

Kolhapur Institute of Technology's
**COLLEGE OF ENGINEERING
(AUTONOMOUS)**

Gokul Shirgaon, Kolhapur



KOLHAPUR INSTITUTE
OF TECHNOLOGY'S
**COLLEGE OF
ENGINEERING
(AUTONOMOUS),
KOLHAPUR**

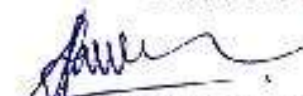
Curriculum Structure

For

**B. Tech Electronics and Telecommunication
Engineering**

Academic Year 2022-2023

Under Graduate Programme


Prof. A. R. Nigavekar
Head




Dr. A. R. Thorvat
Dean Academics

Teaching and Evaluation scheme for Second Year B. Tech. Programme in Electronics & Telecommunication Engineering Semester-III											
Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme			Evaluation Scheme				
				L	T	P	Credit	Component	Marks		
									Max	Min for Passing	
1	ES	UECC 0301	Engineering Mathematics III	3	1	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	PC	UECC 0302	Analog Circuits –I	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	PC	UECC 0303	Digital System	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	PC	UECC 0304	Network Analysis	3	1	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
5	PC	UECC 0305	Electronics Instrumentation & Measurement	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
6	PC	UECC 0306	Analog Circuits –I Lab	0	0	2	1	ISE	25	10	
								ESE (POE)	50	10	
7	PC	UECC 0307	Digital System Lab	0	0	2	1	ISE	25	10	
								ESE (POE)	50	20	
8	PC	UECC 0308	Electronics Instrumentation & Measurement Lab	0	0	2	1	ISE	25	10	
9	PC	UECC 0309	Object Oriented Programming Lab	1	0	2	2	ISE	25	10	
								ESE (POE)	50	20	
10	BS	UECA 0301	Environmental Studies (Audit Course)	2	0	0	0	ESE	100	40	
Total Contact Hrs.: 28			Total	18	2	08	22	500+250+Audit Course			

Teaching and Evaluation scheme for Second Year B. Tech. Programme in Electronics & Telecommunication Engineering Semester-IV										
Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme			Evaluation Scheme			
				L	T	P	Credit	Component	Marks	
									Max	Min for Passing
1	PC	UECC 0401	Analog Circuits –II	3	0	0	3	ISE-I	10	20
								ISE-II	10	
								MSE	30	
								ESE	50	20
2	PC	UECC 0402	Linear Integrated Circuits	3	0	0	3	ISE-I	10	20
								ISE-II	10	
								MSE	30	
								ESE	50	20
3	ES	UECC 0403	Electromagnetic Engineering	3	1	0	4	ISE-I	10	20
								ISE-II	10	
								MSE	30	
								ESE	50	20
4	PC	UECC 0404	Analog and Digital Communication	4	0	0	4	ISE-I	10	20
								ISE-II	10	
								MSE	30	
								ESE	50	20
5	ES	UECC 0405	Data Structures	3	0	0	3	ISE-I	10	20
								ISE-II	10	
								MSE	30	
								ESE	50	20
6	PC	UECC 0406	Analog Circuits-II Lab	0	0	2	1	ISE	25	10
								ESE (POE)	50	20
7	PC	UECC 0407	Linear integrated circuits Lab	0	0	2	1	ISE	25	10
								ESE (POE)	50	20
8	PC	UECC 0408	Analog and Digital Communication Lab	0	0	2	1	ISE	25	10
								ESE (OE)	25	10
9	ES	UECC 0409	Data Structures Lab	0	0	2	1	ISE	25	10
10	PW	UECC 0410	Mini Project-I	0	0	2	1	ISE	25	10
11	BS	UECA 0401	Constitution of India (Audit Course)	2	0	0	0	ESE	100	40
Total Contact Hrs. : 29				Total	18	1	10	22	500+250+Audit Course	

Teaching and Evaluation scheme for											
Third Year B. Tech. Programme in Electronics & Telecommunication Engineering Semester-V											
Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme			
				L	T	P	Credit	Component	Marks		
									Max	Min for Passing	
1	PC	UECC 0501	Antenna and Wave Propagation	4	0	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	PC	UECC 0502	Control System	3	1	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	PC	UECC 0503	Microcontroller	4	0	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	PC	UECC 0504	Antenna and Wave propagation Lab	0	0	2	1	ISE	25	10	
								ESE (POE)	50	20	
5	PC	UECC 0505	Microcontroller Lab	0	0	2	1	ISE	25	10	
								ESE(POE)	50	20	
6	PC	UECC 0506	Model based Design Lab	0	0	2	1	ISE	25	10	
								ESE(OE)	25	10	
7	PW	UECC 0507	Mini Project -II	0	0	2	1	ISE	50	20	
8	PE	UECE 05**	Program Elective I	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
9	OE	UECO 05**	Open Elective-I	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
10	ES	UECA 0501	Web Technologies (Audit Course)	2	0	0	0	ESE	100		40
Total Contact Hrs. : 28			Total	19	1	08	22	500+250+Audit Course			

Teaching and Evaluation scheme for Third Year B. Tech. Programme in Electronics & Telecommunication Engineering Semester-VI											
Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme			
				L	T	P	Credit	Component	Marks		
									Max	Min for Passing	
1	PC	UECC 0601	Embedded Systems	4	0	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	PC	UECC 0602	VLSI Design	4	0	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	PC	UECC 0603	Signals and Systems	3	1	0	4	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	PC	UECC 0604	Embedded Systems Lab	0	0	2	1	ISE	25	10	
								ESE (POE)	50	20	
5	PC	UECC 0605	VLSI Design Lab	0	0	2	1	ISE	25	10	
								ESE (POE)	50	20	
6	PC	UECC 0606	Signal Analysis and Interpretation Lab	0	0	2	1	ISE	25	10	
								ESE (OE)	50	20	
7	PW	UECC 0607	Mini-Project-III	0	0	2	1	ISE	25	10	
8	PE	UECE 06**	Program Elective –II	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
9	OE	UECO 06**	Open Elective-II	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
11	ES	UECA 0601	Design Thinking (Audit Course)	2	0	0	0	ESE	100	40	
Total Contact hrs. : 28			Total	19	1	08	22	500+250+Audit Course			

Program Elective I	
Course code	Course Name
UECE0501	Optical Fibre Communication
UECE0502	Computer Architecture and Organization
UECE0503	Multimedia Engineering
UECE0504	Mechatronics

Program Elective II	
Course code	Course Name
UECE0601	Information Theory and Coding
UECE0602	Biomedical Instrumentation
UECE0603	Automotive Electronics
UECE0604	Operating System

Open Elective-I	
Course code	Course Name
UECO0501	Exploring ARDUINO
Open Elective-II	
UECO0601	Medical Electronics

Teaching and Evaluation Scheme for											
Final Year B. Tech. Programme in Electronics & Telecommunication Engineering Semester-VII											
Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme			
				L	T	P	Credit	Component	Marks		
									Max	Min for Passing	
1	PC	UECC 0701	Power Electronics	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	PC	UECC 0702	Computer Communication Networks	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	PC	UECC 0703	RF & Microwave Engineering	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	PC	UECC 0704	Digital Signal Processing	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
5	PC	UECC 0705	Power Electronics Lab	0	0	2	1	ISE	25	10	
								ESE(POE)	25	10	
6	PC	UECC 0706	Computer Communication Networks Lab	0	0	2	1	ISE	25	10	
								ESE (POE)	25	10	
7	PC	UECC 0707	RF & Microwave Engineering Lab	0	0	2	1	ISE	25	10	
								ESE (OE)	25	10	
8	PW	UECC 0708	Project Phase-I	0	0	4	2	ISE-I	50	20	
								ISE-II	50	20	
9	PE	UECE 07**	Program Elective-III	3	0	0	3	ISE-I	10	20	40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
10	ES	UECA 0701	Industry 4.0 (Audit Course)	3	0	0	0	ESE	100	40	
Total Contact hrs. : 28			Total	18	0	10	20	500+250+Audit Course			

Teaching and Evaluation Scheme for

Final Year B. Tech. Programme in Electronics & Telecommunication Engineering Semester-VIII

Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme				
				L	T	P	Credit	Component	Marks			
									Max	Min for Passing		
1	PW	UECC 0801	Internship	0	0	4	2	ISE-I	50	20		
								ISE-II	50	20		
2	PW	UECC 0802	Project Phase-II	0	0	8	4	ISE-I	50	20		
								ISE-II	50	20		
								ESE (OE)	100	40		
3	PE	UECE 08**	Program Elective-IV*	3	0	0	3	ISE-I	10	20	40	
								ISE-II	10			
								MSE	30	20		
								ESE	50	20		
4	PE	UECE 08**	Program Elective-V*	3	0	0	3	ISE-I	10	20	40	
								ISE-II	10			
								MSE	30	20		
								ESE	50	20		
Total Contact hrs. : 18			Total	6	0	12	12	200+300				

Program Elective III	
Course code	Course Name
UECE0701	Digital Image Processing
UECE0702	CMOS VLSI
UECE0703	Real Time Systems
UECE0704	Cyber Security

Program Elective IV	
Course code	Course Name
UECE0801	System on Chip
UECE0802	Satellite Communication
UECE0803	Cloud Computing & IoT
UECE0804	Machine Learning

Program Elective V	
Course code	Course Name
UECE0805	Wireless Mobile Communication
UECE0806	Embedded Linux
UECE0807	Wireless Sensor Network
UECE0808	Control System Design
UECE0809	Deep Learning
UECE0810	Control System Design MSC

Title of the Course: Power Electronics	L	T	P	Credits
Course Code: UECC0701	3	-	-	3

Course Pre-Requisite: Electronic Devices and circuits. Network analysis, signals and systems.

Course Description:

Power Electronics course introduces the basic concepts of power semiconductor devices and power converters. The course deals with the basic analysis of ac-dc, dc-ac, dc-dc, ac-ac converters.

