

Title of the Course: Antenna & Wave Propagation										L	T	P	Credit
Code: UECC0501										4	0	0	4
Course Pre-Requisite: Analog Communication Systems, Network Analysis, Electromagnetic Engineering.													
Course Description: Antennas and propagation effects play a crucial, even though often overlooked, role in RF systems. In practice the design of a working system such as mobile phone networks, WiFi, RFID, Satellite communication and GPS requires a good understanding of these components. This course teaches the fundamentals of antenna and wave propagation and shows the application in practical examples. The course covers the theory of radiation fundamental antenna parameters and concepts, broadband and frequency independent antennas such as aperture antennas (e.g. horns), micro-strip antennas, then measurement of antenna parameters & At last wave propagation and radar systems.													
Course Objectives: The course should enable the students to: 1. Be Proficient in the radiation phenomena associated with various types of antennas and understand basic terminology and concepts of antennas along with emphasis on their applications. 2. Describe radar systems and explain how they are used to detect remote objects 3. Understand the various methods involved in the antenna measurements 4. Justify the propagation of the waves at different frequencies through different layers in the existing layered free space environment structure.													
Course Learning Outcomes: Student will able to: 1. Interpret the important elements of antenna and propagation theory; 2. Calculate the fundamental antenna parameters; 3. Compare important classes of antennas and their properties; 4. Select a particular class of antenna for given specifications; 5. Apply theoretical principles to design an antenna; 6. Understand the propagation of radio waves in the atmosphere.													
CO	After the completion of the course the student should be able to									Bloom's Taxonomy			
										level	Descriptor		
CO1	Calculate and compare performance parameters like HPBW, FNBW, directivity, VSWR, input impedance, gain of different antennas.									III	Calculate, Compare		
CO2	Design and analysis of antennas and measurement of antenna parameters									IV	Design		
CO3	Describe radar systems and explain how they are used to detect remote objects									II	Describe, Explain		
CO4	Understand the wave propagation mechanism at different frequencies.									II	Understand		
CO-PO Mapping:													
CO	1	2	3	4	5	8	9	10	11	12	PSO1	PSO2	
CO1	3	2	2	1									
CO2	2	1	3	2							2	2	
CO3	1	2	3	1						2			
CO4	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:--- Fundamentals of Antenna**

Basic antenna radiation mechanism (single & double wire), parameters- radiation resistance, pattern, beam area, radiation intensity, beam efficiency, directivity, gain and resolution, antenna aperture, effective height, radio communication link, field from oscillating dipole, field zones, shape impedance consideration.

Introduction to antenna array

05 Hrs.**Unit 2:--- Broadband & Frequency Independent Antenna**

Broadband & Frequency Independent Antenna: Broadband basics, infinite and finite biconical antennas, directional biconicals, conical, disk cones and bowties, the frequency-independent concept: Rumsey's principle, the Illinois story, the frequency independent planar log-spiral antenna, frequency independent conical-spiral antenna, the log periodic antenna, the composite yagi-uda corner-log-periodic array

05 Hrs.**Unit 3:--- Antenna Measurements & Microstrip Antenna**

Antenna measurement: Antenna ranges, Radiation pattern, Gain measurements, Directivity measurements, Radiation efficiency, Impedance measurements, MICROSTRIP Antenna - Introduction, Basic characteristics, Feeding methods, basic types – rectangular, circular & transmission line model.

08 Hrs.**Unit 4:--- Ground Wave Propagation**

Plane earth reflection, space wave and the surface wave, elevated dipole antennas above a plane earth, wave tilt of the surface wave, spherical earth propagation, troposphere wave.

05 Hrs.**Unit 5:--- Ionospheric Propagation**

The ionosphere, effective permittivity and conductivity of an ionized gas, reflection and refraction of the waves by the ionosphere, regular and irregular variations of ionosphere, attenuation factor, sky wave transmission calculations, effect of earth magnetic field, wave propagation in ionosphere, Faraday rotation and measurement of total electron content, other ionosphere phenomena.

08 Hrs.**Unit 6:--- Radar System**

Fundamentals, RADAR performance factors, basic pulsed radar system, antennas and scanning, display methods, pulsed radar systems, moving target indication, radar beacons, CW Doppler radar, frequency modulated CW radar, phase array radars, planar array radars

07 Hrs.

Textbooks:

1. Antenna for all Application-John D Kraus, third edition-TMH publication
2. Antenna Theory-Constantine A. Balanis -Third edition-Wiley Publication
3. Electromagnetic Waves and Radiation Systems- Jordan and Balmain PHI publication
4. Electronics Communication System – Kennedy Davis- 4th edition TMH publication

References:

- 1] Antennas and Wave Propagation–G. S. N. Raju (Pearson)
- 2] Foundations of Antenna Theory and Techniques – Vincent F. Fusco(Pearson)

Unit wise Measurable students Learning Outcomes: Student will be able to

- 1 Describe antenna parameters.
- 2 Understand the operating principle of broadband Antennas.
- 3 Demonstrate measurement techniques of antenna & design micro-strip antenna.
- 4 Explain ground wave propagation.
- 5 Explain Ionospheric wave propagation.
- 6 Differentiate among different RADAR systems.

Title of the Course: Control System	L	T	P	Credit
Course Code: UECC0502	3	1	0	4

Course Pre-Requisite: Knowledge of Derivative, Integration, Matrices and Laplace transform.

Course Description:

The course studies dynamic systems encountered in a variety of instrumentation and Mechatronics systems, the modeling of such systems and the response of these systems to a disturbance. In addition, the control of dynamic systems using feedback and the design of control systems using different design techniques will be studied.

Course Objectives:

Objectives of this course are:

1. To study the fundamental concepts of Control systems and mathematical modeling of the system.
2. To study the concept of time response and frequency response of the system.
3. To study the basics of stability analysis of the system.

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze mathematical models of mechanical and electrical systems by their transfer functions using differential equations.	IV	Analyzing
CO2	Analyze time domain and frequency domain systems with response to test inputs.	IV	Analyzing
CO3	Determine the stability of the systems by using Routh's criteria, Nyquist criteria, Bode plot and root locus.	V	Evaluating
CO4	Design of automated system using PLC and PID.	VI	Creating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3												
CO2		3												
CO3		2												
CO4					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	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 and 30-40 % weightage of first three units.

Course Contents:	
Unit 1:---Introduction to Feedback Control System Classification of control System, Mathematical models of physical system- Electrical & Mechanical System , Transfer function of electrical and Mechanical systems, Block diagrams and reduction techniques, signal flow graphs using Mason's gain formula.	06 Hrs.
Unit 2:---: Feedback characteristics of Control system Feedback & Non-feedback systems, Reduction of parameter variations by use of feedback, control over system dynamics by use of feedback, control of effect of disturbance signals by use of feedback, The concept of stability, Routh Hurwitz stability criteria.	04 Hrs.
Unit 3:--- Time Domain Analysis Time response of first order & second order system using standard test signal, steady state errors and error constants, Root locus techniques- Basic concept, rules of root locus, application of root locus techniques for control system.	06 Hrs.
Unit 4:--- Frequency Domain Analysis Introduction, correlation between time & frequency domain, Bode plots, gain margin, phase margin, effect of addition of poles & zeros on bode plots, Nyquist stability. Stability using Bode plot.	06 Hrs.
Unit 5:--- State Space Analysis Concept of state, state variables & state model State-space representation, computation of the state transition matrix, transfer function from the state model, controllability of linear system, observability of linear system.	05 Hrs.
Unit 6:--- Compensators & controllers Compensators- Need of compensation, lead compensation, lag compensation, Lead-lag compensation. Introduction to PID controller.	05 Hrs.
Textbooks: 1. I.J. Nagrath, M.Gopal —Control Systems Engineering, 5th Edition, New Age International Publication 2. R. Anandanatarajan, P. Ramesh Babu , –Control Systems Engineering, Scitech Publications 3. A. Ananadkumar, —Control system Engineering, PHI publication 2nd edition. 4. John R. Hackworth, Fredrick D. Hackworth — Programmable Logic Controller, Pearson publication.	
References: 1. Norman S. Nise —Control Systems Engineering, 8th edition, Wiley edition. 2. Samarjeet Ghosh, —Control Systems Theory & Applications, 1st edition, Pearson education. 3. S.K. Bhattacharya, –Control Systems Engineering, 1st edition, Pearson education. 4. S. N. Shivanandan, S. N. Deepa, Control System Engineering, Vikas Publications 2nd edition 5. Dhanesh N. Manik– Control Systems, Cengage learning.	
Unit wise Measurable students Learning Outcomes: <ol style="list-style-type: none"> The students will be able to determine transfer functions of physical system. The students will be able to plot time response of first and second order system for a step input. The students will be able to design and evaluate Bode plot using Lead Network. The students will be able to design and evaluate Bode plot using Lag Network. The students will be able to design and evaluate ON-OFF controller. The students will be able to design and evaluate PID controller. The students will be able to study PLC The students will be able to plot response of first and second order system for a step and ramp input. The students will be able to determine phase margin and gain margin The students will be able to study MIMO systems. 	

Title of the Course: Microcontroller Course Code:UECC0503	L	T	P	Credit
	4	0	0	4

Course Pre-Requisite: Number system, logic gates, digital system design, memory types

Course Description: Basic introduction to microcontroller based systems design, development and implementation. It includes microcontroller architecture, programming, I/O Interfacing, Interruptmanagement and other related topics.

Course Objectives:

1. Describe the architecture of 8051 and PIC 16f877 microcontroller
2. Analyze the instruction set of 8051 PIC 16f877 microcontroller
3. Understand the peripherals and its programming 8051 and PIC 16f877 microcontroller
4. Understand using peripherals to build a useful system

<p>Course Learning Outcomes:</p>	
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1. Explain von Neumann architecture, Harvard architecture, CISC & RISC architecture of microcontrollers.
2. Demonstrate ON CHIP resources of SOC.
3. Develop assembly language programs.
4. Carry out Interfacing of microcontrollers with off chip resources.
5. Design small applications with KEIL micro vision & MPLAB IDE Tools

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Explain von Neumann architecture, Harvard architecture, CISC & RISC architecture of microcontrollers.	II	Understanding
CO2	Develop assembly language programs.	II	Understanding
CO3	Demonstrate ON CHIP resources.	III	Applying
CO4	Carry out Interfacing of microcontrollers with off chip resources.	III	Applying
CO5	Design small applications with KEIL micro vision & MPLAB IDE Tools	VI	Creating

CO-PO Mapping:									
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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:--- 8 BIT MICROCONTROLLER -8051: Introduction to Microcontrollers, Architecture, Functional pin description, Memory organization (Internal and External memory concept), Introduction to ON CHIP re- sources. External Program and Data memory interface, Comparison between different family members.	8 Hrs.
Unit 2:---PROGRAMMING OF 8051 Addressing modes, Instruction set, Assembly language programming, Assembler directives	7 Hrs.
Unit 3:--- ON CHIP RESOURCES,PROGRAMMING Port structure and operation, Timer/Counters(Internal architecture of different modes and programming),Serial port and its operating modes(hardware details of mode-1 only).	8Hrs.
Unit 4:--- Interrupts & Hardware Interfacing with 8051 Timers, serial port, Interrupts, Interfacing of Keypad, Seven Segment display, ADC, DAC, Stepper motor, LCD to 8051. Introduction to Embedded C Programming.	8 Hrs.
Unit 5:--- INTRODUCTION TO PIC MICROCONTROLLER-16F877 Architecture, RESET options, Watch DOG timer, Memory organization, Instruction set and assembly language programming.	7 Hrs.
Unit 6:--- ON CHIP RESOURCES OF PIC 16F877 Overview of I/O Ports (internal structure of PORT A only) ,Timers, CCP, ADC , Interrupt structure.	8Hrs.
Textbooks: <ol style="list-style-type: none"> 1.”The 8051 microcontroller and embedded systems using assembly and c”,--By M A Mazidi and JG Mazidi, R D McKinlay-Pearson Education 2.”The 8051 Microcontroller “-By I Scott Mackenzie and R C W Phan,4th edition ,Pearson education 3.Desgin with PIC microcontroller By J B Peatman, Pearson education. 4.“The 8051Microcontroller-Architecture,programming & applications”-K. J. Ayala 	
References: <ol style="list-style-type: none"> 1.Intel Handbook on 8 Bit and 16 bit embedded controllersPIC microchip Midrange MCU family reference manual. 2.“microcontrollers theory and Applications”-By Ajay Deshmukh-TATA McGraw Hill 	
Unit wise Measurable students Learning Outcomes: <ol style="list-style-type: none"> 1. Describe the architecture of 8051 and PIC16F877 2. Illustrate the organization of registers and memory. 3. Develop programming skills in assembly language 4. Use timers and counters for delay generation and event counting 5. Write algorithms and develop programs for serial data communication applications. 6. Illustrate the use of interrupts and service routines 7. Illustrate how the different peripherals are interfaced with microcontroller. 	

