmetrical networks: Characteristic impedance and propagation constant - Filter fundamentals: pass and stop bands - Design of filters: constant *k* - lowpass, highpass, bandpass, bandstop, *m*-derived sections - low pass and high pass filters.

UNIT II TRANSMISSION LINE FUNDAMENTALS 9

General theory of transmission lines - General solution - Significance of line equations - infinite line - Wavelength, velocity of propagation - Waveform distortion, distortion less line - Loading and different methods of loading - Line not terminated in Z_0 - Reflection coefficient - calculation of current, voltage and power delivered - Input and transfer impedance - Open and short-circuited lines - Reflection factor and reflection loss.

UNIT III LINE AT RADIO FREQUENCIES 9

Constants for line of zero dissipation - Transmission line equations at radio frequencies - Standing waves, nodes, standing wave ratio - Input impedance of dissipation less line - Open and short-circuited lines - Power and impedance measurement on lines - Reflection losses on unmatched line.

UNIT IV IMPEDANCE MATCHING IN HIGH- FREQUENCY LINES 9

Impedance matching: Quarter-wave line and applications, Half-wave and eighth-wave line - Impedance matching by stubs - Single stub and double stub matching - Smith circle equations - Determination of load impedance, input impedance, reflection coefficient, VSWR, location of V_{min} and V_{max} - Single and double stub matching using Smith chart

UNIT V WAVEGUIDES 9

General wave behaviours along uniform guiding structures - Transverse Magnetic (TM) waves, Transverse Electric (TE) waves and Transverse Electromagnetic (TEM) waves between parallel planes - TM and TE waves in rectangular waveguides - Impossibility of TEM in rectangular

waveguides - Bessel's differential equation and Bessel function, TM and TE waves in circular waveguides.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Apply the knowledge of filter theory in the design of passive filters.
CO2: Comprehend the working of lossy and lossless transmission lines In RF applications.
CO3: Solve RF line problems and stub matching using Smith chart.
CO4: Analyze the field components of parallel planes and waveguides.

TEXT BOOK:

1. John D Ryder, Networks, Lines and Fields, Prentice Hall of India, Second Edition, 2005.

REFERENCE BOOKS:

1. Jordan E.C and Balmain K.G, Electromagnetic Waves and Radiating Systems, Prentice Hall of India, Second Edition, 2011.
2. Cheng D.K, Field and Wave Electromagnetics, Pearson Education, Second Edition 2006.
3. Ulaby F.T, Michielssen E and Ravaioli U, Fundamentals of Applied Electromagnetics Pearson Education, Sixth Edition, 2015.
4. Umesh Sinha, Transmission Lines and Networks, Sathya Prakashan, 2010.
5. Raju G.S.N, Electromagnetic Field Theory and Transmission Lines, Pearson Education 2006.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3								2		1	3	3	1
CO2	2	3								2		1		3	
CO3	3	2												2	
CO4	3	3								2		1		3	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2503	COMMUNICATION NETWORKS	3	0	2	4

PREAMBLE:

Communication network is the basis of communication in information technology. Its purpose is to distribute/share/communicate information from one device to the other. It is the study of procedural setup, standards, protocols and algorithms that are followed to have communication among the devices interconnected to in a network. This course is the foundation for all the networking subjects like computer networks, wireless networks and optical networks.

OBJECTIVES:

- To gain basic and conceptual understanding of computer network.
- To develop an understanding of the flow control and congestion control algorithms.
- To analyze multiple access techniques, network protocols and QoS protocols.

UNIT I FUNDAMENTALS & LINK LAYER 9

Data Communications- Networks – Network and its types – Protocol Layering - OSI Model – TCP/IP model – Introduction to Circuit Switching & Packet Switching - Introduction to Data Link Layer - Link Layer Addressing- Framing – Flow & Error Control – Stop & Wait, Go-Back N, Selective Repeat - Error Detection – CRC, Checksum.

UNIT II MEDIA ACCESS & INTERNETWORKING 9

Media Access Control - CSMA/CD (IEEE 802.3), CSMA/CA (IEEE 802.11) - Network layer services – Packet Switching – IPV4 Addresses – Network layer protocols (IP, ICMP, Mobile IP) - Overview of IPv6 Addressing – Transition from IPv4 to IPv6.

UNIT III ROUTING 9

Routing – Introduction - Routing Algorithms – Distance vector routing, link – state routing - Unicast Routing – Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP.

UNIT IV TRANSPORT & APPLICATION LAYER 9

Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) - Traditional applications - Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP.

UNIT V PROTOCOLS FOR QoS SUPPORT 9

QoS – Application requirements. Integrated Services, Differentiated Services, RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Laboratoryel Switching – Operations, Laboratoryel Stacking, Protocol details - RTP – Protocol Architecture

LIST OF EXPERIMENTS 30

1. Suggest a flow control mechanism that is efficient for noisy links, develop an algorithm and interpret the results using an appropriate software tool.
2. Suggest a flow control mechanism that is inefficient for noisy links, develop an algorithm and interpret the results using an appropriate software tool.
3. Develop an appropriate routing algorithm for a data communication network where each node shares its routing table with its immediate neighbors periodically and when there is a change. Interpret the research findings using an appropriate software tool.
4. Assuming a network scenario where every node constructs a map of the connectivity to the network, in the form of a graph, showing which nodes are connected to which other nodes, suggest a routing algorithm with which each node can independently calculate the next best logical path from to every possible destination in the network, wherein each collection of best paths will then form each node's routing table.
5. Suggest a mechanism that compares the amount of energy on the media after a packet is transmitted. If the value is greater than the energy used by the transmitting device, then a collision has occurred. If there is no difference in two measured values, then a collision has not occurred. Plot the throughput performance of the same.
6. In wireless networks, the terminals can each be within range of some intended third terminal but out of range of each other, because they are separated by excessive distance or by some physical obstacles that makes direct communication between the two terminals impossible. Suggest and plot the throughput performance of the protocol that Can be used to avoid this problem

TOTAL PERIODS: 75

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Demonstrate various networking components and their respective roles in a Communication system.
CO2: Analyze the required functionality at each layer for a given application
CO3: Design and apply routing mechanisms to fulfil the networking requirements
CO4: Analyze the features and operations of various Quality of service protocols.
CO5: Evaluate relevance and use of engineering fundamentals in communication networks to advanced industrial applications or products and their Impact on safety, society as well as underlying legal and ethical considerations.
CO6: Communicate effectively through reflections, reports and presentations.

TEXT BOOK:

1. Behrouz A. Forouzan, ―Data communication and Networking‖, Fifth Edition, Tata McGraw – Hill, 2013 (Unit I to IV).
2. William Stallings, High Speed Networks and Internet, Pearson Education, Second Edition, 2002 (Unit V).

REFERENCE BOOKS:

1. Larry L. Peterson, Bruce S. Davie, ― Computer Networks: A Systems Approach‖, Fifth Edition, Morgan Kaufmann Publishers, 2011.
2. James F. Kurose, Keith W. Ross, ― Computer Networking - A Top-Down Approach Featuring the Internet‖, Seventh Edition, Pearson Education, 2016.

3. Nader. F. Mir, ― Computer and Communication Networks‖, Pearson Prentice Hall Publishers, 2nd Edition, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, ―Computer Networks: An Open Source Approach, Mc Graw Hill Publisher, 2011
5. Andrew S. Tanenbaum, Computer Networks, PHI, Fourth Edition, 2011.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3									1	2	1	3	2
CO2	3	3	1	2	2						1	2	2	2	2
CO3	3	3		2	1	1	1				1	3	2	2	2
CO4	2	2			1	1	1				1	3	2	2	2
CO5	1	2	2	3	2	2	2	2		1	1	1			1
CO6								1	2	2	1	1			1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2504	PRINCIPLES OF VLSI DESIGN	3	0	0	3

PREAMBLE:

The electronics industry is rapidly approaching another revolutionary leap in the global market scenario. Semiconductor technology has crossed the quarter-micron threshold, making billions of transistors available on a single chip. VLSI (Very Large-Scale Integration) technology has emerged as a very important technology in modern electronics featuring deep sub-micron manufacturing processes, low voltage operations, exploding speeds and smart programmable devices. This course introduces the fundamental concepts of the VLSI and implementation of digital circuits using CMOS transistors. This VLSI Design course will help to acquire knowledge in semiconductor technology and to generate skilled manpower in IC design and manufacturing. The prerequisite for the course is the basic knowledge of Digital circuit design.

OBJECTIVES:

- To understand the principles of VLSI System Design.
- To study operation, characteristics, layout & fabrication of MOS Transistor and design of CMOS Inverter.
- To design CMOS Combinational & Sequential Logic Circuits and Arithmetic Blocks.
- To learn the testability of VLSI circuits.

UNIT I VLSI SYSTEM DESIGN 9

Introduction to VLSI Design: VLSI Design Problem - VLSI Design Cycle - VLSI Design Domains - Types of IC Design – Hierarchical Design Approach - VLSI Design Principles.

Implementation Methodologies: Full Custom Design - Standard Cell Based Design - Gate Array Based Design - Programmable Logic Devices Based Design – Overview of SPLD/CPLD/FPGA Architectures.

UNIT II MOS TRANSISTOR 9

Metal Oxide Semiconductor (MOS) Transistor: Structure, Operation & Characteristics - Threshold Voltage (V_{T0} & V_T), Drain Current (I_D). MOS Capacitances - MOS Scaling - Second Order & Non Ideal Effects - Modeling of MOS Transistor – SPICE Models - Fabrication Cycle, NMOS & PMOS Fabrication Processes. Layout Design Rules, Full-Custom Mask Layout Design, Stick Diagrams.

UNIT III CMOS INVERTER 9

CMOS Inverter: Construction and Operation - Static & Dynamic Characteristics – Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics & Delay. Power analysis of CMOS Inverter – Low Power Design Principles. Fabrication & Layout of CMOS Inverter: n-well, p-well, twin-tub & triple-well processes. Latch-Up in CMOS Technology. Layout and Stick Diagram of CMOS Inverter.

UNIT IV CMOS LOGIC CIRCUITS 9

Combinational MOS Logic Circuits: Classical CMOS logic – Pseudo-nMOS logic – Transmission Gates – Design Examples: Basic Gates, Complex Logic Circuits. Sequential MOS Logic Circuits: Behavior of Bistable Elements – SR latch – Clocked Latch and Flip-flop – Timing parameters of Clocked Storage Elements – CMOS D Latch and Edge Triggered Flip-

Flop. Dynamic Logic Circuits: Dynamic CMOS Circuit Techniques – High Performance Dynamic CMOS Circuits.

UNIT V ARITHMETIC BUILDING BLOCKS & TESTING 9

Arithmetic Building Blocks: Adders – Multipliers – Shifters. Design for Testability: Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Boundary Scan Testing, Built-In Self-Test (BIST) Techniques, Automatic Test Pattern Generation (ATPG), Fault Simulation, Current Monitoring IDDQ Test.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Summarize various VLSI design principles and methodologies
CO2: Describe operation, characteristics, layout and fabrication of MOS Transistor and design CMOS Inverter.
CO3: Apply design concepts to realize CMOS Combinational Logic Circuits and Sequential Logic Circuits.
CO4: Analyze various architectures of Arithmetic Building Blocks and implement testing techniques to CMOS VLSI Circuits.

TEXT BOOK:

1. Sung Mo Kang, Yusuf Leblebici, Chulwoo Kim, CMOS Digital Integrated Circuits, Mc Graw Hill India, Fourth Edition, 2016. (Unit I to V)

REFERENCE BOOKS:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson Education India, Second Edition, 2016
2. David Money Harris, Neil Weste and Ayan Banerjee, CMOS VLSI Design: A circuits and Systems Perspective, Pearson Education India, Fourth Edition, 2016.
3. Jacob Baker R, CMOS Circuit Design, Layout and Simulation, Wiley Student Edition 2018.
4. Uyemura J. P, Introduction to VLSI Circuits and Systems, Wiley Student Edition, 2015
5. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, Prentice Hall, Third Edition, 2016.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	2	2				1	1		2	2		2
CO2	3	3	3	3	2				1	1		2	3		2
CO3	3	3	3	3	2				1	1		2	3		2
CO4	3	3	3	3	2				1	1		2	3		2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2511	ANALOG AND DIGITAL COMMUNICATION LABORATORY	0	0	3	1.5

PREAMBLE

This Laboratory provides an experimental examination of various building blocks of the analog and digital communication systems. Students could comprehend the necessity of each block and evaluate their performances through kit and software based implementations. Knowledge of Fourier Transform and Probability Theory would enhance the level of understanding.

OBJECTIVES

- To implement the analog modulation schemes
- To understand the various waveform coding techniques
- To comprehend and simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS

1. AM Modulator and Demodulator
2. FM Modulator
3. Time Division Multiplexing
4. Pulse Code Modulation
5. Delta Modulation
6. Line coding schemes

Using MatLaboratory Simulation:

7. Digital representation of Analog Signals - PCM and DM
8. Generation and Coherent Detection of BPSK
9. Generation and Coherent Detection of BFSK
10. Modulated Signal Generation- DPSK, QPSK and QAM schemes
11. Simulation of signal constellations of BPSK, QPSK and QAM
12. Implementation of a (n, k) error control coder - Linear Block Code and Cyclic Code
13. Implementation of a (n, k, K) Convolutional coder
14. BER analysis through Communication link simulation- M-ary PSK
15. Simulation of Spread Spectrum Modulation Technique

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Construct circuits to experiment the Amplitude and Frequency modulation methods
CO2 : Demonstrate their knowledge in baseband signalling schemes through the implementation of PCM, DM and line coding schemes
CO3 : Simulate an end-to-end communication link and analyze the effect of noise on the performance of the entire system.
CO4 : Apply various error control coding schemes over information bits
CO5 : Demonstrate their knowledge in spread spectrum modulation techniques

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Kits for AM, FM, TDM, PCM, DM and Line Coding Schemes	3 each
2	CRO (20 MHz) and Function Generators (3 MHz)	15
3	MATLABORATORY / SCILABORATORY or equivalent software package for simulation experiments	
4	Dual Regulated Power Supplies (0-30 V)	15
5	PC	15

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		3	3				3	2	1	1		3	
CO2	3	3		3	3				3	2	1	1		3	
CO3	3	3		3	3				3	2	1	1		3	
CO4	3	3		3	3				3	2	1	1		3	
CO5	3	3		3	3				3	2	1	1		3	

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2512	VLSI DESIGN LABORATORY	0	0	3	1.5

PREAMBLE

Field Programmable Gate Arrays (FPGAs) are important semiconductor devices. FPGAs can be reprogrammed to desired applications after manufacturing. Due to their programmable nature, FPGAs are an ideal fit for many different applications such as Industrial, Medical, Consumer Electronics, Wired/Wireless Communications, etc. CMOS technology continues to be the dominant technology for fabricating integrated circuits (ICs). CMOS technology is reliable, easily manufacturable, low power, and most importantly, scalable. This course provides the basic knowledge required for synthesis and hardware implementation of digital integrated circuits using a hardware description language, and to apply these in practice on FPGA boards and also this course provides hands on experience in CMOS digital circuit design using CAD tools.

OBJECTIVES

- To learn Hardware Descriptive Language (Verilog/VHDL)
- To learn the design principles of VLSI circuits in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms

LIST OF EXPERIMENTS

DIGITAL SYSTEM DESIGN USING HDL

1. Design of 4-Bit Carry Look Ahead Adder
2. Design of 4-Bit Booth Multiplier Time Division Multiplexing
3. Design of 8-bit MAC unit
4. Design of 8-Bit ALU
5. Design of 4-Bit Synchronous Up/Down Counter
6. Design of 4-Bit Universal Shift Register
7. Design of Moore FSM
8. Design of Mealy FSM

For the experiments 1-8:

- Use VHDL/Verilog to model either in structural and/or behavioural domains
- Simulate it using by Xilinx/Altera Software
- Implement and Verify the functionality using Xilinx/Altera FPGA Trainer Kit

CMOS DIGITAL CIRCUIT DESIGN

9. Basic CMOS logic gates
10. Half Adder, Full Adder, Half Subtractor & Full Subtractor using the Cells developed in Expt. No. 09
11. CMOS Latches & Flip Flops using the Cells developed in Expt. No. 09
12. 4-Bit Synchronous Up/Down Counter using the Cells developed in Expt. No. 11

For the experiments 9-12: Design, Construct and Verify at circuit level
For the experiments 9-11: Perform Post Layout Simulation
Use CAD Tools: Cadence//Mentor Graphics/Tanner

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Write HDL code for digital integrated circuits, import HDL code & verify the functionality of the logic modules into FPGA Trainer Boards.
CO2 : Design and simulate CMOS Digital Circuits using EDA tools
CO3 : Perform post layout simulation using EDA tools

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Xilinx/Altera FPGA Synthesis Software with Trainer Kits	15Nos
2	Tanner/Mentor Graphics / Cadence Tools/equivalent	15User License
3	Personal Computer	15Nos

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3				3	2		1	3		3
CO2	3	3	3	3	3				3	2		1	3		3
CO3	3	3	3	3	3				3	2		1	3		3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2601	WIRELESS COMMUNICATION	3	0	0	3

PREAMBLE:

It is important that communications engineers understand wireless systems, especially digital cellular systems. Wireless industry has become the fastest growing sector of the telecommunications industry, and there is hardly anybody in the world who is not a user of some form of wireless technology. From the ubiquitous cellphones, to wireless LANs, to wireless sensors that are proliferating – we are surrounded by wireless communications devices. One of the key challenges in studying wireless communications is the amazing breadth of topics that impacts this field. This course introduces the methods towards design and analysis of digital cellular systems. The main topics covered are wireless channel and system models, multicarrier modulation, equalization, diversity and spatial multiplexing. This course tries to get students the

required foundation for taking up courses on advanced wireless communications including massive MIMO.

OBJECTIVES:

- To gain knowledge about technical challenges of wireless communications, and noise and interference limited systems.
- To learn about wireless propagation channels.
- To comprehend the concepts +of diversity and equalization in wireless communications.
- To understand the concepts and benefits of multiple access and advanced transceiver schemes.
- To acquire knowledge about multiantenna systems and wireless standards

UNIT I WIRELESS PROPAGATION CHANNELS 9

Technical Challenges of Wireless Communications, Noise- and Interference-Limited Systems, Propagation Mechanisms-Free Space Attenuation, Reflection and Transmission-The d^{-4} Power Law, Derivation of the d^{-4} Law, Statistical Description of the Wireless Channel-Small-Scale Fading without a Dominant Component, Small-Scale Fading with a Dominant Component, Doppler Spectra and Temporal Channel Variations, Temporal Dependence of Fading, Large-Scale Fading.

UNIT II DIVERSITY 9

Introduction-Principle of Diversity, Definition of the Correlation Coefficient, Microdiversity, Macrodiversity and Simulcast, Combination of Signals, Error Probability in Fading Channels with Diversity Reception, Transmit Diversity.

UNIT III EQUALIZERS 9

Introduction, Linear Equalizers, Decision Feedback Equalizers, Maximum Likelihood Sequence Estimation – Viterbi Detector, Comparison of Equalizer Structures, Blind Equalizer-Blind Maximum Likelihood Estimation.

UNIT IV MULTIPLE ACCESS AND ADVANCED TRANSCEIVER SCHEMES 9

Multiple Access and the Cellular Principle-Frequency Division Multiple Access, Time Division Multiple Access, Duplexing, Principles of Cellular Networks, Co channel and Adjacent Channel Interference, C/I, Handoff, Cellular Code-Division-Multiple-Access Systems, Multiuser Detection, Orthogonal Frequency Division Multiplexing (OFDM)- Principle, Implementation of Transceivers, Frequency-Selective Channels, Peak-to-Average Power Ratio, Inter Carrier Interference, Multiple Access – OFDMA, Multicarrier Code Division Multiple Access.