Course Objectives:

1. To know, identify and define the basic elements of power electronics devices and their characteristics, specifications, operation and protection.
2. To understand fundamentals of controlled rectifier.
3. To analyze working of DC-DC converters (choppers), DC-AC converters and control strategies.
4. To discuss the fundamentals of Electric Vehicles and battery management system.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Illustrate working of simple Power Electronic circuits.	II	Understanding
CO2	Analyze phase controlled converters, Choppers and Inverters.	III	Applying
CO3	Experiment applications of power electronic devices and power converters.	III	Applying
CO4	Understand Fundamentals battery management system.	II	Understanding

CO-PO Mapping:

[illegible]

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks	Minimum for Passing
ISE 1	10	20
MSE	30	
ISE 2	10	
ESE	50	20

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.MSE: Assessment is based on 50% of course content (Normally first three units)

ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (normally last three units) covered after MSE.	
Course Contents:	
Unit 1: Power Semi Conductor Devices Construction- : V-I Characteristics, Dynamic Characteristics during, turn on, turn off, gate triggering Characteristics of SCR, Two transistor analogy – SCR, Construction, working, & V-I Characteristics of Diac, Triac, Construction, working, & V-I Characteristics GTO, MOSFET, IGBT.	8 Hrs.
Unit 2: Firing and Commutation Circuits of SCR Turn On methods of SCR: R triggering circuit RC triggering circuit, UJT triggering circuit with design, Cosine based firing circuit and microprocessor based firing circuit for bridge controlled converter. SCR Turn off method: Class A, Class B, Class C, Class D, Class E, & Class F	5 Hrs.
Unit 3: AC-DC Converters (1-Phase & 3-Phase Controlled Rectifiers) Derivations of V_{dc} & V_{rms} are expected for following configuration: 1 Φ Half Wave Controlled Rectifier with R & RL load. Midpoint converter with RL load. Bridge converter with R, RL for continuous current mode of operation with and without freewheeling diode, Semi converter with RL load. Concepts of 3-phase, 3-phase half controlled and full controlled converter with RL load (continuous and discontinuous current mode of operation). Numerical based on performance parameters of above all converter.	8 Hrs.
Unit 4: DC-AC Converters (Inverters) Single phase inverter – Principle and operation of half bridge and full bridge inverters. Harmonic reduction techniques of inverter: Quasi square wave, Multiple PWM and sine wave PWM Three Phase inverters (180, 120 degrees conduction modes of operation) – Voltage control techniques for inverters. Harmonic analysis is expected. Numerical based on above.	7 Hrs.
Unit 5: Chopper Circuits Introduction to Choppers. Step down chopper with R & RL load. Step up chopper with R & RL load. Classification and quadrant operation of chopper (class A to class F). Voltage control technique of Chopper (frequency modulation & TRC.)	6 Hrs.
Unit 6: Fundamentals of Electric vehicles Introduction, ICEV – power train operation and the need of gears and clutch. EV power train, Introduction to HEV, comparison between ICEV, HEV, EV, Vehicle terminology and architectures. Energy Storage for Electric vehicles: Battery performance parameters and design of battery pack. Li ion cell- structure, varieties of Li ion battery and comparison between them, other advanced batteries for EV, structure and working of Fuel Cell energy storage, Super Capacitor, Necessity of hybridization of energy sources.	8 Hrs.
Text Books: 1. I.M.H. Rashid, “Power Electronics”, 3rd Edition, Pearson. 2. M.D. Singh, K.B. Khanchandani, “Power Electronics”, 2nd Edition, Tata- McGraw Hill.	

3. Tom Denton “Electric and Hybrid Vehicles” Routledge, 2016

Reference Books:

1. . Mohan, Undeland, Riobbins, “Power Electronics” 3rd Edition, Willey.
2. P.C.Sen, “**Power Electronics**”, Tata McGraw-Hill Education.
3. Dr. P. S. Bhimra “Power Electronics” Khanna Publications.

Title of the Course: Computer Communication Network Course Code: UECC0702		L	T	P	Credit							
		3	-	-	3							
Course Pre-Requisite: Basics of Analog & Digital Communication System.												
Course Description: This course provides an introduction to Computer Networking. This Course deals with different types of topologies, Models, Functions of layers, protocols and algorithms of layers. It also discusses TCP/IP Protocol suite.												
Course Objectives: The course aims to 1. Introduce various topologies, types, devices and layered models in computer networking. 2. Expose the students to the design issues, standards and protocols at various layers. 3. Discuss the TCP/IP protocol suite.												
Course Learning Outcomes: Upon successful completion of this course, the student will be able to												
CO	After the completion of the course the student should be able to	Bloom's Cognitive										
		Level		Descriptor								
CO1	Distinguish between various network topologies, types, OSI and TCP/IP models.	Comprehension		Describe								
CO2	Explain the various roles, characteristics, and protocols of the physical layer and data link layer.	Analysis		Analyze								
CO3	To Understand the concepts of protocols, network interfaces, Routing algorithms and design/performance issue's in networks.	Analysis		Analyze								
CO4	Analyze the various roles, characteristics and protocols of transport and application layer.	Comprehension		Describe								
CO-PO Mapping:												
CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	1	1	1	-	-	-	-	-	-
2	2	3	3	1	1	1	-	-	-	-	-	-
3	1	2	2	2	1	1	-	-	-	-	-	-
4	2	2	3	1	1	1	-	-	-	-	-	-

Assessments :**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks	Minimum for Passing
ISE 1	10	20
MSE	30	
ISE 2	10	
ESE	50	20

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Introduction: Computer Networks, Network Hardware, Network Software, OSI & TCP/IP Reference models, ARPANET, Frame Relay, Introduction to Internet, ATM, Network devices: Hub, Bridge, Repeaters, Switch (Layer 2 & Layer 3), Router & Gateway, Addressing: Physical addresses, Logical addresses, Port Addresses..	6 Hrs.
Unit 2:--- Physical Layer: Data Communication concepts, Wired and Wireless transmission media, Transmission Impairments and Performance, Parallel and Serial Transmission, Switching, Circuit Switching, Packet Switching, and Virtual Circuit Switching	6 Hrs.
Unit 3:--- Data Link Control: Data Link Layer: Data link layer Design Issues, Framing, Error Detection and Correction, Flow Control, Sliding Window Protocols, HDLC, SLIP, and PPP. Medium Access Control Sublayer: Channel Allocation, Description and Analysis of ALOHA, Slotted ALOHA, CSMA, CSMA/CD, IEEE LAN Standards: Ethernet (802.3), Gigabit Ethernet, Wireless LAN (802.11), Broadband Wireless (802.16), Bluetooth	7Hrs.
Unit 4:--- Network Layer: Design issues, Routing Algorithms- shortest path, distance vector routing, link state routing, flow based routing, routing for mobile hosts, congestion control- congestion prevention policies- leaky bucket and token bucket algorithm, congestion control in virtual circuit subnet and choke packets.	7Hrs.
Unit 5:--- TCP/IP Protocol Suite: TCP/IP and internet, IP protocol and its header format, addressing, subnetting, other network layer protocols – ARP, RARP, ICMP, IGMP, Transport Layer Protocols: TCP, UDP	6Hrs.
Unit 6:--- Application Layer: Domain Name System, SMTP, FTP, HTTP, WWW, SNMP, Multimedia and Cryptography.	6 Hrs

Textbooks: Text Books

- 1) Computer Networks Andrew S. Tanenbaum, Fourth Edition, PEARSON
- 2) Data Communication and Networking, Fifth Edition, Behrouz A. Forouzan, TMH
- 3) TCP/IP Protocol Suite, Fourth Edition, Behrouz A. Forouzan, MGH
- 4) T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall

References:

- 1) Computer Networking with Internet Protocols and Technology, William Stallings, 2008
- 2) Computer Networking A top down approach, James F. Kurose, Person, Fifth Edition
- 3) S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education
- 4) D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall

Course Learning Outcomes:

At the end of this course student will be able to-

1. Differentiate types of networks and topologies.
2. Distinguish OSI and TCP/IP Reference models.
3. Explain the various roles, characteristics, and protocols of the physical layer and data link layer.
4. Analyze the various routing algorithms and protocols of the network layer.
5. Analyze the various roles, characteristics and protocols of transport and application layer.

Assessment	Marks	Minimum for Passing
ISE 1	10	20
MSE	30	
ISE 2	10	
ESE	50	20

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Microwave Wave Guides. Rectangular and circular wave guides: TE, TM and TEM modes in wave guides, power transmission in wave guide, power losses in wave guide, excitation modes in wave guide, Characteristics of standard wave guides.	6Hrs
Unit 2:--- Microwave Components. Scattering parameters, microwave cavities, microwave hybrid circuits, directional coupler, two hole directional coupler, circulators and isolators, microwave attenuators(fixed and Variable Type), slotted lines, parallel, coplanar & shielded micro strip lines.(Operating principle & S-parameter equations of above mentioned microwave components.)	7 Hrs
Unit 3:--- Microwave Tubes. Linear beam: Klystrons, Reflex Klystrons, TWTs.Magnetron (Operating principle, construction & analytical treatment of above mentioned microwave tube. Working of microwave Oven using Magnetron.	6 Hrs
Unit 4:--- Microwave Solid State Devices. Microwave tunnel diodes, microwave FETs, Gunn effect diodes, RWH Theory, Varactor Diode , PIN diodes, MESFETs and HEMT.(Operating principle, construction & analytical treatment of above mentioned microwave devices.)	7Hrs
Unit 5:--- Microwave Measurements and Microwave Applications. Detection of microwave power: measurement of microwave, power bridge circuit, thermistor parameters, and waveguide thermistor mounts, barreters, theory of operation of barreters, direct reading barreters bridges, Measurement of wavelengths: single line cavity coupling system, Transmission cavity wavemeter & reaction wavemeter, measurement of VSWR, measurements of attenuation, free space attenuation, ISM Applications.	6Hrs
Unit 6:--- Monolithic Microwave Integrated Circuits & Hazards. Materials: substrate, conductor dielectric & resistive MMIC growth, MOSFET Fabrication Thin Film Formation, Hybrid Integrated Circuit Fabrication , Microwave hazards: HERO, HERF & HERP.	4Hrs

Textbooks:
1) Microwave Engineering: Sushrut Das, Oxford Publication
2) Microwave Devices and Circuit – Samul Liao (Prentice hall of India)
3) Microwave Engineering-Annapurna Das ,TMH Publication

References:
1) Foundation for Microwave Engg. – R.E.Collin, Wiley Publications
2) Microwave Engineering-David M. Pozer., Wiley Publications

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|---|
| 3) Techniques of Microwave Measurement-Carol G. Montgomery
4) Microwave Active Devices vacuum and solid state – M.L. Sisodia
5) Basic laboratory microwave techniques- Manual, Sisodia and Raghuvanshi Wiley
6) Microwave Engineering:Dr.K.T.MathewsWiley Publications |
| Unit wise Measurable students Learning Outcomes:
After the completion of the course the student should be able to
1) Distinguish various TE and TM modes in Waveguides.
2) Distinguish various Microwave components.
3) Describe various types of Microwave Tubes.
4) Illustrate various types of Microwave Solid state devices.
5) Demonstrate different types of Microwave measurement techniques.
6) Describe MMIC fabrication techniques & various microwave hazards. |

	ESE	50	20	
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (normally last three modules) covered after MSE.				
Course Contents:				
Unit 1:--- Discrete Fourier Transform & FFT Algorithms: Overview of DFT , Fast Fourier transform algorithms – Radix -2 DIT , DIF , Filtering of long duration sequences using overlap-Add and Overlap-save algorithm.				06Hrs.
Unit 2:--- wavelet Transform : Fourier Transform and its limitations , short time Fourier transform, continuous wavelet Transform , Discretization of the continuous wavelet Transform, Multi resolution Ap- proximations; wavelet and Scaling function coefficients, Orthogonality of compactly sup-ported wavelets , Biorthogonal decomposition , harr wavelets , the daubechies wavelets construction , denoising using wavelets , perfect reconstruction filter bank design using walelets.				07 Hrs.
Unit 3:--- FIR Filter Design : Characteristic of FIR filter , properties of FIR filter , type of FIR filter Fourier series method, frequency sampling , Fourier series & windowing method.				07 Hrs.
Unit 4:--- IIR Filter Design: Analog filters approximations Butterworth filters, Chebyshev filters mapping of s-plane to z-plane, filter stability, characteristics of discrete time IIR filter , Design of IIR using Impulse Invariance Method , Bilinear Z- Transform method, Placement of poles & zeros , Frequency Transformation.				06 Hrs.
Unit 5:---Realization of filter : FIR and IIR filter realization in cascade form and parallel form, effect of finite word length on redirection of filter. Introduction to DSP processor 67XX: Introduction, TMS320C67XX Architecture, Functional Units, pipelining, Registers, Addressing modes.				9 Hrs.
Unit 6:--- Multi-rate digital signal processing : Need of Multirate digital signal processing , decimation by factor D, two stage decimator, interpolation by factor I , two stage Interpolator , sampling rate conversion by initial factor I by D, application of multirate signal processing.				05 Hrs.
Textbooks: 1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.				
References: 1. Emmanuel C..Ifeachor, & Barrie.W.Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002. 2. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007. 3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, “Discrete-Time Signal Processing”, 8th Indian Reprint, Pearson, 2004. 4. Andreas Antoniou, “Digital Signal Processing”, Tata Mc Graw Hill, 2006.				