Title of the Course: Antenna & Wave Propagation Lab Code: UECC0504										L	T	P	Credit	
										0	0	2	1	
Course Pre-Requisite: Coordinate systems, vector algebra, Electromagnetic Engineering etc														
Course Description: Course covers antenna parameters measurement, transmission line Parameters measurement & RADAR applications.														
Course Objectives: 1. To measure the parameters of the antenna & specify application. 2. To measure the different parameters of the transmission line. 3. To perform the practical on RADAR for the measurement.														
Course Outcome:														
CO	After the completion of the course the student should be able to								Bloom's Taxonomy					
									level	Descriptor				
CO1	Compare the Antenna parameters of the different types of antenna								Cognitive	Compare				
CO2	Use transmission line parameters to match the antenna with transmission line.								Cognitive	Use				
CO3	Distinguish the RADAR measurement for different applications.								Psychomotor	Distinguish				
CO-PO Mapping:														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3		1				2					
CO2			3		1				2					
CO3			3		1				2					

Assessments :		
Teacher Assessment:		
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE)having 25%, and 50% weights respectively.		
Assessment	Marks	Minimum for Passing
ISE	25	10
ESE-POE	50	20

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

ESE: Assessment is based on Practical oral examination

Course Contents:	
Experiment No. 1:--- Antenna Trainer kit Aim and Objectives: To know about the antenna trainer kit Outcomes: Perform the experiment using the antenna trainer kit. Theoretical Background: Antenna Trainer kit manual Experimentation: Connect the antenna trainer system Transmitter & Receiver Results and Discussions:Conclusion:	02Hrs.
Experiment No. 2:--- Proof of Theorems 1) Inverse Square law 2) Reciprocity Theorem	
Experiment No. 3:--- To measure parameters of Aperture type of Antenna(Horn & open ended wave guide Antenna)	02 Hrs.
Experiment No. 4:--- To measure parameters of Microstrip Antennas	02 Hrs.
Experiment No. 5:--- To measure parameters of Circularly Polarized Antennas	02 Hrs.

Experiment No. 6:--- To measure parameters of log periodic antenna	02 Hrs.
Experiment No. 7:--- To measure parameters of Phase Array(Broadside & End fire array)	02 Hrs.
Experiment No. 8:--- To calculate the attenuation of the transmission line	01 Hrs.
Experiment No. 9:--- To calculate the input impedance of the transmission line	01 Hrs.
Experiment No. 10:--- SWR measurement of the transmission line	01 Hrs.
Experiment No. 11:-- Fault localization on the transmission line	01 Hrs.
Experiment No. 12 :--- To measure velocity of the object.	01 Hrs.
Experiment No. 13 :--- To measure frequency of the tuning fork.	01 Hrs.
Experiment No. 14 :--- To measure the time period of the pendulum	01 Hrs.
Experiment No. 15 :--- To measure the speed of the fan	01 Hrs.
Textbooks: 1. Antenna trainer kit manual - Academia 2. Transmission Line trainer kit Manual- Scitech 3. RADAR Trainer kit manual- Scitech	
References: 1] “Antenna & Wave Propagation” By GSN Raju ,Pearson Publication.	

Title of the Course: Microcontroller Lab Code:UECC0505											L	T	P	Credit
											0	0	2	1
Course Pre-Requisite: KEIL micro vision software, MPLAB IDE, C programming														
Course Description: Basic introduction to microcontroller based systems design, development and implementation. It includes microcontroller architecture, programming, I/O Interfacing, Interrupt management and other related topics.														
Course Objectives: 1. Understand the architecture of 8051 and PIC 16f877 microcontroller 2. Understand the instruction set of 8051 & PIC 16f877 microcontroller 3. Understand the peripherals and its programming 8051 and PIC 16f877 microcontroller 4. Understand the embedded C language 5. Understand using peripherals to build a useful system														
Course Learning Outcomes: 1. Demonstrate ON CHIP resources of soc 2. Develop assembly language & embedded c programs 3. Carry out Interfacing of microcontrollers with off chip resources. 4. Design small applications with KEIL micro vision & MPLAB IDE Tools														
CO	After the completion of the course the student should be able to										Bloom's Cognitive			
											level	Descriptor		
CO1	Demonstrate ON CHIP resources of soc										II	Understanding		
CO2	Develop assembly language & embedded c programs										III	Applying		
CO3	Carry out Interfacing of microcontrollers with off chip resources.										V	Evaluating		
CO4	Design small applications with KEIL micro vision & MPLAB IDE Tools										VI	Creating		
CO-PO Mapping:														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												1	
CO2	1		3									2	2	1
CO3	2	2	3									2	1	
CO4	2	2	3	2	2							3	3	1
Assessments :														
Teacher Assessment:														
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.														
Assessment								Marks			Minimum Passing Marks			
ISE								25			10			
ESE -POE								50			20			
ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/Internal oral etc. ESE: Assessment is based on Practical and oral examination														
Course Contents:														
Experiment No. 1:--- Assembly language programming. Aim and Objectives: Understand the instruction set of 8051 Outcomes: Develop assembly language Theoretical Background: 8051 architecture & instruction set of 8051 Experimentation: Based on keil microvision software Results and Discussions: --Conclusion:													02 Hrs	

Experiment No. 2:--- Port programming Aim and Objectives: Understand the architecture of 8051 Outcomes: Demonstrate ON CHIP resources of soc Theoretical Background: 8051 architecture	02 Hrs.
Experimentation: Based on keil microvision software Results and Discussions: -- Conclusion:	
Experiment No. 3:--- Port programming Aim and Objectives: Understand the architecture of 8051 Outcomes: Demonstrate ON CHIP resources of soc Theoretical Background: 8051 architecture & instruction set of 8051 Experimentation: Based on keil microvision software Results and Discussions: -- Conclusion:	02 Hrs.
Experiment No. 4:---Timer programming Aim and Objectives: Understand the peripherals and its programming 8051(Timmersection) Outcomes: Demonstrate ON CHIP resources of soc Theoretical Background: 8051 architecture & instruction set of 8051 Experimentation: Based on keil microvision software Results and Discussions: -- Conclusion	02 Hrs.
Experiment No. 5:---Serial port programming Aim and Objectives: Understand the peripherals and its programming 8051(Serialcommunication section) Outcomes: Demonstrate ON CHIP resources of soc Theoretical Background: 8051 architecture & instruction set of 8051 Experimentation: Based on keil micro vision software Results and Discussions: -- Conclusion	02 Hrs.
Experiment No. 6:--- LED interfacing Aim and Objectives: Understand the OFF chip peripherals and its programming Outcomes: Demonstrate Off CHIP resources of soc Theoretical Background: Port structure of 8051 ,current sink & current source capacity of port pins Experimentation: Based on 89V51RD2 development kit. Results and Discussions: -- Conclusion	02 Hrs.
Experiment No. 7:--- 7 Segment displays interfacing with 8051. Aim and Objectives: Understand the off chip peripherals and its programming. Outcomes: Demonstrate Off CHIP resources of soc Theoretical Background: Types of 7 segment displays, various interfacing tech-niques of 7 seg. displays Experimentation: Based on 89V51RD2 development kit. Results and Discussions: -- Conclusion	02 Hrs.
Experiment No. 8:--- LCD interfaces with 8051. Aim and Objectives: Understand the off chip peripherals and its programming . Outcomes: Demonstrate Off CHIP resources of soc Theoretical Background: Types of LCD displays, various interfacing techniques ofLCD displays Experimentation: Based on 89V51RD2 development kit. Results and Discussions: -- Conclusion	02 Hrs.

Experiment No. 9:-- Assembly language programming OF pic 16f877 - Aim and Objectives: Understand the instruction set of PIC 16F877 Outcomes: Develop assembly language program Theoretical Background: PIC 16F877 architecture & instruction set. Experimentation: Based on MPLAB IDE software. Results and Discussions: - - Conclusion	02 Hrs.
Experiment No. 10: ----- Assembly language programming of PIC 16f877 - Aim and Objectives: Understand the instruction set of PIC 16F877 Outcomes: Develop assembly language programs Theoretical Background: PIC 16F877 architecture & instruction set. Experimentation: Based on MPLAB IDE software. Results and Discussions: -- Conclusion	02 Hrs.
Experiment No. 11:-- Port programming of PIC 16f877 - Aim and Objectives: : Understand the on chip peripherals and its programming of PIC16F877 Outcomes: Develop assembly language programs Theoretical Background: PIC 16F877 architecture & instruction set. Experimentation: Based on MPLAB IDE software. Results and Discussions: -- Conclusion	02 Hrs.
Experiment No.12:-- 7 segment display interfacing with pic 16f877 -Aim and Objectives: Understand the peripherals and its programming pic 16f877 Outcomes: Demonstrate Off CHIP resources of soc Theoretical Background: PIC 16F877 architecture & instruction set. Experimentation: Based on 16F877 development kit. Results and Discussions: Conclusion	02 Hrs.
Experiment wise Measurable students Learning Outcomes: 1. Ability to write assembly program for 8051 & PIC 16F877 2. Ability to design simple 8051 based hardware and use peripherals to build an 8051based system using C language 3. Ability to design simple PIC 16F877 based hardware and use peripherals to build an 8051 basedsystem using C language	