UNIT V MULTIANTENNA AND STANDARDIZED WIRELESS SYSTEMS 9

Multiple Input Multiple Output Systems-System Model, Channel State Information, Spatial Multiplexing, Layered Space–Time Structure, Tradeoffs between Diversity, Beamforming Gain, and Spatial Multiplexing, Multiuser MIMO.System Overview-GSM, IS-95 and CDMA 2000, WCDMA/UMTS, WiMAX/IEEE 802.16, LTE.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Comprehend the impact of noise and interference in wireless communications.
CO2: Determine the appropriate fading channel models based on the design parameters.
CO3: Analyze and design diversity and equalization techniques.
CO4: Understand the design of multiple access and multi-carrier systems.
CO5: Analyze the performance of multi antenna systems and different wireless standards

TEXT BOOK:

1. Andreas F. Molisch, Wireless Communications, John Wiley India, Second Edition, 2013.

REFERENCE BOOKS:

1. Rappaport T.S, Wireless communications, Pearson Education, Second Edition, 2014.
2. Gordon L. Stuber, Principles of Mobile Communication, Springer International Ltd, Fourth Edition, 2017.
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
4. Simon Haykin & Michael Moher, adapted by David Kovilpillai, Modern Wireless Communications, Pearson Education, 2011.
5. David Tse and Pramod Vishwanath, Fundamentals of Wireless Communication Edition, Cambridge University Press, 2005.
6. Abd-Elhamid M. Taha, Hossam S. Hassanein and Najah Abu Ali. "LTE, LTE-Advanced and WiMAX towards IMT-Advanced networks", John Wiley & Sons, Ltd, 2012

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		2								1	3	2	1
CO2	3	3		2								1	3	2	2
CO3	3	3		2	2			1				1	3	3	2
CO4	3	3		2	2			1				1	2	2	2
CO5	3	3		2								1	3	3	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2602	SYSTEM DESIGN FOR IoT	3	0	0	3

PREAMBLE:

The Internet of Things (IoT) is a network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. Nowadays IoT enabled devices are designed and developed for wide range of applications such as building and home automation, smart city, smart grid, smart agriculture, transportation, military and healthcare etc. System Design for IoT is one of the most essential subjects for Electronics and Communication Engineers. The main topics covered

are fundamental concepts, Architectures & Protocols, Security issues, steps to build IoT systems and few case studies.

OBJECTIVES:

- To learn the fundamentals of Internet of Things and interference limited systems.
- To understand IoT Reference Model and IoT Reference Architecture.
- To learn about the basics of IoT protocols.
- To understand the security issues possible with IoT schemes.
- To build a small low cost IoT system and to apply the concept of Internet of Things in the real world scenario

UNIT I FUNDAMENTAL CONCEPTS OF IoT 9

Internet of Things - Physical Design- Logical Design - IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management – YANG Model.

UNIT II IoT ARCHITECTURES 9

IoT Platform Design Methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications, functional view specification, operational view specification, device and component integration, application development.

UNIT III IoT PROTOCOLS 9

Protocols – IEEE 802.15.4 – Zigbee – BACNet – Modbus – 6LowPAN – CoAP-MQTT - LoRA - SigFox..

UNIT IV SECURITY ISSUES OVERVIEW 9

Introduction – Phases of IoT System – Internet of Things as Interconnection of Threats – Phase attacks: Data leakage or breach, data sovereignty, data loss, data authentication, attack on availability, modification of sensitive data – Attacks as per architecture – Attacks based on components.

UNIT V BUILDING IoT SYSTEM & CASE STUDIES 9

IoT Physical Devices & Endpoints - Basic building blocks of an IoT Device - Raspberry Pi - Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Real world design constraints – IoT use cases – Case Study: Commercial building

Automation today and in the future: Background, Technology overview, and Evolved value chain for commercial building automation – Case Study: Smart cities: The need, working definition, some examples, Roles – actors – engagement, Transport and logistics – an IoT perspective.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Interpret the fundamental concepts of IoT
CO2: Develop IoT Architecture for a particular application scenario
CO3: Identify the correct protocol for a specific application

CO4: Identify the security issues possible with IoT systems
CO5: Design a portable IoT using Raspberry Pi, Analyze applications of IoT in real time Scenario

TEXT BOOK:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A hands-on approach Universities Press, 2015. (UNIT – I, II, V).
2. Rolando Herrero, Fundamentals of IoT Communication Technologies, Springer, 2022. ISBN 978-3-030-70080-5 (UNIT-III)

REFERENCE BOOKS:

1. Fei Hu, Security and Privacy in Internet of Things (IoTs): Models, Algorithms & Implementations, CRC Press, Taylor & Francis group, 2016. (UNIT –IV).
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand and David Boyle, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014.
3. Honbo Zhou, the Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
4. Dieter Uckelmann, Mark Harrison and Michahelles Florian (Eds), Architecting the Internet of Things, Springer, 2011.
5. Mayur Ramgir, Internet of Things- Architecture, Implementation, and SecuritY, Pearson Education, 2019

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2							2	2	2	2
CO2	3	3	3	3	2							2	3	3	3
CO3	3	3	3	3	2							2	2	3	3
CO4	3	3	3	2	2							2	2	2	2
CO5	3	3	3	3	2							2	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2603	MICROWAVE AND ANTENNA ENGINEERING	3	0	0	3

PREAMBLE:

This course provides an in-depth understanding of microwave engineering and antennas. The prerequisite for the course is basic knowledge of electromagnetic fields and transmission lines. Future applications, like smart antennas and antenna beamforming techniques require expertise

in both antennas and microwave electronics. This course provides the required theoretical foundation for the design and development of such antenna and microwave systems.

OBJECTIVES:

- To study the various microwave sources, microwave passive and active devices.
- To understand the basic antenna parameters and the radiation principles of wire antennas.
- To learn the design and operation of array and aperture antennas.
- To study the various antenna and microwave measurement techniques.

UNIT I MICROWAVE GENERATION AND COMPONENTS 9

Microwave Sources: Microwave frequency bands, Theory and operation of two cavity klystron amplifier, Reflex klystron, TWT, Cylindrical magnetron.
Microwave devices: Microwave Hybrid Circuits, Directional couplers, Circulator, Isolator, Gunn diode and IMPATT diode.

UNIT II ANTENNA FUNDAMENTALS 9

Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Radiation from the Hertzian dipole, short dipole and half wavelength dipole.

UNIT III ARRAY AND APERTURE ANTENNAS 9

Antenna Arrays: Two element and N-element linear array, Pattern multiplication, Broadside and end-fire array, Array synthesis: Binomial array.
Aperture Antennas: Horn antennas, Reflector antennas, Slot antennas

UNIT IV SPECIAL ANTENNAS 9

Yagi-Uda Array, Helical Antenna, Log-periodic dipole array, Spiral antenna, Microstrip patch antenna, Smart antennas and antenna beamforming.

UNIT V MEASUREMENTS 9

Frequency measurement, Power measurement, VSWR Measurement, Antenna measurement Range, Radiation pattern measurement, Gain and directivity measurement, Polarization measurement.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Identify and explain the operation of microwave sources and devices
CO2: Comprehend antenna parameters and the radiation mechanism of simple antennas to complex antenna structures
CO3: Design antennas for given specifications and perform array synthesis
CO4: Acquire knowledge on the operation of antennas designed for specific applications
CO5: Evaluate antenna and microwave parameters using appropriate systems and techniques

TEXT BOOKS:

1. Samuel Y. Liao, Microwave Devices and Circuits, Pearson, Third Edition, 2003. (Unit I)

2. Harish A R and Sachidananda M, Antennas and Wave Propagation, Oxford University Press, Fourth Edition, 2007. (Unit II to V)

REFERENCE BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, Antennas and Wave Propagation, Tata McGraw-Hill, Fourth Edition, 2006.
2. Balanis C A, Antenna Theory: Analysis and Design, John Wiley & Sons, Inc., Fourth Edition, 2016.
1. David M. Pozar, Microwave Engineering, John Wiley & Sons, Inc., Fourth Edition 2012
2. Annapurna Das and Sisir K Das, Microwave Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi, Second Edition, 2009.
3. Warren L Stutzman and Gary A. Thiele, Antenna Theory and Design, John Wiley & Sons, Inc., Third Edition, 2012

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2							1				2	
CO2	2	3	2	2										2	
CO3	3	3	3	3	3	1		1	2	3		3		3	2
CO4	2	3	2											2	
CO5	3	3	3	3	3			1	2	3		3		3	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2604	MACHINE LEARNING	3	0	2	4

PREAMBLE:

Machine learning is a branch of artificial intelligence wherein concepts/hypothesis/patterns are learnt from data by using heuristic algorithms. This course provides a broad perspective of the Machine learning framework and introduces the core concepts of supervised, unsupervised, evolutionary and reinforcement learning. Moreover, this course will give an insight to artificial neural network, deep learning techniques and its application. Furthermore, the course gives hands-on experience to develop a mini project using state-of-the-art machine learning concept.

OBJECTIVES:

- To introduce the fundamental concepts of machine learning.
- To explain the core concepts of learning methods such as supervised, unsupervised, evolutionary and reinforcement learning techniques.
- To understand the concepts of artificial neural network and deep learning of learning.

- To provide exposure to the students with hands-on experience on various machine learning techniques.

UNIT I FUNDAMENTALS OF MACHINE LEARNING 9

Introduction to machine learning - Types of machine learning: supervised, unsupervised and reinforcement learning - The machine learning process – Basic terminologies in machine learning – datasets, weight space, the curse of dimensionality, overfitting, accuracy metrics - Perspectives and issues in machine learning.

UNIT II SUPERVISED LEARNING 9

Bayes decision theory - Minimum-error-rate classification – Linear Regression - Logistic Regression – K-Nearest Neighbor - Support Vector Machines (SVM) - Learning with decision Trees – Constructing decision trees – Classification and Regression Trees (CART) - Ensemble learning: boosting, bagging and random forest.

UNIT III UNSUPERVISED LEARNING 9

Clustering: K-means – Adaptive K-means - K Nearest Neighbours - Vector Quantization. Dimensionality reduction: Linear Discriminant Analysis (LDA) - Principal Component Analysis (PCA) - Independent component analysis (ICA)

UNIT IV EVOLUTIONARY AND REINFORCEMENT LEARNING 9

Evolutionary Learning: Genetic algorithms – Genetic offspring – Genetic operators – Using Genetic algorithms. Reinforcement Learning: State and action space – Rewards function – Discounting – Action selection – Policy – Markov decision process – Values - Uses of reinforcement learning.

UNIT IV ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING 9

Learning - The brain and the neuron - Models of a neuron - Feed-Forward neural networks - Perceptron learning - Multi-layer feed-forward neural network - Gradient descent -Back

Propagation algorithm. Introduction to Deep Neural Network (DNN) – Convolutional Neural Network – Auto Encoders – Applications of Deep Learning Networks.

MINI PROJECT 30

Students can be assessed based on a mini project that involves application of various machine learning algorithms on a given text/speech/image/video dataset. A written report on the results and a presentation can be included as a part of assessment.

LIST OF PROJECTS:

1. Textual description of images
2. Car damage assessment with cost estimation
3. Estimating facial features using speech
4. Speech reconstruction from silent video
5. Quality check for manuscripts/reports for possible acceptance
6. Fake news detection in social media
7. Food calories analytics
8. Predictive maintenance of automobiles

9. Any other similar projects related to machine/deep learning

TOTAL PERIODS: 75

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Describe the fundamental framework of machine learning.
CO2: Explain the core concepts of Supervised, Unsupervised, Evolutionary and Reinforcement learning
CO3: Apply dimensionality reduction techniques for machine learning problems
CO4: Explain the artificial neural network and DNN for machine learning applications
CO5: Design and implement various machine learning algorithms to solve real-world Applications for societal transformations
CO6: Communicate effectively through reflections, reports and presentations for better Teamwork

TEXTBOOKS:

1. Stephen Marsland - Machine learning - an algorithmic perspective, Chapman and Hall / CRC machine learning and Pattern recognition series, Second Edition, 2014. (Unit ItoIV)
2. Duda R.O., Hart P.E. and Stork D.G., Pattern Classification, John Wiley, 2001. (Unit II)

REFERENCE BOOKS:

1. Bishop C.M, Pattern Recognition and Machine Learning, Springer, 2006.
2. Simon Haykin, Neural networks - a comprehensive foundation, Pearson Education, Second Edition, 2008.
3. Tom. M. Mitchell, Machine learning, McGraw Hill education, First Edition, 2013.
4. Francois Chollet, Deep Learning with Python, Manning Publication, 2017.
5. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, Second Edition, Packt Publishing Ltd., Livery Place, UK, 2017.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3							2	3	1	3
CO2	3	3	3	3	2							1	2	1	3
CO3	3	3	2	3	2							1	3	1	3
CO4	3	3	2	3	2							2	3	1	3
CO5	3	3	3	3	3	1	1	2	2	2	2	3	3	1	3
CO6					2			1	3	3	1	1	3	1	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2611	MICROWAVE AND ANTENNAS LABORATORY	0	0	3	1.5

PREAMBLE

This course explores the concepts of antenna and microwave systems in a Laboratory setting with an emphasis on measurement techniques. The objective of this course is to enable the students to design, simulate and experiment the characteristics of microwave devices, sources and antennas.

OBJECTIVES

- To learn the various microwave sources, microwave passive and active devices
- To understand the antenna and microwave measurement techniques
- To understand antenna parameters and the radiation principles of wire antennas
- To understand the design and operation of array and aperture antennas

LIST OF EXPERIMENTS

1. Mode Characteristics of Reflex Klystron
2. VI Characteristics of Gunn diode and attenuation measurement
3. Measurement of VSWR, frequency and wavelength using Reflex Klystron
4. S parameter analysis of E plane Tee, H plane Tee and Magic Tee
5. S parameter analysis of Isolator and circulator
6. S parameter analysis of Directional Coupler
7. Characterization of microwave integrated circuits using the vector network analyzer
8. Design and characterization of a printed monopole antenna
9. Design and characterization of a microstrip patch antenna
10. Design of a horn antenna and analysis using the 3D electromagnetic tool
11. Radiation pattern and gain measurement of X band horn antenna
12. Design of beam-steering antennas

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Characterize microwave components using S parameters
CO2 : Operate vector network analyzer for microwave measurements
CO3 : Design antennas and analyze its characteristics
CO4 : Determine antenna parameters using real-time measurements

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Microwave Test Bench at X band	6
2	PC loaded with CST Microwave Studio Suite	4
3	Vector Network Analyzer	1
4	MIC trainer kit	1

CO – PO/PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2										2		3	
CO2	2	2										2		3	
CO3	2	2	3	3	3							2		3	2
CO4	2	2		3	3							2		3	

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2612	SYSTEM DESIGN FOR IoT LABORATORY	0	0	3	1.5

PREAMBLE

System Design for IoT Laboratory is one of the most essential practical courses for Electronics and Communication Engineers. The students are trained to apply the IoT principles and design tools for building IoT enabled systems for few real world scenarios. The course also gives an in-depth knowledge about recording and reporting the measure data with connectivity between the developed system and the cloud. The course also gives an introduction about implementing control applications.

OBJECTIVES

- To understand about the different boards available to develop IoT system
- To build an IoT system and connect to the cloud
- To apply the concept of Internet of Things in the real world scenario
- To implement actuator control in the IoT system

LIST OF EXPERIMENTS

PART I

1. Configure Raspberry Pi and energize it for blinking a LED
2. Access real time sensor data: IR sensor, PIR sensor, Ultrasonic sensor & Soil moisture sensor
3. Acquisition of Real-time temperature and humidity sensor data over cloud
4. Design an alert system by analyzing the physical parameters over cloud
5. IEEE 802.15.4 CSMA – MAC implementation using MATLABORATORY
6. Developing a lightweight cryptographic algorithm suitable for IoT devices

PART II

Mini project on building IoT system for specific applications

1. IoT based intelligent traffic management system

2. Smart irrigation system using IoT
3. IoT based smart waste management system for smart city
4. IoT based weather reporting system
5. IoT based water management system

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Use Raspberry Pi for IoT systems
CO2 : Apply IoT principles and design tools for developing IoT systems
CO3 : Comprehensively record and report the measured data
CO4 : Establish connectivity between IoT system and cloud
CO5 : Implement control applications using IoT

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	Raspberry Pi 3 model B with accessories (SD card, power adapter HDMI to VGA connector, USB mouse, Keyboard)	15
2	Personal Computer	15
3	Sensors and interfaces based on the application to be build	5 Nos. each
4	Freeware available for installation of OS - SD card formatter, Win32 disk images, Operating system - Raspbian Buster, Cloud platform –Thingspeak	15

CO – PO/PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3				2			1	3	3	2
CO2	3	3	3	2	3				2			1	3	3	3
CO3	3	3	3	2	3				2			1	3	3	3
CO4	3	3	3	2	3				2			1	3	3	3
CO5	3	3	3	2	3				2			1	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2701	HIGH FREQUENCY COMMUNICATION SYSTEMS	3	0	0	3

PREAMBLE:

This course provides an in-depth understanding of Optical and High frequency Communication systems. With the development trend of wireless and broadband in the communication link, the demand of high-frequency microwave bandwidth has been increasing. The problem of spectrum congestion in low-frequency bands can be solved by providing signals at mm wave frequency microwave optical fiber links. The prerequisite for the course is basic knowledge of electromagnetic fields and wireless communication.

OBJECTIVES:

- Understand the mechanism of light propagation for signal transmission within a fiber.
- Understand the components of Fiber optic networking.
- Understand the fundamentals issues related to mmWave propagation.
- Appreciate the design requirements for mmWave Communications system.

UNIT I LIGHT PROPAGATION IN FIBER OPTICS 9

Transmission Characteristics of Fibres: Attenuation, material absorption and scattering loss, bending loss, intra-modal and inter-modal dispersion in step and graded fibres, FOC System description and design considerations.

UNIT II FIBER OPTIC NETWORKS 9

Principles of WDM, DWDM, Telecommunications & broadband application, wavelength-routed networks SONET/SDH, MUX, Analog & Digital broadband, optical switching.

UNIT III FREE SPACE OPTICAL COMMUNICATION 9

Propagation of light in unguided media, LASER beam characteristics, atmospheric effects on optical signals, FSO transceiver design, Point-to-Point FSO systems, point-to-point with transponder nodes, Hybrid FSO and RF, FSO applications , LIDAR

UNIT IV MILLIMETER WAVE PROPAGATION 9

Radio Wave Propagation for Mm Wave, Large-Scale and small scale propagation effects of Mm waves, Outdoor Channel Models, Indoor Channel Models, Vehicle-to-Vehicle Models, Spatial Characterization of Multipath and Beam Combining, Angle Spread and Multipath Angle of Arrival.

UNIT V MILLIMETER WAVE COMMUNICATION 9

Arrays and antenna topologies for MmWave Communications, Adaptive Antenna Arrays — Beam Steering and Beamforming, ESPRIT and MUSIC, Emerging Applications of MmWave Communications – Massive MIMO.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Identify the fiber optic communications system and components for networking
CO2: Explain the merits of fiber optic networks and multiplexing of light signals
CO3: Design free space light communication against atmospheric effects
CO4: Art the need for mm Wave Communications systems
CO5: Design applications involving mm Wave systems for high bit rate communications

TEXTBOOKS:

1. Gerd Keiser, Optical Fiber Communications, 2nd Edition, McGraw - Hill, 2007 (Unit I &II).
2. Theodore S. Rappaport, Robert W. Heath, Robert C. Daniels, and James N. Murdock Millimeter Wave Wireless Communications, PHI, 2018 (Unit IV & Unit V)

REFERENCE BOOKS:

1. Stamatios V. Kartalopoulos, Free Space Optical Networks for Ultra-Broad Band Services, First Edition, John Wiley & Sons, Inc. 2011 (Unit III)
2. John M. Senior, Optical Fiber Communication, 3rd Edition, PHI/Pearson, 2009
3. G. Agrawal, Fiber optic Communication Systems, 4th Edition, John Wiley and sons, 2010.
4. Ke Wang, Indoor Infrared Optical Wireless Communications Systems and Integration CRC press, 2020
5. Manuel García Sanchez, Millimeter-Wave (mm Wave) Communications, MDPI, 2020

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	1	1						1	2	1	1
CO2	2	1	1	2	1	1						2	2	2	1
CO3	2	3	2	3	1	1						2	2	2	1
CO4	1	2	2	3	1	1						1	2	1	1
CO5	1	2	2	3	1	1						1	2	1	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2711	HIGH FREQUENCY COMMUNICATION LABORATORY	0	0	4	2

PREAMBLE

This course takes an experimental approach to advanced communication systems. Theory studied in the context of digital communications, wireless and optical communications is translated directly into practice with the help of the National Instruments USRP software defined radio platform, MATLABORATORY/IT++ and Optical trainer kits. The emphasis is on physical layer concepts rather than implementation considerations. This Laboratory course is unique because it approaches wireless communications from the perspective of digital signal processing. Background in digital communications and programming knowledge are assumed.

OBJECTIVES

- To get to know the actual building blocks of a communication link and their importance in the system as a whole.
- To acquire in-depth knowledge on various advanced communication techniques with hardware and software platforms
- To understand various wireless channel impairments and their impact on the performance of a wireless system and mitigation techniques
- To gain understanding on indoor and fixed channel models.
- To attain better knowledge on LABORATORYVIEW programming.
- To develop understanding of simple optical communication link.