Unit wise Measurable students Learning Outcomes:

1. **Comprehend** the principles of wavelet transform, DFT and FFT.
2. **Apply** the fundamentals of DSP to **analyze** the performance of FIR and IIR filter design
3. **Compare and contrast** difference between FIR and IIR filter design.
4. **Design** the decimation and interpolation of circuits for DSP

Title of the Course: Power Electronics LAB Course Code : UECC705		L	T	P	Credit									
		-	-	2	1									
Course Pre-Requisite: Basic knowledge of Electronic devices and circuits, Network analysis. Signals and Systems.														
Course Description: Power Electronics Lab course demonstrate the basic power devices and power converters which is the foundation for power transmission, distribution and utilization of the Electrical Engineering discipline. The course deals with the basic analysis of ac-dc, dc-ac, dc-dc converters and fundamentals of Electric Vehicles.														
Course Objectives: 1. To know, identify and define the basic elements of power electronics devices and their characteristics, specifications, operation and protection. 2. To understand fundamentals, phase controlled rectifiers (1ph and 3ph) and line commutated inverters. 3. To have the ability to analyze working of DC-DC converters (choppers), DC-ACconverters and control strategies. 4. To discuss the important applications of power devices and provide critical evaluation, of the mostcommon types of dc-dc, ac-dc and dc-ac converters 5. To discuss fundamentals of Electric Vehicles and Battery Management system.														
Course Learning Outcomes:														
CO	After the completion of the course the student should beable to		Bloom“s Cognitive											
			level	Descriptor										
CO1	Demonstrate simple Power Electronic circuits.		II	Understanding										
CO2	Develop the practical skills in analysis of basic phase con- trolled converters, Choppers and Inverters.		III	Applying										
CO3	Demonstrate the various applications of power electronic devices and power converters.		II	Understanding										
CO4	Understand Basics of Electric Vehicles.		II	Understanding										
CO-PO Mapping:														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3								2				2	
CO2	3	3	3											3
CO3	2									2				
CO4	1						3						3	
Assessments :														
Teacher Assessment:														
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and50% weights respectively.														
Assessment										Marks				
ISE										25				
ESE(POE)										25				
ISE are based on practical performed/ Quiz/ Lab assignments/ Presentations/ Group Discussions/ Internaloral etc.														
ESE: Assessment is based on oral examination and lab experimentation.														

Course Contents:	
Experiment No. 1:--- Aim and Objectives: To Study of VI characteristics of SCR. Outcomes: The students will be able to plot V-I Characteristics of the SCR for the Forward Theoretical Background: Theory of V-I characteristics of diode. Experimentation: Characteristics of SCR. Results and Discussions: Observed and noted analysis Parameters Conclusion: Implemented circuit and observed the result	2Hrs.
Experiment No. 2:--- Aim and Objectives: To Study of Triggering circuits of SCR. Outcomes: The students will be able to demonstrate working of different triggering circuits of SCR. (R, R-C, UJT Triggering circuits) Theoretical Background: Theory of Triggering methods of SCR. Experimentation: Triggering methods of SCR. Results and Discussions: Observed Waveforms and noted analysis Parameters. Conclusion: Implemented circuit and observed the result.	2Hrs.
Experiment No. 3:--- Aim and Objectives: Commutation method of SCR Outcomes: The students will be able to demonstrate working of commutation technique of SCR by observing waveforms. Theoretical Background: Theory and operation of commutation techniques of SCR. Experimentation: Analysis of commutation techniques of SCR. Results and Discussions: Observed Waveforms and noted analysis Parameters Conclusion: Implemented commutation circuit.	2Hrs.
Experiment No. 4:--- Aim and Objectives: To Study step-down chopper. Outcomes: The students will be able to demonstrate working of step-down chopper. Theoretical Background: Theory and operation step-down chopper. Experimentation: Analysis and implementation of step-down chopper. Results and Discussions: observed Waveforms and noted analysis Parameters Conclusion: Implemented step-down chopper.	2Hrs.
Experiment No. 5:--- Aim and Objectives: To Study single phase HWR with R and RL load. Outcomes: The students will be able to demonstrate working of single phase HWR. Theoretical Background: Theory and operating principle single phase HWR for R and RL load. Experimentation: Analysis of out waveforms and o/p voltage for R and RL load. Results and Discussions: Observed Waveforms and noted analysis Parameters. Conclusion: Implemented single phase HWR.	2Hrs.
Experiment No. 6:--- Aim and Objectives: To Study of single phase FWR with R and RL load. Outcomes: The students will be able to demonstrate working of single phase FWR. Theoretical Background: Theory and operation principle single phase FWR. Experimentation: Analysis of out waveforms and o/p voltage for R and RL load. Results and Discussions: observed Waveforms and noted analysis Parameters Conclusion: Implemented FWR for R and RL Loads.	2Hrs.

Experiment No. 7:--- Aim and Objectives: To Study of single phase semiconverter with R and RL load. Outcomes: The students will be able to demonstrate working of single phase FWR. Theoretical Background: Theory and operation principle single phase FWR. Experimentation: Analysis of out waveforms and o/p voltage for R and RL load. Results and Discussions: Observed Waveforms. Conclusion: Implemented semiconverter for R and RL Loads.	2Hrs.
Experiment No. 8:--- Aim and Objectives: Three Phase Fully Controlled Converter Outcomes: The students will be able to demonstrate working principle of 3-phase Fully Controlled Converter.	2Hrs.
Experiment No.9 :--- Aim and Objectives: Single Phase PWM Bridge Inverter Outcomes: The students will be able to demonstrate working principle of Single Phase PWM Bridge Inverter.	2Hrs.
Experiment No. 10:--- Aim and Objectives: To study Battery Management system. Outcomes: The students will be able to demonstrate working principle Battery Management system.	2Hrs.
Note: Any two experiments should be conducted using simulation.	

Course Contents:	
Experiment No. 1:--- Aim and Objectives: Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool. Outcomes: Knowledge about physical mediums Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 2:--- Aim and Objectives: Study of basic network command and Network configuration commands. Outcomes: Knowledge about networking commands Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 3:--- Aim and Objectives: Configuration of various types of LAN Outcomes: Knowledge about LAN Configuration Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 4:--- Aim and Objectives: Performing an Initial Switch Configuration Outcomes: Knowledge about switch configuration Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 5:--- Aim and Objectives: Performing an Initial Router Configuration Outcomes: Knowledge about Router configuration Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 6:--- Aim and Objectives: Configuring RIP Outcomes: Knowledge about RIP Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.

Experiment No. 7:--- Aim and Objectives: Configuring a DHCP Server Outcomes: Knowledge to configure DHCP Theoretical Background: IJ Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 8:--- Aim and Objectives: Configuring a FTP Server Outcomes: Knowledge to configure FTP Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No.9 :--- Aim and Objectives: Configure network Topology using Distance vector Routing protocol Outcomes: Knowledge about Distance vector Routing protocol Theoretical Background: IJ Experimentation: IJ Results and Discussions: IJ Conclusion: IJ	2Hrs.
Experiment No. 10:--- Aim and Objectives: Configure network Topology using Link State vector Routing protocol Outcomes: Knowledge about Link State vector Routing protocol Theoretical Background: Experimentation: Results and Discussions: Conclusion:	2Hrs.
Textbooks: 5) Computer Networks Andrew S. Tanenbaum, Fourth Edition, PEARSON 6) Data Communication and Networking, Fifth Edition, Behrouz A. Forouzan, TMH 7) TCP/IP Protocol Suite, Fourth Edition, Behrouz A. Forouzan, MGH 8) T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall	
References: 5) Computer Networking with Internet Protocols and Technology, William Stallings, 2008 6) Computer Networking A top down approach, James F. Kurose, Person, Fifth Edition 7) S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education 8) D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall	

Experiment wise Measurable students Learning Outcomes:

1. Knowledge about physical mediums
2. Knowledge about networking commands
3. Knowledge about LAN Configuration
4. Knowledge about switch configuration
5. Knowledge about Router configuration
6. Knowledge about RIP
7. Knowledge to configure DHCP
8. Knowledge to configure FTP
9. Knowledge about Distance vector Routing protocol
10. Knowledge about Link State vector Routing protocol

Title of the Course: RF & Microwave Engineering Lab Course Code: UECC0707		L	T	P	Credit
		-	-	2	1
Course Pre-Requisite: Basic knowledge of Maxwell's equations.					
Course Description: Course deals with different types of Microwave tubes. Different types of waveguides and modes. Also we discuss different microwave measurements techniques.					
Course Objectives: The course aims to: 1. Introduce the students about various microwave Devices, amplifiers and oscillators to know their applications in various domains. 2. Introduce different microwave junctions and use them to measure some parameters.					
CO	After the completion of the course the student should be able to	Bloom's Taxonomy			
		level	Descriptor		
CO1	Illustrate different microwave devices.	Understanding	Illustrate		
CO2	Select different devices for microwave measurement Techniques.	Applying	Select		
CO3	Classify microwave component for various applications.	Understanding	Classify		

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		2		2						2		1	1	
CO2		2								2		1	1	
CO3	1	2		2						2		1	1	

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion Internal oral etc.