Title of the Course: Model Based Design Lab Course Code:UECC0506											L	T	P	Credit																																													
											0	0	2	1																																													
Course Pre-Requisite: Electronics Instrumentation, Control system basics, Programming basics																																																											
Course Description: This course is designed to understand concepts in Development methodologies in MBD using methods like Waterfall, V model, iterative and incremental, Spiral. The industry standard simulation tools like Matlab and Simulink will be used to model basic systems like motor, generators PID controllers etc. The Automotive subsystems will be discussed and simulated.Few models previously designed will be tested on real time targets like Arduino																																																											
Course Objectives: 1. To understand the concepts of Model based systems design 2. To understand Matlab/ Scilab programming Applications 3. To understand, design and model various automotive control systems using Simulink/ Scilab 4. To develop test strategy for model evaluation 5. To understand automotive systems and develop models for the same																																																											
Course Learning Outcomes:																																																											
CO	After the completion of the course the student should be able to										Bloom's Cognitive																																																
											level	Descriptor																																															
CO1	Illustrate Development methodologies in MBD										II	Understanding																																															
CO2	Develop models of system in design										III	Applying																																															
CO3	Evaluate performance of models										V	Evaluating																																															
CO4	Testing of automotive systems model developed										IV	Analyzing																																															
CO-PO Mapping:																																																											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2																																													
CO1			3																																																								
CO2	3												3	3																																													
CO3				3										3																																													
CO4							2							3																																													
The faculty should publish sufficient number of Design problems based on syllabus contents. The students should implement the designed problems throughout the semester. Teacher Assessment: ISE is based on Lab assignment/declared test/quiz/seminar/Group Discussions etc. ESE: Assessment based on Lab assignments demonstration in oral examination.																																																											
<table><tr><td colspan="7">Assessment</td><td colspan="3">Marks</td><td colspan="5">Minimum Passing Marks</td></tr><tr><td colspan="7">ISE</td><td colspan="3">25</td><td colspan="5">10</td></tr><tr><td colspan="7">ESE -OE</td><td colspan="3">25</td><td colspan="5">10</td></tr></table>															Assessment							Marks			Minimum Passing Marks					ISE							25			10					ESE -OE							25			10				
Assessment							Marks			Minimum Passing Marks																																																	
ISE							25			10																																																	
ESE -OE							25			10																																																	
Course Contents:																																																											
Unit 1:- Introduction to model based design: Work flow of model based design (MBD), Need of MBD, Core concepts of MBD, Develop-ment methodologies in MBD: Waterfall, V model, iterative and incremental, Spiral.													-																																														

Unit 2:--- Introduction to MATLAB, Simulink and SIMSCAPE tool boxes. An overview of Matlab, Numeric, cell and structure array, Functions and files, Programming with matlab. Creating and simulating model, Modelling programming construct, modelling discrete system, Modelling continuous system, Solver selection, developing model hierarchy, modelling conditionally executing algorithms, combining models into diagrams, creating library.	-
Unit 3:- Model-Based Design for a small system - Motor Model, Generator Model, Controller Model, modelling using state flow.	
Unit 4:- Explore the system response using different control methods. Tune the system, Explore system limitations, understand and refine models, Generating and Applying a PID Controller in Simulink.	
Unit 5:- Study of modelling and simulation of the automotive systems.	-
Unit 6:- Real time simulations on a Simple target (like Arduino)	-
Textbooks: <ol style="list-style-type: none"> 1. Managing Model based design, Roger Aarensrup, MathworksInc 2. Introduction to Matlab for Engineers, William J Palm, Mc Graw Hill 3. Using Simulink and Stateflow in Automotive Applications, MathworksInc 	
References: <ol style="list-style-type: none"> 1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999. 2. James D Halderman, "Automotive Electricity and Electronics", PHI Publication 2005. 3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003. 4. Process control CD Johnson 	
Unit wise Measurable students Learning Outcomes: <ol style="list-style-type: none"> 1. Students should be able understand concepts of Model based design. 2. Students should be able to simulate motor generator models use in automotive industry 3. Students should be able to develop models atleast 2 models using state flow 4. Students should be able evaluate performance of models 5. Students should be able test models 6. Students should be able simulate models on real time target hardware platform 	

Title of the Course: Mini Project – II	L	T	P	Credit
Course Code: UECC0507	0	0	2	1

Course Pre-Requisite: Analog Circuits, Digital Design, Linear integrated circuits, Network Analysis.

Course Description: Course will cover all the implementation of theoretical design & its practical implementation.

Course Objectives:

1. Design working, reliable and electronic circuits to meet specifications.
2. Inculcate circuit designing skills and ability and to use modern design tools.
3. Enhance employability based on knowledge and understandings, Arduino programming.
4. To create an interest in the field of electronic project design.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Apply their knowledge for development of these individual functional areas	III	Applying
CO2	Analyse the project idea and separate the different functional areas	IV	Analyzing
CO3	Design a solution for the identified problem by applying acquired technical knowledge.	VI	Creating
CO4	Test the Prototype to meet functional requirements and specifications..	VI	Creating

CO-PO Mapping:

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

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) .

Assessment	Marks	Minimum Passing Marks
ISE	25	10

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

Guidelines:

1. The mini project is a team activity having 4 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hardware or a combination of hardware and software.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ Industry requirements analysis, the student shall identify the title and define the aim and objectives of mini project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development, and testing of the proposed work as per the schedule.
8. Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Textbooks:

1. Measurement, Instrumentation, and Sensors Handbook, John G. Webster, CRC Press, 1999.
2. Exploring Arduino: Tools and Techniques for Engineering Wizardry book by Jeremy Blum

References:

Students are advised to refer Application Notes, research publications & data sheet of various electronics devices. From Motorola, National Semiconductors, Analog devices, Texas instruments, Fairchild, Cypress Semiconductors, Microchips, International Rectifiers, ST Microelectronics, Maxim, Philips, NXP, IEEE.

Note: -

1. Project report should include report and conclusion.
2. Project group should demonstrate and deliver seminar on project.
3. A mini project should not exceed four students per group.

Title of the Course: Optical Fiber Communication	L	T	P	Credit
Course Code: UECE0501	3	0	0	3

Course Pre-Requisite: Semiconductor Physics, Fundamentals of Electromagnetic theory, Principles of Communication Systems

Course Description: To introduce the students to various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors, optical amplifiers, SONET/SDH, WDM / DWDM and their use in the optical communication system. Fiber optical communication enables telecommunications networks to provide high bandwidth high speed data connections across countries and the globe. This type of communication can transmit voice, video and telemetry through local area networks, computer networks across long distance. Optical fiber also offers low power loss, lost cost, lower attenuation, and greater security.

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
3. To learn the various optical source materials, LED structures, Laser diodes
4. To learn the fiber optical receivers, noise performance in photo detector, receiver operation and configuration
5. To learn the varies fiber optical technologies

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Describe the basics of optical fiber and its Mode Characteristics.	II	Describe
CO2	Classify the construction and characteristics of optical sources and detectors.	I	Classify
CO3	Apply the basic knowledge of optical fibers to get the design aspect of optical amplifiers	III	Apply
CO4	Understand different optical fiber technologies	II	Understand

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2											
CO2	1	1	-											
CO3	2	2	2		1								2	2
CO4	1	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% 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 OF OPTICAL FIBERS Elements of Optical Fiber Transmission Link, optical spectral band, The nature of Light, Basic Optical Laws and Definitions, Single Mode Fibers, Graded Index fiber structures. Mode theory for waveguides, Fiber Materials and fabrication methods.	7 Hrs.
Unit 2:--- OPTICAL SOURCES Light source materials - LED -Structure - Quantum efficiency -Modulation. Laser Diode - Modes and threshold condition - Structures and Radiation Pattern. Light Source Linearity, Modal, Partition and Reflection Noise, Reliability considerations.	7 Hrs.
Unit 3:--- OPTICAL DETECTORS AND RECEIVERS Physical Principal of Photodiodes, Photo-detector Noise, Detectors Response Time, Avalanche Multiplication Noise, Structure for InGaAs APDs, Temperature effect of Avalanche Gain, Comparison of Photo-detectors ,Fundamental Receiver Operation, Digital Receiver Performance	7 Hrs.
Unit 4:-- Optical Amplifiers Basic applications and types, amplification mechanism, Stimulated Emission, Spontaneous Emission, semiconductor optical amplifiers, Erbium Doped Fiber amplifiers, Raman amplifier, wideband optical amplifiers, analog and digital links. Link budget.	6 Hrs.
Unit 5:--- WDM CONCEPTS AND COMPONENTS The WDM concept, WDM operation, WDM components, DWDM, WDM Amplifiers, couplers, splitters, Add/ Drop multiplexers, gratings, tunable filters, system performance parameters, LiFi technology and VLC. Optical Time Domain Reflectometer (OTDR) – fault detection, length and refractive index measurements.	8 Hrs.
Unit 6:-- FIBER BASED TECHNOLOGIES CPAN Technology - introduction, Net-picking, Running Perl, tools, Standard library, Running Perl CPAN, why CPAN, how to use CPAN, CPAN manual, the CPAN module, configuration, script, testers, Fiber based access technologies – Introduction, FFTx architecture, FFTx network architecture, types, FFTH, FFTH network, FFTH network architecture, requirements, FFTH technology, P2MP, P2P, network layers, open access networks, PON, PON link budget, NGPON2, GPON, GPON network, data transmission, ONU, OLT.	8 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education(India) Private Limited. 2. John M Senior, Optical Fiber Communications, Principles and Practice, 3 Edition, Pearson Education, 2010. 3. S. E. Miller and I. P. Kaminow, eds., Optical fiber Telecommunications- II, Academic, new York. 4. Rajeev Ramaswamy and Kumar N Sivarajan, “Optical Networks: A Practical Perspective”, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier). 	
References: <ol style="list-style-type: none"> 1. Harold Kolimbris, “Fiber Optic Communication”, 2nd Ed, 2004, PEI 2. Uyless Black, “Optical Networks: Third Generation Transport Systems”, 2nd Ed, 2009, PEI 3. Govind Agarwal, “Optical Fiber Communications”, 2nd Ed, 2004, TMH. 4. S. C. Gupta, “Optical Fiber Communications and its Applications”, 2004, PHI 5. P.E Green, “Optical Networks” Prentice Hall. 6. C.S.Murthy & M. Gurusamy, “WDM Optical Networks”, Prentice Hall (India). 	
Unit wise Measurable students Learning Outcomes: <ol style="list-style-type: none"> 1. To understand the basics of fiber optics and signal degradation. 2. Classify the optical transmitters and detectors . 3. Discuss the operation and design of optical amplifiers 4. To learn the fiber optical network components, SONET/SDH and operational principles of WDM/DWDM. 	

Title of the Course: Computer Architecture and Organization Course Code: UECE0502	L	T	P	Credit
	3	0	0	3

Course Pre-Requisite: Knowledge of basic functional units of Computer. Digital Design

Course Description:

Study basic and core concepts in Computer organization and advanced architectures.

Course Objectives:

1. To understand the structure, function and characteristics of computer architecture..
2. To design of the various functional units and components of computers.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Explain the organization of basic computer and its function, instruction types and data formats.	II	Understanding
CO2	Design arithmetic unit and control unit.	VI	Creating
CO3	Evaluate cost, performance measures of computer system and design trade-offs.	V	Evaluating
CO4	Analyze memory organization and memory management of computer system	IV	Analyzing

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	PSO 1	PSO 2
CO1	1	1			1								1	
CO2	1	2			1								1	
CO3	2	2											1	
CO4	2	1	1										1	

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	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:--- History of Computer architecture and Design Methodology Introduction and History, I AS Computer architecture, IBM 360 model, stack passed computer and polish notation. Design levels: Gate level and register level, processor level, programmable logic devices, performance measurement.	6 Hrs.
Unit 2:--- Processor Basic CPU organization fundamental, Data representation, Basic formats, Floating point numbers, Instruction sets: Instruction formats, Instruction type, Programming consideration, Introduction to RISC and CISC.	6 Hrs.
Unit 3:-- Arithmetic Unit Design. Fixed point arithmetic: Byte and word, Adders, Subtracters, And Multipliers: Booth's algorithm, Robertson's algorithms, combinational array multiplier. 32/64 bit floating point arithmetic :(IEEE 754 format), introduction to pipeline processing.	6 Hrs.
Unit 4:--- Control Design Introduction, Hard wired control, Micro programmed control, GCD processor Design, Design of Control unit for accumulator based CPU, DMA controller, control unit design, Micro Instruction format, Interrupt and Branch, Micro Instruction processing, Instruction sequencing and Interruption	8 Hrs.
Unit 5:--- Memory Organization Memory Systems, Multilevel memories, Address Translation, Memory allocation schemes FIFO, LRU, OPT, etc. Virtual Memory, Cache memory.	6 Hrs.
Unit 6:--- IO and System Control Processor programmed I/O architecture, DMA architecture, Interrupt I/O hardware.	4 Hrs.
Textbooks: 1. J.P. Hayes "Computer Architecture and Organization" McGraw Hill publication	
References: 1. Hamacher Zaki "Computer Organization" McGraw Hill publication	
Unit wise Measurable students Learning Outcomes: 5. Discuss the nature of design process, examines design at register and processor level. 6. Explain the fundamentals of CPU organization and operation. 7. Address the Control Unit Design. 8. Understand the computer memory system and its impact on its performance. 9. Discuss the design of IO system.	