LIST OF EXPERIMENTS

Using NI USRP

1. BER analysis of Digital Modulation and Detection techniques
2. Demonstration of the impact of Pulse shaping and Matched Filtering
3. Channel estimation and linear equalization
4. Implementation of Frame Detection & Frequency Offset Correction Techniques
5. OFDM modulation including channel estimation, synchronization, and equalization
6. Implementation of channel coding in OFDM Systems

Simulation Using IT++ or MatLaboratory

1. Simulation of small scale fading, large scale fading and link budgets
2. Study of receive diversity, selection diversity, and maximum ratio combining
3. Simulation of transmit diversity (Alamouti - STBC)
4. MIMO communication systems including spatial multiplexing
5. Simulation study of interference cancellation techniques in multiple-input multiple-Output (MIMO) systems
6. Implementation of IEEE 802.11n standard (PHY layer)
7. Simulation of MIMO multipath fading channels based on the IEEE 802.11n channel Models for indoor wireless local area networks (WLAN).
8. Simulation of MIMO multipath fading channels based on the IEEE 802.16 channel Models for fixed wireless applications

Using Optical Trainer Kit

1. Measurement of connector, bending and fiber attenuation losses.
2. Numerical Aperture and Mode Characteristics of Fibers.
3. Study of the gain characteristics of an EDFA for various pump powers
4. Fiber optic Analog and Digital Link Characterization - frequency response (analog), eye diagram and BER (digital)
5. Study of a WDM optical transmission link

TOTAL PERIODS: 60

OUTCOMES

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

CO1 : Implement and demonstrate various digital modulation, transmission and signal processing techniques using NI Hardware platform.
CO2 : Design multicarrier communications using NI USRP platform
CO3 : Simulate and construe the impact of fading and diversity techniques in wireless Systems.
CO4 : Design and simulate realistic channel models for advanced wireless standards
CO5 : Analyse the performance of simple optical link by measurement of losses and Analyzing the mode characteristics of fiber.

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.No	Description of Equipment / Software	Quantity
1	USRP Software Defined Radio Reconfigurable Device - 3 sets of the transceiver	6
2	LABORATORYVIEW programming module	4
3	2 x 2 MIMO antenna - 3 pairs	6
4	IT++ or MatLaboratory Simulation Software Installed PCs	10
5	Trainer kit for carrying out Fiber Optic experiments	2

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2		1	3	3			2	2	2		1		2	
CO2	2		1	3	3			2	2	2		1		2	
CO3	2		1	3	3			2	2	2		1		2	
CO4	2		1	3	3			2	2	2		1		2	
CO5	3	1	1	3	3				2	2		1		2	

HUMANITIES I – ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
UEN2241	LANGUAGE AND COMMUNICATION	2	0	2	3

OBJECTIVES

- To enhance communicative competence in general.
- To improve the ability of the students to negotiate with meaning in context.
- To develop speaking skills of the students for career needs.
- To develop sensitivity to gender, human rights, politeness and other aspects
- To enhance the skills in being persuasive in writing and speech

UNIT I APPROACHES TO COMMUNICATION 9

- The information Processing school, Shannon and Weaver; A Mathematical Theory of
- Communication, Formal Signal Processing approach.
- Semiotic approach; information, communication and significance.
- Chomskyan distinction between language structure and language use; form and function.
- Towards a theory of performance; acceptability and grammaticality.
- Communicative Competency; Possibility, appropriacy, feasibility.

UNIT II MEANING IN LANGUAGE USE 9

- Speech Act Theory; communicative activity, elocutionary act, directives, commissive,
- expressive, declarations and representatives.
- Grice's theory of conversational meaning; the cooperative principle, quantity maxim, quality
- maxim, relational maxim, manner maxim.
- Ancient Indian theory of meaning; lexical, compositional, extended.
- Speaker intention in communication.
- Discourse meaning; context and situation.

UNIT III STRUCTURE OF DISCOURSE/CONVERSATION 9

- Coherence
- Cohesion
- Initiating and closing conversations
- Intervention
- Turn-taking

UNIT IV POWER STRUCTURE AND LANGUAGE USE 9

- Gender and language use
- Politeness expressions and their use
- Ethical dimensions of language use
- Language rights as part of human rights

UNIT V MEDIA AND PERSUASIVE COMMUNICATION 9

- Power of media, Orwell's problem (Chomsky)
- Manufacturing of opinion and hidden agendas.
- Fundamentals of persuasive communication.
- Persuasive quotient
- Politics and communication barrier.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: To improve their communicative competency across all skills of language.
CO2: To improve their writing ability in writing for persuasion and convincing someone.
CO3: To attend job interviews more confidently,
CO4: To improve social communication sensitive to gender and other prejudices.
CO5: To do better in the spoken component of the placement tasks

TEXT BOOK:

1. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University Press

REFERENCE BOOKS:

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989.
2. Studies in the way of words. Cambridge, M.A: Harvard University Press.
3. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge.
4. Chomsky, N.2006. Language and Mind, Cambridge University Press.
5. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
6. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
7. Stangley, J. 2007. Language in Context. Clarendon press, Oxford.
8. Shannon, 1942. A Mathematical Theory of Communication.
9. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1									2	3		2			
CO2									2	3		2			
CO3									2	3		2			
CO4									2	3		2			
CO5									2	3		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UEN2242	FUNDAMENTALS OF LINGUISTICS	2	0	2	3

OBJECTIVES

- To introduce the students to Linguistics (the scientific study of language).
- To explore some basic issues and questions related to language such as what do we know when we know a language,
- To discover the relation between language and brain, language and society,
- To understand how a child learns a language, how the languages of the world are similar as well as different, how we can analyze language as a structure etc.
- To provide students to a brief outline of language studies in Indian and western tradition and many applications of linguistics in different fields.

UNIT I DEFINING LANGUAGE 9

- What is language and where is language?
  - Language is a means of communication, a social product
  - Language is a cognitive ability, relation between language and brain
- Study of Language in Indian and western traditions

UNIT II AN INSIGHT INTO LINGUISTICS 9

- What is Linguistics and what is not Linguistics?
  - Linguistics is not prescriptive grammar learnt in the school
  - Linguistics is not learning of many languages
  - Linguistics provides tools to analyze language structure scientifically

UNIT III FORM AND FUNCTION 9

- Levels of Language Analysis: Form and content
  - Sound
  - Word
  - Sentence
  - Meaning
- Similarities and differences of languages

UNIT IV APPLICATIONS 9

- Applications of Linguistics
  - Natural Language Processing
  - Clinical Linguistics
  - Psycholinguistics etc.

UNIT V IMPACT ON CAREER 9

- Impact of linguistics on one’s career
  - An understanding of Linguistics for better use of language
  - Language and personality development
  - Linguistic features specific to Engineers.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Understand what is linguistics
CO2: Explore some basic issues and questions related to language
CO3: Understand the subtle difference between the use of English in Indian and western tradition.
CO4: Familiarize themselves with the unique features of language in technology
CO5: Understand the basics of how children acquire languages

TEXT BOOK:

1. Raj Kumar Sharma, 'Fundamentals of Linguistics', Atlantic Publishers, Chennai:2019.

REFERENCE BOOKS:

1. Thomas Herbst, 'English Linguistics: A coursebook for students of English', De Gruyter Mouton Publication, Germany: 2010.
2. Victoria A. Fromkin (ed.), Linguistics: An introduction to linguistic theory, Blackwell Publishers, USA: 2001.
3. Jeff Connor - Linto and Ralph W Fasold, 'An Introduction to Language and Linguistics’, Cambridge University Press, 2014.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1									2	3		2			
CO2									2	3		2			
CO3									2	3		2			
CO4									2	3		2			
CO5									2	3		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UHS2243	FILM APPRECIATION	2	0	2	3

OBJECTIVES

- To introduce students to the development of film as an art and entertainment form.
- To discuss the language of cinema as it evolved over a century.
- To enable the students to read the script of a film and appreciate the various nuances.
- To enable students, understand the evolution of film industry from the past to present
- To guide the students to study films joyfully and appreciate all aspects of the film.

UNIT I THE COMPONENTS OF FILMS 9

- The material and equipment
- The story, screenplay and script
- The actors, crew members, and the director
- The process of filmmaking

UNIT II EVOLUTION OF FILM LANGUAGE 9

- Film language, form, movement etc.
- Early cinema - silent film (Particularly French)
- The emergence of feature films: Birth of a Nation Talkies
- Films and their influence on the language of people

UNIT III FILM APPRECIATION 9

- Realist theory; Auteurists
- Psychoanalytic, Ideological, Feminists
- How to read films?
- Film Criticism / Appreciation

UNIT IV DEVELOPMENT OF FILMS 9

- Representative Soviet films
- Representative Japanese films
- Representative Italian films
- Representative Hollywood film and the studio stem

UNIT V INDIAN FILMS 9

- The early era
- The important films made by the directors E-3: The regional films
- The documentaries in India
- The Indian Film Industry and the Hollywood
- The impact of Films on students in India.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: the process of the development of film as an art and entertainment form.

CO2: the evolution of the language of cinema as it evolved over a century.

CO3: the script writing techniques of a film and appreciate the various nuances.

CO4: the evolution of film industry from the past to present

CO5: how to appreciate all aspects of the film.

TEXT BOOK:

1. Jim Piper, 'The Film Appreciation Book': The Film Course You Always Wanted to Take, Allworth Press, New York: 2014.

REFERENCE BOOKS:

1. Stanley Cavell, 'The World Viewed: Reflections on the Ontology of Film, Enlarged Edition', Harvard University Press, 1979.
2. Joseph M. Boggs, Dennis W. Petrie, 'The Art of Watching Films', McGraw – Hill, 2006.
3. Bernard F. Dick, 'Anatomy of Film', St. Martins Press, 1990.
4. Understanding the Film: An Introduction to Film Appreciation by Jan Bone and Ron Johnson

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1									2	3		2			
CO2									2	3		2			
CO3									2	3		2			
CO4									2	3		2			
CO5									2	3		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UHS2241	HUMAN RELATIONS AT WORK	2	0	2	3

OBJECTIVES

The course aims at making the students:

- aware of human relations at work and its relationship with self.
- aware of the processes involved in interaction with people at work.
- understand the importance of psychological and physical health in maintaining human relations at work and progressing in career.
- Understand the ways and means to improve human relations at work.
- Realize the importance of safeguarding themselves from any exploitation.

UNIT I HUMAN RELATIONS 9

- Understanding and Managing Yourself
- Human Relations and You
- Self-Esteem and Self Confidence
- Self-Motivation and Goal Setting
- Emotional Intelligence
- Attitudes and Happiness
- Values and Ethics and Problem Solving and Creativity.

UNIT II INTERPERSONAL RELATIONSHIP 9

- Dealing Effectively with People
- Communication in the Workplace
- Specialized Tactics for Getting Along with Others in the Workplace
- Managing Conflict; Becoming an Effective Leader
- Motivating Others and Developing Teamwork
- Diversity and Cross-Cultural Competence

UNIT III HEALTHY LIVING 9

- Staying Physically Healthy
- Yoga, Pranayama
- Exercise: Aerobic and anaerobic.

UNIT IV MENTAL WELL BEING 9

- Staying Psychologically Healthy

- Managing Stress and Personal Problems
- Meditation.

UNIT V CAREER READINESS 9

- Developing Career Thrust
- Getting Ahead in Your Career
- Learning Strategies
- Perception
- Life Span Changes
- Developing Good Work Habits.

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student

CO1: will enhance their awareness about human relations at work and its relationship with self.
CO2: become aware of the processes involved in interaction with people at work.
CO3: Will understand the importance of psychological and physical health in maintaining human relations at work.
CO4: will be able to understand the ways and means to improve human relations at work.
CO5: will realize the importance of safeguarding themselves from any exploitation.

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCE BOOKS:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition). New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1						2		2	3	2		2			
CO2						2		2	3	2		2			
CO3						2		2	3	2		2			
CO4						2		2	3	2		2			
CO5						2		2	3	2		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UHS2242	APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE	2	0	2	3

OBJECTIVES

The objectives of this course are to make students:

- aware of the different applications of psychology to everyday issues of life,
- aware of the different social issues, workplace issues, and behavioral issues, and
- understand how the knowledge gained from this course can be used in their own personal and professional work life.
- Understand the psychological principles relevant to human development.
- Understand the impact of Psychology on human life

UNIT I PSYCHOLOGY OF AN INDIVIDUAL 9

- Introduction: Nature and fields.
- The individual human being and his or her experiences, mental processes and behaviors.

UNIT II DIFFERENT TYPES OF PSYCHOLOGY 9

- Psychology in industries and organizations: Job analysis; fatigue and accidents; consumer behavior.
- Different types of psychology: cognitive, forensic, social, and developmental psychology

UNIT III PSYCHOLOGY AND MENTAL HEALTH 9

- Psychology and mental health: Abnormality, symptoms and causes psychological disorders.
- Psychology for better decision making, stress management and behavior.

UNIT IV COUNSELING 9

- Psychology and Counseling: Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V SOCIAL BEHAVIOR 9

- Psychology and social behaviour: Group, group dynamics, team building, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: raise their awareness on applications of psychology to everyday issues of life,
CO2: deal more efficiently with different issues in society, workplace and human behavior.
CO3: Apply principles of psychology in their own personal and professional lives.
CO4: Use the psychological principles for their own human development.
CO5: Appreciate the impact of Psychology on human life

TEXT BOOK:

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey: Pearson/Prentice Hall.

REFERENCE BOOKS:

1. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.).New York: Pearson
2. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
3. Aronson, E., Wilson, T. D., &Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1						2		2	3	2		2			
CO2						2		2	3	2		2			
CO3						2		2	3	2		2			
CO4						2		2	3	2		2			
CO5						2		2	3	2		2			

COURSE CODE	COURSE TITLE	L	T	P	C
UEN2243	UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE	2	0	2	3

OBJECTIVES

- To acquire skills not only the ones necessary for one's "trade", but also the ones to acquire knowledge and become a better human being, as a means towards the end of

creating a better society.

- To facilitate understanding a society, its people, their mind, prevalent traditions and culture with a view to developing a holistic worldview, which is essential for a sustainable society.
- To felicitate self-reflection and deeper understanding of oneself.
- To introduce students to literary works of various countries/ regions / societies and attempt to understand the respective traditions to which the works belong.
- To understand the relationship between life and literature

UNIT I LITERATURE AND LIFE 9

- Traditional Knowledge.
- what is Literature?
- Significance of studying literature,
- Studying society and culture through literature,
- Understanding morality through literature.
- Reading of Literary texts – The literary piece will be given to students beforehand so that they read it and become familiar with the texts before coming to the class. In the class, the text will be read once again, where doubts if any will be cleared.
- First Discussion – The reading will be followed by a discussion where the text will be analyzed in detail. The students will be encouraged to share their interpretation of the text.

UNIT II RESOLVING DILEMMA 9

- Definition and Description of 'Dilemma'
- Choice of literary texts to confront situations where one is faced with a dilemma (differentiating what is right and wrong? and develop a deeper insight into the various realities of life.
- Presentation of analysis of the literary text (The students will keep in mind the author's background and the socio-historical and cultural backgrounds while preparing this presentation)

- Q&A Session on the Presentation (the students will be encouraged to ask questions to their respective classmates regarding the presentation/ analysis initiating a second discussion on the text.

UNIT III GENDER STUDIES 9

- Literary pieces that question the current notions of gender, and raises uncomfortable questions,
- Literature that challenges the status quo, forcing us to think about the real meaning of equality and emancipation
- Second Discussion – (Having made their presentation, and heard the presentations made by their classmates, the students would now have a fairly good idea of the various nuances of the text, making it a ripe moment to have the second detailed discussion on the text.

Here the teacher may refer to those points which may have been missed by the students.)

UNIT IV READING LITERATURE 9

- Reading of select Literary works
- The author's Background, Historical and Social Background for a better understanding of the literary work
- Study of other significant study material as required for an overall understanding of the literary work.

UNIT V SUBMISSION OF A REPORT 9

- Submission of a report – Having faced questions from their classmates, and after having a second discussion on the text, the student would come across new ideas which will be incorporated into the analysis and submitted in the form of a report.

TOTAL PERIODS: 45

OUTCOMES

CO1: Improvement in the awareness of various traditions.
CO2: Not only understand not just the diversity found between various traditions but also celebrate them.
CO3: strengthen their analytical capability.
CO4: improve their language skills and also the ability to express complex ideas.
CO5: understand the relationship between life and literature

REFERENCES:

1. Literary works will be provided by the teacher.
2. Author's Background, Historical and Social Background which are significant for a better understanding of the work will be provided by the teacher.
3. Reference materials or other significant study material as required for an overall understanding of the literary work will be sourced out by the students in consultation with the teacher

CO – PO/PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1									2	3		2			
CO2									2	3		2			
CO3									2	3		2			
CO4									2	3		2			
CO5									2	3		2			

MANAGEMENT ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
UBA 2541	PRINCIPLES OF MANAGEMENT	3	0	0	3

OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL PERIODS: 45

OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.

CO2: Have same basic knowledge on international aspect of management.

CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich “Essentials of Management”, Tata McGraw Hill, 1998.
2. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCE BOOKS:

1. Robert Kreitner and Mamata Mohapatra, “ Management”, Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management”, Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

CO – PO MAPPING

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											2	1
CO2									2		3	1
CO3									2		2	1
CO4					3					2	2	1
CO5											1	1

COURSE CODE	COURSE TITLE	L	T	P	C
UBA2542	TOTAL QUALITY MANAGEMENT	3	0	0	3

OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM

(Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process CapabilityBench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL PERIODS: 45

OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Bester field, MaryB. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCE BOOKS:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.

3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006

CO – PO MAPPING

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1						3		2	1		1	1
CO2						3			2		1	1
CO3					2	3			1		1	1
CO4						3	1		1		1	1
CO5						3	2		1		1	1

COURSE CODE	COURSE TITLE	L	T	P	C
UBA 2543	WORK ETHICS, CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE	3	0	0	3

OBJECTIVES:

- To impart the value of professional practices with code of conduct and ethical values
- Discuss the various outlooks of roles and responsibilities with work ethics.
- Introduce the Indian constitutional statutes for ethical practices by citizens
- Analyze the ethical commitments to be hold by industry with protecting environment
- Insist on corporate and social responsibilities through Governance practices and regulation

UNIT I INTRODUCTION 9

Ethics - Definition & nature, Characteristics, Attributes of Ethics - Business Ethics; Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

UNIT II ETHICS THEORY AND BEYOND 9

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice – ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation.

UNIT III LEGAL ASPECTS OF ETHICS 9

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of

MRTP & FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values.

UNIT IV ENVIRONMENTAL ETHICS 9

Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.

UNIT V CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE 9

Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.

TOTAL PERIODS: 45

OUTCOMES:

CO1: Understand ethical issues in workplace and have good practices in professional duties.
CO2: Learn roles and responsibilities in professional career as a team worker
CO3: Understand the legal aspects in Indian constitutional for protection of societal values
CO4: Analyze the economical development by industry with importance to environment protection.
CO5: Understand need of good Governance in a corporate with ethical organizational behavior.

TEXT BOOKS:

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc., 2011
3. VVRobert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.

REFERENCE BOOKS:

5. VW.H. Shaw, Business Ethics, Cengage Learning, 2007.
6. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.
7. Philip Kotler and Nancy Lee, Corporate social responsibility: doing the most good for company and your cause, Wiley, 2005.
8. Subhabrata Bobby Banerjee, Corporate social responsibility: the good, the bad and the ugly, Edward Elgar Publishing, 2007.
9. Satheesh kumar, Corporate governance, Oxford University, Press, 2010.
10. Bob Tricker, Corporate governance- Principles, policies and practices, Oxford University Press, 2009
11. Larue Tone Hosmer and Richard D., The Ethics of Management, Irwin Inc., 1995.
12. Joseph A. Petrick and John F. Quinn, Management Ethics - integrity at work, Sage, 1997.

CO – PO MAPPING

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1								3	1	1		2
CO2								3	1	1		2
CO3						3	2	3	1	1		2
CO4							2	3	1	1	3	2
CO5								3	1	1	2	2

PROFESSIONAL ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2521	INFORMATION THEORY AND CODING	3	0	0	3

PREAMBLE

Information theory and coding are the two load-bearing pillars of modern digital communication systems. Its purpose is to determine the ultimate data compression and ultimate transmission rate, when transferring the information from one end to the other. It is a subset of communication theory. This course finds applications in a variety of fields like economics, probability, Computer Science and Physics.