ESE: Assessment is based on oral examination

Assessment	Marks
ISE	25
ESE(OE)	25

Lab Contents:	
Experiment No. 1:--- Aim: Experiment on studying different microwave components. Objectives: Understand analysis and working of each component. Outcomes: S- matrix analysis. Theoretical Background: Properties of S-matrix. Experimentation: Results and Discussions: Conclusion: We discuss different types of components with properties of S-matrix.	02 Hrs.
Experiment No. 2:--- Aim: Experiment on characteristics of Klystron Tube. Objectives: Understand working of Klystron tube. Outcomes: Plotting characteristics. Theoretical Background: Working of Bunching Process. Experimentation: Results and Discussions: We study Applegate diagram. Conclusion: We understand bunching process.	02 Hrs.
Experiment No. 3:--- Aim: Experiment on studying E-plane Tee. Objectives: Demonstrate working of E-plane Tee. Outcomes: Show how it works as Subtractive Tee. Theoretical Background: Properties of S-matrix. Experimentation: Results and Discussions: To see how S-matrix of E-Plane Tee works. Conclusion: We observed output as in opposite phase.	02 Hrs.
Experiment No. 4:--- Aim: Experiment on studying H-plane Tee. Objectives: Demonstrate working of H-plane Tee. Outcomes: Show how it works as Additive Tee. Theoretical Background: Properties of S-matrix. Experimentation: Results and Discussions: To see how S-matrix of H-Plane Tee works. Conclusion: We observed output as in phase.	02Hrs.
Experiment No. 5:--- Aim : Experiment on studying Magic Tee. Objectives: Demonstrate working of Magic Tee. Outcomes: Show how it works as Additive and Subtractive Tee. Theoretical Background: Properties of S-matrix. Experimentation: Results and Discussions: To see how S-matrix of Magic Tee works. Conclusion: We observed output as in phase and out of opposite phase.	02 Hrs.
Experiment No. 6:--- Aim: Experiment on char. of Gunn diode. Objectives: Demonstrate working of Gunn diode. Outcomes: Observed output of Gunn Diode. Experimentation: Results and Discussions: Conclusion: In this, by observing output characteristics, we study Gunn Diode.	02Hrs.
Experiment No. 7:---	

Aim: Experiment on HFSS. Objectives: Demonstrate FSS software. Outcomes: Design rectangular waveguide. Theoretical Background: Working of Waveguides. Experimentation: Results and Discussions: Conclusion: We design rectangular waveguide.	02 Hrs
Any 4 Experiments from Virtual Lab.	02 Hrs
Textbooks: 1) Microwave Engineering: Sushrut Das, Oxford Publication 2) Microwave Devices and Circuit – Samul Liao (Prentice hall of India) 3) Microwave Engineering-Annapurna Das ,TMH Publication	
References: 1) Foundation for Microwave Engg. – R.E.Collin, Wiley Publications 2) Microwave Engineering-David M. Pozer., Wiley Publications 3) Techniques of Microwave Measurement-Carol G. Montgomery 4) Microwave Active Devices vacuum and solid state – M.L. Sisodia 5) Basic laboratory microwave techniques- Manual, Sisodia and Raghuvanshi Wiley 6) Microwave Engineering:Dr.K.T.MathewsWiley Publications	
Experiment wise Measurable students Learning Outcomes: After the completion of Lab, the student should be able to:	
1) Study of different microwave components.	
2) Working of Klystron Tube.	
3) Study how E- Plane Tee works as Subtractive Tee.	
4) Study how H- Plane Tee works as Additive Tee.	
5) Study how Magic Tee works as Subtractive and Additive Tee.	
6) Working of Gunn Diode.	
7) Designing of Rectangular Waveguide using H.F.S.S.	

Title of the Course: Project – I Course Code:UECC0708	L	T	P	Credits
	-	-	4	2

Course Pre-Requisite: knowledge of micro-projects and mini-projects, Matlab, protius, KIEL, Tinkercad etc

Course Description:

The project-I is a capstone experience in which students integrate and apply knowledge and skills acquired in earlier units to a substantial real-world design challenge relevant to their discipline. Students work in teams, typically with four members, and are supervised by an academic and/or industry mentor. Teams are responsible for managing their project as well as reporting against milestones and preparing the necessary design documentation. The academic objectives of the project are to lead students through a systematic engineering design and synthesis process and to better prepare them for professional practice as engineers. The focus of the unit is on teamwork, skills, lifelong learning and the design process.

Course Objectives:

1. To apply engineering knowledge in practical real time problem solving
2. To foster innovation in design of products, processes or systems
3. To develop creative thinking in finding viable solutions to engineering problems

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Identify innovative research ideas, question or problem to formulate a research hypothesis for a complex engineering problem.	I	Identify
CO2	Design and demonstrate appropriate research methodologies for a complex engineering problem.	V	Design, Demonstrate
CO3	Apply appropriate modern tools to execute the project work.	III	Applying
CO4	Evaluate application of project work with appropriate societal consideration.	VI	Evaluate
CO5	Develop presentation and interpersonal communication skills through project work.	III	Develop
CO6	Analyze ethical practices and tools used for different technologies.	IV	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2								2		
CO2	3	2	2	2								2	2	2
CO3	2	2			3							2		
CO4						2	2							
CO5	1		2						2	2		1		
CO6	1	2						3				1		

Assessments :**Teacher Assessment:**

ISE components are synopsis presentation, design methodology, final presentation of detailed system design etc.

Assessment	Marks
ISE-I	50
ISE-II	50

ISE is based on Identification of Problem Domain and Detailed Analysis, Study of the Existing Systems, Feasibility of Project Proposal, Objectives, and Methodology of the Proposed Work, Design Methodology and project report.

ESE (OE): Assessment is based on work done in entire semester – I, project group should give the presentation of complete work done in semester - I

Course Contents:

1. The project work is to be carried out in two semesters of B. Tech. (Electronics & Telecommunication Engg.) i.e. Semester 7 & semester 8.
2. The practical batch for project shall be of maximum 16 students. The batch will be preferably divided into groups, each consisting of not more than 4 students.
3. In semester – 7, the group will select an innovative project with the approval of the guide and submit the synopsis of project compulsory in the 7th or 8th week of the semester.
4. The group is expected to complete **problem identification, literature survey, feasibility of project proposal, detail system design with component values, objectives and methodology of proposed work , layout, PCB etc.** in semester – 7, as a part of ISE.
5. In addition all students of project group will deliver a seminar on latest topics related to proposed project and submit the joint seminar report consisting of Literature survey, basic proposed project work and the size of the report should be at least 30 pages.
6. ISE comprises of **Identification of Problem Domain and Detailed Analysis, Study of the Existing Systems, Feasibility of Project Proposal, Objectives, Methodology of the Proposed Work, Design Methodology and project report.**

Note: The group should compulsorily maintain a logbook of progress of the project activities. The logbook should have entries related to the work done, problems faced, solution evolved etc. duly signed by internal guide.

Title of the Course: DIGITAL IMAGE PROCESSING	L	T	P	Credit
Course Code: UECE0701	3	-	-	3

Course Pre-Requisite:

Signals and systems, Digital Signal Processing.

Course Description:

This course intends to provide the fundamentals and different levels of processing of digital images. The course introduces the steps and components of image processing, how images are acquired, sampled, quantized and the relationship between pixels. In image enhancement and restoration both spatial and frequency domain techniques are utilized. Segmentation techniques explained with edge detection and morphological processing. This course also addresses the compression techniques and standards for efficient storage.

Course Objectives:

- 1) To describe basic concepts of digital image processing.
- 2) To describe and implement various methods for image enhancement and recognition.
- 3) To explain concept of image segmentation and compression.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain basic concepts of information theory and entropy coding.	Comprehension	Describe
CO2	Mathematically analyze communication channel models.	Application	Apply
CO3	Analyze the error detecting and correcting capability of coding scheme.	Application	Apply
CO4	Design encoder and decoder for various coding techniques as per the need and specification.	Application	Apply

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks	Minimum for Passing
ISE 1	10	20
MSE	30	
ISE 2	10	
ESE	50	20

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- UNIT I: Digital Image Fundamentals: Image sensing and acquisition, Basic concept of sampling and quantization, Representations of digital image. Spatial and gray level resolution. Metric & topological properties of digital image, color fundamentals, color models.	06 Hrs.
Unit 2:--- Image enhancement in spatial domain : Gray level transformation function: image negation, Log transformation, power law transformation, Piecewise linear transformation functions, Histogram equalization, Enhancement using arithmetic / Logic operation.	06 Hrs.
Unit 3:--- Image filtering : Basics of spatial filtering, smoothening, sharpening, Gradient and Laplacian filter, Filtering in frequency domain: basic properties, filtering in frequency domain.	06 Hrs.
Unit 4:--- Morphological image processing : Dilation & erosion, opening and closing operation, Hit- or –miss transformation, Morphological algorithms: Boundary extraction, region filling, thinning and thickening.	06 Hrs.
Unit 5:--- Image segmentation: Detection of discontinuities: Point detection, line detection, edge detection, Sobel, Prewitt, Laplacian mask for edge detection, Thresholding, Region based segmentation: region growing, region splitting and merging.	06 Hrs.
Unit 6:--- Image compression : Fundamentals, coding redundancy, interpixel redundancy, fidelity criteria, lossless predictive coding, Lossy predictive coding, DCT compression, JPEG 2000 standard.	06 Hrs.
Textbooks: 1) Digital Image Processing - Rafael C Gonzalez, Richard E.Woods: Pearson Publication 2) Fundamentals of Digital Image Processing - Anil K.Jain 3) Digital Image Processing and Analysis- B. Chanda , D. Dutta Majumder	
References: 1) 1. Digital Image Processing - S. Jayraman, S Esakkirajan, Veerakumar: MGH 2) Digital Image Processing using Matlab - Rafael C Gonzalez. 3) Fundamentals of Digital Image Processing - S.Annadurai, R. Shanmugalaxmi: Pearson Publication 4) Digital Image Processing –Pratt 5) Image Processing Analysis and Machine vision - Milan Sonka, Vaclav Hlavac: Thomson	
Unit wise Measurable students Learning Outcomes: 1. Describe fundamental concepts in digital image processing. 2. Apply image enhancement techniques to a grey level image. 3. Describe different filters used in image processing. 4. Understand the morphological operators in image processing. 5. Explain various discontinuities and methods for image segmentation. 6. Describe the basics of image compression.	

Title of the Course: CMOS VLSI Design Course Code: UECE0702										L	T	P	Credit	
										3	-	-	3	
Course Pre-Requisite: Student should have knowledge of Basics of Transistors, FET, MOSFET, and Principles of Digital Design.														
Course Description: This course gives an introduction to CMOS VLSI Design aspects, Circuitformations, Problems and Advantages associated with CMOS.														
Course Objectives: 1. To understand the MOS Transistor Basics and its construction. 2. To introduce the concepts CMOS and its Variants. 3. To Understand construction of different circuits, subsystems using CMOS Technology.														
Course Learning Outcomes:														
CO	After the completion of the course the student should be able to										Bloom''s Taxonomy			
											level	Descriptor		
CO1	Explain the structure of CMOS										II	Understanding		
CO2	Illustrate different parameters in CMOS design										II	Understanding		
CO3	Design and Test CMOS circuits using different Strategies.										VI	Creating		
CO4	Design subsystems using CMOS.										VI	Creating		
CO-PO Mapping:														
CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2													
CO2		2												
CO3			3										1	1
CO4			3										1	1
Assessments :														
Teacher Assessment:														
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and oneEnd Semester Examination (ESE) having 20%, 30% and 50% weights respectively. ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with60-70% Weightage for course content (nor- mally last three modules) covered after MSE.														
Assessment										Marks	Minimum for Passing			
ISE 1										10	20			
MSE										30				
ISE 2										10				
ESE										50	20			

Course Contents:	
Unit 1:--- INTRODUCTION MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Rep-resentations, MOS Transistor Theory - Introduction MOS Device Design Equations,The Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters,The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices.	5 Hrs
Unit 2:- CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION Introduction, Resistance Estimation Capacitance Estimation, Inductance, Switching Characteristics, CMOS-Gate Transistor Sizing, Power Dissipation, Sizing RoutingConductors, Charge Sharing, Design Margining, Reliability.	8 Hrs.
Unit 3:--- CMOS CIRCUIT AND LOGIC DESIGN CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design.	5 Hrs.
Unit 4:--- SYSTEM DESIGN AND DESIGN METHOD Design Strategies CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, Design Economics, Data Sheets.	8 Hrs.
Unit 5:--- TESTING CMOS Testing - Manufacturing Test Principles, Design Strategies for Test, Chip Level Test Techniques, System Level Test Techniques, Layout Design for Improved Testability.	4 Hrs.
Unit 6:--- CMOS SUB SYSTEM DESIGN Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.	6 Hrs.
Textbooks: 1. Nell H. E. Weste and Kamran Eshraghian, " Principles of CMOS VLSI Design ", Addison Wesley, II nd edition .	
References: 1. John P . Uyemura “ Introduction to VLSI Circuits and Systems ”, Wiley IndiaEdition 2. Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998.	
Unit wise Measurable students Learning Outcomes: 1. Student would be able to explain what the structure of CMOS is. 2. Student would be able to explain characterization of CMOS and different performancemeasures. 3. Student would be able to design basic logic circuits in CMOS. 4. Student would be able to identify different tools required for CMOS design. 5. Student would be able to explain different testing techniques for CMOS. 6. Student would be able to design different subsystems using CMOS.	