Title of the Course: Multimedia Engineering	L	T	P	Credit
Course Code: UECE0503	3	0	0	3

Course Pre-Requisite: Digital Communication, Information coding & theory, Digital Signal Processing.

Course Description: Course will cover all the multimedia data representation, efficient techniques for better bandwidth utilization & its hardware & software.

Course Objectives:

1. To study the Multimedia information representations.
2. To study compression techniques for efficient utilization of bandwidth.
3. To understand multimedia hardware & software.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Charting the Multimedia information representations.	III	Apply
CO2	Analyze compression techniques for efficient utilization of bandwidth.	IV	Analyze
CO3	Create multimedia animation..	VI	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	3										
CO2	1		2	3										
CO3	1		2	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	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 : Multimedia Information Representation Introduction, Digitization principles, Text, Images, Audio and Video, Global structure of Multimedia, Multimedia system and properties.	06 Hrs.
Unit 2 : Text and Image Compression Introduction, Digital Image Representation, Image and graphics Format, Compression principles, text compression, image Compression	06 Hrs.
Unit 3 : Audio and video compression	06 Hrs.

Introduction, Audio compression, video compression, video compression principles, video compression.	
Unit 4 : Data Compression Storage Space, Coding Requirements, Source, Entropy and Hybrid Coding, Lossy Sequential DCT-based Mode, Expanded Lossy DCT-based Mode, JPEG and MPEG	06 Hrs.
Unit 5 : Multimedia Hardware and Software Understand analog and digital conversion process, Discuss the hardware requirement of multimedia system, Classify multimedia software based on its function, Text and Graphics: text-related element in multimedia design, bitmap and vector graphic	08 Hrs.
Unit 6 : Audio, Video and Animation Audio digitization, audio file format and audio software, digital video standards, basic principles behind animation and techniques, Multimedia Applications : Media preparation and composition, Media integration and communication, Media Entertainment	08 Hrs.
Textbooks: 1. Tay Vaughan, “Multimedia making it work”, Tata McGraw-Hill, 2008. 2. Rajneesh Aggarwal & B. B Tiwari, “Multimedia Systems”, Excel Publication, New Delhi, 2007.	
References: 1. Parekh Ranjan, “Principles of Multimedia”, Tata McGraw-Hill, 2007 2. Li & Drew, “Fundamentals of Multimedia”, Pearson Education, 2009.	

Title of the Course: Biomedical Instrumentation	L	T	P	Credit
Course Code:UECE0504	3	0	0	3

Course Pre-Requisite:

Knowledge of Instrumentation and Measurement

Course Description:

The course is designed to teach fundamental concepts of human physiology and the instrumentation used in the medical industry. Biomedical Instrumentation is application of technology for Medical field. During the course, Students will study electrophysiological measures, medical imaging, and other topics during the course. The course will help the students comprehend the tools utilized in disease diagnosis.

Course Objectives:

1. To introduce fundamentals of transducers as applicable to physiology
2. To explore human body parameters measurement setup
3. To understand the function of various biomedical devices used in hospitals
4. To Consider safety requirements for biomedical instrumentation

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Identify Physiological parameters used in biomedical engineering.	1	Remembering
CO2	Understand various bio signals/potentials	2	Understanding
CO3	Describe the engineering principles of commonly used medical equipment and medical imaging systems	2	Understanding
CO4	Learn the working principles of Surgical & Therapeutic Instruments with safety requirements.	3	Knowledge

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2									1		1		
CO2		2				1				1		1	2	
CO3			3		2	2		1		1		1	2	1
CO4	1		2	1	3	1		1		1		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	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:--- Fundamentals of Medical Instrumentation Fundamentals of medical instrumentation: Sources of biomedical signals, Block diagram of medical instrumentation system, Medical transducers: Body temperature, Blood pressure, respiration rate. Classification of Medical instruments based on: Application - (diagnostic, therapeutic, Imaging, analytical) , Physiological parameter and bio- potential , Biological system, Different departments in the hospital Unit .	6
Unit 2:--- Electro-Physiological measurements Electro- cardiograph(ECG) machine : ECG block diagram , Bipolar and unipolar leads, Phono-cardiograph. Electro- encephalograph (EEG):10-20 electrode placement system EEG readout device .Electro- myograph (EMG) machine.Bio-feedback Instrumentation	6
Unit 3:-- Non-electrical parameter measurements Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, Plethysmography, Blood Gas analyzers : pH of blood, finger-tip oximeter, Standard HL7.	6
Unit 4:--- Medical Imaging Generation, Characteristics, Block diagram/Circuit diagram, Working of X-ray machine. CT-Scan machine, MRI, Ultrasound, Echo-cardiograph, Colour Doppler ultrasound machine.	6
Unit 5:--- Surgical & Therapeutic Instruments Block diagram, Working of Electro-surgery machine (cautery), Hemo-dialysis machine, Muscle stimulator, Defibrillator Machine Unit	6
Unit 6:--- PATIENT SAFETY: Electric shock hazards , Leakage currents , Safety Codes for Electro medical Equipment, Electrical Safety Analyzer, Test instruments for checking safety parameters of biomedical equipment.	6

Textbooks:

1. Handbook of biomedical instrumentation, R. S. Khandpur, Tata McGraw Hill, New Delhi
2. Biomedical instrumentation measurements, Lesli P Cromwell, Fred J. Weibell, Erich A. Pfeiffer, PHI Learning, New Delhi
3. Medical instrumentation application & design, John G. Webster, John Wiley and Sons, New Delhi

References:

2. Principles of Applied Bio-Medical Instrumentation, L.A. Geddes and L.E.Baker John Wiley & Sons, 1975
3. Bio-Medical Instrumentation and Measurements, Leslie Cromwell, Fred J.Weibell, Pearson Education, 2002

Unit wise Measurable students Learning Outcomes:

After the completion of the course the student should be able to

- 1) Explain the human body electro- physiological parameters and recording of bio-potentials
- 2) Illustrate the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.

- 3) Understood the various assist devices used in the hospitals.
- 4) Know about recent trends, diagnostic and therapeutic techniques in medical instrumentation

Title of the Course: Exploring Arduino	L	T	P	Credit
Course Code:UECO0501	3	0	0	3

Course Pre-Requisites:

Boolean algebra, Logic gates, Binary and hexadecimal number systems, Basics of C programming

Course Description:

A *microcontroller* is a programmable platform that gives you the power to define the operation of complex mechanical, electrical, and software systems using relatively simple commands. The Arduino microcontroller platform shall help to explore the world of electronics, programming, human-computer interaction, art, control systems, and communicating over the Internet above mentioned concepts can be practiced on ready to use hardware platform and integrated development environment like Arduino for programming.

Course Objectives:

1. Introduction to world of micro computing and its application
2. To understand programming Arduino using embedded C
3. Develop compact codes to interface switches, relays, LCDs Motors to Arduino
4. Installing and Using Library for developing applications using Arduino
5. Connecting Ardunino to Internet

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Illustrate Application development environment of Arduino	1	Knowledge
CO2	Interpret Sensor, Actuators, LCDs Electronic devices	2	Understand
CO3	Device moderate complexity applications on Arduino platform	4	Analyze
CO4	Design internet ready applications on Arduino platform	6	Create

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		3			3									
CO2		3												
CO3	2		3											
CO4	3					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	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:- Arduino Engineering Basics: Exploring the Arduino Ecosystem, Arduino Functionality , Atmel Microcontroller, software architecture, IDE study, drivers, libraries, Serial monitor Microprocessor basics.	6 Hrs.
Unit 2:--- Digital Inputs, Outputs, and Pulse-Width Modulation, Programming Digital Outputs, Reading Digital Inputs, Working with “Bouncy” Buttons,Building a Controllable RGB LED Nightlight, Pulse-Width Modulation with analog Write().	8 Hrs.
Unit 3:- Reading Analog Sensors: Understanding Analog and Digital Signals, Reading Analog Sensors with the Arduino: analogRead(),Working with Analog Sensors.	6 Hrs.
Unit 4:- Controlling and Driving Motors: Driving DC Motors, Controlling Motor Speed with PWM, Driving Servo Motors and stepper motors, Building a Sweeping Distance Sensor.	7 Hrs.
Unit 5:- Interfacing with Liquid Crystal Displays: Setting Up the LCD, Using the Liquid Crystal Library to Write to the LCD, Adding Text to the Display, Creating Special Characters and Animations, Setting Up the Hardware, Displaying Data on the LCD.	8 Hrs.
Unit 6:- Connecting Arduino to the Internet: IP Address, Network Address Translation,MAC Address, HTML, HTTP, GET/POST, DHCP, DNS, Clients and Servers, Controlling Arduino from the Web.	7 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. Exploring Arduino®: Tools and Techniques for Engineering Wizardry, Jeremy Blum, John Wiley & Sons, Inc. 2. C programming for Arduino Julien Bayle PACKT Publishing 	
References: <ol style="list-style-type: none"> 1. C in depth S K Srivastava, Deepali Srivastva, BPB publication 2. Beginning C for Arduino, Jack Purdum, Apress 	
Unit wise Measurable students Learning Outcomes: <ol style="list-style-type: none"> 1.Students should be able understand algorithms development and programing in embedded C 2.Students should be able write embedded C codes to develop embedded systems on arduino platform 3. Students should be able interface input devices to Arduino 4. Students should be able Interface actuators to Arduino 6. Students should be able develop internet ready applications using Arduino programming environment and ready to use hardware platforms 	

Title of the Course: Web Technology	L	T	P	Credit
Course Code: UECA0501	2	0	0	0

Course Pre-Requisite: Basic knowledge of Programming Language

Course Description: This Course contains various techniques and technologies used for website designing and development.