OBJECTIVES

- To know the basic principles and understanding of information measure and channel.
- To gain the conceptual understanding of various source coding techniques.
- To develop an understanding of Rate distortion theory and Scalar Quantization

UNIT I INFORMATION MEASURE 9

Introduction to information theory – Definition of information measure and entropy – Entropy, relative entropy and mutual Information – Properties of joint and conditional information measures a-Markov source - Problem solving in entropy.

UNIT II INTRODUCTION TO SOURCE CODING 9

Block code and its properties – Instantaneous code and its properties – Non Singular codes, Prefix codes, Uniquely Decodable codes, Kraft-McMillan Equality and compact codes – Shannon's first theorem. Coding Strategies, Huffman Coding and Proof of its Optimality.

UNIT III CODING TECHNIQUES 9

Source coding techniques: Non- Binary Huffman Code, Golomb codes, Tunstell codes, Adaptive Huffman Coding, Shannon- Fano – Elias Coding, Arithmetic code – Lempel Ziv code,

.

UNIT IV INFORMATION CHANNEL 9

Introduction to information channel –Properties of Different Information Channel – Reduction of Information Channel- Introduction to Channel capacity – Binary symmetric channel – Binary erasure channel, Calculation of channel capacity for different information channel – Z channel, Noisy Channel, Noiseless Channel, Typewriter Channel, Uniform channel.

UNIT V RATE DISTORTION THEORY 9

Introduction to Rate-Distortion Theory – Definition and Properties of Rate-Distortion Functions, Calculation of Rate-Distortion Functions, Introduction to quantization – Lloyd-Max Quantizer, Companded Quantization.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Measure the performance of the information over a channel.
CO2: Design and implement various coding techniques in communication systems.
CO3: Analyze the information capacity of different types of channel

CO4: Analyze the Rate Distortion functions and features of different Quantizers.

TEXTBOOKS:

1. Cover T M and Thomas J A, Elements of Information Theory, John Wiley & Sons, 1991. (Unit – I & II, IV & V)
2. Khalid Syaood, Introduction to Data Compression, Elsevier, 2012. (Unit III & V)

REFERENCE BOOKS:

1. Yeung R W, A First Course in Information Theory, Kluwer Academic, 2002.
2. Ranjan Bose, ITC and Cryptography, Tata Mc Graw Hill Company, Second Edition, 2007.
3. Muralidhar Kulkarni and Shivaprakasha K.S, Information Theory and Coding, Wiley India Pvt. Ltd, 2015.
4. Morelos-Zaragoza R H, The Art of Error Correcting Coding, John Wiley & Sons, 2006.
5. Sklar B, Digital Communication Fundamentals and Applications, Pearson Education, Second Edition, 2009

CO – PO AND PSO MAPPING

.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	1						1	2	2	2
CO2	3	3	2	2	2	1						1	2	3	2
CO3	3	3	3	2	2	1						1	2	3	2
CO4	3	3	1	2	2							1	2	2	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2522	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3

PREAMBLE

Advanced digital signal processing course begin with an introduction to discrete time random process and includes theoretical and design aspects of spectrum estimation, linear prediction and adaptive filtering techniques. This course also introduces compressed sensing used for signal processing applications This course require the knowledge of discrete time signals, systems and signal processing as a prerequisite.

OBJECTIVES

- To introduce the basics of discrete time random signal processing
- To learn the concept of signal modeling, estimation and prediction theory
- To know about linear and adaptive filtering and its applications
- To understand the spectrum estimation techniques
- To learn the concepts of compressed sensing

UNIT I DISCRETE TIME RANDOM PROCESSES 9

Review of Discrete Stochastic Processes - Stationary processes, Autocorrelation, Autocovariance, Parseval's theorem, Wiener-Khinchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes.

UNIT II SPECTRAL ESTIMATION 9

Nonparametric methods of spectrum estimation - Periodogram, Modified periodogram, Bartlett, Welch and Blackman Tukey methods, Performance Comparison, Parametric methods - Special types of Random Processes – MA, AR, ARMA – Yule-Walker equations and spectral estimation.

UNIT III SIGNAL MODELING AND LINEAR PREDICTION 9

Least square method, Prony's pole-zero model – Prony's all pole model, Iterative Prefiltering, Finite Data Records – Linear Prediction of Signals -The Autocorrelation and Covariance Method, Levinson Durbin Algorithm, Forward and Backward Predictions.

UNIT IV OPTIMUM FILTERS 9

Linear Minimum Mean - Square Error (LMMSE) Filtering, Wiener Hopf Equation, FIR Wiener filter, Noise Cancellation Application, Causal and Noncausal IIR Wiener filter, Discrete Kalman Filter.

UNIT V COMPRESSED SENSING 9

Traditional Sampling system and its drawback- Compressed sensing process - Mathematical background- Sparse filtering - Signal Representation: Basis vectors -Restricted Isometric Property- Coherence- Stable recovery- Number of measurements- Sensing matrix-Sparse Recovery Algorithms: Basis Pursuit algorithm- L1 minimization- Matching pursuit- Orthogonal Matching Pursuit (OMP).

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Acquire knowledge on power spectral density and apply to discrete time random signals and systems
CO2: Analyze non-parametric and parametric methods for spectrum estimation
CO3: Analyze signal modelling techniques to discrete time random process
CO4: Apply linear estimation and prediction techniques to discrete random signals for signal separation, detection and estimation
CO5: Apply optimum filtering techniques for discrete random signals
CO6: Apply the concepts of compressed sensing for signal processing applications

TEXT BOOKS:

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc, Singapore, 2002D.Roody, J.Coolen, ―Electronic Communications, PHI, Fourth Edition, 2006. (Unit I to IV)
2. Radha Sankararajan, Hemalatha Rajendran and Aasha Nandhini Sukumaran, Compressive Sensing for Wireless Communication: Challenges and Opportunities, River Publications, 2016. (Unit V)

REFERENCE BOOKS:

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson Education India; Fourth Edition, 2007.
2. Sanjit K. Mitra, Fundamentals Digital Signal Processing: A Computer - Based Approach, McGraw Hill Education, 2013.
3. Dimitris G. Manolakis and Vinay K.Ingle, Applied Digital Signal Processing, Cambridge University Press, 2011.
4. John G. Proakis, Charles Rader, Fuyun Ling Marc.S.Moonen, Ian Proudler and C.L.Nikias, Algorithms for Statistical Signal Processing, Prentice Hall, First Edition, 2002.
5. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Fourth Edition, 2017.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3										1		3	
CO2	3	3		3	3							1		3	1
CO3	3	3										1		3	1
CO4	3	3										1		3	1
CO5	3	2										1		3	1
CO6	3	3		3	3							1		3	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2523	COMPUTER ARCHITECTURE AND ORGANIZATION	3	0	0	3

OBJECTIVES:

- To learn the basic structure and operations of a computer
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit
- To learn the basics of pipelined execution
- To understand the memory hierarchies, cache and virtual memories and communication with I/O devices
- To understand parallelism and multi-core processors.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance; Instructions: Language of the computer – Operations, Operands – Instruction representation; Logical operations – Decision making; MIPS addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and subtraction; Multiplication; Division; Floating Point Representation: Floating point operations.

UNIT III PROCESSOR AND CONTROL UNIT 9

A Basic MIPS implementation: Building a datapath – Control implementation scheme; Pipelining: Pipelined datapath and control – Handling data hazards & Control hazards – Exceptions – Issues in predictive branching: Spectre and Meltdown.

UNIT IV MEMORY & I/O SYSTEMS 9

Memory Hierarchy; Memory technologies; Cache Memory: Basics and cache mapping techniques; Measuring and improving cache performance; Virtual Memory: TLBs; Accessing I/O devices – Interrupts; Direct memory access; Bus structure – Bus operation – Arbitration; Interface circuits; USB.

UNIT V PARALLEL PROCESSORS 9

Parallel processing challenges; Flynn's classification: SISD – MIMD – SIMD – SPMD and Vector Architectures; Hardware multithreading; Multi-core processors and other shared memory multiprocessors; Introduction to Graphics Processing Units.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Explain the basics structure of computers, operations and instructions (K2).
CO2: Design arithmetic and logic unit (K3).
CO3: Explain pipelined execution and design its control unit (K3)
CO4: Design of various memory systems and understand I/O communication (K3)
CO5: Explain parallel processing architectures (K2)
CO6: Design a multi-functional ALU as per the requirement in teams by applying best practices of system design (K3)

TEXT BOOKS:

1. David A Patterson, John L Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, Computer Organization and Embedded Systems, 6th Edition, Tata McGraw Hill, 2012.

REFERENCE BOOKS:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, 8th Edition, Pearson Education, 2010.
2. John P Hayes, Computer Architecture and Organization, 3rd Edition, Tata McGraw Hill, 2012.
3. John L Hennessey, David A Patterson, Architecture – A Quantitative Approach, 5th edition, Morgan Kaufmann, Elsevier, 2012 (Units I, III).
4. Morris Mano M, Computer System Architecture, Revised 3rd Edition, Pearson Publication, 2017.
5. Chakraborty P, Computer Architecture and Organization, JAICO Publishing House, 2010.
6. https://www.techrepublic.com/article/spectre-and-meltdown-explained-a-comprehensive-guide-for-professionals/

7. https://arxiv.org/pdf/1807.07940.pdf (Spectre Attack)
8. https://meltdownattack.com/meltdown.pdf.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2										2		
CO2	2	3	3	1								1	2		
CO3	2	2	3										2		
CO4	2	2	3										2		
CO5	2	3	2										2		
CO6	2	3	3	1	2			1	2	2		1	2		

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2524	MEMS AND NEMS	3	0	0	3

PREAMBLE

The MEMS and NEMS market has been tremendously developing in the device fabrication. The corresponding technology has quickly spread across various scales of application. A variety of MEMS/NEMS devices have been developed and some of them including accelerometers, pressure sensors, gyroscopes, microphones, and optical mirror displays have been proven commercially successful. This course provides the knowledge about MEMS and NEMS concepts, fabrication, devices, and its packaging.

OBJECTIVES

- To understand the concepts of micro electromechanical devices and quantum mechanics
- To learn the fabrication process of Microsystems.
- To understand the design concepts of micro sensors and micro actuators.
- To understand the packaging and characterization of MEMS/NEMS

UNIT I INTRODUCTION TO MEMS AND NEMS 9

MEMS and Microsystem, Microsystem and microelectronics, Applications of MEMS, Materials for MEMS: Silicon, silicon compounds, polymers, metals.
Introduction to NEMS, Nano scaling, classification of nano structured materials, Applications of nanomaterials.

UNIT II FABRICATION OF MEMS AND NEMS 9

Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching; Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

UNIT III MICRO AND NANO SENSORS 9

Acoustic sensor – Quartz crystal microbalance, Surface acoustic wave, Flexural plate wave, shear horizontal; Vibratory gyroscope, Pressure sensors, Quantum well infrared photodetectors.

UNIT IV MICRO AND NANO ACTUATORS 9

Electrostatic actuators, piezoelectric actuators, Thermal actuators, Actuators using shape memory alloys, Microgrippers, Micromotors, Microvalves, Micropumps.

UNIT V PACKAGING AND CHARACTERIZATION OF MEMS AND NEMS 9

Micro / nano systems packaging, Essential packaging technologies, Selection of packaging materials; Nano material characterization - XRD, SEM, TEM, AFM, STM.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Familiarize the basics of micro/nano electromechanical structures, devices and systems including their theoretical foundations, applications and advantages
CO2: Recognize the use of materials in micro/nano fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA
CO3: Analyze the key performance aspects of micro/nano electromechanical transducers including sensors and actuators
CO4: Explore the techniques for characterization and packaging requirements of MEMS/NEMS

TEXT BOOKS:

1. Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002. (Unit I to V)
2. Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013. (Unit I, III & V)

REFERENCE BOOKS:

1. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002
2. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006
3. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press, 2012.
4. Mahalik N P, MEMS, Tata McGraw Hill, 2007.
5. Manouchehr E Motamedi, MOEMS: Micro-Opto-Electro-Mechanical Systems, SPIE press, First Edition, 2005.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1	1	2	1		1			1	3	2	2
CO2	1	1	3	3	1									1	2
CO3	3	3	3	2	3	2	2		1	1		1	3	2	2
CO4	1	2	3	1	2					1		1	1		2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2621	INTRODUCTION TO RADAR AND SATELLITE COMMUNICATION	3	0	0	3

PREAMBLE

Radar and satellite communication play a vital role in the fields of space communication, telephone and GPS systems etc., The processing and analysis of radar and satellite signals are essential for processing and application. The various types of radar and segments of satellite systems and their performance are important. This course provides the basic knowledge required for fundamentals of radar and satellite systems.

OBJECTIVES

- To understand the operation of radar systems for a variety of applications
- To learn various types of radars and their principles of operation.
- To Study the satellite orbits and earth segments in satellite communication
- To understand the space segment of satellite system
- To understand various multiple access schemes in satellite and its applications

UNIT I PRINCIPLES OF RADAR AND RADAR EQUATION 9

Nature of Radar - Simple form of Radar Equation, Radar Operation, Radar Frequencies and Applications. Radar Equation - Minimum Detectable Signal, Receiver Noise, SNR, Envelope Detector — Integration of Radar Pulses, Radar Cross Section of Targets Transmitter Power, PRF and Range Ambiguities, System Losses.

UNIT II TYPES OF RADAR SYSTEMS 9

Doppler Effect, CW Radar — Block Diagram, Applications of CW radar, FM-CW Radar -Range and Doppler Measurement, Block Diagram and Characteristics, Block diagram of MTI and Pulse Doppler radar, Tracking Radar - Monopulse Tracking Radar — Amplitude Comparison Monopulse, Phase Comparison Monopulse. Comparison of trackers, tracking with Surveillance radar.

UNIT III SATELLITE ORBITS AND EARTH SEGMENT 9

Kepler's Laws, Newton's Law, Orbital parameters, Satellite orbits – Low earth, Medium earth, High earth Orbits, polar, inclined , geosynchronous orbits, Transfer Orbit. Earth Segment - Receiver only home TV system, Master antenna TV system, Community Antenna TV system, Transmit – Receiver earth station,

UNIT IV SPACE SEGMENT 9

Power Supply, Altitude Control – Spinning Satellite stabilization and momentum wheel stabilization, Station keeping, thermal control, TTC subsystems, Transponders – the wideband receiver, input demultiplexer, power amplifier, , Antenna subsystem, Advanced Tiros – N Spacecraft.

UNIT V SATELLITE ACCESS AND ITS APPLICATIONS 9

Satellite Access - Single Access, Pre and demand assigned FDMA, SPADE system, TDMA, Pre and demand assigned TDMA, Satellite switched TDMA, CDMA, Satellite Applications - INTELSAT Series, INSAT, VSAT, GPS, Global Navigation Satellite Systems - Basic concepts of GPS. GPS constellation, Interdisciplinary application.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Acquire knowledge on the fundamentals of radar systems.
CO2: Analyse various types of radars and its operational functions.
CO3: Acquire knowledge on the fundamentals of satellite orbits and earth segment
CO4: Interpret the multiple access schemes for satellite communication.

TEXTBOOKS:

1. Merrill L Skolnik, Introduction to Radar Systems, TMH Special Indian Edition, Second Edition, 2007(Units I & II)
2. Dennis Roddy, Satellite Communications, McGraw-Hill International, Third Edition, 2006(Units III - V)

REFERENCE BOOKS:

1. Mark A Rkhards, James A Scheer, William A HoIm. Yesdee, Principles of Modem Radar: Basic Principles, 2013.
2. Byron Edde, Radar Principles, Technology Applications, Pearson Education, 2004.
3. Wilbur L Pritchard, Hendri G Suyderhoud, Robert A Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.
4. Madhavendra Richharia, Satellite systems for personal Applications, John Wiley and Sons, Ltd.
5. Mohinder S Grewal, Lawerence R, Weill, Angus P Andrews, Global Positioning Systems, Inertial Navigation, and Integration. 2nd Edition, A John Wiley & Sons, Inc. Publication, 2007.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2										1		2	1
CO2	3	3	3	1	3							1		1	1
CO3	2	2		1								1	1	2	1
CO4	2	2	3	1								1		3	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2622	DIGITAL IMAGE AND VIDEO PROCESSING	3	0	0	3

PREAMBLE

This course covers the fundamental concepts and principles of image and video processing. Digital images and videos find applications in the many fields such as astronomical, bio-medical, consumer, industry etc. in everyday life. The processing of image and video signals is therefore very important for software developers, and practicing engineers. Students will also get an opportunity to implement the algorithms that are specific to real time image and video processing systems/applications.

OBJECTIVES

- To mathematically present the image representation and processing concepts
- To understand the effect of image transforms
- To perform digital manipulation of images using morphology.
- To understand video segmentation process
- To understand methods of objects in video signals

UNIT I INTRODUCTION 9

Image Acquisition, Color Images -RGB, HIS, HSV YUV and YCbCr Color representations, Point Processing, Neighbourhood Processing; Image Transforms – KL, DCT, Continuous and Discrete Wavelet Transform

UNIT II GEOMETRIC TRANSFORMATIONS AND VISUAL EFFECTS 9

Affine, Translation, Scaling, Rotation, Shearing Transformations, Backward Mapping, Interpolation, Homography, Visual Effects, Visual Effects Based on Pixel Manipulation and Geometric Transformations

UNIT III MORPHOLOGY AND BLOB ANALYSIS 9

Hit and Fit, Dilation and Erosion, Closing and Opening operations, Boundary Detection, BLOB Extraction: The Recursive and Sequential Grass-Fire Algorithm, BLOB Features, BLOB Classification

UNIT IV IMAGE AND VIDEO COMPRESSION 9

Image Compression in the Transform Domain, JPEG, Zero -tree Coding, JPEG 2000, Basics of Video compression: MPEG -1, MPEG -2, MPEG -7, and H.264 standards.

UNIT V VIDEO SEGMENTATION AND TRACKING 9

Video Acquisition, Change Detection Algorithm, Background Subtraction, Threshold Value, Image Differencing Tracking-by-Detection, Prediction, Tracking Multiple Objects, Applications of Video Processing Systems - Edutainment Game, Coin Sorting Using a Robot.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Extract images for better understanding of the color information
CO2: Apply transformation on images to develop further understanding
CO3: Apply morphology techniques and BLOB detection
CO4: Apply algorithms for segmentation in video
CO5: Solve object tracking in video

TEXT BOOKS:

1. T.B. Moeslund, Introduction to Video and Image Processing, Springer-Verlag, 2012 (Unit I - III and Unit V)
2. K. S. Thyagarajan, Still image and video compression with MATLABORATORY, John Wiley & Sons, Inc.2011. (Unit I and Unit -IV)

REFERENCE BOOKS:

1. Yao wang, Joem Ostarmann and Yaquin Zhang, Video processing and communication, PHI, First Edition.
2. Alberto S. Aguado and Mark S. Nixon, Feature extraction and image processing,Academic Press, Third Edition, 2012.
3. Ranjan Parekh, Fundamentals of IMAGE, AUDIO, and VIDEO PROCESSING Using MATLABORATORY® With Applications To Pattern Recognition, CRC Press, 2021
4. Rama Chellappa, Sergios Theodoridis, Image and Video Processing and Analysis and Computer Vision Academic Press Library in Signal Processing, Volume 6,2017

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1								1	3	2	1
CO2	2	2	1	2								1	3	2	1
CO3	1	2	1	1								1	3	2	1
CO4	1	2	1	1								1	3	2	1
CO5	2	2	1	2								1	3	2	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2623	ADVANCED MICROCONTROLLERS	3	0	0	3

PREAMBLE

Design and development of application specific-electronic systems requires deeper understandings of architectures of various embedded processors. The efficient choice of processor can be done with the exploration of the salient features of the processors. This course provides the basic understanding of the different kinds of embedded processors and its architectural features.

OBJECTIVES

- To familiarize the features, specification of RISC architectures
- To gain knowledge on the enriched instruction set of ARM processor
- To familiarize the features, specification of modern microcontrollers
- To gain knowledge on the 32 bit microcontrollers based ARM architectures

UNIT I RISC ARCHITECTURES 9

Evolution of Embedded Architectures – CISC vs RISC – The RISC Design Philosophy – The ARM Design Philosophy – Embedded system hardware – Embedded system software, ARM processor fundamentals – Registers – CPSR – Pipeline - Exceptions, Interrupts and the Vector table – Core Extensions – Architecture Revisions – ARM processor families.

UNIT II ARM INSTRUCTION SET 9

Data processing instructions – Branch Instructions – Load-store instructions – Software interrupt instruction – Program status register instructions – Loading constants – Conditional execution, THUMB register usage – ARM-Thumb interworking – Data processing instructions – Load-store instructions – Stack instructions – Software interrupt instruction.