	Assessment	Marks	Minimum for Passing
	ISE 1	10	20
	MSE	30	
	ISE 2	10	
	ESE	50	20

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- Introduction to real time computing, Structure of real time system, Task classes, Characterizing Real Time Systems and Tasks: Performance measures for real time machines, estimating program run times.	5 Hrs.
Unit 2: Task Assignment and Scheduling : Classical uni-processor scheduling algorithms, uni-processor scheduling of IRIS tasks, task assignment, mode changes, fault tolerant scheduling.	6Hrs.
Unit 3:- Programming Languages and Tools : Desired languages characteristics, data typing, control structures, facilitating hierarchical decomposition, packages, run time errors handling, overloading and generics, multitasking, low programming, task scheduling, timing specification, some experimental languages, programming environments, run time support.	5 Hrs.
Unit 4: Real Time Databases Basic definitions, real time vs general purpose databases, main memory databases, transaction priorities, transaction aborts, concurrency control issues, disk scheduling algorithms, a two phase approach to improve predictability, maintaining serialization consistency, database for hard real time systems.	5 Hrs.
Unit 5: Fault Tolerance Techniques : Fault types, fault detection, fault and error containment, redundancy, Data diversity, Reversal checks, malicious or Byzantine failures, Integrated failure handling, Integrated failure handling.	6 Hrs.
Unit 6: Reliability Evaluation Techniques Reliability models for hardware redundancy, software error models, taking time into account. Clock Synchronization : Clock, nonfault tolerant, synchronization algorithm, impact of faults, fault tolerant, synchronization in hardware, synchronization in software .	5 Hrs.

Textbooks:
1. Real Time Systems – By C.M.Krishna, Kang G. Shin (McGraw Hill International Edn.)
2. Real Time Systems – By Jane W.S.Liu, (Peasson Education Asia, 2001).

References:
1. Giorgio C. Buttazzo , “Hard real-time computing systems: predictable scheduling algorithms and applications” , Springer, 2008.
2. C. Siva Ram Murthy, G. Manimaran, “Resource management in real-time systems and networks”, PHI, 2009.

Unit wise Measurable students Learning Outcomes:

Students will be able

1. To understand characteristics of Real time systems
2. To understand the basic of tasks and scheduling
3. To understand programming languages and databases
4. To analyze real time communication
5. To analyze evaluation techniques and reliability models for Hardware Redundancy
6. To understand clock synchronization

Title of the Course: Cyber Security		L	T	P	Credit							
Course Code: UECE0704		3	-	-	3							
Course Pre-Requisite: Web Technology, Software skills. operating systems												
Course Description: The cyber security course syllabus is designed to focus on risk management, network security, security operations, software development, and also on practical applications of cyber security. The goal of the course is to educate students about the importance of cyberspace, alongside different legal and social challenges associated with it. Also learn about different legal remedies offered to citizens under the Information Technology Act.												
Course Objectives: The course aims to 1. Understand Cyber security. issues and challenges 2. Study of Cyber crime and Cyber law 3. Digital Devices Security , Tools and Technologies for Cyber Security 4. E-Commerce security, Digital Devices Security												
Course Learning Outcomes: Upon successful completion of this course, the student will be able to												
CO	After the completion of the course the student should be able to	Bloom’s Cognitive										
		Level		Descriptor								
CO1	To Understand Issues and challenges of cyber security	Comprehension		Describe								
CO2	To Study of Cyber crime and Cyber law	Comprehension		Describe								
CO3	To Understand Types of Social media, Social media platforms for cyber security	Comprehension		Describe								
CO4	To Study E-Commerce security, Digital Devices Security and best practices	Comprehension		Describe								
CO-PO Mapping:												
CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	1	1	1	1	-	-	-	-	-	-
2	2	2	2	1	1	1	-	-	-	-	-	-
3	2	2	2	1	1	1	-	-	-	-	-	-
4	2	2	2	1	1	1	-	-	-	-	-	-

Assessments :**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks	Minimum for Passing
ISE 1	10	20
MSE	30	
ISE 2	10	
ESE	50	20

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:**Unit 1:--- Introduction to Cyber security.**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance Internet society, Regulation of cyberspace, Concept of cyber security.

6 Hrs.**Unit 2:--- Issues and challenges of cyber security.**

Basic checklist, privacy and security settings for popular Social media platforms, Reporting and redressal mechanism for violations and misuse of Social media platforms, legal aspects and best practices for the use of Social media platforms.

6 Hrs.**Unit 3:--- Cyber crime and Cyber law**

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime.

8 Hrs.**Unit 4:---. Social Media Overview and Security**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies

8 Hrs.**Unit 5:--- E - Commerce and Digital Payments**

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets.

6 Hrs.**Unit 6:---. Digital Devices Security , Tools and Technologies for Cyber Security**

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software,

8 Hrs.

Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.	
Textbooks: Text Books 1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010. 2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)	
References: 1. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001) 2. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd. 3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers. 4. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd. Fundamentals of Network Security by E. Maiwald, McGraw Hill.	
Unit wise Measurable students Learning Outcomes: 1. To understand the concept of Cyber security and issues and challenges associated with it. 2. To understand the cyber crimes, their nature, legal remedies 3. Students should be able to appreciate various privacy and security concerns on online Social media Processing 4. Students would be able to understand the basic concepts related to E-Commerce and digital payments. 5. To understand the basic security aspects related to Computer and Mobiles.	

Title of the Course: Industry 4.0	L	T	P	Credit
Course Code:UECA0701	2	-	-	-

Course Pre-Requisite: Nil. No prior technical background is required.

Course Description:

The world is at the onset of the Fourth Industrial Revolution and this revolution is very much driven by the smarts in automating decision making and processes. Advancements in IT has resulted in immense improve-ments in computational power across nearly all electronic devices and enhanced capabilities in connecting the dots in an increasingly networked society. This course provides a comprehensive coverage on, among others, the role of data, manufacturing systems, various Industry 4.0 technologies, applications and case studies. In particular, we also draw input from researchers and practitioners on what are the opportunities and challenges brought about by Industry 4.0, and how organizations and knowledge workers can be better prepared to reap the benefits of this latest revolution

Course Objectives:

1. To understand the concept of Industry 4.0 and its application in business world
2. To gain deep insights to harness smartness from input data describe physical model of basic components
1. To understand what needs to be done in order to overcome business challenges.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Understand drivers and enablers of Industry 4.0	II	Understanding
CO2	Understand the various systems used in a manufacturing plant and their role in an Industry 4.0 world	II	Understanding
CO3	Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individualsshould prepare to reap the benefits	IV	Understanding
CO4	Analyze the power of Cloud Computing in a net-worked economy	IV	Analyzing

CO-PO Mapping:

[illegible]

Assessments : Teacher Assessment: one End Semester Examination (ESE) having 100% Weightage. ESE: Assessment is based on 100% course content 100% Weightage for entire course content.	
Course Contents:	
Unit 1: INTRODUCTION TO INDUSTRY 4.0: The Various Industrial Revolutions, need of Industry 4.0, industry 4.0 and IIoT data flow chart, industry 4.0 and Indian Business transformation, industry 4.0 in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation	3 Hrs.
Unit 2: COMPONENTS OF Industry 4.0 Software components related to industry 4.0, Hardware components related to industry 4.0 viz. Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, datastorage and data analysis, Smart Manufacturing, Smart Devices and Products, Predictive Analytics	4 Hrs.
Unit 3: FUNDAMENTALS OF IO LINK TECHNOLOGY Concept of IO link, various IO link blocks and their functionality, IO link competency, IO link solutions to the real industrial problems, benefits of IO link, IO link masters into industry 4.0 and IIoT, Support System for Industry 4.0, Cloud Computing Basics, Cloud Computing and Industry 4.0.	5 Hrs.
Unit 4: IMPACT OF INDUSTRY 4.0 ON INDIAN BUSINESS DEVELOPMENT Need of adopting industry 4.0 in Indian Business, Impact on quality of growth, smart growth, sustainable growth, inclusive/shared growth, integrated growth, return on investments of mechanical and digital factories	5 Hrs.
Unit 5: BUSINESS AND RELATED ISSUES IN INDUSTRY 4.0 Opportunities and Challenges, Strategies for competing in an Industry 4.0 world, issues related to cyber-physical securities, PLC systems, mobile computing systems etc.	4 Hrs.
Unit 6:- Other Applications and Case Studies Industry 4.0 laboratories, IIoT case studies (International) : Russia's experience, Japan's experience, China's experience, Contrasting interpretations of the British experience, India's experience, German Experience, IIoT case studies (National): related to CNC industry, Milk Processing and Packaging Industries, Manufacturing Industries, Electronic Manufacturing Industries.	3 Hrs.
Textbooks: 1. Industry 4.0: Managing The Digital Transformation by Alp Ustundag, Springer Publication 2. Industry 4.0: Industrial Revolution of the 21st Century, by Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz	
References: 1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress) 2. "Industrial Internet of Things: Cybermanufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)	

Unit wise Measurable students Learning Outcomes:

1. The student will be able to explain basics of Industry 4.0 revolutions and standards.
2. The student will be able to understand different services given by industry 4.0 standards.
3. The student will be able to understand different disciplines and preventive measures followed in industry4.0
4. The student will able to understand the role of data in cloud computing and the significance of cloud com-puting in industry 4.0
5. The student will be able to analyze and inculcate the industry 4.0 standards
6. The student will be able to analyze different opportunities, challenges and strategies associated with industry 4.0

Title of the Course: Project Phase – II Course Code:UECC0802	L	T	P	Credits
	--	--	8	4

Course Pre-Requisite: knowledge of micro-projects and mini-projects, Matlab, protius, KIEL, Tinkercad etc

Course Description:

The project-I is a capstone experience in which students integrate and apply knowledge and skills acquired in earlier units to a substantial real-world design challenge relevant to their discipline. Students work in teams, typically with four members, and are supervised by an academic and/or industry mentor. Teams are responsible for managing their project as well as reporting against milestones and preparing the necessary design documentation. The academic objectives of the project are to lead students through a systematic engineering design and synthesis process and to better prepare them for professional practice as engineers. The focus of the unit is on teamwork, skills, lifelong learning and the design process.