Course Objectives:

1. To learn basic user interface.
2. To develop static and responsive web pages using HTML and CSS
3. To develop interactive websites using jQuery and JS.
4. To learn how to host the website

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Apply basic knowledge of HTML and CSS to design web pages	III	Application
CO2	Create attractive web pages	V	Synthesis
CO3	Apply bootstrap to develop responsive website	III	Application
CO4	Design and host websites using javascript and jquery	V	Design

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	1	2		3			1				1	1	
CO2	1	2	3	1	3			1				2	2	1
CO3	1	2	3	2	3			1				2	3	2
CO4	1	2	3	1	3			1				2	3	2

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
ESE	100

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:---HTML 5.0

Introduction to HTML5, Features of HTML5, HTML5 DocType, New Structure Tags, Section, Nav, Article, Aside, Header, Footer, Designing an HTML Structure of Page, New Media Tags, Audio

06 Hrs.

Tag, Video Tag, Require Attribute, Pattern Attribute, Autofocus Attribute, email, tel, URL types, number type, date type, range type, voice search, Examples of Form	
Unit 2:---CSS 3.0 Introduction to CSS 3, New CSS 3 Selectors, Attribute Selectors, First-of-type, Last- of-type, Nth-child, Element: empty, New CSS3 Properties, Custom Fonts, Text- Shadow Property, Text-Stroke Property, Rounded Corners, Box Shadows, CSS Gradients, CSS Multiple backgrounds, Opacity Property, Using CSS3 in Practical Layout	06 Hrs.
Unit 3:--BootStrap Introduction to Responsive Design, Mobile first design concepts, Common device dimensions, Viewport tag, Using CSS media queries, Menu conversion script, Basic Custom Layout, Introduction to Bootstrap, Installation of Bootstrap, Grid System, Forms, Buttons, Icons Integration, Using CSS3 in Practical Layout	06 Hrs.
Unit 4:---JavaScript Introduction to Client Side Scripting, Introduction to JavaScript, Javascript Types, Variables in JS, Operators in JS, Conditions Statements, Java Script Loops, JS Popup Boxes, JS Events, JS Arrays, Working with Arrays, JS Objects, JS Functions, UsingJavaScript in Realtime, Validation of Forms, Related Examples, Frameworks of js.	06 Hrs.
Unit 5:---jQuery and jQuery UI Introduction to jQuery, jQuery Features, Installing jQuery, jQuery Syntax, jQuery Ready Function, jQuery Selectors, jQuery Actions, jQuery plugins, jQuery Validation plugin, jQuery Slideshow, jQuery Dropdown, jQuery UI, Working with jQueryUI, jQuery Accordions, jQuery Tabs, jQuery Tooltips, jQuery Autocomplete	06 Hrs.
Unit 6:---Web Hosting Web Hosting Basics, Types of Hosting Packages, registering domains, Defining Name Servers, Using Control Panel, Creating Emails in Cpanel, Using FTP Client, Maintaining a Website, Introduction to Joomla &WordPress CMS	06 Hrs.
Reference Books: 1. HTML & CSS: The Complete Reference, Fifth Edition by Thomas Powell 2. JavaScript: The Definitive Guide, 6th Edition By David Flanagan 3. Learning jQuery Fourth Edition by Jonathan Chaffer , Karl Swedberg	
Unit wise Measurable Learning Outcomes: Unit 1:--- HTML 5.0 Students are able to a) identify different tags in HTML5.0 b) Use different HTML Tags Unit 2:--- CSS3.0 Students are able to a) Design attractive web pages. b) Use CSS attributes in web pages. Unit 3:--- Bootstrap. Students are able to a) use grid-layout of bootstrap to make pages responsive b) apply different CSS classes of bootstrap	

Unit 4:--- Javascript

Students are able to

- a) write basic programs using javascript
- b) Perform validations using javascript.

Unit 5:---Jquery

Students are able to

- a) Understand the use of jQuery.
- b) Use different JQuery UI tags.

Unit 6:--- Web Hosting

Students are able to

- a) Host websites on web servers.
- b) Develop websites using CMS.

Title of the Course: Embedded System	L	T	P	Credit
Course Code: UECC0601	4	0	0	4

Course Pre-Requisite: Digital electronics, Study of 8 bit microcontroller architecture and assembly language programming, Basics of C programming, Programming resources on microcontroller SOC

Course Description:

The main focus of the course is to study architecture of 32 bit microprocessors used in modern SOC. writing effective Assembly language and C codes to design and program embedded system with due consideration to meet performance metrics like low power design, meeting compliances for Embedded system. All above mentioned concepts should be practiced on ready to use hardware platform and integrated development environment for programming

Course Objectives:

To impart the concepts and architecture of Embedded systems and to make the students capable of designing Embedded systems. To illustrate the architecture and programming of Industry popular 32-bit Microcontroller, ARM7, Cortex M3

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Illustrate facts and innovative ideas practised in Industry standard 32-bit ARM7TDMI architecture	Understand	Illustrate
CO2	Demonstrate ARM ISA programming	Apply	Evaluate
CO3	Validate resources of SOC by programming embedded C using super loop method Practice Serial data communication: inter IC / system	Evaluate	Validate
CO4	Compare Industry standard 32-bit Cortex M3 architecture with ARM 7 TDMI	Evaluate	Compare
CO5	Develop applications by RTOS programming	Create	Develop

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO1
CO1	1	3	1	2					1				2	2
CO2	1	3	1	2									2	3
CO3		2	2	2									2	3
CO4								3					2	2
CO5	1	3	2	2									2	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	Minimum for Passing
ISE 1	10	20
MSE	30	
ISE 2	10	
ESE	50	20

ISE 1 and ISE 2 are based on Lab 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 ARM PROCESSOR

ARM Design philosophy, ARM Core data flow model, registers, operating modes, pipeline, exceptions, interrupts & the vector table, ARM processor families

06 Hrs.

Unit 2:--- ARM instruction set: conditional execution. Branch and Load/Store, software interrupt instruction, program status register instruction, review of Thumb instruction set. Exception handling schemes.

06 Hrs.

Unit 3:--- ARM7TDMI-S MICROCONTROLLER LPC 2148 (4 Hrs.)

Features, LPC 214X Device Information, Block Diagram, Memory Maps, Memory Acceleration Module-Block Diagram & Operation, System Control Block(SCB)-Register Description, Fosc. Selection Algorithm, external interrupt logic, phase locked loop, power control, Reset- Block Diagram& RSI register.

08 Hrs.

Unit 4:- LPC 2148 ON CHIP RESOURCES

Features, Block diagram and SFR planning: Pin connect block, GPIO, UART & Architecture, I2C, SPI, Timer, PWM, ADC, DAC, Vectored interrupt controller, features of on chip USB

06 Hrs.

Unit 5:- Cortex-M3 Architecture

Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.

06Hrs.

Unit 6:- INTRODUCTION TO RTOS

Architecture of kernel, task and task scheduler, ISR, shared data and re-entrancy, Semaphores, Mutex, Mailboxes and Pipes, Message Queues, Timers, Memory Management.

04 Hrs.

Textbooks:

1. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", 2006, Elsevier.
2. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010.
3. LPC214x USER MANUAL By Philips/ NXP semiconductor
4. Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK

References:

1. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education
2. Cortex-M series-ARM Reference Manual
3. Cortex-M3 Technical Reference Manual (TRM)
4. David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers
5. STM32L152xx ARM Cortex M3 Microcontroller Reference Manual

6. William Hohel ,”**ARM assembly language: fundamentals and Technique**”

7. ARM Architecture Reference Manual By: ARM

8. ARM7TDMI Technical Reference Manual Revision: r4p1 By: ARM

9. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Unit wise Measurable students Learning Outcomes:

Unit1: Ability to discuss ARM7TDMI architecture and develop ARM ISA codes to solve engineering problem

Unit2: Ability to program on chip resources to optimize system performance

Unit3: Ability to program on chip peripherals to meet design goal

Unit4: Ability to program on chip serial buses to meet design goal

Unit5: Ability to discuss Cortex M architecture and implementation

Unit6: Ability to program RTOS to build application

Title of the Course: VLSI Design	L	T	P	Credit
Course Code:UECC0602	4	0	0	4

Course Pre-Requisite: Digital Electronics

Course Description: This course covers the design of digital systems using VHSIC Hardware Description Language (VHDL) and Verilog and its implementation in Field Programmable Gate Arrays (FPGAs) and CPLDs. This technology allows rapid prototyping and system realizations by enabling design reuse and simplifying custom circuit design. The design tools are first introduced and used to implement Register level digital circuits and applications.

Course Objectives:

1. To study HDL based design approach using VHDL and Verilog.
2. To learn VLSI design flow for implementing Behavioral /RTL/gate level architectures on FPGA.
3. To explain features and capabilities of HDL to simulate, synthesize and test digital logic modules.
4. To Design the Data path and Control unit Design for a given algorithm
5. To Design Control unit and implementation using FSM description using HDL.
6. To comprehend importance of testability in logic circuit design

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
CO 1	Model digital circuit with HDL, simulate, synthesis and prototype in FPGA/CPLD	III	Applying
CO 2	Construct FSM for sequential logic circuits and simulate it for functional verification	VI	Creating
CO 3	To Design implement the algorithmic FSM using HDL	VI	Creating
CO 4	Determine the test vector by making use of various testing techniques for FPGA based designs.	V	Evaluating

CO-PO Mapping:

CO - PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	3	2	3	-	-	-	-	1	-	1	3	3
CO2	2	3	3	3	3	-	-	-	-	-	-	1	3	3
CO3	2	3	3	3	3	-	-	-	-	-	-	1	3	3
CO4	1	2	1	-	-	-	-	-	-	-	-	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

<p>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)</p> <p>ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (normally last three modules) covered after MSE.</p>	
Course Contents:	
<p>Unit 1:--- Introduction to VHDL: Introduction to VHDL, Level of abstraction, Need of HDL, VLSI Design flow, Features and capabilities of VHDL, Elements of VHDL [Entity, Architecture (Structural, Data flow and Behavioral), Library, Package, Configuration], Identifiers, literals, data types, Operators & Attributes.</p>	10 Hrs.
<p>Unit 2:--- VHDL Modeling: VHDL Test bench, Concurrent & Sequential constructs , Combinational logic using data flow and behavioural modeling (Adder, subtractor, Encoder, Decoder, multiplexer, De multiplexer, Tristate buffer, Parity generator & checker, Comparator) sequential logic (flip flops, shift registers and counters)</p>	08 Hrs.
<p>Unit 3:--- FSM Design Using VHDL: Impediments to synchronous design, clock jitter, skew, gating the clock, asynchronous inputs, meta-stability and synchronizer failure Wait statement, delays- Inertial delay & Transport delay, FSM, VHDL implementation of counter using FSM, Sequence detector, Bus Arbiter,</p>	06 Hrs.
<p>Unit 4:--- Introduction to Verilog: Introduction to Verilog, Basic Verilog naming conventions, Verilog operators, data types, Assignment statements, control statements, Behavioral modeling in Verilog HDL, Combinational and sequential logic design using Verilog.</p>	04 Hrs.
<p>Unit 5: Processor Design: Design of Data path, Design of control unit, Design of General purposes processor having instructions like LOAD, STORE, ADD, SUB, IN, JZ, JPOS, HALT. test bench using text IO</p>	08 Hrs.
<p>Unit 6:--- PLD and Testing: Testing: Fault models, Path sensitizing, Sequential circuit test, design for testability, Built-in self test(BIST), Test pattern generation, JTAG & Boundary scan Programmable Logic Devices: Architecture of CPLD, FPGA</p>	08 Hrs.
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Fundamentals of Digital Logic with VHDL design, Tata–Mcgraw Hill-Stephen Brown and Zvonko Vranesic. 2. Enoch O. Hwang “Digital logic and microprocessor design with VHDL”, Thomson Publication 3. Roth John “Principals of Digital System Design using VHDL”, 2nd Edition, Cengage Learning 	
<p>References:</p> <ol style="list-style-type: none"> 1. “Design through Verilog HDL”, TR Padmanabhan, B. Bala Tripura Sundari, Wiley Publications. 2. “Introduction to VLSI Systems”, Carver Mead – Lynn Conway, BS Publications. 3. “VLSI Design- Black Book”, Dr. KVKK Prasad, Kattula Shyamala, Wiley-Dreamtech Press. 4. “Digital integrated circuits- A design perspective”, Jan Rabaey, Anantha C, 2nd edition, PHI. 3. “VLSI Design”, Debaprasad Das, Oxford University press. 5. Charles H. Roth, “Digital systems design using VHDL”, PWS. 	