UNIT III ARM CORTEX PROCESSORS 9

Introduction to the Cortex-M Processor Family - ARM 'Cortex-M3' architecture for microcontrollers – Thumb 2 instruction technology – Internal Registers - Nested Vectored Interrupt controller - Memory map - Interrupts and exception handling – Applications of Cortex- M3 architecture

UNIT IV ARM CORTEX IMPLEMENTATION 9

The pipeline – Detailed block diagram – Bus interfaces- Other interface – The External PPB – Reset types and Reset signals, Cortex-M3 Programming – Overview – A Typical development flow – Using C – CMSIS –Using Assembly – Using Exclusive Access for semaphores – Using bit band for semaphores

UNIT V MSP430 MICROCONTROLLERS 9

Functional Block diagram of MSP430F2003 - Memory Mapped CPU, Exceptions, Architecture of MSP430 - Processor Addressing Modes - Instruction Set, Interrupts, Digital in-outs, Timer, Communication interfaces.

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Summarize the key features of RISC architecture
CO2 : Comprehend the enriched instruction set of ARM processor
CO3 : Summarize the architectural features of ARM Cortex M processor
CO4 : Implement the salient features of ARM Cortex M Processor in embedded system design and development
CO5 : Summarize the architectural features of MSP 430 Microcontrollers

TEXT BOOKS:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM system Developer's Guide, Designing and optimizing system software, Morgan Kaufmann Publishers, 2004. (UNIT-I, II)
2. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3, Newnes, 2010. (UNIT-III, IV)

REFERENCE BOOKS:

1. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008. (UNIT-V)
2. Steve Furber, ARM System – On – Chip architecture, Addision Wesley, 2000
3. Yifeng Zhu, Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC; 3rd edition, July 2017.
4. Trevor Martin, The Designers Guide to the Cortex-M Processor Family, Newnes,2013.
5. Manuel Jimenez, Rogelio Palomera and Isidoro Convertier, Introduction to Embedded systems using Microcontrollers and the MSP430, Springer 2014.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3		2	2									2		
CO2	3	2	2	2										2	
CO3	3	2	2	2								2			3
CO4	3		2	2									2		
CO5	3	2	2	2								2		2	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2624	NANOELECTRONICS	3	0	0	3

PREAMBLE: Nano electronics plays an important role in miniaturization of electronic devices. It is the emerging area of electronics dealing with nanometer sized devices used for electronic circuits and systems. Nano electronics is the most advanced of the Nanotechnologies and products using the Nano electronics are appearing in the market. It provides ultra-low power consumption with increased features and functionalities. Current technology developments hugely support the fabrication and testing of Nano devices.

OBJECTIVES

- To understand the concepts of Nano electronics
- To know the basics of quantum electronics.
- To know the basic concepts of Nano electronics transistors, tunneling devices and superconducting devices.
- To understand the basics of nanotube devices.

UNIT I ELECTRONICS TO NANO ELECTRONICS 9

Scaling to nano-Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics-General postulates of quantum mechanics-Time independent Schrodinger wave equation- Electron confinement-Quantum dots, wires and well-Spin and angular momentum-Wave packets and uncertainty.

UNIT II QUANTUM ELECTRONIC DEVICES 9

Quantum electronic devices-Short channel MOS transistor-Split gate transistor-Electron wave transistor-Electron wave transistor- Electron spin transistor-Quantum cellular automata-Quantum dot array.

UNIT III NANO ELECTRONIC TRANSISTORS 9

Coulomb blockade-Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions-Single electron transistors, Logic and memory circuits, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics-

UNIT IV NANO ELECTRONIC TUNNELING AND SUPERCONDUCTING DEVICES 9

Tunnel effect-Tunneling element-Tunneling diode-Resonant tunneling diode-Three terminal resonant tunneling devices- Digital circuit design based on RTDs- Superconducting switching devices- Cryotron- Josephson tunneling device.

UNIT V BIOELECTRONICS AND MOLECULAR ELECTRONICS 9

Bioelectronics, DNA Analyzer as Biochip, Molecular Electronics, Carbon Nanotubes- Fullerenes, Switches based on Fullerenes and Nanotubes, Polymer Electronic, Self-Assembling Circuits ,Optical Molecular Memories

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Familiarize the basics of nano electronics including quantum wires, dots and wells.
CO2: Comprehend the mechanism behind quantum electronic devices.
CO3: Analyze the key performance aspects of tunneling and superconducting nano electronic devices.
CO4: Explore the development of nanotubes and nanostructure devices.

TEXT BOOKS:

1. Hanson, "Fundamentals of Nanoelectronics", Pearson education, 2009. (Unit I & III)
2. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices", Springer-Verlag, 2004. (Unit II, IV & V)

REFERENCE BOOKS:

1. Mircea Dragoman, Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.
2. Robert Puers, Livio Baldi, Marcel Van de Voorde, Sebastiaan E. van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
3. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018.
4. S. Datta,Lessons from Nanoelectronics: A New Perspective on Transport (Lessons from Nanoscience: a Lecture Notes Series) World Scientific, 2012
5. V. Mitin, V. Kochelap, and M. Stroscio, Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications, Cambridge University Press, 2008.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	0	0	0	0	0	1	1	0	1	0	1	1	2
CO2	3	2	2	3	0	3	0	1	1	0	1	0	2	1	3
CO3	3	2	2	3	0	3	0	1	2	0	0	0	2	1	3
CO4	3	3	2	3	1	2	1	1	1	0	1	1	3	1	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2721	UNDERWATER ACOUSTIC SYSTEM	3	0	0	3

PREAMBLE

Underwater Communication plays a vital role in the fields of communication in ocean/sea like signal transmission in space. Signals are mostly acoustic based in nature and hence good understanding about the acoustic communication is essential. Various types of noises that affect the signal in the ocean and the sensors used for recording underwater signals are essential to study. This course provides the basic knowledge required for further processing and analysis of signals and systems for any application in underwater.

OBJECTIVES

- To understand the properties of underwater acoustic signal
- To understand the characteristics of noises in the sea
- To understand the principles of SONAR and acoustic modem
- To understand the challenges in underwater signal processing and sensor networks

UNIT I FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

The Ocean acoustic environment, measuring sound level, Sources and receivers, relevant units, sound velocity in seawater, typical vertical profiles of sound velocity, Sound propagation in the Ocean, Sound attenuation in seawater, Bottom loss, Surface bottom and volume scattering, Snell's law for range dependent ocean.

UNIT II AMBIENT NOISE IN THE SEA 9

Sources of ambient noise-introduction, different frequency bands of ambient noise, spatial coherence of ambient noise, directional characteristics of ambient noise, intermittent sources of noise- biological & non biological - rain, earthquakes, explosions and volcanoes.

UNIT III CHARACTERISTICS OF SONAR SYSTEMS 9

Sonar systems, active and passive sonar equations, transducers and their directivities, Sensor array characteristics-array gain, receiving directivity index, beam patterns, adaptive beamforming.

UNIT IV ADAPTIVE SIGNAL PROCESSING 9

Adaptive Systems, Open Loop and Closed loop Adaptations, Adaptive Linear Combiner, Adaptive Algorithms and Structures, Acoustic Modem.

UNIT V UNDERWATER SENSOR NETWORK 9

Underwater Networking- Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, challenges in design of Underwater Sensor Networks, Factors that affect the UWSN.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Summarize the properties of underwater acoustic signal.
CO2: Analyze the characteristics of noises in the sea.
CO3: Apply the principles of SONAR and acoustic modem

CO4: Acquire knowledge on the challenges in underwater signal processing and sensor networks.

TEXT BOOKS:

1. Robert J Urick, Principles of Underwater Sound, Peninsula Pub, Third Edition, 1983 (Unit I & II)
2. William S Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002 (Unit III & V)
3. Richard O.Nielsen, Sonar signal processing, Artech House Publishers, 1991.(Unit IV)

REFERENCE BOOKS:

1. Robert S H Istepanian and Milica Stojanovic, Underwater Acoustic Digital signal processing & communication system, Kluwer academic Publisher, 2002.
2. Robert J Urick, Ambient noise in the sea, Peninsula Pub, Second Edition, 1986.
3. William S Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002.
4. Clay Medwin, Acoustical Oceanography: Principles and Applications, Physics Today, 1978.
5. Brekhovskikh L M and Lysanov Yu P, Fundamentals of ocean acoustics, Springer, Third Edition, 2003.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2									1	2	1	3
CO2	3	3	2		3		3					1	2	1	2
CO3	3	2	2										2	2	2
CO4	2	3										1	1	3	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2722	SPEECH TECHNOLOGY	3	0	0	3

PREAMBLE

The course "Speech Technology" offers a practical and theoretical understanding of how human speech can be processed by computers. It covers mathematical foundations required for speech signal processing, speech recognition and speech synthesis. The course involves practical implementations in the form of assignments, where the student will analyze his or her own voice, build working speech recognition systems, and build their own synthetic voice. These analyses and system building will be based on existing toolkits. Details of algorithms, techniques and limitations of state of the art speech systems will be presented during the course. This course will help students apply statistical and machine learning techniques on speech technology while understanding their limitations.

Prerequisites for this course are fundamental knowledge on digital signal processing, and exposure to fundamental concepts of probability theory.

OBJECTIVES

- Learn the fundamentals of speech processing
- Introduce various features required to build speech-based systems
- Understand statistical modeling techniques and its application in building speech-based systems.

UNIT I BASIC CONCEPTS 9

Articulatory phonetics - production and classification of speech sounds; Acoustic phonetics – Acoustics of speech production, discrete time model of speech. Speech perception - human auditory system. Short-time Fourier transform, spectrogram, pitch and formant estimation using cepstrum. Linear prediction – basic concepts, pitch and formant estimation using linear prediction.

UNIT II FEATURE EXTRACTION 9

Fundamentals of pattern recognition and significance of feature selection. Feature Extraction - MFCC, LPCC and PLP. Speech distortion measures– mathematical and perceptual – Log–spectral distance, cepstral distances, likelihood distortions. Time alignment and normalization–- dynamic time warping.

UNIT III SPEECH MODELING 9

Statistical modeling of speech - Gaussian mixture modeling, Hidden Markov models - Markov processes. HMMs - probability evaluation, optimal state sequence - Viterbi search, Baum-Welch parameter re-estimation.

UNIT IV SPEECH AND SPEAKER RECOGNITION SYSTEMS 9

Large Vocabulary Continuous Speech Recognition: subword speech units, sub-word unit models, training of sub-word units, language models - n-gram statistics. Speaker recognition - speaker identification and verification. Applications and current status.

UNIT V TEXT-TO-SPEECH SYNTHESIS 9

Text-to-speech synthesis: Text and phonetic analysis, role of prosody in TTS, concatenative and waveform synthesis, prosody modification of speech - PSOLA. HMM-based text-to-speech synthesis. Evaluation of TTS systems - quality and intelligibility.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Model speech production system and describe the fundamentals of speech.
CO2: Extract and compare various speech features
CO3: Choose an appropriate statistical speech model for a given application.
CO4: Build a speech and speaker recognition system.
CO5: Build a text-to-speech synthesis system.

TEXT BOOKS:

1. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003 (Unit I to IV).
2. Huang X., Acero A. and Hon H. W., Spoken language processing- a guide to theory, algorithm and system development, Prentice Hall, 2001 (Unit V)

REFERENCE BOOKS:

1. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson, 2012.

2. Rabiner L. R. and Schafer R. W., Digital Processing of speech signals, Pearson Education, 2004.
3. Douglas O'shaughnessy, Speech communications: Human and Machine, Wiley-IEEE Press, 2000.
4. Shrikanth Narayanan, Text to speech synthesis: new paradigms and advances, Prentice hall, 2005.
5. Daniel Jurafsky and James H. Martin., Speech and Language Processing (2nd Edition), 2009, Prentice-Hall, Inc., USA

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3				3				2					2	
CO2	3				3				2					2	
CO3	3			3	3										
CO4	3			3	3				3			3		3	3
CO5	3			3	3				3			3		3	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2723	EMBEDDED AND REAL TIME OPERATING SYSTEMS	3	0	0	3

PREAMBLE

Embedded and Real time systems have dominated the technology trend in a variety of applications. Most systems in real life are Cyber Physical systems which require a deeper understanding of control and computing which are prevalent in Embedded Systems. This course offers the fundamental concepts and understanding of the design of Embedded Systems

OBJECTIVES

- To understand the concepts of embedded system design and analysis
- To learn the architecture and programming of ARM processor
- To be exposed to the basic concepts of embedded programming
- Learn about real time operating systems

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Complex systems and microprocessors– Embedded system design process –UML overview-Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques - Designing with computing platforms – platform-level performance analysis.

UNIT II ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

UNIT III EMBEDDED PROGRAMMING **9**

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT IV REAL TIME OPERATING SYSTEMS **9**

Preemptive real-time operating systems- Task Assignment and Scheduling - Priority based scheduling—RM and EDF scheduling- Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE- – Fault Tolerance techniques – Reliability, Evaluation

UNIT V NETWORKS AND MULTIPROCESSORS **9**

Multiple tasks and multiple processes – Multirate systems - Interprocess communication mechanisms - Distributed embedded systems –CAN Bus-I^2C Bus- MPSoCs and shared memory multiprocessors. – Design Example – Engine Control Unit- Video accelerator.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Use the concepts of embedded computing for system design
CO2: Describe the architecture and programming of ARM processor
CO3: Develop and optimize software for embedded systems
CO4: Analyze the concepts of real time Operating system design
CO5: Realize the applications of Distributed Embedded Systems

TEXT BOOKS:

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (Unit I to III, V)
2. Jane W.S.Liu, Real Time Systems‖, Pearson Education, Third Indian Reprint, 003. (Unit IV)

REFERENCE BOOKS:

1. Lyla B.Das, ―Embedded Systems : An Integrated Approach Pearson Education, 2013.
2. Jonathan W.Valvano, ―Embedded Microcomputer Systems Real Time Interfacing, Third Edition Cengage Learning, 2012.
3. David. E. Simon, ―An Embedded Software Primer, 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
4. Raymond J.A. Buhr, Donald L.Bailey, ―An Introduction to Real-Time Systems- From Design to Networking with C/C++, Prentice Hall, 1999.
5. C.M. Krishna, Kang G. Shin, ―Real-Time Systems, International Editions, McGrawHill, 1997

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	3	2		2	1		2	1	2	2	2		1
CO2			1	3	3										2
CO3	2	1	2	2	3	1	1	1			1	1	2		1
CO4	1	1	2	2	2	1	2	1			1	2	2	1	1
CO5	3	2	2	2	2	1	1	1			2	2	3	2	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2724	MIC AND RF SYSTEMS DESIGN	3	0	0	3

PREAMBLE

This is an advanced course on electromagnetics with a particular interest in the design and analysis of components that work at radio frequency and microwave bands. The prerequisite for this course is electromagnetic fields. The course provides a broad overview of component integration and system development at microwave frequency range.

OBJECTIVES

- To study the fundamentals of scattering parameters
- To understand the concepts of microwave filter and amplifier design
- To familiarize the design aspects of oscillators and mixers
- To study the various microwave systems

UNIT I POWER DIVIDERS AND COUPLERS 9

The Scattering Matrix - Basic Properties of Dividers and Couplers - Wilkinson Power Divider - Waveguide Directional Coupler - The Quadrature Hybrid - Coupled Line Directional Coupler - The Lange Coupler - The 180˚ Hybrid.

UNIT II MICROWAVE FILTERS 9

Periodic Structures - Filter Design by Insertion Loss Method, Filter Transformations - Filter Implementation - Stepped Impedance Low Pass Filter - Coupled Line Band Pass Filter.

UNIT III MICROWAVE AMPLIFIER DESIGN 9

Two port power gains - Stability - Single Stage Transistor Amplifier Design - Design for maximum gain, Design for specified gain, Low-Noise Amplifier Design - Power Amplifiers.

UNIT IV OSCILLATORS AND MIXERS 9

RF Oscillators – Microwave Oscillators – Oscillator Phase Noise –Mixers: Characteristics, Single Ended and Balanced Mixers.

UNIT V MICROWAVE SYSTEMS 9

System Aspects of Antennas – Wireless Communications – RADAR Systems, Radiometer Systems - Microwave propagation – Microwave Heating – Power Transfer – Biological Effects and Safety.

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Interpret the concepts of power divider and couplers at microwave frequencies
CO2 : Design microwave filters and amplifier elements
CO3 : Design RF and microwave oscillators and mixers
CO4 : Describe the application of microwave components in systems

TEXTBOOK:

1. David M. Pozar, Microwave Engineering, John Wiley & Sons, Fourth Edition, 2012. (Unit I to V).

REFERENCE BOOKS:

1. Jia Sheng Hong and Lancaster M J, Microstrip Filters for RF/Microwave Applications, John Wiley & Sons, Second Edition, 2011.
2. Gupta K C and Amarjit Singh, Microwave Integrated Circuits, John Wiley, New York, 1975.
3. Hoffman R K, Handbook of Microwave Integrated Circuits, Artech House, Boston, 1987.
4. Annapurna Das, Sisir K Das, Microwave Engineering, McGraw Hill Education, Third Edition, 2015.
5. Guillermo Gonzalez, Microwave Transistor Amplifiers: Analysis and Design, Second Edition, Prentice Hall, New Jersey, 1996.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1								2	2	3	
CO2	3	3	3	3								2	2	3	
CO3	3	3	3	3								2	2	3	
CO4	2	3	3	1								2	2	3	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2725	WIRELESS ADHOC AND SENSOR NETWORKS	3	0	0	3

PREAMBLE:

Wireless Ad hoc and sensor networks deal with in-depth understanding about Ad hoc and wireless sensor networks. It is one of the most essential subjects for Electronics and Communication Engineers for developing IoT enabled applications. The main topics covered are Architectures, physical layer concepts, MAC and Network layer protocols, Transport layer and security issues of Ad hoc and sensor networks. The course also gives an introduction about sensor network platforms and tools.

OBJECTIVES:

- To learn Ad Hoc network and Sensor Network fundamentals.
- To understand the different MAC and routing protocols.
- To have an in-depth knowledge on sensor network architecture, design issues and Networking concepts.
- To understand the transport layer and security issues possible in Ad Hoc and Sensor Networks.
- To have an exposure to mote programming platforms and tools

UNIT I AD HOC NETWORKS – INTRODUCTION & MAC PROTOCOLS 9

Design Issues in Ad Hoc Networks - MAC Protocols – Issues, Classifications of MAC protocols: Contention Based Protocols, Contention Based Protocols with reservation mechanisms, and Contention Based Protocols with Scheduling Mechanism – MAC protocol with Directional Antenna - Multi channel MAC & Power control MAC protocol.

UNIT II AD HOC ROUTING PROTOCOLS AND TRANSPORT LAYER 9

Issues in designing a routing protocol for Ad Hoc Wireless Networks – Classifications of routing protocols: Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), On–Demand Routing protocols – AODV, Dynamic
Source Routing (DSR), Location Aided Routing (LAR), Hierarchical – Cluster based routing protocol, Power Aware Routing (PAR), Ad Hoc Transport Layer Issues, TCP Over Ad Hoc – Feedback based, TCP with explicit link, TCP-Bus, Ad Hoc and Split TCP.

UNIT III WSN ARCHITECTURES 9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles, service interfaces and Gateway Concepts, Protocol Architecture

UNIT IV WSN NETWORKING CONCEPTS 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, and Contention based protocols - PAMAS, Schedule based Protocols – LEACH, SMACS, TRAMA, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Geographic Routing, Transport layer issues and security issues.

UNIT V SENSOR NETWORKS PLATFORM & TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, Node-level Simulators – The NS2 and its sensor network extensions, TOSSIM, Programming beyond individual nodes – State centric programming.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Identify the necessity of Ad Hoc networks and Wireless Sensor Networks
CO2: Examine the MAC issues in Ad Hoc and Wireless Sensor Networks
CO3: Describe the sensor node architecture, network and protocol architectures
CO4: Identify the suitable routing algorithm based on the network and user requirement
CO5: Analyze transport layer and security issues possible in ad hoc and sensor networks
CO6: Familiarize with the OS used in WSN and build basic modules using NesC

TEXT BOOK:

1. Siva Ram Murthy C and Manoj B S, Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004. (Unit I & II)
2. Holger Karl, Andreas Willig, Protocol and Architecture for Wireless Sensor Networks, John wiley publication, Jan 2006. (Unit III, IV & V)

REFERENCE BOOKS:

1. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: an information processing approach, Elsevier publication, 2004. (Unit V)
2. Charles E. Perkins, Ad Hoc Networking, Addison Wesley, 2000.
3. Jun Zheng and Abbas Jamalipour, Wireless Sensor Network A Networking Perspective, A John Wiley & Sons, Inc., Publication, 2009.
4. KazemSohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, A John Wiley & Sons, Inc., Publication, 2007.
5. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, Ad Hoc and Sensor Networks, Theory and Applications, World Scientific 2006.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3	1								1		1	
CO2	3	3	3	2	1							1		3	
CO3	2	2	1	1	1							1		3	
CO4	3	2	3	1	1							1		3	2
CO5	3	2	1	1								1		2	

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2726	OPTIMIZATION IN WIRELESS COMMUNICATION	3	0	0	3

PREAMBLE:

This course provides an in-depth understanding on the use of optimization techniques in wireless communications. The prerequisite for the course is basic knowledge of Linear Algebra with knowledge on wireless technologies. Recent advances in linear and nonlinear optimization facilitate progress in many areas of communications. It is a challenging technical knowledge due to various factors and constraints such as limited bandwidth and battery power, channel variability and user mobility, higher data rates, system robustness, and seamless service.