Course Objectives:

4. To apply engineering knowledge in practical real time problem solving
5. To foster innovation in design of products, processes or systems
6. To develop creative thinking in finding viable solutions to engineering problems

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom''s Cognitive	
		level	Descriptor
CO1	Apply appropriate modern tools to execute the project work.	III	Applying
CO2	Design and demonstrate hardware and software of a complex engineering problem.	V	Design, Demonstrate
CO3	Make use of research ethics and responsibilities while conducting a complex engineering problem.	III	Make use of
CO4	Outline collaboratively with team members and lead in diverse teams	VI	Outline
CO5	Explain confidently and constructively the various system components	II	Explain
CO6	Elaborate the knowledge and understanding of complex research problem in teams of final demo	IV	Elaborate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					3							2		
CO2		2	2	2								2	2	2
CO3	2			1				3				2		
CO4						1			3	2		1		
CO5									2	2		1	2	
CO6	2	2		2					2	2		1		

Assessments :**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), that is ISE-1 and ISE-2 and one End Semester Examination (ESE).

Assessment	Marks
ISE -1	50
ISE -2	50
ESE (OE)	100

ISE – 1: ISE marks shall be based on the project evaluations 1, 2 and 3.

ISE – 2: ISE marks shall be based on the internship in industry.

ESE (OE): ESE is based on final demonstration of project in front of external examination.

Course Contents:

1. The project work is to be carried out in 8th semesters of B. Tech. (Electronics & Telecommunication Engg.).
3. In semester – 8, the project group will continue the project work from semester VII.
4. In this semester, the project work is evaluated in three phases, evaluation -I, evaluation-II and evaluation – III. At the same time project group has to complete the internship in industry minimum for 4 weeks.
4. The group is expected to complete **PCB, rough design notes, component receipts, circuit testing, and complete system design** in Evaluation-1, as a part of ISE - 1.
5. The group is expected to complete **PCB, rough design notes, component receipts, circuit testing, software programming** in Evaluation-II, as a part of ISE - 1.
6. The group is expected to complete **PCB, rough design notes, component receipts, circuit testing, software programming** in Evaluation-III, as a part of ISE - 1.
7. In addition all students of project group will deliver a final project demonstration in front of evaluation panel and submit the final hard bound report of project work done in semester-8 which at least consists of 50 pages.

Note: The group should compulsorily maintain a logbook of progress of the project activities. The logbook should have entries related to the work done, problems faced, solution evolved etc. duly signed by internal guide.

Title of the Course: System on Chip Course Code: UECE0801										L	T	P	Credit	
										3	-	-	3	
Course Pre-Requisite: Number system basics, Fundamentals of Digital Design, Boolean Logic Simplification and Combinational Logic Design, MSI devices, Sequential Logic Design, Semiconductor Memories, Design using HDL, Computer fundamentals, Microprocessor, Programming skills, Operating system fundamentals														
Course Description: This course covers the fundamentals of System on Chip, Digital system design using System Verilog, SOC level components, system bus architectures, Verification and and testing of Systems.														
Course Objectives: 1. To study and use system verilog HDL for design and implement digital design problems 2. To develop an approach for SOC design and testing. 3. To study System verilog a hardware verification language used to model, design, simulate, test. 4. To study SOC Interconnect Architectures.														
Course Learning Outcomes:														
CO	After the completion of the course the student should be able to									Bloom's				
										level	Descriptor			
CO1	Design and implement digital design problems using System verilog HDL.									VI	Creating			
CO2	Analyze the implications of design approach for components of SOC.									IV	Analysing			
CO3	model, design, simulate, test using System verilog									VI	Creating			
CO4	Compare the various SOC Interconnect Architectures									IV	Analysing			
CO-PO Mapping:														
CO	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
CO1	3			3					3				2	
CO2		2												
CO3						2							2	
CO4			2					3			1			
Assessments :														
Teacher Assessment:														
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.														
Assessment									Marks	Minimum for Passing				
ISE 1									10	20				
MSE									30					
ISE 2									10					
ESE									50	20				
ISE 1 and ISE 2 are based on assignment/declared test/quiz etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.														
Course Contents:														
Unit 1:--- Introduction to System Verilog: Introduction, System Verilog Declaration spaces, System Verilog Literal Values and Built-													6Hrs.	

in Data Types, System Verilog User-Defined and Enumerated Types, System Verilog Arrays, Structures and Unions, System Verilog Procedural Blocks, Tasks and Function, System Verilog Procedural Statements	
Unit 2:--- Combination circuit designs using System Verilog: Memory modeling, state machines, CMOS gate modeling, Combination and sequential circuit designs, Memory modeling, , state machines, CMOS gate modelling, Writing Tasks, Writing Functions, Compiler directives, Conditional Compilation, System Tasks, Gate level primitives, User defined primitives, Delays, Specify block	8Hrs.
Unit 3:-- sequential circuit designs using System Verilog Modeling Finite State Machines with System Verilog, System Verilog Design Hierarchy, System Verilog Interfaces, Behavioral and Transaction Level Modeling.	5Hrs.
Unit 4:--- Introduction To The Systems Approach System Architecture: An Overview, Components of the System: Processors, Memories and Interconnects, Hardware and Software: Programmability „Versus Performance, Processor Architectures, Memory and Addressing, System-Level Interconnection, An Approach for SOC Design, System Architecture and Complexity, Product Economics and Implications for SOC	5Hrs.
Unit 5:--- Interconnect Architectures Introduction, Overview: Interconnect Architectures, Bus: Basic Architecture, SOC Standard Buses: AMBA, Core Connect, Bus Interface Units: Bus Sockets and Bus Wrappers, Analytic Bus Models. Introduction to Bus Protocols like AHB,AXI, ACE, OCP	7Hrs.
Unit 6:--- SOC Testing and Verification Testbenches, modelling, timing checks, Assertion based verification, Code for synthesis, Advanced topics, Writing reusable code.	6Hrs.
Textbooks: 1. Vaibbhav Taraate “Digital Logic Design Using Verilog” (Coding and RTL Synthesis) Springer ISBN 978-81-322-2789-2, ISBN 978-81-322-2791-5 (eBook)	
References: 1. Mark Zwolinski “Digital System Design with SystemVerilog” Prentice Hall 2. Stuart Sutherland , Simon Davidmann , Peter Flake , “SystemVerilog for Design : A Guide to Using SystemVerilog for Hardware Design and Modeling” Springer 3. AMBA® AXI™ and ACE™ Protocol Specification at http://www.arm.com/products/solutions/Ambahomepage.html	
Unit wise Measurable students Learning Outcomes: Unit 1: Student should be able to Describe the features of system verilog HDL Unit 2: Student should be able to Design and implement combination Digital H/w using system Verilog HDL. Unit 3: Student should be able to Design and implement Sequential Digital H/w using system Verilog HDL. Unit 4: Student should be able to Summarize overview various SOC architectures. Unit 5: Student should be able to Illustrate features of SOC interconnect architectures. Unit 6: Student should be able to Test various SOC components and systems.	

Title of the Course: Satellite Communication Course Code: UECE0802										L	T	P	Credit	
										3	-	-	3	
Course Pre-Requisite: Analog Communication Systems, Digital Communication, Electromagnetic Engineering, Antenna & Wave Propagation.														
Course Description: This course presents the fundamentals of satellite communications link design and an in-depth treatment of practical considerations. Existing commercial, civil, and military systems are described and analyzed, including direct broadcast satellites, high throughput satellites, VSAT links, and Earth-orbiting and deep space spacecraft.. While distribution of television programming remains the largest sector of commercial satellite communications, low earth orbit constellations.														
Course Objectives: The course aims : 1. To introduce the fundamental concept in the field of satellite communication. 2. To enable the student know how to place satellite in orbit. 3. To know the concept of space subsystem. 4. To analyze, design and evaluate satellite communication subsystem its networking.														
	CO	After the completion of the course the student should be able to								Bloom"s Taxonomy level				
	CO1	Understand Orbital aspects involved in satellite Communication.								II				
	CO2	Apply various communication techniques for satellite applications								III				
	CO3	Understand Satellite system and services provided.								II				
	CO4	Illustrate advanced techniques and regulatory aspects of satellite communication								II				
CO-PO Mapping:														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1		-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	1	-	-	1	-
CO3	-		-	-	-	2	1	-	1	-	1	-	-	2
CO4	-	1	2	-	1	-	-	-	-	-	-	-	2	1
Assessments :														
Teacher Assessment: Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.														
	Assessment								Marks					
	ISE 1								10					
	MSE								30					
	ISE 2								10					
	ESE								50					
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.														

Course Contents:	
Unit 1: Introduction of Satellite Communication: Introduction, basic concept of satellite communication, Orbital Mechanics, Look angle determination, Orbital perturbation, Orbital determination, Launchers and Launch vehicles, Orbital effects in communication system performance.	7 Hrs.
Unit 2: Satellite subsystem: Satellite Subsystem, Attitude and control system(AOCS), Telemetry, Tracking, Command and Monitoring, Power systems, Communication subsystem, Satellite antennas, Equipment reliability and space qualification.	7 Hrs.
Unit 3: Satellite Link Design: Introduction, Basic transmission Theory, System Noise Temperature and G/T Ration, Design of Downlinks, Satellite System using Small Earth Stations, Uplink Design, Design of specified C/N : Combining C/N and C/I values in Satellite Links.	6 Hrs.
Unit 4: Satellite Networks: Reference architecture for satellite networks, basic characteristics of satellite networks, Onboard connectivity with transparent processing, analogue transparent switching, Frame organization, Window organization, On board connectivity with beam scanning	6 Hrs.
Unit 5: Low Earth Orbit and Non Geo-Stationary satellite system: Introduction, Orbit considerations, Coverage and Frequency Consideration, Delay and Throughput Consideration, Operational NGSO constellation design: Iridium, Teledesic.	5 Hrs.
Unit 6: Satellite Radio and GPS: C-Band and Ku- Band Home satellite TV, Digital DBS TV, Satellite Radio Broadcasting, Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and codes.	5 Hrs.
Textbooks: 1. Satellite Communications-Timothy Pratt, Charles Bostian, Jeremy Allnut John Wiley & Sons (II Edition) 2. Satellite Communications-Anil k. Maine and Varsha Agaraval, Wiley Publications (All chapters) 3. Robert.M.Gagliardi, "Satellite Communication", CBS Publishers.	
References: 1. Satellite Communications- Dennis Roddy McGraw Hill(All Chapters) 2. Satellite Communications- Gerard Maral and Michel Bousquet, Wiley Publication (5th Edition For chapter IV) 3. Satellite Communications systems Engineering, 2nd edition- Wilbur L. Pritchard, Henri G.	