Unit wise Measurable students Learning Outcomes:**UNIT-I:**

UO1: Students will understand basic language construct of VHDL.

UO2: Students will explain the VLSI design flow from design specification to hardware implementation.

UNIT-II:

UO1: Students will be able to implement and simulate Register level combinational digital circuits using VHDL.

UNIT-III:

UO1: Students will be able to introduce delay models in circuits.

UO2: Students will be able to design state diagram for Digital and describe the FSM using HDL

UNIT –IV:

UO1: Students will be able to explain basic language constructs of Verilog.

UO2: Students will be able to simulate and implement combinational digital circuits using Verilog.

UNIT –V:

UO1: Students will be able to design the data path for simple algorithms

UO2: Students will be able to design the control unit FSM for simple Data paths to implement algorithms

UO3: Students will be able to design basic instruction set processor.

UNIT –VI:

UO1: Students will be able to describe Xilinx CPLD XC95 xxx serie and Spartan III FPGA.

UO2: Students will be able to derive the test vectors for stuck-at-fault model for combinational circuits using fault coverage and path sensitization approach.

UO3: Students will be able to explain the technique for testing sequential logic.

UO4: Students will be able to explain the significance of BIST and boundary scan.

Title of the Course: Signals and Systems	L	T	P	Credit
Course Code: UECC0603	3	1	0	4

Course Pre-Requisite: Engineering Mathematics, Network Analysis: Elementary signals.

Course Description:

In modern age of technology, signals and systems play vital roles. It is core subject in electronics and telecommunication field with diverse applications in area of science and technology such as signal and image processing, communications, control systems, circuit design etc. This course focuses on analysis of signals and systems using various transforms.

Course Objectives:

On completion of the course, students should be sufficiently familiar with the theoretical structure, formal representation, computational methods, notation, and vocabulary of linear models to be able to apply them to the analysis and design of digital and analog communications and control systems. The students will be able to perform signal analysis with reference to spectrum analysis of deterministic and non-deterministic signals.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	To apply skills to solve problems related to system classification & its properties	II	Explain
CO2	To know the Fourier series & Fourier Transforms for representation of periodic and non periodic signals	III	Applying
CO3	To analyze the systems in time & frequency domain by applying knowledge of Z Transforms	III	Applying
CO4	To Analyze signals using Discrete Fourier Transform (DFT)	IV	Analyzing

CO-PO Mapping:

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

<p>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.</p>	
Course Contents:	
Unit 1:-Introduction to Signals and Systems Introduction, standard signals, signal representation, classification of signals, System Representation, continuous & discrete systems, properties of system.	5 Hrs.
Unit 2: Linear time invariant Systems The representation of signals in term of impulses, discrete time LTI systems, continuous time LTI systems, properties of CT-LTI and DT-LTI systems, Convolution integral and convolution sum, graphical representation of convolution.	6Hrs.
Unit 3:- Sampling Representation of continuous time signals by it's samples, The sampling theorem, Reconstruction of signals from its samples using interpolation, The effect of under sampling, aliasing, Discrete time processing of continuous time signals, Sampling in the frequency domain.	5 Hrs.
Unit 4: Fourier Domain Analysis Signals: Continuous time Fourier Series : Trigonometric Fourier series, Exponential Fourier series, relation between trigonometric and exponential Fourier series, Discrete time Fourier series, properties of Fourier series. Fourier transform, Fourier transform pair, Fourier spectra, Convergence of FT, properties of Fourier transform.	6 Hrs.
Unit 5: Z Transform : Introduction of Z transform, ROC, properties of ROC, Unilateral Z-transform, properties of Z transform, Inverse Z transform : long division method, PFE method, residue method, Transfer function (Poles & Zeros).	6 Hrs.
Unit 6: Discrete Fourier Transform : Discrete Fourier Transform (DFT), Properties of DFT, Circular Convolution and Circular Co-relation using DFT and IDFT , Linear Convolution using Circular Convolution, Fast Convolution. Overlap Save and Overlap add algorithm. Relationship between DTFT, DFT and ZT.	6 Hrs.
Textbooks: 1 A.V. Oppenheim, A.S. Willsky, S.H. Nawab, <i>Signals and Systems</i> , Prentice Hall, 1997. 2. B. P. Lathi, "Linear Systems and Signals", OXFORD University Press 3. Ashok Ambardar, <i>Analog and Digital Signal Processing</i> , CL Engineering, 1999 4. Digital Signal Processing Principles, Algorithms and Application – By John G Prokis, Manolakis, Pearson Education publication	
References: 1. B. P. Lathi, <i>Linear systems and signals</i> ,Oxford University press, 2005 2. M. J. Roberts , <i>Signals and systems</i> , Tata Macgraw Hill,2005 3. Simon Haykin, Barry Van Veen, <i>Signals and systems</i> ,Wiley, 2003 Hwei P Hsu, <i>Schaum's Outline Signals and Systems</i> , Tata Macgraw Hill, 1995 4. Digital Signal Processing P. Ramesh Babu, Scitech publication	
Unit wise Measurable students Learning Outcomes: 1. Understand fundamental characteristics of Signals and Systems.	

2. Analyze response of linear continuous-time and discrete-time signals and systems.
3. Apply time-domain and frequency-domain analysis tools to linear continuous systems.
4. 4. Analyze discrete-time signals and system responses using the concepts of transfer function representation by use of Z and inverse-Z transforms.
- 5.** Analyze signals using Discrete Fourier Transform (DFT)

Title of the Course: Embedded System Lab Course Code: UECC0604										L	T	P	Credit	
										0	0	2	1	
Course Pre-Requisite: Basic knowledge of C programming														
Course Description: The main focus of the course is to practice ARM ISA. writing effective Assembly language and C codes to design and program embedded system with due consideration to meet performance metrics like low power design, meeting compliances for Embedded system. All above mentioned concepts should be practiced on ready to use hardware platform and integrated development environment for programming														
Course Objectives: The objective is to practice concepts and architecture of Embedded systems and to make the students capable of designing Embedded systems. To achieve this, the programming of Industry popular 32-bit Microcontroller, ARM7, Cortex M3 is covered in detail														
Course Learning Outcomes:														
CO	After the completion of the course the student should be able to									Bloom's				
										level	Descriptor			
CO1	examine ARM ISA by Solving engineering computational problems									VI		Creating		
CO2	Experiment with resources of LPC2148 by programming embedded C using super loop method									VI		Creating		
CO3	Practice philosophy of environment friendly embedded systems design by reducing system power consumption and RF emission									VI		Creating		
CO4	Develop Embedded system applications by RTOS programming									VI		Creating		
CO-PO Mapping:														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	1	2					1				2	2
CO2	1	3	1	2					1				2	3
CO3								3					2	3
CO4		2	2	2									2	2
Assessments :														
Teacher Assessment: One component of ISE and one ESE: end semester examination having 50 % weight for each. ISE is based on practical performed/ Quiz/ Lab assignment/ presentation/ group discussion/ Internal oral etc.														
ESE: Assessment is based on practical and oral examination														
Assessment					Marks					Minimum Passing Marks				
ISE					25					10				
ESE (POE)					50					20				
Course Contents:														
Experiment No. 1:- Study of ARM assembly language programming: Develop function to perform following operations. a. 64 bit Addition. b. 64 bit subtraction. c. Logical Operation. d. 32 bit Multiplication. e. Comparison of two numbers.													02 Hrs.	

f. Finding factorial of a number using lookup table. g. Add series of 16 bit numbers. h. Nested Call. i. Use of SW1. Aim and Objectives: Study ARM ISA Outcomes: Students will be able to program ARM ISA Theoretical Background: ARM7 architecture. Experimentation: Programming Results and Discussions: RJ(Refer Journal) Conclusion: RJ	
Experiment No. 2: . Programming GPIO using ARM SOC LPC2148 a. Flashing LED b. Read key and activate relay. Aim and Objectives: Practice GPIO Outcomes: RJ Theoretical Background: .RJ Experimentation: Results and Discussions: RJ Conclusion: RJ	02 Hrs.
Experiment No. 3:--- Programming GPIO using ARM SOC LPC2148. a. Tone generation. b. Generation of sequence for stepper motor control. Aim and Objectives: Practice GPIO Outcomes: RJ Theoretical Background: RJ Experimentation:RJ Results and Discussions: RJ Conclusion:RJ	02 Hrs.
Experiment No. 4:--- Programming ARM SOC LPC2148: Phase Locked Loop (PLL) for clock scaling . Aim and Objectives: Outcomes: RJ Theoretical Background: RJ Experimentation: RJ Results and Discussions:RJ Conclusion: RJ	02 Hrs.
Experiment No. 5:--- Programming ARM SOC LPC2148: Memory Acceleration Module for improving performance. Aim and Objectives: Outcomes: Practice performance scaling Theoretical Background: RJ Experimentation:RJ Results and Discussions:RJ Conclusion:RJ	02 Hrs.
Experiment No. 6:--- Programming ARM SOC LPC2148: Power Saving Mode. Aim and Objectives: Practice performance scaling Outcomes:.RJ Theoretical Background: RJ Experimentation: RJ Results and Discussions:RJ Conclusion:RJ	02 Hrs.
Experiment No. 7:--- Programming ARM SOC LPC2148: System Peripheral – ADC DAC.	02 Hrs.

Aim and Objectives: Practice ADC/ DAC Outcomes: RJ Theoretical Background: RJ Experimentation: RJ Results and Discussions: RJ Conclusion: RJ	
Experiment No. 8:--- Programming ARM SOC LPC2148: System Peripheral – UART 0. Aim and Objectives: Programming UART for desired baud rate and parity Outcomes: RJ Theoretical Background: RJ Experimentation: RJ Results and Discussions: RJ Conclusion: RJ	02 Hrs.
Experiment No. 9:--- Programming ARM SOC LPC2148: System Peripheral – Vectored Interrupt Controller. Aim and Objectives: Outcomes: Handling interrupts in C Theoretical Background: RJ Experimentation: RJ Results and Discussions: RJ Conclusion: RJ	02 Hrs.
Experiment No. 10:--- Programming ARM SOC LPC2148: Applications with RTOS to demonstrate: Scheduling algorithms, Events, Timers, Semaphor-Mutex . Aim and Objectives: RTOS based Application development Outcomes: RJ Theoretical Background: RJ Experimentation: RJ Results and Discussions: RJ Conclusion: RJ	02 Hrs.
Textbooks: William Hohel ,”ARM assembly language: fundamentals and Technique” LPC214x USER MANUAL By Philips/ NXP semiconductor Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK	
Reference Books: 1 . ARM Architecture Reference Manual By: ARM 2. ARM7TDMI Technical Reference Manual Revision: r4p1 By: ARM 5	
Topic wise Measurable students Learning Outcomes: Unit1: Ability develop ARM ISA codes to solve engineering problem Unit2: Ability to program on chip resources to optimize system performance Unit3: Ability to program on chip peripherals to meet design goal Unit4: Ability to program on chip serial buses to meet design goal Unit5: NA Unit6: Ability to program RTOS to build application	