OBJECTIVES:

- To understand convex sets, functions and their representations.
- To understand the fundamentals of convex optimization.
- To apply convex optimization techniques to wireless systems
- To perform optimal beamforming using Second order cone programming and Semidefinite programming

UNIT I CONVEX SETS AND FUNCTIONS 9

Affine and Convex sets – Examples of convex sets - Convexity preserving operations, Convex functions - properties and examples - Jensen's inequality.

UNIT II CONVEX OPTIMIZATION 9

Convex Optimization Problems– Examples- Linear minimum mean-squared estimator (LMMSE) of random vectors, Dimension reduction and noise suppression, Low rank matrix approximation, optimal power assignment.

UNIT III APPLICATIONS IN TRANSMIT POWER ALLOCATION 9

Geometric, Linear and Quadratic Programming, Applications in power allocation - blind source separation, unmixing and beamformer design.

UNIT IV APPLICATIONS IN TRANSMIT BEAMFORMING 9

Robust Beamforming via SOCP, Minimum – Variance Beamformer, Transmit Beamforming via SOCP, Power Minimization, Max-Min Fair, Multicell and Femtocell Beamforming

UNIT V APPLICATIONS IN MIMO DETECTION 9

Semidefinite program: Applications in combinatorial optimization, practical Examples: ML MIMO detection and higher order QAM OSTBC detection, applications in transmit beamforming, Lagrangian Dual problem, KKT conditions.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Summarize concepts of convex sets and functions
CO2: Formulate problems in wireless Communication
CO3: Characterize solutions to convex optimization problems
CO4: Solve optimization problems in MIMO Detection and beamforming

TEXT BOOK:

1. Chong-Yung-Chi, Wei-Chiang Li, Chia-Hsiang Lin, Convex Optimization for Signal Processing and Communications: From Fundamentals to Applications, CRC Press 2017 (Unit I to V)

REFERENCE BOOKS:

1. S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, First Edition, 2009.
2. Ezio Biglieri, Robert Calderbank, Anthony Constantinides, Andrea Goldsmith, Arogyaswami Paulraj, Vincent Poor.H, MIMO Wireless Communications, Cambridge University Press, First Edition, 2007.
3. Aditya K Jaganatham, Principles of Modern Wireless Communication Systems, Tata McGraw Hill, First Edition, 2015.
4. Randy L. Haupt, Wireless Communications Systems: An Introduction Wiley-IEEE Press, 2019.
5. Kim, A, Design and optimization for 5g wireless communications, Wiley-IEEE Press, 2020

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1								1	1		
CO2	2	2	1	2								2	1	2	1
CO3	2	3	2	3								2	1	2	1
CO4	1	2	2	3								1		1	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2727	ASIC and FPGA BASED DESIGN	3	0	0	3

PREAMBLE:

This course helps the students to understand the design and implementation of VLSI circuits using various implementation methodologies. This course also provides the design and development of standard cells and a design flow for Application Specific integrated Circuit (ASIC). This course overviews the architectures of logic blocks (LB), input/output (IOB) and interconnect architectures of several FPGA and CPLD families. The FPGA based design flow and physical design of FPGA based systems are also discussed in this course.

OBJECTIVES:

- To understand the design flow of different types of ASIC.
- To learn the different types of programming elements, programmable logic blocks, programmable input-output blocks and programmable interconnects of various types FPGA/CPLDs
- To know various steps involved in ASIC implementation for specific targets.
- To comprehend various steps involved in ASIC physical design

UNIT I INTRODUCTION TO ASICS, ASIC LIBRARY DESIGN AND PROGRAMMING TECHNOLOGY 9

Introduction to ASICs: ASIC Design Flow, Types of ASIC - Full Custom, Semi-Custom – Standard Cell Based ASIC and Gate Array ASIC, Programmable ASIC – PROM, PLA, PAL, CPLD, FPGA. ASIC Cell Library Design: Combinational Logic Cell – Sequential Logic Cell - Data Path Logic Cell - Library Cell Design - Library Architecture Programming Technology**:** Antifuse, SRAM, EPROM, EEPROM, ASIC construction.

UNIT II PROGRAMMABLE ASIC LOGIC CELLS, I/O CELLS AND INTERCONNECT 9

Programmable ASIC Logic Cells: Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX, Vertex and Spartan FPGAs, Cyclone FPGAs Programmable ASIC I/O Cells: DC & AC Inputs and Outputs - Clock & Power Inputs - Xilinx I/O Blocks Programmable ASIC Interconnect: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX, Vertex and Spartan FPGAs, Cyclone FPGAs.

UNIT III LOGIC SYNTHESIS, SIMULATION & TEST 9

Logic Synthesis: Logic Synthesis – FPGA Synthesis - Verilog and Logic Synthesis -VHDL and Logic Synthesis
Simulation: Types of Simulation, Logic Simulation – Cell Models & Delay Models, Static Timing Analysis, Formal Verification, Switch Level Simulation, Transistor Level Simulation
Test: Importance of Test, Boundary Scan Test, Faults, Fault Simulation, ATPG, Scan Test, BIST

UNIT IV SYSTEM PARTITIONING, FLOORPLANNING AND PLACEMENT 9

System Partitioning: Measurement of Partitioning, Partitioning Algorithms – Constructive Partitioning, Iterative Partitioning Improvement Algorithms - K-L Algorithm, FM algorithm, Ratio-Cut Algorithm, Look-Ahead Algorithm, Simulated Annealing, FPGA Partitioning, Power Dissipation. Floor planning and Placement: Floor Planning Measurement and tools, I/O, Power and clock planning, Measurement of Placement, Placement Algorithms – Min-cut Placement, Eigen Value Placement, Iterative Placement Improvement and Timing Driven Placement Algorithms.

UNIT V ROUTING AND CIRCUIT EXTRACTION 9

Routing and Circuit Extraction: Global Routing Measurement – Measurement of Interconnect Delay using Elmore‟s constant, Global routing for CBIC and GA, Detailed Routing Measurement - Measurement of Channel Density, Detailed routing Algorithms – LEA, Lee Maze and High tower Algorithms, Circuit extraction process, Layout Design Rules and Technology related issues.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Explain the features of ASIC Design and various implementation methods of ASIC Design

CO2: Apply design concepts to construct the logic cells and programmable elements.

CO3: Describe the architectures of programmable logic block, programmable input-output Block and programmable interconnect of Xilinx, Altera and Actel FPGA/CPLD.

CO4: Apply the concepts of logic synthesis to implement an ASIC Design for a specific target.

CO5: Analyze performance of the ASIC using the concepts of simulation, verification and testing.

TEXT BOOKS:

1. Michael John Sebastian Smith, Applications Specific Integrated Circuits, Pearson Education, Ninth Indian Reprint, 13th Edition, 2004 (UNIT I - V)

REFERENCE BOOKS:

1. Trimberger S, Edr. Field Programmable Gate Array Technology, Kluwer Academic Publishers, 1994.
2. Old Field J, Dorf, R, Field Programmable Gate Arrays, John Wiley& Sons, New York, 1995.
3. Chan P.K, & Mourad S, Digital Design using Field Programmable Gate Array, Prentice Hall, 1994.
4. Sherwani N A, Algorithms for VLSI Physical Design Automation, Kluwer Academic, Publishers, 2002.
5. Gerez, H, Algorithms for VLSI Design Automation, John Wiley, 1999.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1					2		2	3		2
CO2	3	3	3	3	1					2		2	3		2
CO3	3	3	3	3	1					2		2	3		2
CO4	3	3	3	3	1					2		2	3		2
CO5	3	3	3	3	3					2		2	3		2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2728	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	3	0	0	3

PREAMBLE:

Electromagnetic compatibility (EMC) refers to the ability of electrical equipment to operate satisfactorily when exposed to electromagnetic interference (EMI). Especially in the development of embedded systems, EMI is a major problem. Students undertaking this course will develop a broad understanding of the various aspects of EMC, including standards, measurements and testing and considerations in wireless and broadband technologies. They will also learn interference control techniques, with specific focus on shielding.

OBJECTIVES:

- To gain broad conceptual understanding of the various aspects of electromagnetic Interference and compatibility.
- To develop a theoretical understanding of electromagnetic shielding effectiveness.
- To understand ways of mitigating EMI by using shielding, grounding and filtering
- To understand the need for standards and to appreciate measurement methods
- To understand how EMI impacts wireless and broadband technologies

UNIT I INTRODUCTION 9

Introduction - Classification of sources - Natural sources - Man-made sources - Surveys of the electromagnetic environment.

UNIT II SHIELDING 9

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures.

UNIT III INTERFERENCE CONTROL TECHNIQUES 9

Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.

UNIT IV EMC STANDARDS, MEASUREMENTS AND TESTING 9

Need for standards - The international framework - Human exposure limits to EM fields -EMC measurement techniques - Measurement tools - Test environments

UNIT V EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES 9

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks - EMC and digital subscriber lines - EMC and power line telecommunications.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Define and explain various terms, ideas, issues and methods in the field of EMI/EMC.
CO2: Analyze electromagnetic field coupling through apertures.
CO3: Critically examine the need for standards and why limits prescribed by different Standards could be widely different.
CO4: Evaluate the impact of EMI on wireless and broadband technologies.

TEXT BOOKS:

1. Christopoulos C, Principles and Techniques of Electromagnetic Compatibility, CRC Press, Second Edition, Indian Edition, 2013. (Units I, III, IV and V).
2. Paul C R, Introduction to Electromagnetic Compatibility, Wiley India, Second Edition, 2008. (Unit II)

REFERENCE BOOKS:

1. Kodali V P, Engineering Electromagnetic Compatibility, Wiley India, Second Edition, 2010.
2. Ernhard Keiser, Principles of Electromagnetic Compatibility, Artech house, Norwood, Third Edition, 1986.
3. Henry W Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons Inc, Newyork, 2009.
4. Scott Bennett W, Control and Measurement of Unintentional Electromagnetic Radiation, John Wiley & Sons Inc., Wiley Interscience Series, 1997
5. Online book "EMC testing: The beginners' guide.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3											1	1	
CO2	3	3			1								2	2	
CO3	3	3			1	2		2				2			3
CO4	3	3			1	2									2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2729	WIRELESS TECHNOLOGIES	3	0	0	3

PREAMBLE:

Wireless industry has become the fastest growing sector of the telecommunications industry, and there is hardly anybody in the world who is not a user of some form of wireless technology. This course introduces with the most up-to-date technological developments in wireless communication systems/networks and the major 3G standards, such as W-CDMA, CDMA2000 as well as 4G that has come into use in the recent past and 5G wireless technologies that have emerged only very recently. This course is unique because it provides the foundation of understanding and working for future generation of wireless systems.

OBJECTIVES:

- To gain knowledge about the 3G cellular standards.
- To comprehend LTE specific signalling protocols and procedures.
- To build an understanding of the concepts of wireless data networks
- To acquire broad knowledge on 5G mobile and wireless communications technologies.

UNIT I 3G MOBILE CELLULAR TECHNOLOGIES 9

CDMA2000-Operational Advantages, General Architecture, Airlink Design, Data Throughput, Forward Link Scheduling, Reverse Link, CDMA2000 1xEV Signaling, Handoffs, CDMA2000 1xEV-DO, CDMA2000 1xEV-DV.
WCDMA-ETSI UMTS versus ARIB WCDMA, UMTS Cell and Network Structure, UMTS Radio Interface, UMTS, UTRA Channels, UTRA Multiplexing and Frame Structure, Spreading and Carrier Modulations, Packet Data, Power Control, Handovers.

UNIT II LTE AND LTE-ADVANCED NETWORKS 9

Overview of LTE Networks - The Radio Protocol Architecture, The Interfaces, Support for Home eNBs (Femtocells), Air Interface, Frame Structure, UE States and State Transitions, Quality of Service and Bandwidth Reservation, Mobility Management, Security, Frame-Structure in LTE, Frame-Structure in LTE-Advanced, LTE Identification, Naming and Addressing.

UNIT III WIRELESS DATA NETWORKS 9

IEEE 802.11 Standards for Wireless Networks, IEEE 802.11a Supplement to 802.11 Standards, IEEE 802.11 Security, IEEE 802.15 WPAN Standards, IEEE 802.16 WMAN Standards, ETSI HIPERLAN and ETSI HIPERLAN/2 Standards, MMAC by Japan.

UNIT IV THE 5G ARCHITECTURE 9

Introduction- NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture- Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfil 5G, requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment

UNIT V THE 5G RADIO-ACCESS TECHNOLOGIES 9

Access design principles for multi-user communications, Multi-carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access, Radio access for dense

deployments, Radio access for V2X communication, Radio access for massive machine-type communication.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Build and design wireless networks based on the 3G standards.
CO2: Illustrate the concepts behind LTE standard.
CO3: Explain the wireless data network related components and its functions.
CO4: Demonstrate advanced knowledge on 5G technologies.

TEXT BOOKS:

1. Hsiao-Hwa Chen and Mohsen Guizani**, "**Next Generation Wireless Systems and Networks", John Wiley & Sons Ltd, 2006. (Unit I & III).
2. Afif Osseiran Jose F, Monserrat and Patrick Marsch "5G Mobile and Wireless Communications Technology", Cambridge University Press 2016. (Unit IV & V)

REFERENCE BOOKS:

1. Abd-Elhamid M. Taha, Hossam S. Hassanein and Najah Abu Ali. "LTE, LTE-Advanced and WiMAX towards IMT-Advanced networks", John Wiley & Sons, Ltd, 2012. (Unit II)
2. Harri Holma, Antti Toskala LTE for UMTS: Evolution to LTE-Advanced, 2nd Edition, Wiley, 2011.
3. K. Fazel and S. Kaiser, "Multi-Carrier and Spread Spectrum Systems-From OFDM and MC-CDMA to LTE and WiMAX", 2nd ed. John Wiley & Sons, 2008.
4. Steve Rackley, "Wireless Networking Technology: From Principles to Successful Implementation", Elsevier, 2007.
5. Angeliki Alexiou, "5G Wireless Technologies", IET Telecommunications Series 69, 2017.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1	2			1				1	3	3	2
CO2	2	2	1	1	2			1				1	2	2	1
CO3	2	2	1	1	2			1				1	2	2	1
CO4	2	2	1	1	2			1				1	2	2	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2731	COMMUNICATION NETWORK SECURITY	3	0	0	3

PREAMBLE:

Communication Network Security deals with the symmetric, asymmetric cryptographic algorithms and authentication algorithms that give an understanding of the techniques to be used for real time applications. It also explains the various key management techniques and to analyze the same for real time scenarios. The subject deals with some of the security issues and challenges occurring in various types of networks.

OBJECTIVES:

- To understand the classical ciphers, and public key cryptography
- To Study block ciphers for practical implementation
- To study Hash functions and MAC functions
- To have a clear knowledge about the key management techniques
- To understand and study the security issues and challenges in various networks

UNIT I CLASSICAL CIPHERS 9

Services – Mechanisms and Attacks – OSI security Architecture – Model for Network Security – Classical Encryption Techniques – Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Rotor Machines– Stenography.

UNIT II PUBLIC KEY ENCRYPTION 9

Block Ciphers and Data Encryption Standard: Simplified DES – Block Cipher Principles, Block Cipher Design Principles – Block Cipher Modes of Operation. Principles of Public Key Cryptosystems – RSA Algorithm, Key Management and other public key cryptosystems– Diffie–Hellman Key Exchange. Basics of ECC algorithm.

UNIT III HASH & MAC FUNCTIONS 9

Message Authentication and Hash Functions – Authentication Requirements– Authentication Functions – Message Authentication Codes – Hash Functions and MACs; Hash Algorithms – MD5 Message Digest Algorithm, Digital Signatures and Authentication protocols.

UNIT IV MUTUAL TRUST 9

Key Management and Distribution-Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure.

UNIT V NETWORK & INTERNET SECURITY 9

Web security-Secure Electronic Transaction, Web Security Considerations- Web Security Threats, Web Traffic Security Approaches, Wireless Security-Wireless Network Threats, Wireless Security Measures, Mobile Device Security-Security Threats, Mobile Device Security Strategy, IP Security Overview.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Acquire knowledge on different types of classical, public key cryptographic algorithms, and authentication algorithms
CO2: Apply block ciphers for software and hardware applications
CO3: Analyse various key management techniques
CO4: Acquire Knowledge on network and Internet security

TEXT BOOKS:

1. William Stallings, Cryptography and Network Security, Prentice Hall of India, New Delhi, Fourth edition, 2005. (Unit I to IV)
2. William Stallings, Cryptography and Network Security, Prentice Hall of India, New Delhi, Sixth edition, 2016. (Unit V)

REFERENCE BOOKS:

1. R.K.Nichols and P.C. Lekkas, Wireless Security: Models, Threats, and Solutions Mc Graw-Hill, First edition, 2002.
2. Charlie Kaufman, Network Security Private Communication in Public World, Prentice, Hall of India New Delhi, Second edition, 2004.
3. C K Shyamala, N Harini and Dr.TR Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd, First edition, 2001.
4. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill, First Edition, 2007.
5. Jonathan Katz, Yehuda Lindell, Introduction to modern cryptography, Chapman & Hall/CRC Taylor & Francis Group, First edition, 2008

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	2	2	2	2		1	2		2	1	3	3
CO2	3	2	2	2	2	2	1		1	1		2	1	3	3
CO3	3	2	2	2		2	1			1		1	1	3	3
CO4	3	3	3	3		2	1			2		2	1	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2732	MIXED SIGNAL DESIGN	3	0	0	3

PREAMBLE:

Mixed signal design is an advanced topic for undergraduate education that plays a vital role in many fields such as communication system, signal processing, where data conversion from analog-to-digital or digital-to-analog conversion is required. Analog signals need to be discretized to be used in digital data processing and vice-versa. This course provides the basic understanding of data sampling and its hardware requirements, possible architectures and analysis of analog-to-digital and digital-to-analog conversion, and an introduction to its building blocks.

OBJECTIVES:

- To understand and design Sample/hold circuits, and analog Comparators
- To understand and design Digital to Analog converters
- To understand and design Analog to Digital Converters
- To understand and design data converter amplifiers and comparators

UNIT I SAMPLE AND HOLD CIRCUITS 9

Analog versus Discrete time signals, analog to digital signal conversion, Sampling switches: Impulse sampling, decimation, sample and hold, track and hold, interpolation, sample and hold gain, aperture error, Analog integrator, Issues in data converters: sampling, quantization and reconstruction, oversampling and aliasing.

UNIT II SWITCHED CAPACITOR CIRCUITS AND COMPARATORS 9

Switched capacitor architecture: Switched capacitor integrator, Current mode architecture, Basic comparator, characteristics of comparator, clock comparator, Comparator: Single stage amplifier, cascaded amplifier, latched comparator.

UNIT III DIGITAL TO ANALOG CONVERTERS 9

Differential non-linearity (DNL), Integral non-linearity (INL), Offset, Gain Error, Signal to noise ratio, dynamic range, Reference multiplication and division: voltage, current and charge division, Resistor ladder DAC: switching functions, architecture with switched sub divider, Current steering DAC: R-2R network switching functions, R-2R network architecture, Binary to thermometer code conversion, Design challenges: Current element matching, clock feed through, zero order hold.

UNIT IV ANALOG TO DIGITAL CONVERTERS 9

Quantization error, Differential non-linearity (DNL), Integral non-linearity (INL), Offset, Gain Error, Signal to noise ratio, aliasing, ADC architecture: Successive approximation register(SAR) ADC, Pipelined ADC, Flash ADC, Performance metrics: Slew in sampling point, input capacitance non-linearity, charge redistribution in DAC, comparator offset cancellation.