Course Contents:	
Unit 1:- Overview of Internet of Things: IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M communication, Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at Gateway,	6 Hrs.
Unit 2:--- Protocols for IoT: Internet connectivity, Internet-based communication, IPv4, IPv6, 6LoWPAN protocol, IP Addressing in the IoT, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP, MQTT,), Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports.	8 Hrs.
Unit 3:- cloud architecture and concepts: Cloud Types and Models: Private Cloud, Community Cloud, Public Cloud, Hybrid Clouds Cloud Computing Stack, Infrastructure, Platforms, Communication Protocols, Connecting to the Cloud, Concepts and Enabling Technologies Load balancing, Scalability & Elasticity, Deployment, Replication, Monitoring, Identity and Access Management, Billing Cloud Services & Platforms, Examples of cloud computing.	6 Hrs.
Unit 4:- Virtualization Introduction and benefits, Implementation Levels of Virtualization, Virtualization at the OS Level, Virtualization Structure, Virtualization Mechanism, Open Source Virtualization Technology, Xen Virtualization Architecture, Binary Translation with Full Virtualization, Paravirtualization, Virtualization of CPU, Memory and I/O Devices	7 Hrs.
Unit 5:- Prototyping and Designing Software for IoT Applications: Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server	8 Hrs.
Unit 6:-. IoT Security: Introduction to IoT privacy and security. Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model	7 Hrs.
Textbooks: 1. Internet of Things : Architecture And Design Principles, Raj Kamal, McGraw Hill 2017 2. Internet of Things (A Hands-on-Approach) , Vijay Madiseti , Arshdeep Bahga 3. Cloud Computing Black Book- Jayaswal, Kallakurchi, Houde, Shah, Dreamtech Press	
References: 1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley 2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers 3. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning 4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010 5. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally	

Unit wise Measurable students Learning Outcomes:

1. Discuss the basics concepts of IoT.
2. Discuss and analyze protocols used in IoT implementation
3. Discuss architecture of cloud
4. Discuss Concept of Virtualization
5. Demonstrates how to write programs for Cloud based IoT on standard hardware platform.
6. Discuss analyze security concerns of IoT

Title of the Course: Machine Learning											L	T	P	Credit
Course Code: UECE0804											3	-	-	3
Course Pre-Requisite: Linear Algebra, Statistics, Probability Theory														
Course Description: This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. It covers the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbor, an introduction to Bayesian learning and the naïve Bayes algorithm, support vector machines and neural networks.														
Course Objectives: 1. .														
Course Learning Outcomes:														
CO	After the completion of the course the student should be able to										Bloom's Cognitive level		Descriptor	
CO1	Outline the basic concepts and statistical foundation methods behind machine learning algorithms										I		Understand	
CO2	Develop machine learning models to solve various types of machine learning problems, including regression and classification.										III		Apply	
CO3	Demonstrate understanding of basic supervised and unsupervised machine learning models.										III		Apply	
CO4	Evaluate the performance of machine learning models.										VI		Creating	
CO-PO Mapping:														
CO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	3	1												
CO2				1								3		
CO3	1	2	1	1										3
CO4			3	1							1			3
Assessments :														
Teacher Assessment: Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.														
Assessment										Marks				
ISE 1										10				
MSE										30				
ISE 2										10				
ESE										50				
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.														

Course Contents:	
Unit I Introduction To Machine Learning Machine Learning: Definition, Terminology, Types of learning, Machine Learning Problem categories, Machine learning architecture, process, Lifecycle, Performance measures, tools and framework, data visualization.	8 Hrs.
Unit II: Regression Regression: Simple regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression, examples, simple regression in matrix form. Multivariate Linear Regression – Multiple features, hypothesis functions, Gradient Descent for multiple variables, Feature scaling, polynomial regression	6 Hrs.
Unit III: Classification- logistic regression & Naïve Bayes : Classification- logistic regression & Naïve Bayes : Logistic Regression – Definition, Hypothesis representation, decision boundary, cost function, Gradient Descent for Logistic Regression. Multiclass Classification, Regularization - Over fitting & Under fitting, cost function, Regularized Linear Regression, Regularized Logistic Regression, Conditional probability and Naïve Bayes Classifier. Instance-based classifier – K-Nearest Neighbor Classifier, Bayesian Network, Hidden Markov Model.	10 Hrs.
Unit IV Classification- Decision trees and Support Vector Machine: Decision trees: definition, terminology, the need, advantages, and limitations. Constructing and understanding Decision trees, common problems with Decision trees, Decision tree algorithms, random forest, examples. Support Vector Machine: What is SVM, Kernel Trick, Cost Function, Decision Trees vs. Support Vector Machine.	10 Hrs.
Unit V: Unsupervised learning : Unsupervised learning: Clustering, K Means clustering, Hierarchical clustering, Association Rule mining.	8 Hrs.
Unit VI : Neural Network Neural Networks- Neuron and Perceptron, Hypothesis for neuron, cost function, solution of problem using single neuron. Gradient descent for a neuron. Neural network, Multiclass classification with neural network. Learning in neural network-back propagation algorithm	6 Hrs.
Textbooks: 1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Dos, “Machine Learning”, 1 st edition, Pearson, 2019. 2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014. 3. Tom Mitchell, —Machine Learning, McGraw Hill, 3rd Edition, 1997. 4.. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020. Christopher M. Bishop, —Pattern Recognition and Machine Learning, Springer 2011 Edition.	
References: 1. Aurelien Geron , “ Hands on Machine Learning with Scikit -learning , Keras & Tensorflow “, Concepts , Tools & Techniques to build Intelligent systems 2. Andreas Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, 1st Edition, O’Reilly	

Media,2017.

3. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021

4. Kevin P. Murphy, Machine Learning: a Probabilistic Perspective, The MIT Press, 2012.

Title of the Course: Wireless Mobile Communication	L	T	P	Credit
Course Code: UECE0805	3	-	-	3

Course Pre-Requisite: Antenna Wave Propagation.

Course Description: The course has been designed to expose the students to the most recent technological developments in Mobile communication systems.. The Course considers the basic concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course. The Course provides various multiple access techniques and Standards in Cellular mobile Communication.

The course aims to:

1. Focus on basic fundamentals of wireless communication.
2. Explain large & small scale radio wave propagation
3. Understand basic mobile communication and its multiple access techniques.
4. Understand mobile network and its connectivity.

Course Learning Outcomes:

Upon successful completion of this course, a student will be able to:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	List the basic fundamentals of wireless communication.	List	Remembering
CO2	Explain large and small scale radio wave propagation	Explain	Understanding
CO3	Explain multiple access techniques to mobile communication	Explain	Understanding
CO4	Explain mobile network.	Explain	Understanding

CO-PO Mapping:

[illegible]

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	Hr.
Unit I :Introduction of Wireless Communication 2G, 3G, 4G wireless networks, WLL, Cellular Concept	4
Unit II : Mobile Radio Propagation. Large Scale Path Loss: Introduction to Radio Wave propagation, The three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Outdoor Propagation Models, Indoor Propagation Models Small-Scale Fading and Multipath : Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of small-Scale Fading	7
Unit III : Wireless Networking: Introduction to wireless Networks Difference Between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling (CCS), Architecture of B-ISDN & services, Signaling System No. 7 (SS7), An Example of SS7-Global Cellular Network Interoperability,	5
Unit IV : Introduction to Mobile Communication & Multiple Access Technique Mobile and Personal Communication, mobile and wireless devices, Specialized packet and mobile radio networks, circuit switched data services on cellular networks, packet switched data services on cellular networks, Multiple Access Technique-FDMA, TDMA, SDMA, CDMA, spread spectrum multiple access	6
Unit V : WIRELESS LAN TECHNOLOGY Overview, WLAN technologies, infrared LANs, Spread Spectrum LANs Narrowband Microwave LANs IEEE 802.11- Architecture, protocols, MAC layer .MAC frame, MAC management.	5
Unit VI : Mobile Network & Transport Layer Mobile IP, DHCP (Dynamic Host Control Protocol), Mobile adhoc networks, Bluetooth & Wi-Fi network	5
Text Books: 1 Wireless Communications Principles & Practice- Theodore S. Rappaport, (P.E.) 2 Mobile Communications: Jochen Schiller (Addison Westy) Reference Books: 1 Wireless Networks by P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou, A. S. Pomportsis; Wiley Pub. 2 Wireless Communication & Networks by William Stallings(Pearson Edition) 3 Wireless communication and Networks by Upena Dalal(Oxford) 4 Wireless and Mobile network by Manvi (Wiley India)	

Title of the Course: Embedded Linux Course Code:UECE0806											L	T	P	Credit
											3	-	-	3
Course Pre-Requisite: Embedded System Programming in C														
Course Description: This Course aims to develop the basic concepts of Super loop programming, RTOS programming, programming on Embedded Linux platform and develop application on embedded Linux.														
Course Objectives: To develop understanding for selecting platform for embedded system programming specific to application in design. To develop understanding of Embedded Linux architecture, file system and boot sequence of Embedded Linux To develop understanding of board support package of embedded Linux. To develop understanding of embedded storage system using MTD To develop understanding of Drivers for embedded Linux To study Beagle Bone Black and Raspberry Pi as platform and develop applications on the same														
Course Learning Outcomes:														
CO	After the completion of the course the student should be able to										Bloom's Cognitive			
											level	Descriptor		
CO1	Familiarity of the embedded Linux development model.										4	Analyze		
CO2	Understand and create Linux BSP for a hardware platform.										2	understand		
CO3	Develop and debug applications and drivers in embedded Linux.										2	understand		
CO4	Develop applications on standard hardware platform										3	Apply		
CO-PO Mapping:														
CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	-	-	-	2	-	-	-	-	-	2	2	1
CO2	2	3	2	-	-	2	-	-	-	-	-	-	2	2
CO3	3	3	3	2	-	-	2	2	2	-	-	-	3	2
CO4	2	3	2	-	3	-	-	2	2	2	2		3	3
Assessments :														
Teacher Assessment:														
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.														
Assessment								Marks						
ISE 1								10						
MSE								30						
ISE 2								10						
ESE								50						
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.														
Course Contents:														
Unit 1:- Review of super loop and RTOS programming, Need of embedded Linux, Embedded Linux Versus Desktop Linux, Embedded Linux Distributions and porting												6 Hrs.		
Unit 2:--- Architecture of Embedded Linux, Linux Kernel Architecture: HAL, Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC, User space, Linux Start-Up Sequence												6 Hrs.		

Unit 3:- Board Support Package: Inserting BSP in Kernel Build Procedure, The Boot Loader Interface, Memory Map, Interrupt Management, Timers, UATRS, Power management	8 Hrs.
Unit 4:- Embedded Storage: MTD, Architecture, Drivers, Embedded File System	7 Hrs.
Unit 5:- Introduction to Raspberry PI hardware platform, Programming hardware resources of above boards using programming languages	6 Hrs.
Unit 6:- Introduction to BeagleBone hardware platform, Programming hardware resources of above boards using programming languages	6 Hrs.
Textbooks: 1. P Raghvan, Amol Lad, SriramNeelakandan, “Embedded Linux System Design and Development”, Auerbach Publications 2. Derek Molloy, “Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux”, Wiley, 1st Edition, 2014. 3. Derek Molloy, “Exploring Raspberry Pi® “, Wiley, 1st Edition, 2016	
References: 4. Karim Yaghmour, “Building Embedded Linux Systems”, O'Reilly & Associates 5. Christopher Hallinan, “Embedded Linux Primer: A Practical Real World Approach”, Prentice Hall, 2nd Edition, 2010. 6. Mastering Embedded Linux Programming.	
Unit wise Measurable students Learning Outcomes: 1. Differentiate methods of embedded system programming and state features of embedded Linux distributions 2. State architectural aspects of Embedded Linux 3. Able to understand Board support package 4. State different file systems used in Embedded Linux 5. Understand Embedded Linux drives 6. Able to develop applications on Beagle Bone/ Raspberry Pi platform	

Title of the Course: WIRELESS SENSOR NETWORK										L	T	P	C
Course Code: UECE0807										3	-	-	3
Course Pre-Requisite: Basic knowledge of Data Communication Networks.													
Course Description: The course demonstrates the implementation of Wireless Embedded Networks by using state of art concepts and technologies like wireless sensor networks, TinyOS, NXP KW41Z and corresponding Protocols.													
COURSE OBJECTIVES													
1.	To make students understand the basics of Wireless sensor Networks.												
2.	To familiarize with learning of the Architecture of WSN.												
3.	To understand the concepts of Networking in WSN.												
4.	To study the design consideration of topology control and solution to the various problems.												
5	To introduce the hardware and software platforms and tool in WSN.												