Title of the Course: VLSI Design Lab Course Code:UECC0605	L	T	P	Credit										
	0	0	2	1										
Course Pre-Requisite: Digital Electronics														
Course Description: This lab-oriented course covers the design of digital systems using VHSIC HardwareDescription Language (VHDL), Verilog and its implementation on Field Programmable Gate Arrays (FPGAs).														
Course Objectives: 1. To understand working of Xilinx ISE 14.2 and Digilent NEXYS 3 board. 2. To understand working of ModelSim simulator. 3. To Design & implement digital circuits using VHDL & Verilog. 4. To implement combinational, sequential and FSM design using VHDL & Verilog.														
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	Create Digital Design projects using Xlilinx ISE and Model sim simulator			V		Applying							
	CO2	Synthesize and simulate VHDL and Verilog descriptions of digital circuits			VI		Creating							
	CO3	implement digitl system design using FPGA and CPLD			VI		Creating							
CO-PO Mapping:														
CO -PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	3	-	-	-	-	1	-	1	3	3
CO2	2	3	3	3	3	-	-	-	-	-	-	1	3	3
CO3	2	3	3	3	3	-	-	-	-	-	-	1	3	3
Assessments :														
Teacher Assessment: Two components of In Semester Evaluation (ISE), and one End Semester Examination (ESE) having 50% and 50% weights respectively.														
Assessment		Marks			Minimum Passing Marks									
ISE		25			10									
ESE (POE)		50			20									

<p>ISE 1 and ISE 2 are based on Lab assignment/ test/quiz/seminar/Group Discussion/ Oral etc. : ESE: Assessment is based on Practical, Oral Examination.</p>	
Course Contents:	
Experiment No. 1:--- Aim: Write a VHDL code to describe the functions of full adder and full subtractor using (Structural/Data flow / Behavioral Modeling). Objectives: To implement the functions of full adder and full subtractor. Outcomes: Functional verification of full adder and full subtractor. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 2:--- Aim: Write a VHDL program for the following combinational logic designs. Objectives: To implement combinational logic designs using VHDL. Outcomes: Functional verification of combinational logic designs. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 3:--- Aim: Write a VHDL code for 4-bit Binary up down counter (Asynchronous counter with clear and synchronous set). Objectives: To implement 4-bit Binary up down counter on FPGA. Outcomes: Functional verification of 4-bit Binary up down counter. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 4:--- Aim: Write a Verilog code for 4-bit Binary up or down counter. Objectives: To implement 4-bit Binary up down counter on FPGA Outcomes: Functional verification of 4-bit Binary up down counter using Verilog. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 5:--- Aim: Write a VHDL code for 4-Bit BCD up-down Counter with asyn. reset and synchronous clock enable. Objectives: To implement 4-Bit BCD up-down Counter on FPGA. Outcomes: Functional verification of 4-Bit BCD up-down Counter. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 6:--- Aim: Write VHDL code to display messages on the given seven-segment display interface. Objectives: To implement seven-segment display interface. Outcomes: Functional verification of seven-segment display interface. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.

Experiment No. 7:--- Aim: Write a VHDL code for universal shift register. Objectives: To implement universal shift register on FPGA. Outcomes: Functional verification of universal shift register on FPGA. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 8:--- Aim: Write a VHDL code for sequence detector and arbiter. Objectives: To implement sequence detector and arbiter. Outcomes: Functional verification of sequence detector and arbiter. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 9:--- Aim: Write a VHDL code for LFSR. Objectives: To implement LFSR on FPGA. Outcomes: Functional verification of LFSR. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 10:--- Aim: Write a VHDL code to implement FIFO. Objectives: To implement FIFO on FPGA. Outcomes: Functional verification of FIFO. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Experiment No. 11:--- Aim: Write a VHDL code for 8 bit generalpurpose ALU. Objectives: To implement 8 bit generalpurpose ALU. Outcomes: Functional verification of ALU. Theoretical Background: Experimentation: Results and Discussions: Conclusion:	02 Hrs.
Textbooks: 1. Fundamentals of Digital Logic with VHDL design, Tata–Mcgraw Hill-Stephen Brown and Zvonko Vranesic.	
References: 1. Principals of Digital System Design using VHDL, Cengage Learning-Roth John. 2. Principals of Digital System Design using VHDL, Cengage Learning-Roth John. Charles H. Roth, “Digital systems design using VHDL”, PWS.	

Experiment wise Measurable students Learning Outcomes:

1. Functional verification of full adder and full subtractor.
2. Functional verification of combinational logic designs.
3. Functional verification of 4-bit Binary up down counter.
4. Functional verification of 4-bit Binary up down counter using Verilog.
5. Functional verification of 4-Bit BCD up-down Counter.
6. Functional verification of seven-segment display interface.
7. Functional verification of universal shift register on FPGA.
8. Functional verification of sequence detector and arbiter.
9. Functional verification of LFSR.
10. Functional verification of FIFO.
11. Functional verification of ALU.

Title of the Course: Signal Analysis and Interpretation Lab	L	T	P	Credit
Course Code: UECC0606	0	0	2	1

Course Pre-Requisite: Strong Mathematical Analysis Skills, concepts of signals and systems.

Course Description: This course is dedicated to study and analyze different types of signals and their interpretation.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Study of different signals and Fourier analysis of signals	III	Applying
CO2	Analyzing and interpretation of Speech and seismic Signals	IV	Analyzing
CO3	Analyzing and interpretation of Biomedical Signals	IV	Analyzing
CO4	Analyzing and interpretation of X-RAY,MRI and Harmonics Signals Signals	IV	Analyzing

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	2									2		
CO2	1	1		3	3							2		
CO3	1	1		3	3							2		
CO4	1	1		3	3							2		

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE).

Assessment	Marks	Minimum Passing Marks
ISE	25	10
ESE-OE	50	20

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

ESE: Assessment is based on oral examination.

Course Contents:

Experiment No. 1: Generation of Basic Discrete Signals	2 Hrs.
Experiment No.2: Fourier Analysis of signals	2 Hrs.
Experiment No.3 : Auto correlation and cross correlation analysis of signal	2 Hrs.
Experiment No.4: Linear and Circular Convolution of signals	2 Hrs.
Experiment No. 5: -Analysis and interpretation of speech Signals	2 Hrs.
Experiment No.6 : Analysis and interpretation of seismic Signals	2 Hrs.
Experiment No.7 : Analysis and interpretation of Biomedical Signals a) ECG signal b)EEG signal c)EMG signal	2 Hrs.
Experiment No. 8: Analysis and interpretation of Vibration Signals	2 Hrs.

Experiment No.9 :Analysis and interpretation of X-RAY,MRI Signals	2 Hrs.
Experiment No.10 :Analysis and interpretation of Harmonics Signals from power supplies.	2 Hrs.
Advance Learners	
Experiment No.11 Basics of forensic signals its analysis and interpretation.	2 Hrs.
Experiment No. 12 Analysis and interpretation of crowd behavior using Video processing	2 Hrs.
Experiment No. 13 Analysis and interpretation of Emotions through face recognition.	2 Hrs.
Experiment No.14 Analysis and interpretation of RADAR Signals	2 Hrs.
* Use of appropriate tool and database is expected for each independent experimentation	

Title of the Course: Mini Project-III Course Code:UECC0607	L	T	P	Credit
	0	0	2	1

Course Pre-Requisite: Digital systems and Microcontrollers etc.

Course Objectives:

1. Evaluate industry/societal needs.
2. Identify suitable problem that can be solved using Electronics engineering knowledge
3. Design and implement the solution using hardware / software or both
4. Testing of the implementation

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Identify industry/ societal problem that can be implantable knowledge and skills.	III	Applying
CO2	Apply Engineering knowledge to identify and evaluate societal and industrial problems.	IV	Analyzing
CO3	Design / simulate the model/ project work	VI	Creating
CO4	Implement and test targeted project using various tools and equipments.	VI	Creating

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					2	2	1	1		
CO2		2	3	1					2	2	1	1		
CO3				1	3			1	2	2	1	1		

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE).

Assessment	Marks	Minimum Passing Marks
ISE	25	10

ISE are based on practical performed Mini-Project assigned/ Presentation/ Group Discussion/ Oral etc.
ESE: Assessment is based on oral examination

Guidelines:

10. The mini project is a team activity having 4 students in a team. This is electronic product design work with a focus on electronic circuit design.
11. The mini project may be a complete hardware or a combination of hardware and software.
12. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
13. After interactions with course coordinator and based on comprehensive literature survey/ Industry/societal requirements analysis, the student shall identify the title and define the aim and objectives of mini project.
14. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
15. The student is expected to exert on design, development, and testing of the proposed work as per the schedule.
16. Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
17. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Textbooks:

1. Measurement, Instrumentation, and Sensors Handbook, John G. Webster, CRC Press, 1999.
2. Exploring Arduino: Tools and Techniques for Engineering Wizardry book by Jeremy Blum

References:

Students are advised to refer Application Notes, research publications & data sheet of various electronics devices. from Motorola, National Semiconductors, Analog devices, Texas instruments, Fairchild, Cypress Semiconductors, Microchips, International Rectifiers, ST Microelectronics, Maxim, Philips, NXP, IEEE.

Note: -

1. Project report should include report and conclusion.
2. Project group should demonstrate and deliver seminar on project.
3. A mini project should not exceed four students per group.

Title of the Course: Information Theory And Coding Course Code: UECE0601	L	T	P	Credit
	3	0	0	3

Course Pre-Requisite: Probability, Fundamentals of digital communication.

Course Description: The course introduces information theory, the fundamentals of error control coding techniques and their applications.

Course Objectives:

1. To understand information theory, estimate information content of a random variable from its probability distribution.
2. To understand the types of communication channels, their capacities and construct efficient codes for data on imperfect communication channels.
3. To understand the need & objective of error control coding with encoding & decoding procedure to analyze error detecting & correcting capability of different codes.

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.	II	Comprehension
CO2	Analyze the basic communication channel models.	IV	Analysis
CO3	Analyze the error detecting and correcting capability of different coding scheme.	IV	Analysis
CO4	Design encoder and decoder for various coding techniques as per the need and specification.	V	Synthesis

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	3	2	1	1	1	1								
CO2	3	2	1	1	1	1								
CO3	3	2	2	1	1	1								
CO4	2	3	2	2	3	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% 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 30%-40% Weightage (Normally first three modules)