UNIT V BUILDING BLOCKS OF DATA CONVERSION SYSTEMS 9

Amplifier circuits: open-loop amplifiers, closed-loop amplifiers, operational amplifiers, Gain boosting techniques, common-mode feedback, Comparator circuits: Bipolar comparators, CMOS comparators and BiCMOS comparators, Comparator offset cancellation, operational amplifier offset cancellation.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Design and analyze sample and hold and design sampling switches
CO2: Design and analyze switched capacitor banks and analog comparators for data Converters
CO3: Design DAC circuits and analyze its performance through its the various parameters
CO4: Design ADC circuits and analyze its performance through its the various parameters
CO5: Design MOSFET based amplifier and comparator circuits for data converters

TEXT BOOK:

1. Behzad Razavi, Principles of data conversion system design, Wiley-Blackwell, First Edition, 1994. (Unit I to V)

REFERENCE BOOKS:

1. R. Jacob Baker, CMOS: Mixed-Signal Circuit Design, Wiley, 2008.
2. Franco Maloberti, Data converters, Springer, 2007.
3. Rudy Van De Plassche, CMOS integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, Second Edition, 2005.
4. Mikael Gustavsson, J. Jacob Wikner, and Nianxiong Tan, CMOS Data Converters for Communications, Kluwer academic publishers, 2000.
5. Jacob Baker R, CMOS: Circuit design, layout and simulation, Wiley Interscience, Second Edition, 2008.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3	1	1	1					1		1	3		
CO2	1	3	1	1	1					1		1	3		
CO3	1	3	1	1	1					1		1	3	1	1
CO4	1	3	1	1	1					1		1	3	1	1
CO5	1	3	1	1	1					1		1	3		

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2733	DIGITAL SIGNAL INTEGRITY	3	0	0	3

PREAMBLE:

Signal integrity plays a dominant role in the field of electronic system design. Design of digital electronic systems requires knowledge of electromagnetic theory, transmission-line analysis and differential equations. Effective functioning of such systems while scaled / operated at high speeds defines its robustness. This course provides the basic knowledge required to understand and analyze the issues associated with high speed circuits and the techniques to overcome them.

OBJECTIVES:

- To understand the fundamental concepts of signal integrity.
- To understand cross talk in unbounded conductive media.
- To learn the types of dielectric materials.
- To understand differential cross talk and CMOS based I/O circuit models.

UNIT I FUNDAMENTALS 9

The Basics - Maxwell's Equations, Common Vector Operators - Wave Propagations-Electrostatics - Magneto statics - Power flow and the Poynting Vector - Reflections of Electromagnetic Waves.

UNIT II CROSS TALK AND ITS MITIGATION 9

Mutual Inductance and Capacitance - Coupled Wave Equations - Coupled Line Analysis - Modal Analysis - Crosstalk Minimization - Signals Propagation in Unbounded Conductive Media - Classic Conductor Model for Transmission models.

UNIT III DIELECTRIC MATERIALS 9

Polarization of Dielectrics - Classification of Dielectric Materials - Frequency Dependent Dielectric Behavior - Fiber Weave Effect - Environmental Variation in Dielectric Behavior Transmission Line Parameters for Lossy Dielectrics and Realistic Conductors.

UNIT IV DIFFERENTIAL SIGNALING 9

Removal of Common Mode Noise - Differential Crosstalk - Virtual Reference Plane -Propagation of Modal Voltages - Common Terminology - Drawbacks of Differential Signaling.

UNIT V CHANNEL AND I/O CIRCUITS MODELLING 9

Creating a Physical Transmission Line Model - I/O Design Considerations - Push-Pull Transmitters - CMOS Receivers - ESD Protection Circuits - On Chip Termination - Bergeron Diagrams.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Apply the fundamental concepts of signal integrity in high speed PCBs.
CO2: Identify and resolve crosstalk.
CO3: Interpret the frequency dependence of dielectrics
CO4: Explain the design considerations in channel and I/O circuits.

TEXT BOOK:

1. Stephen H. Hall, Howard L. Heck, Advanced Signal Integrity for High-Speed Digital Designs, Second Edition, John Wiley and Sons, 2009. (Unit I to V)

REFERENCE BOOKS:

1. James Edgar Buchanan, Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS, Second Edition, McGraw-Hill, 1996.
2. Mike Peng Li, Jitter, Noise, and Signal Integrity at High-Speed, First Edition, Prentice, Hall, 2007.
3. Eric Bogatin, Signal and Power Integrity - Simplified, Second Edition, Prentice Hall, 2004.
4. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, First Edition, Prentice Hall PTR, 2003.
5. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Second Edition, Prentice Hall, 1993.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2										3		
CO2	3	3	3	2					1		1	1	3		1
CO3	2	3	2	2			3			2		1	2		
CO4	1	3	3	3									2		

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2821	COGNITIVE RADIO	3	0	0	3

PREAMBLE:

This course introduces an intelligent wireless communication system that is aware of its surrounding environment, able to learn from the environment and adapts to the dynamic variations in the environment, thus improving spectrum utilization. The cognitive radio evolution, architecture, standards, applications and concepts such as spectrum sensing and dynamic spectrum access are explored in detail.

OBJECTIVES:

- To understand the concepts and architecture of cognitive radio.
- To learn spectrum sensing and dynamic spectrum access.
- To understand the MAC and Network layer design for cognitive radio.
- To describe the advancements and applications of cognitive radio.

UNIT I INTRODUCTION TO COGNITIVE RADIOS 9

Evolution of Software Defined Radio and Cognitive radio - key applications, regulatory issues of cognitive access, spectrum measurements and usage, Applications for spectrum occupancy data.

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, Cognition cycle – orient, plan, decide and act phases, SDR as a platform for Cognitive Radio Architecture, Cognitive Radio Standards - Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing.

UNIT IV MAC AND NETWORK LAYER DESIGN 9

MAC for cognitive radios – Random Access, Time Slotted and Hybrid Protocols, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Acquire knowledge on the concepts and challenges of cognitive radio.
CO2: Comprehend various standardization activities of cognitive radio.
CO3: Apply detection techniques for cognitive radio spectrum sensing
CO4: Implement MAC and Network layer protocols for dynamic spectrum sharing.
CO5: Identify the role of cognitive radio for public safety networks and spectrum markets

TEXT BOOK:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, Cognitive Radio Communications and Networks, Academic Press, Elsevier, 2010. (Unit I, III and V)

REFERENCE BOOKS:

1. Bruce Fette, Cognitive Radio Technology, Newnes, 2006. (Unit II).
2. Kwang-Cheng Chen, Ramjee Prasad, Cognitive Radio Networks, John Wiley and Sons, 2009. (Unit IV).
3. Huseyin Arslan (Ed.), Cognitive Radio, Software Defined Radio, and Adaptive Wireless, Systems, Springer, 2007.
4. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein H. Vincent Poor, Narayan B. Mandayam, Principles of Cognitive Radio, Cambridge University Press, 2013.
5. Geetam Tomar, Ashish Bagwari, Jyotshana Kanti, Introduction to Cognitive Radio Networks and Applications, CRC Press, First Edition, 2016

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3			3						1			2
CO2	2	2	3			3						1			2
CO3	3	3	3		3								3	3	
CO4	3	3	3		3								3	3	
CO5	2	3	3			3						1			2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2824	INTRODUCTION TO COMPUTER VISION	3	0	0	3

PREAMBLE:

This course covers the fundamentals of how computers can be made to see and interpret the world as humans do. The course covers core concepts on the capabilities of human vision to understand the digital processing of images and video. Computer vision has evolved an area of its own. In the last few years, a number of applications have emerged in Automotive, Healthcare, Agriculture, Banking AR and VR etc. with the increased availability of vast amounts of reordered data and computational capability, deep Learning is one of the most exciting fields of interest. Thus, this course also provides basic knowledge about deep learning.

OBJECTIVES:

- To understand the image formation and processing.
- To understand feature-based image matching.
- To understand the models for motion estimation in video.
- To study Depth estimation algorithms for 3D reconstruction.
- To understand deep learning techniques for computer vision.

UNIT I IMAGE FORMATION AND PROCESSING 9

Introduction - Geometric transformations – Photometric image formation -digital camera- Point operators, Linear Filtering Nonlinear filtering, Bilateral filtering, Binary image processing. Pyramids and wavelets.

UNIT II FEATURE DETECTION AND MATCHING 9

Feature detectors and descriptors -matching techniques and feature tracking, Points and patches, Edge detection, Contour detection and Tracking

UNIT III MOTION ESTIMATION 9

Alignment techniques, translational motion, Parametric and spline-based motion estimation, Optical flow model, layered motion model.

UNIT IV DEPTH ESTIMATION AND 3D RECONSTRUCTION 9

Epipolar geometry, Sparse correspondence, Dense correspondence, Multi view stereo, Monocular depth estimation, 3D Shape reconstruction – Surface, Point, Volume and Model based reconstruction, Image-based and video-based rendering, 3D Video.

UNIT V DEEP LEARNING FOR COMPUTER VISION 9

Deep neural networks, Convolutional neural networks - Lenet, Alexnet, VGG and U-Net architectures, Three-dimensional CNNs, Sequence modelling, Generative models. Application of deep learning in hand written digit recognition.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Describe image formation and fundamental image processing techniques required for computer vision.
CO2: Outline feature detectors and implement image matching techniques.
CO3: Evaluate motion estimation techniques
CO4: Analyse importance of depth estimation and 3D construction.
CO5: Apply Deep learning models for computer vision applications.

TEXT BOOK:

1. Zaleski R., Computer Vision: Algorithms and Applications, Second Edition Springer 2020. (Unit I to V)

REFERENCE BOOKS:

1. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for. Computer Vision, Third Edition, Academic Press, 2012
2. John C. Russ, the Image Processing Handbook, CRC Press, 2007.
3. Baggio D. L. et al., MPoastering OpenCV with Practical Computer Vision Projects, Packet Publishing, 2012.
4. Manas Kamal Bhuyan , Computer Vision and Image Processing: Fundamentals and Applications, CRC press 2019.
5 Gonzalez, Rafael C., Woods, Richard E, Digital image processing, Pearson, 2018.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1								1	3	2	1
CO2	2	2	1	2								1	3	2	1
CO3	1	2	1	1								1	3	2	1
CO4	3	2	1	1								1	3	2	1
CO5	2	2	1	2								1	3	2	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2822	CMOS ANALOG IC DESIGN	3	0	0	3

PREAMBLE:

CMOS Analog IC Design plays a vital role in the design of Analog VLSI circuits and eventually its applications in communication systems, signal processing, memory subsystems etc., Analog signals are swing limited, frequency dependent, sensitive to noise from surrounding circuitry and power supply. This course provides a deep understanding of MOSFET based amplifiers design (Single stage, and differential amplifier), their frequency response analysis, and their use as an operational amplifier suitable for many applications.

OBJECTIVES:

- To study the construction, operation, characteristics and analysis of analog CMOS circuits such as current sources/sinks, current mirrors/reference, voltage references.
- To familiarize with the construction, operation, characteristics and analysis of CMOS single stage and differential amplifiers.
- To learn the construction, operation, characteristics and analysis of single stage and two stage CMOS operational amplifiers.
- To understand the construction, operation, characteristics and analysis of CMOS data converters.

UNIT I CMOS ANALOG SUBCIRCUITS 9

Introduction to Analog Integrated Circuit Design – Analog Switches - Active Resistors - Current Sources & Sinks – Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors and Active Current Mirrors – Voltage & Current References – Bandgap References: General Considerations, Supply Independent Biasing, Temperature Independent, PTAT Current Generation, Constant Gm Boosting, Speed and Noise issues.

UNIT II SINGLE STAGE AMPLIFIERS 9

Basic Concepts - Common Source Stage - Common Gate Stage - Source Follower - Cascode & Folded Cascade Stages. Frequency Response & Noise Analysis.

UNIT III DIFFERENTIAL AMPLIFIERS 9

Single Ended & Differential Operation - Basic Differential Pair – Qualitative & Quantitative Analysis - Common Mode Response, Differential Pair with MOS Loads - Gilbert Cell. Frequency Response & Noise Analysis.

UNIT IV FEEDBACK, STABILITY AND FREQUENCY COMPENSATION 9

Feedback topologies: Voltage-voltage feedback, current-voltage feedback, voltage-current feedback, current-current feedback, Stability and frequency compensation: general considerations, multiple systems, phase margin, frequency compensation, frequency compensation in two-stage Op. Amp.

UNIT V OPERATIONAL AMPLIFIERS 9

General Considerations - One Stage Op Amps - Two Stage Op Amps – Gain Boosting – Common Mode Feedback- Input Range Limitations – Slew Rate – Power Supple Rejection – Frequency Response of One Stage and Two Stage Op Amps - Noise in OpAmps.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Design and analyze current and voltage reference and biasing circuits.
CO2: Design and analyze CMOS single stage amplifiers based on their performance metrics.
CO3: Design and analyze CMOS Differential amplifiers based on their performance metrics.
CO4: Design and analyze feedback topologies and frequency response of amplifiers.
CO5: Design CMOS operational amplifiers and analyze its performance metrics.

TEXT BOOK:

1. Behzad Razavi, Design of CMOS Analog Integrated Circuits, McGraw Hill Publications, Second Edition, 2016. (Unit I to V)

REFERENCE BOOKS:

1. Jacob Baker R, CMOS: Circuit Design, Layout and Simulation, Wiley Publications, third Edition, 2018.
2. Philip E Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, Third Edition, 2012.
3. Hurst, Gray and Lewis Meyer, Analysis and Design of Analog Integrated Circuits, Publications, Fifth Edition, 2014.
4. Kenneth Martin Chan Carusone, David Johns, Analog Integrated Circuit Design, 2ed, Wiley, 2013.
5. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th edition, McGraw Hill, 2016.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3	1	1	1					1		1	3		
CO2	1	3	1	1	1					1		1	3		
CO3	1	3	1	1	1					1		1	3		
CO4	1	3	1	1	1					1		1	3	1	1
CO5	1	3	1	1	1					1		1	3	1	1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2823	SENSORS, ACTUATORS AND INTERFACES	3	0	0	3

PREAMBLE:
Sensors and actuators deal with the study of measurement of different types of sensors and actuators and to perform the statistical analysis of measurements subject to errors in the system. It defines the characteristics of sensors and actuators and gives an in-depth knowledge of the operation of various sensors and its applications when subjected to different physical parameters. The subject also deals with the operation of smart sensors and its requirements for interfacing the sensors with embedded systems for real time engineering applications.

OBJECTIVES:

- To understand the definitions and characteristics of sensors and actuators.
- To perform statistical analysis of measurements subject to errors in the system.
- To acquire knowledge on type of sensors to be used for practical applications.
- To interface electronic sensors for various engineering applications.

UNIT I INTRODUCTION TO SENSOR-BASED MEASUREMENT SYSTEMS 8

Introduction, Measurement Units, Measurement System Design, Measurement System Applications, Classification of sensors and actuators, Performance characteristics of sensors and actuators-Static and dynamic Characteristics of Instruments.

UNIT II STATISTICAL ANALYSIS OF MEASUREMENT SUBJECT TO RANDOM ERRORS 9

Definitions of Systematic and Random errors, Mean and Median Values, Standard Deviation and Variance, Graphical Data Analysis Techniques-Frequency Distributions, Gaussian (Normal) Distribution, Standard Gaussian Tables (z-Distribution), Standard Error of the Mean, Estimation of Random Error in a Single Measurement, Distribution of Manufacturing Tolerances, Sensor Signal Characteristics, Aliasing, Quantization, Analog Signal Processing.

UNIT III TEMPERATURE, ACOUSTIC SENSORS & ACTUATORS 9

Thermoresistive sensors- Resistance temperature detectors (RTD), Thermistors, Thermoelectric sensors-Thermopiles, p–n junction temperature sensors, other temperature sensors-Thermo mechanical sensors and actuators. Piezoelectric effect-Electrostriction, Piezoelectric sensor, Ultrasonic sensor and actuators.

UNIT IV OPTICAL SENSORS & ACTUATORS 9

Feedback Effects of optical radiation-Thermal effects, Quantum effects, Quantum-based optical sensors-Photo conducting sensors, Photodiodes, Photovoltaic diodes and Phototransistors, Photoelectric sensors- The photoelectric sensor and Photomultipliers, Thermal based optical sensors-Passive IR sensors, Thermopile PIR, Pyroelectric sensor, Optical actuators.

UNIT V ELECTRIC, MAGNETIC & RADIATION SENSORS AND ACTUATORS 10

The electric field- capacitive sensors and actuators-Capacitive position, proximity, and displacement sensors, Capacitive fluid level sensors, Capacitive actuators, Magnetic fields- sensors and actuators-Inductive sensors, Hall effect sensors. Radiation sensors- Antennas as sensors and

actuators, General relations, Antennas as sensing elements, Smart Sensors-Wireless sensors and actuators and issues associated with their use, RFIDs and embedded sensors and general requirements for interfacing sensors and actuators-signal level and impedance.

TOTAL PERIODS: 45

OUTCOMES:

At the end of the course, the student should be able to:

CO1: Classify various sensors & actuators and acquire knowledge of the performance characteristics of sensors and actuators.
CO2: Analyze the statistical measurements of sensors subject to different types of errors.
CO3: Measure and apply the sensors for various physical parameters.
CO4: Apply & Interface sensors and actuators for various real time engineering applications

TEXT BOOKS:

1. Alan S Morris, Measurement and Instrumentation Principles, Butterworth Hienemann, Second edition, 2001 (Unit I & II).
3. Nathan Ida, Sensors, Actuators and their Interfaces, A multidisciplinary introduction Published by the Institution of Engineering and Technology, London, United Kingdom, Second Edition, 2020. (Unit III to V)

REFERENCE BOOKS:

1. Ramon Pallás Areny, John G. Webster, Sensors and Signal conditioning, John Wiley and Sons, Second Edition, 2000.
4. Doebelin E O, Measurement Systems, Application and Design, McGraw Hill, Fifth Edition, 2004.
3. Ian R Sinclair, Sensors and Transducers, Newnes publishers, Third Edition, 2001.
4. Jack P Holman, Experimental Methods for Engineers, McGraw Hill, USA, Seventh Edition, 2001.
5. Patranabis D, Sensors and Transducers, Tata McGraw Hill, Seventh Edition, 2003.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1				1						1		
CO2	3	3	3	3	3	2			1	1		1	2	2	3
CO3	3	3	3	2	3	2	2		1	1		1	2	2	3
CO4	3	3	3	2	3	3	2		1	1		1	2	2	3

SYLLABI FOR HONOURS COURESES

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2H61	EMBEDDED PROGRAMMING	2	0	2	3

PREAMBLE

Embedded and Real time systems have dominated the technology trend in a variety of applications. Most systems in real life are Cyber Physical systems which require a deeper understanding of control and computing which are prevalent in Embedded Systems. This course offers the fundamental concepts and understanding of the design of Embedded Systems

OBJECTIVES

- To expose the students to the fundamentals of embedded Programming
- To introduce the GNU C Programming Toolchain in Linux.
- To study basic concepts of embedded C, Embedded OS & Python Programming

UNIT I EMBEDDED PROGRAMMING 12

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - Variable Scope and Functions - C Preprocessor - Advanced Types – Simple Pointers –Debugging and Optimization – In-line Assembly.

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX 12

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Introduction to GNU C Library

UNIT III EMBEDDED C 12

Adding Structure to ‘C’ Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism -Creating loop timeouts - Creating hardware timeouts.

UNIT IV EMBEDDED OS 12

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOSMemory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system.

UNIT V PYTHON PROGRAMMING 12

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions –Functions – Modules, Imaging libraries, Networking libraries, Classes and OOP – Execution Environment, Case study: Traffic sign detection system for Autonomous Electric Vehicles.

TOTAL PERIODS: 60

LABORATORY REQUIREMENTS

S.No	Description of Equipment / Software
1	PCs with Embedded IDE
2	PCs with Linux OS
3	Any freeware RTOS

OUTCOMES

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

CO1: Understand the principles of embedded programming
CO2: Apply toolchain programming in an embedded system design
CO3: Understand the programming constructs of embedded C
CO4: Apply and analyse OS-features for an embedded real-time system
CO5: Design various software modules of embedded system using Python

REFERENCE BOOKS

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Michael J Pont, "Embedded C", Pearson Education, 2007.
3. Christian Hill, Learning Scientific Programming with Python, Cambridge University Press ,2016.
4. Wesley J.Chun, "Core python application Programming 3rd Edition", Pearson Educat, 2016.
5. Mark J.Guzdial," Introduction to computing and programming in python –a Multimedia approach" ,4th edition, Pearson Education, 2015.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3		2	2									2		
CO2	3	2	2	2										2	
CO3	3	2	2	2								2			3
CO4	3		2	2									2		
CO5	3	2	2	2								2		2	3

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2H21	IoT ARCHITECTURES	3	0	0	3

PREAMBLE

The Internet of Things (IoT) is a network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. Nowadays IoT enabled devices are designed and developed for wide range of applications such as building and home automation, smart city, smart grid, smart agriculture, transportation, military and healthcare etc. IoT Architectures becomes one of the most essential subjects for Electronics and Communication Engineers. The main topics covered are M2M and IoT technology fundamentals, Architecture reference model, Reference architecture and real-world design constraints followed by a case study.