Course Learning Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand challenges and technologies for wireless networks
CO2	Understand architecture and sensors
CO3	Describe the communication, energy efficiency, computing, storage and transmission
CO4	Establishing infrastructure, simulations and programming the WSN environment

CO-PO Mapping:

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

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% Weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:		
Unit 1:-- OVERVIEW OF WIRELESS SENSOR NETWORKS- Single Node Architecture, Hardware Components , Network Characteristics, unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks , Types of wireless sensor networks.		6 Hrs.
Unit 2:-- ARCHITECTURES- Network Architecture, Sensor Networks- Scenarios - Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts,.		5 Hrs.
Unit 3:-- NETWORKING SENSORS- MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy Efficient Routing, Geographic Routing.		7 Hrs
Unit 4:-- INFRASTRUCTURE ESTABLISHMENT- Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.		6 Hrs
Unit 5:-- SENSOR NETWORK PLATFORMS AND TOOLS Sensor Node Hardware – Berkeley Motes, Programming Challenges, Nodelevel software platforms, Node level Simulators, Statecentric programming		6 Hrs
Unit 6:--- TinyOS Overview, Component Model, Execution Model and Concurrency, Active Messages, key requirements: limited resources, reactive concurrency, flexibility and low power Implementation, Enabled Innovations , study of APIs for WSN/ IOT		6 Hrs.
Textbooks: 1. Wireless Communications Principals & Practice- Theodore S. Rappaport, (P.E.) 2. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005. 3. NETWORKING PROTOCOLS AND STANDARDS FOR INTERNET OF THINGS- Wiley Telecom 4. Ambient Intelligence- Springer, Berlin, Heidelberg eBook ISBN978-3-540-27139-0 5. https://www.nxp.com/		
References: 1. Wireless & Mobile Network Architecture- Yi-Bing Lin, Imrich Chiamtac (John Wiley) 2. Fundamental of Wireless Communication- David Tse, Pramod Viswanath (Cambridge) 3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003 4. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007 5. KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007. 6. TinyOS Programming by Cambridge University Press 7. Internet of Things: Architectures, Protocols and Standards Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri Wiley 8. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor NetworksTechnology, Protocols, and Applications”, John Wiley, 2007. 9. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003		

Title of the Course: Control System Design											L	T	P	Credit
Course Code: UECE0808											3	-	-	3
Course Pre-Requisite: Knowledge of Matrix algebra, Root-locus, Bode-plot and Nyquist stability criterion.														
Course Description:														
Course Objectives:														
1. To develop the skills to represent the system in state space form.														
2. To impart knowledge required to design state feedback controller and state estimator.														
3. To develop the skills to design the compensator in time and frequency domain and to design the PID compensator.														
Course Learning Outcomes:														
CO	After the completion of the course the student should be able to										Bloom's Cognitive			
											level		Descriptor	
CO1	To Study State Space Model and its Solution										I		Understand	
CO2	Design Lead, Lag and Lead –lag compensator using time domain and frequency domain method.										III		Apply	
CO3	Examine system for its stability, controllability and observability and design controller and observer with given transient specifications.										III		Apply	
CO4	Study the PID controller tuning by Ziegler Nicholas and Cohen-coon methods										VI		Creating	
CO-PO Mapping:														
CO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	1	1												
CO2				1								3		
CO3	1	2	1	1										3
CO4			3	1							1			3
Assessments :														
Teacher Assessment:														
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.														
Assessment										Marks				
ISE 1										10				
MSE										30				
ISE 2										10				
ESE										50				
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.														
MSE: Assessment is based on 50% of course content (Normally first three modules)														
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.														
Course Contents:														

Unit I State Space Representation of Continuous Time Systems: Terminology of state space representation, advantages of state space representation over classical representation, physical variable form, phase variable forms: controllable canonical form (companion I), observable canonical form (companion II), diagonal/Jordan canonical form (parallel realization), cascade realization, conversion of state model to transfer function. Similarity transformation for diagonalization of a plant matrix, Vander Monde matrix.	8 Hrs.
Unit II: Solution of State Equation: State Transition Matrix and its properties, computation of state transition matrix using Laplace transformation method, Cayley Hamilton theorem, matrix exponential series and via diagonalization.	6 Hrs.
Unit III: Analysis and Design of Control System in State Space Controllability, stabilizability, observability and detectability properties. Necessary and sufficiency conditions for complete state controllability and observability. State feedback structure, Pole placement design using state feedback. State observers – Full state observer.	10 Hrs.
Unit IV Introduction to Compensator: Derivative and integral error compensation, Analysis of the basic approaches to compensation, cascade compensation, feedback compensation. Compensator Design using Root-locus: Improving steady-state error and transient response by feedback compensation, cascade compensation, integral, derivative compensation, Lag, Lead, Lag-Lead compensation.	10 Hrs.
Unit V: Compensator Design using Frequency response: Systems with time delay, transient response through gain adjustment, Lag, Lead, Lag-Lead compensation.	8 Hrs.
Unit VI:--- PID Controller Design: PID controller tuning: Ziegler-Nichols method, Cohen-coon method, Designing PID controller using Root-Locus.	6 Hrs.
Textbooks: 1. K. Ogata, Modern Control Engineering, Prentice Hall of India, 4th edition, 2002 2. M. Gopal, Control Systems Principles and Design, TMH, New Delhi, 2nd edition, 2002	
References: Reference Books: 1. Norman S. Nise, Control Systems Engineering, John Wiley and Sons, Inc. 2000. 2. Francis Raven, Automatic Control Engineering, 5th edition McGraw-Hill International Edition, 3. G.C. Goodwin, S.F. Graebe, M.E. Salgado, Control System Design, Pearson education 4. B. C. Kuo “Automatic control systems”, Prentice Hall of India. 5. M. Gopal, Control Systems Principles and Design, TMH, New Delhi, 2nd edition, 2002. 6. Stefani, Shahian, Savant, Hostetter, Design of Feedback Control Systems, Oxford University Press, 4th Edition, 2007. 7. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, Addition-Wesley, 1999. 8. I.J. Nagrath and M. Gopal, Control System Engineering, 3rd Edition, New Age International (P) Ltd., Publishers - 2000. 9. B.C. Kuo, Farid Gdna Golnaraghi, Automatic Control Systems, PHI, 7th edition, 2003. 10. M. N. Bandopadhyay, Control Engineering - Theory & Practice, PHI, 2003	
Unit wise Measurable students Learning Outcomes: 1. Obtain state-space model of electrical circuits, translational/rotational mechanical systems and electromechanical systems etc with emphasis on linear time-invariant systems 2. Obtain solution of state equations by using Laplace transform methods, Cayley Hamilton method etc.	

3. Examine system for its stability, controllability and observability and design controller and observer with given transient specifications.
4. Design Lead, Lag and Lead-lag compensator using time domain method.
5. Design Lead, Lag and Lead-lag compensator using frequency domain method.
6. Study the PID controller tuning by Ziegler Nicholas and Cohen-coon methods

Title of the Course: Deep Learning	L	T	P	Credit
Course Code: UECE0809	3	-	-	3

Course Pre-Requisite: Machine Learning

Course Description: In this course we will learn about the building blocks used in these Deep Learning based solutions. Specifically, we will learn about feedforward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms. We will also look at various optimization algorithms such as Gradient Descent, Nesterov Accelerated Gradient Descent, Adam, AdaGrad and RMSProp which are used for training such deep neural networks.

Course Objectives:

The course aims :

1. Understand the fundamentals of deep learning
2. Analyze and evaluate deep learning models
3. Explore advanced deep learning architectures
4. Apply deep learning techniques to real-world problems.

	CO	After the completion of the course the student should be able to	Bloom's Taxonomy level
	CO1	Understand the fundamentals of deep learning	II
	CO2	Analyze and evaluate deep learning models	III
	CO3	Explore advanced deep learning architectures	II
	CO4	Apply deep learning techniques to real-world problems.	II

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	2	1				3			2	1	1
CO 2	3	2	2	2	2				1			3	1	1
CO 3	3	3	2	2	2				1			2	1	1
CO 4	3	3	2	2	2				1			2	1	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Unit 1: Introduction To Deep Learning Overview of deep learning and its applications: Introduction to Deep Learning, A brief history, Need of Deep Learning, Applications of Deep Learning, Neural networks and their Architecture: ANN Intuition, Components of NN Architecture, Types of NN- Supervised - ANN, CNN, RNN, Unsupervised - SOM, AE, BM Activation functions and their properties: Sigmoid, Hyperbolic Tangent (tanh) Function, Rectified Linear Unit (ReLU), Leaky ReLU, Softmax	07 Hrs.
Unit 2: Feedforward Neural Networks and Optimization Multilayer perceptron (MLP): Architecture of MLP with Feedforward, Error Functions-Mean Squared Error (MSE), Binary Cross-Entropy, Categorical Cross-Entropy (CCE), Backpropagation algorithm: Difficulty of Training Deep Neural Networks, Regularization techniques: Early Stopping, Drop Out Optimization algorithms: Adagrad, Adam.	07 Hrs.
Unit 3: Convolution Neural Networks (CNNs) CNN architecture and components Convolution operation, pooling, flattening, ReLU Layer, Pooling, Flattening, Softmax and Cross Entropy, Transfer learning with CNNs	06 Hrs.
Unit 4: Recurrent Neural Networks (RNNs) Basics of sequence modeling, RNN architectures (LSTM, GRU), Word embeddings and attention mechanisms	06 Hrs.
Unit 5: Autoencoders Autoencoders -Introduction, Sparse, Denoising, Contractive Autoencoder, Stacked and Deep Autoencoder	5 Hrs.
Unit 6: Advanced Deep Learning Generative Adversarial Networks (GANs) Variation Autoencoders (VAEs), Basics of reinforcement learning: Q-learning and value iteration	5 Hrs.
Textbooks: 4. Deep Learning with Python by Francois Chollet, Manning Publications 4. Dive into Deep Learning, Aston Zhang, Zachary C. Lipton, Mu Li, And Alexander J. Smola	
References: 1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press Book - Andreas Muller, "Introduction to 2. Deep Learning: A Practitioner's Approach by Josh Patterson and Adam Gibson - Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021	