OBJECTIVES

- To study about transition from M2M to IoT with the required architectural overview.
- To learn M2M and IoT technology fundamentals.
- To gain in-depth knowledge about architecture reference model.
- To understand the steps involved in building IoT reference architecture.
- To apply the concept of Internet of Things in the real-world scenario

UNIT I M2M TO IoT: AN ARCHITECTURAL OVERVIEW 9

Introduction – From M2M to IoT – The Global context – A use case example - Building architecture - Main design principles and needed capabilities - An IoT architecture outline - Standards considerations.

UNIT II M2M AND IoT TECHNOLOGY FUNDAMENTALS 9

Devices and Gateways – Device types, Deployment scenarios for devices, Basic devices, Gateways, Advanced devices – Local and Wide Area Networking – Managing M2M data – Data generation, Data acquisition, Data validation, Data storage, Data processing, Data remanence and Data analysis.

UNIT III ARCHITECTURE REFERENCE MODE 9

Introduction - Reference model and architecture - IoT reference model - IoT domain model - Information model - Functional model - Device functional group, Communication functional group, IoT Service functional group, Virtual Entity functional group, IoT Service organization functional group, IoT Process Management functional group, Management functional group, Security functional group, Application functional group, Modular IoT functions - Communication model - Safety, privacy, trust, security model.

UNIT IV IoT REFERENCE ARCHITECTURE 9

Introduction - Functional view - Device and application functional group, Communication functional group, IoT Service functional group, Virtual Entity functional group, IoT process management functional group, Service Organization functional group, Security functional group, Management functional group - Information view - Deployment and operational view.

UNIT V REAL WORLD CASE STUDIES 9

Real world technical design constraints - Devices and networks - Functional requirements, Sensing and communications field, Programming and embedded intelligence, Power, Gateway Nonfunctional requirements, financial cost - Data representation and visualization - Interaction and remote control – Case Study: Participatory Sensing – Roles, actors, engagement, Participatory sensing process, Technology overview, Recent trends and modern example.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Demonstrate the transition from M2M to IoT transition with architectural overview.
CO2: Interpret the M2M and IoT technology fundamentals
CO3: Develop IoT Architecture for a particular application scenario.
CO4: Build IoT reference architecture for a given scenario.
CO5: Demonstrate the real-world technical design constraints for a given application scenario.

REFERENCES

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis,Karnouskos, Stefan Avesand. David Boyle, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014.
2. ArshdeepBahga, Vijay Madisetti, Internet of Things – A hands-on approach, Universities Press, 2015.
3. Edward Ashford Lee, SanjitArunkumarSeshia, Introduction to Embedded Systems – A Cyber Physical Systems Approach, Second Edition, MIT Press, 2017.
4. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things – Key applications and Protocols, Wiley, 2012.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1						1		1			1
CO2	3	2	2	1						1		1			1
CO3	3	2	2	1						2		1	2		3
CO4	3	2	2	1						2		1	2		3
CO5	3	2	2	1						2		1			1

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2H22	IOT COMMUNICATION TECHNOLOGIES	3	0	0	3

PREAMBLE

Internet of Things (IoT) is rapidly gathering momentum due to the advancements in sensor networks, mobile devices, wireless communications, networking, and cloud technologies. This course is intended to cover communication technologies of IoT. It provides an insight on communication principles, protocols, advanced networking concepts and LPWAN technologies used in the IoT scenario.

OBJECTIVES

- To appreciate the IoT communication fundamentals.
- To understand and differentiate between the various connective technologies
- To comprehend the advanced IoT networking and routing methodologies
- To learn the various LPWAN technologies.

UNIT I IOT COMMUNICATION BASICS 9

M2M and IoT, Layered Architectures, System Components - IoT Networking, Types of Networks, Devices, Security, Wireless Sensor Networks.

UNIT II IOT PROTOCOLS: PHYSICAL & LINK LAYERS 9

Physical & Link Layer - Wireline- ITU-T G.9903, MSTP – Wireless- IEEE 802.15.4, BLE, ITU-T G.9959, DECT ULE, NFC.

UNIT III IOT PROTOCOLS: HIGHER LAYERS 9

Network and Transport Layers – 6LoWPAN, 6TiSCH - Application Layer - CoAP, MQTT, AMQP

UNIT IV IOT NETWORKING AND ROUTING 9

DNS- mDNS - CoAP Service Discovery - UPnP- Routing Concepts – RPL- LOADng

UNIT V LPWAN TECHNOLOGIES 9

LoRa - SigFox - D7AP - Weightless - NB-IoT- More LPWAN Technologies- NB-Fi, IQRF, RPMA Telensa, SNOW, NWave

TOTAL PERIODS: 45

OUTCOMES

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

CO1 : Apply the communication concepts of IoT in real world applications
CO2 : Identify a suitable protocol for a specific application.
CO3 : Differentiate various connective technologies
CO4 : Comprehend the networking and routing procedures used in IoT.
CO5 : Appreciate the need for LPWAN technologies in real time applications.

TEXT BOOK

1. Rolando Herrero, Fundamentals of IoT Communication Technologies, Springer, 2022. ISBN 978-3-030-70080-5

REFERENCE BOOKS

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT Cambridge University press 2021.
2. Veena S. Chakravarthi, Internet of Things and M2M Communication Technologies, Architecture and Practical Design Approach to IoT in Industry 4.0, Springer 2021. ISBN 978-3-030-79271-8
3. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things – Key applications and Protocols, Wiley, 2012.
4. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand and David Boyle, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1								1			2
CO2	3	2	2	1								1			2
CO3	3	2	2	1								1			2
CO4	3	2	2	1								1			2
CO5	3	2	2	1								1			2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2H23	DATA SCIENCE FOR IoT	3	0	0	3

PREAMBLE

The intention and purpose of this course are to learn the basics of IoT architectural components for efficient implementation of data analytics and data visualization tools to collect, store and analyse IoT data.

OBJECTIVES

- To learn fundamentals of Data Science using Python
- To understand probability distributions and statistical Inferences
- To be familiar with supervised and unsupervised methods in machine learning
- To handle different databases and store values from sensors in the databases.
- To learn about visualization.

UNIT I INTRODUCTION TO DATA SCIENCE 9

Introduction: Need for data science, Facets of data, Big data ecosystem – The data science process: Retrieving data – Cleansing, integrating and transforming data – Data analysis – Build the models Toolbox - Introduction to Python: Fundamental Python Libraries for Data Scientists, Pandas, Matplotlib; IDE Data Manipulation with Python - Examples

UNIT II INTRODUCTION TO IOT ANALYTICS 9

Introduction to IoT - IoT architectures – IoT analytics challenges – IoT networking data messaging protocols - Analyzing data to infer protocol and device characteristics

UNIT III EXPLORING IOT DATA 9

Exploring IoT Data: Exploring and visualizing data, Techniques to understand data quality, Basic time series analysis, Statistical analysis - Data summarization – Data distribution – Outlier Treatment – Measuring asymmetry – Continuous distribution

UNIT IV DATA SCIENCE FOR IOT ANALYTICS 9

Introduction to Machine Learning: Supervised: kNN classifier, Regression analysis: Linear regression – Logistic regression – Unsupervised: Clustering - Feature engineering with IoT data, Validation methods, Understanding the bias–variance trade-off, Case study: Use cases for deep learning with IoT data

UNIT V STRATEGIES TO ORGANIZE DATA FOR ANALYTICS 9

Strategies to Organize Data for Analytics: Linked Analytical Datasets, Managing data lakes, data retention strategy – Applications - Case study: IoT data analytics challenges in an organization.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Develop Python programs to perform analysis on data.
CO2: Understand various probability distributions and statistical inferences
CO3: Explore IoT data and summarize it for a specific application
CO4: Apply machine learning techniques for IoT analytics
CO5 Apply various strategies to organize IoT data

REFERENCE BOOKS

1. Minteer, Andrew, Analytics for the Internet of Things (IoT), Packt Publishing Ltd., 2017
2. Kai Hwang, Min Chen, Big-Data Analytics for Cloud, IoT and Cognitive Computing, Wiley, 2017
3. Hwaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley, 2016

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	1							1	2	1	2
CO2	3	3	3	3	2							1	2	2	2
CO3	3	3	2	3	2							1	3	2	2
CO4	3	3	2	3	2							2	3	2	2
CO5	3	3	2	3	2							2	3	2	2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2H24	SECURITY AND PRIVACY IN IoT	3	0	0	3

PREAMBLE

Security and privacy are important aspects of IoT networks. Given the widespread use of IoT devices in many fields, keeping the network secure is becoming increasingly important. Similarly, preserving data integrity is essential, especially when IoT sensors are used in sensitive applications. This course provides learners an introduction to the security requirements in IoT architecture with an indepth understanding about possible threats and attacks layer wise. Learners will get an understanding about identity & access management solutions, privacy impact assessment along with the understanding about need for security in cloud perspective.

OBJECTIVES

- To understand the layer wise security requirements in IoT architecture along with possible threats and attacks.
- To introduce the cryptographic fundamentals required for securing IoT.
- To gain in-depth knowledge about identity and access management solutions.
- To explore the possible privacy challenges and the corresponding solutions.
- To understand the need for security from cloud perspective.

UNIT I INTRODUCTION: SECURING THE IoT 9

Security requirements in IoT architecture – Security issues in enabling technologies – Security concerns in IoT applications – IoT Security Architecture – Sensing layer, network layer, service layer and application layer – Threats to authorization/authentication, access control, privacy and availability – Attacks specific to IoT.

UNIT II CRYPTOGRAPHIC FUNDAMENTALS FOR IoT 9

Types and uses of cryptographic primitives in IoT – Encryption and Decryption – Hashes – Digital Signatures – Cryptographic key management fundamentals – Examining cryptographic controls build into IoT messaging and communication protocols.

UNIT III IDENTITY AND ACCESS MANAGEMENT SOLUTIONS 9

Introduction to identity and access management for IoT – Authentication credentials – passwords, symmetric keys, certificates, and biometrics – Identity and Access Management (IAM) Infrastructure – Authorization and access control, Case Study: Aadhar Registered Devices Authentication.

UNIT IV MITIGATING IOT PRIVACY CONCERNS 9

Privacy challenges introduced by IoT – Privacy Impact Assessment – Privacy by design principles – Privacy engineering recommendations.

UNIT V CLOUD SECURITY FOR INTERNET OF THINGS 9

Cloud Services for IoT – Asset and inventory management, Service provisioning billing and entitle management, Real time monitoring, Sensor coordination, Customer intelligence and marketing, Information sharing, Message transport & broadcast – Examining IoT threats from cloud perspective – Exploring cloud service provider IoT offerings – Cloud IoT security control – Tailoring an enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Outline the layer wise attacks possible in IoT.
CO2: Apply the fundamentals of cryptography in IoT.
CO3: Interpret the methods and solutions for authorization and access control
CO4: Analyze the principles, practices and policies associated with privacy issues.
CO5: Demonstrate the various cloud service provider IoT offerings with respective security controls.

REFERENCES

1. Shancang Li, Li Da Xu, “Securing the Internet of Things”, Syngress, Elsevier Publishing, 2017.
2. Brian Russell, Drew Van Duren, “Practical Internet of Things Security”, Packt Publishing, 2018.
3. Fei Hu, “Security and Privacy in Internet of Things (IoTs): Models, Algorithms and Implementations”, CRC Press, 2016.
4. Alasdair Gilchrist, “IoT Security Issues”, Walter de Gruyter GmbH & Co KG, 2017.
5. Shivani Agarwal, Sandhya Makkar, Duc-Tan Tran, “Privacy Vulnerabilities and Data Security Challenges in the IoT”, CRC Press, 2020.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1								2			
CO2	3	3	2	1								2	3		3
CO3	3	3	2	1						2		2	2		2
CO4	3	3	2	1						2		2	2		2
CO5	3	3	2	1						2		2			2

COURSE CODE	COURSE TITLE	L	T	P	C
UEC2H25	INDUSTRIAL IoT 4.0	3	0	0	3

PREAMBLE

Industrial Internet of Things is a relatively new and emerging paradigm, which interconnects sensors and actuators to enhance industrial working conditions, product quality, machine lifetime, automated fault detection and maintenance, and optimal asset utilization. This course provides learners an introduction to Industry IoT 4.0 and its applications in the business world. Learners will get an understanding about various implementation systems for IIoT and the key enabling technologies for IIoT.

OBJECTIVES

- To learn the fundamental concepts of Industry 4.0.
- To understand the business models and reference architecture of IIoT.
- To gain in-depth knowledge about various implementation systems for IIoT.
- To introduce the possible key enabling technologies for IIoT.
- To explore the challenges involved in providing IIoT as solution to real world applications.

UNIT I INTRODUCTION TO INDUSTRIAL 4.0 9

Industry 4.0 – Phases of development & evolution, environmental impacts of industrial revolution, Industrial internet and applications of industry 4.0 – Industrial Internet of Things (IIoT) – Prerequisites of IIoT, Role of IoT & IIoT in industry, Basics of CPS, CPS & IIoT – Applications of IIoT.

UNIT II INDUSTRIAL INTERNET OF THINGS BASICS 9

Industrial internet systems – Industrial sensing – Industrial processes – Introduction to business model – Business models of IIoT – Reference Architecture for IIoT – Categorization of reference architecture in IIoT.

UNIT III IMPLEMENTATION SYSTEMS FOR IIoT 9

Sensors and Actuators, Industrial data transmission – Features & Components - Field bus, Modbus, Controller Area Network, Wireless HART, LoRa and LoRaWAN, NBIoT & IEEE 802.11ah – Industrial data acquisition – Introduction to IIoT analytics and predictive maintenance.

UNIT IV KEY ENABLING TECHNOLOGIES FOR IIoT 9

Cloud computing – Fog computing – Big data analytics – Augmented reality – Virtual reality – Smart factories – Characteristics of smart factory, Technologies used in smart factory.

UNIT V IIoT APPLICATIONS 9

Healthcare – IIoT based healthcare system, Inventory Management & Quality Control, Plant Safety and Security – Case study: Automotive industry – Background of the industry, Challenges, IIoT as a solution, Benefits.

TOTAL PERIODS 45

OUTCOMES

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

CO1: Understand the benefits of Industry 4.0 and the role of IIoT in industry.
CO2: Demonstrate the business models of IIoT with the reference architecture.
CO3: Analyze various systems that can be used for implementing IIoT.
CO4: Identify the possible key enabling technologies for Industrial Internet of Things.
CO5: Analyze the challenges involved to provide IIoT as solution to various real world applications

REFERENCES

1. S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press, 2020.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.
3. Ismail Butun, "Industrial IoT: Challenges, Design Principles, Applications and Security", Springer, 2020.
4. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing Systems", Springer, 2017.
5. Ovidiu Vermesan, Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, 2013.

CO – PO AND PSO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1								2			
CO2	3	2	2	1								2			
CO3	3	2	2	1						2		2	2	2	3
CO4	3	2	2	1						2		2	2	2	3
CO5	3	2	2	1						2		2			3

OPEN ELECTIVES OFFERED BY OTHER DEPARTMENTS

OPEN ELECTIVE I (SEMESTER VI)

SL. NO	DEPARTMENT OFFERING	COURSE CODE	COURSE TITLE	L	T	P	C
1	EEE	UEE2041	Autonomous Vehicles	3	0	0	3
2		UEE2042	Sensors and Instrumentation	3	0	0	3
3		UEE2043	Energy Management	3	0	0	3
6	CSE	UCS2041	Introduction to Data Structures	2	0	2	3
7		UCS2042	Object Oriented Programming Techniques	2	0	2	3
8		UCS2043	Problem Solving and Programming in C	2	0	2	3
10	IT	UIT2041	Introduction to AR and VR	2	0	2	3
		UIT2042	Databases and Applications Development	2	0	2	3
11		UIT2043	Introduction to Artificial Intelligence	2	0	2	3
12		UIT2044	Introduction to Data structures and Algorithms	2	0	2	3
13		UIT2045	Introduction to Object-Oriented Programming and Patterns	2	0	2	3
14		UIT2046	Introduction to Data Science	2	0	2	3
15	BME	UBM2041	Principles of Biomedical Instrumentation	3	0	0	3
16		UBM2042	Materials for Biomedical Applications	3	0	0	3
17		UBM2043	Hospital planning and Waste Management	3	0	0	3
18	Chemical	UCH2041	e-Waste Management	3	0	0	3
19		UCH2042	Nanoscience for Engineers	3	0	0	3
20		UCH2043	Sustainable Development	3	0	0	3
21	Mechanical	UME2041	Six Sigma Data analysis	2	0	2	3
22		UME2042	Product Engineering	3	0	0	3
23		UME2043	Operations Management	3	0	0	3

24	Civil	UCE2041	Green Building Design	3	0	0	3
25		UCE2042	Sustainable Infrastructure	3	0	0	3
26		UCE2043	Integrated Water Resource Management	3	0	0	3
27		UCE2044	Environmental Impact Assessment	3	0	0	3
28	MBA	PBA2041	Entrepreneurship	3	0	0	3
29		PBA2042	Supply Chain and Logistics Management	3	0	0	3
30		PBA2043	Design Thinking	2	0	2	3
31	Mathematics	UMA2041	Graph Theory and Applications	3	0	0	3
33	Physics	UPH2041	Optical and luminescence characteristics of materials	3	0	0	3
34		UPH2042	Nanotechnology and Imaging Techniques	3	0	0	3
36		UPH2044	Crystal growth and Radiation detection Measurements	3	0	0	3
37	English	UEN2041	English for Career needs	2	0	2	3
38		UEN2042	Word power for Academic needs	2	0	2	3
39		UEN2043	Writing skills for university admission	2	0	2	3

OPEN ELECTIVE II (SEMESTER VIII)

SL. NO	DEPARTMENT OFFERING	COURSE CODE	COURSE TITLE	L	T	P	C
1	EEE	UEE2044	Cyber Security in Smart Grid	3	0	0	3
2		UEE2045	FEA and CAD for Electromagnetic design	3	0	0	3
3		UEE2046	Renewable Energy Systems	3	0	0	3
7	CSE	UCS2044	Introduction to Big Data Analytics	2	0	2	3
8		UCS2045	Machine Learning Applications	2	0	2	3
9		UCS2046	Web Technology	2	0	2	3
10	IT	UIT2047	Introduction to Cyber Security	2	0	2	3
11		UIT2048	Introduction to Software Engineering	2	0	2	3
12		UIT2049	IoT Architectures and Programming	2	0	2	3
13		UIT2051	Introduction to Deep learning	2	0	2	3
14		UIT2052	Introduction to Machine learning	2	0	2	3
15		UIT2053	Web services and DevOps	2	0	2	3
16	BME	UBM2044	Brain Machine Interface	3	0	0	3
17		UBM2045	Biomedical Physics	3	0	0	3
18		UBM2046	Telehealth Technology	3	0	0	3
19	Chemical	UCH2044	Industrial Safety	3	0	0	3
20		UCH2045	Industrial Waste Management and Audit	3	0	0	3
21		UCH2046	Energy Conservation and Audit	3	0	0	3
22	Mechanical	UME2044	Enterprise Resource Planning	3	0	0	3
23		UME2045	Project Management and Planning	3	0	0	3
24		UME2046	Introduction to Industrial Engineering	3	0	0	3
25	Civil	UCE2045	Experimental Techniques and Instrumentation	3	0	0	3

26		UCE2046	Air Pollution and Control Engineering	3	0	0	3
27		UCE2047	Remote Sensing and GIS	3	0	0	3
		UCE2048	Environmental Geo-technology	3	0	0	3
28	MBA	PBA2044	Innovation and Creativity	3	0	0	3
29		PBA2045	Intellectual Property Rights	3	0	0	3
30	Mathematics	UMA2044	Random Variables and Partial Differential Equations	2	1	0	3
31	Physics	UPH2045	Advanced Functional Materials	3	0	0	3
32		UPH2047	Astrophysics	3	0	0	3
33	English	UEN2044	Creative writing	2	1	0	3
34		UEN2045	Introduction to Children's literature	2	0	2	3