for syllabus covered up to MSE and 60-70% Weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Unit 1:--- : INFORMATION THEORY: Introduction, Concept of information: Unit, Properties, Entropy (Average Information) Definition, Mathematical expression, Entropy of Binary Source, Information Rate, Joint Entropy, Conditional entropy, relation between Joint & Conditional Entropy, Mutual Information: Average Mutual Information, Mathematical expression, Relation between Mutual Information & Entropy	7Hrs.
Unit 2:--- CHANNEL CAPACITY AND CODING: Channel Capacity, Redundancy and Efficiency of channel, Discrete memory less channel – Channel Matrix, Classification of channels: lossless Channel, Deterministic Channel, Noise free channel, Binary Symmetric Channel (BSC), Cascaded Channels and Binary Erasure Channel (BEC), Calculation of channel capacity of all channel theorem, Capacity of a band limited Gaussian channel, Shannon-Hartley Theorem, Trade of between Bandwidth and Signal to Noise ratio. Entropy Coding: Shannon Fano Coding, Huffman Coding.	6 Hrs.
Unit 3:-- LINEAR BLOCK CODE: Introduction: Error Control Coding: Need, Objectives & Approaches of Error Control Coding ,Classification, Error Detection and Error Correction Techniques, Linear Block Code: Structure, Terms Related to Block Code, Matrix Description of Linear Block Code, Generator and Parity Check Matrices, Hamming Codes, Encoder and Syndrome decoder for (n, k) block Code.	5 Hrs.
Unit 4:--- CYCLIC CODE: Algebraic structure, Properties, Polynomial representation of Codeword, Generator Polynomial, Generation of Code Vector in Non-systematic and Systematic form, Generator and Parity check matrices in Systematic form, Encoding of Cyclic Code, Syndrome decoding for Cyclic code, Hardware Representation of (n, k) cyclic code. Cyclic Redundancy Check Code.	7 Hrs.
Unit 5:--- CONVOLUTIONAL CODE: Introduction, Encoding of Convolution Codes, Generation of Output code sequence : Time Domain Approach, Transform Domain Approach, Graphical Approach – Code Tree, State diagram and Trellis Diagram, Decoding of Codes : Maximum Likelihood Decoding - Viterbi Algorithm.	6 Hrs.
Unit 6:--- BCH & RS CODE: Binary Field Arithmetic, BCH Code: Properties, Primitive element and primitive polynomial, Primitive BCH Code, Construction of Galois Field $GF(2^m)$, Addition & Multiplication of $GF(2^m)$, Minimal & Generator Polynomial for BCH Code, Decoding of BCH Code, Reed-Solomon code.	5 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. R.P Singh &S.D.Sapre ,Analog Communication Systems,Mc-Graw Hill, &IInd Edition, 2001. 2. Muralidhar Kulkarni, K.S. Shivprakash,Information Theory,& Coding Wiley (India) Publication 2014 3. ArijitSaha,Surajit Mandal, Information Theory Coding& Cryptography Pearson Education, Ist Edition, 2013. 4. Salvatore Gravano,“Introductionto Error Control Codes”, Oxford University Press, Ist Edition,2001 	
References: <ol style="list-style-type: none"> 1.Simon Haykin, “Communication Systems” John Wiley&Sons,Inc, IVth Edition 2. Sam Shanmugam, “Digital and Analog CommunicationSystems JohnWileyPublication , 2005. 3. Martin Roden, “ Analog Digital& CommunicationSystems”,Prentice Hall India,IIIrd Edition. 4. Ranjan Bose, “Information Theory Coding &Cryptography”,TataMcGraw-Hill Publishing Company Ltd, IInd Edition 2008 	
Unit wise Measurable students Learning Outcomes: <ol style="list-style-type: none"> 1. Demonstrate knowledge of Information Theory 2. Explain basic concepts of communication channel and entropy coding. 3. Analyze the Linear block code error detecting and correcting capability. 4. Analyze the cyclic code error detecting and correcting capability. 5. Analyze the convolution code error detecting and correcting capability. 6. Analyze the BCH code error detecting and correcting capability. 	

Title of the Course: Mechatronics	L	T	P	Credit
Course Code: UECE0602	3	0	0	3

Course Pre-Requisite: Sensors, Control system, Digital systems, Electrical machines

Course Description:

Studying the mechatronics course is of importance due to the developments in Mechatronics systems, Industry 4.0 and automated manufacturing planning and controlling activities etc. The mechanical systems are becoming smart and for designing and developing such smart systems students must understand basic elements of smart systems such as sensors, actuators, process controllers, PLC and programs for automating the processes.

Course Objectives:

1. Study of different Mechanical operations & Processes.
2. To study different Actuators.
3. To study PLC & programming of PLC using standard tool.
4. To study CNC, NC machine's structure and design.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Select actuators according to need.	III	Apply
CO2	Compare different Process controllers to meet application requirement.	II	Understand
CO3	Describe PLC and Design solutions for industrial automation problems using PLC programming instructions.	III	Apply
CO4	Illustrate different concept related to CNC and DNC machines and design.	II	Understand

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	1	2									1	1	1
CO2	2	1	3										1	1
CO3	3	1	3		2	1						2	1	1
CO4	1	1	1		2	1						2	1	1

Assessments: 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 mechatronics:

What is mechatronics, design of process, systems, measurement of system, Control system, Programmable logic controllers.

06 Hrs.

Unit 2:---Actuators and Mechanisms:

Introduction, Actuators Types and Application Areas, Electro- mechanical Actuators, DC motor, AC motor, Piezoelectric Actuators, Chemical Actuator, Bearings, Gears.

07 Hrs.

Unit 3:---Process Controllers :

Controller Principles, Two position controller (ON/OFF controller), Proportional controller, integral controller, Derivative controller, Pneumatic controllers, PID controller tuning.

06 Hrs.

Unit 4:--Programmable Logic Controllers:

Introduction, Definition of PLC, PLC system and components of PLC input output module, PLC advantages and disadvantages, RS-232 serial interface, Block diagram for interfacing of PLC, Various Communication Protocols in PLC, interfacing PLC of IO cards to CPU.

06 Hrs.

Unit 5:---Ladder diagram & PLC programming fundamentals

Basic components and other symbols, Fundamentals of ladder diagram, PLC input instructions, outputs, coils, indicators, operational procedures, contact and coil input output, programming example, simple industrial applications, Nesting of ladders. PLC timer functions – Introduction, timer functions, industrial applications, industrial process timing applications, PLC control functions – PLC counters and its industrial applications.

06 Hrs.

Unit 6:--- Introduction to CNC machines and Design of Mechatronics system: CNC machines, NC machines, CNC machines, DNC machines, machine structure. Introduction, Mechatronics approach into design, Case Examples, Future Trends-smart homes.

05 Hrs.

Textbooks

1. Mechatronics”, W. Bolton, Pearson Education, 4th Edition.
2. “ Mechatronics principles , concept and application ”, Mahalik, TATA McGraw Hill, 2nd edition
3. “Introduction to PLC Programming” NIIT.
4. Mechatronics Integrated mechanical electronic system, K.P Ramachandan, G.K Vijayaraghavan Willey India.

References:

1. Programmable logical controller, Reis Webb, Prentice Hall
2. Mechatronics – Appu Kuttam, Oxford publications
3. Automated Manufacturing systems, S. Brain Morris, McGraw Hill
4. Programmable logical controller, Hackworth & Hackworth, Pearson Education
5. Programmable logical controller, 3e Gary Dunning Cengage Learning

Unit wise Measurable students Learning Outcomes:

- 1** Identification of key elements of mechatronics system and its representation in terms of block diagram
- 2** Interface at least 5 sensors & Actuators with controller.
- 3** Use different process controllers for minimum 3 applications.
- 4** Development of PLC ladder programming and implementation for simple applications.
- 5** Write difference in CNC, NC machines by visiting any industry.

Title of the Course: Automotive Electronics	L	T	P	Credit
Code:UECE0603	3	0	0	3

Course Pre-Requisite: Electronics Instrumentation, Control system basics

Course Description: This course is designed to understand concepts in automotive electronics namely Power train, EV power train, control systems, sensors interfacing, safety systems and onboard diagnostics. Students will be able to correlate concepts learned in electronics engineering to modern automobiles designs.

Course Objectives:

1. To understand the concepts of Automotive Electronics systems & subsystems
2. To understand EV mechanisms and subsystems
3. To Explain various sensors and actuators used in automotive
4. To describe various communication systems, wired and wireless protocols used in vehicle networking
5. To understand automotive Safety standards,
6. To understand vehicle on board and off board diagnostics

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Illustrate use of electronics control system in Automotive power train of IC Engine and EV	II	Illustrate
CO2	Explain various sensors and actuators used in automotive	V	Evaluating
CO3	Identify various protocols and standards used in ECU communication	III	Applying
CO4	Outline concepts in automotive safety and on board diagnostics	II	Outline

CO-PO Mapping:

CO -PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2		2	1						2	1
CO2	2	1	2	2	1	2	1						2	1
CO3	2	1	2	2	2	1							1	1
CO4	2	1	2	2	2	1	3					2	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% weights respectively.

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

<p>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)</p> <p>ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (normally last three modules) covered after MSE.</p>	
Course Contents:	
<p>Unit 1:--- I.C. Power-train:</p> <p>Engine types and their operations: Engine Operating Cycles, Engine Components, Spark Ignition Engine Operation, Examples of Spark-Ignition Engines, Compression-Ignition Engine Operation. Basic Automotive System, System Components, Evolution of Electronics in Automotive. Fuel control system, Ignition control system. Emission control Vehicle braking fundamentals, Antilock systems, Variable assist steering and steering control, Controls for Lighting, Wipers, Air conditions/Heating.</p>	07 Hrs.
<p>Unit 2:--- Electric Vehicle Drive-trains:</p> <p>Hybrid and Electric power train. Control techniques used in hybrid system, Alternators, battery technology and charging systems, Special Control Schemes: Battery operated electric vehicles, EV subsystems, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, Configuration and controllers for BLDC Motor drives, PMSM drives, induction motor drives, drive system efficiency</p>	07 Hrs.
<p>Unit 3:--- Automotive sensors and Actuators:</p> <p>sensors : Accelerometers, wheel speed sensors, brake pressure sensors, Seat occupancysensor, Engine speed, Steering wheel angle, Vehicle speed sensor, Throttle position sensor, Turbine speed sensor, Temperature sensor, Mass air flow (MAF) rate sensor, Exhaust gas oxygen concentration sensor, Throttle plate angular position sensor, Crankshaft angular position/RPM sensor, Manifold Absolute Pressure (MAP) sensor, Differential exhaust gas pressure sensor, Actuators: Solenoids, various types of electric motors, and piezoelectric force generators, Examples for actuators: Relays, solenoids and motors. Sensors in Airbag system, Chassis Control systems, Automatic transmission control system</p>	06Hrs.
<p>Unit 4:--- Automotive Communication Systems:</p> <p>Automotive Buses: CAN, LIN, Flex Ray, Recent trends in Automotive buses (Such as, MOST, IE, IELLI, D2B, and DSI)</p>	08Hrs.
<p>Unit 5:--- Safety Systems in Automobiles:</p> <p>Safety in Automotive: Safety norms and standards. Passenger comfort and security systems A) Active Safety Systems: ABS, TCS, ESP, Brake assist etc B) Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (Lane Departure Warning, Collision Warning, Pedestrian Protection, Headlights Control) C) Functional Safety: Need for safety systems, safety concept, safety process for product life cycle, safety by design, validation.</p>	07Hrs.
<p>Unit 6:--- Automotive Diagnostics Fundamentals of Diagnostics:</p> <p>Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History memory, Diagnostic tools, Diagnostic protocols: KWP2000 and UDS.</p>	05Hrs.
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Internal Combustion Engines Fundamentals by J B Heywood, McGraw-Hill 2. Williams. B Ribbens, "Understanding Automotive Electronics", 6th Edition, 2003, Elsevier Science, Newness Publication 3. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004. 4. C. Mi, M. A. Masrur and D. W. Gao "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011 5. S. Onori, L. Serrao and G. Rizzoni "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015 	
<p>References:</p> <ol style="list-style-type: none"> 1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999. 2. James D Halderman, "Automotive Electricity and Electronics", PHI Publication 2005. 3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003. 4. Tom Denton, "Advanced Automotive Diagnosis", 2nd Edition, Elsevier, 2006. 5. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design" CRC Press, 2004 6. T. Denton, "Electric and Hybrid Vehicles" Routledge, 2016 	

Unit wise Measurable students Learning Outcomes:

1. To understand the concepts of I.C. engine power trains
2. To understand EV mechanisms and subsystems and components
3. To Explain various sensors and actuators used in automotive
4. To describe various communication systems, wired and wireless protocols used in vehicle networking
5. To understand automotive Safety standards,
6. To understand vehicle on board and off board diagnostics

Title of the Course: Operating System	L	T	P	Credit
Course Code:UECE0604	3	0	0	3

Course Pre-Requisite:

Computer Architecture, Fundamentals of Data Structure ,C programming

Course Description:

In this course we will explore the core principles of operating systems design, including basic operating system structure; process and thread synchronization and concurrency; file systems and storage servers; memory management techniques; process scheduling and resource management.

Course Objectives:

1. To introduce basic concepts and functions of modern operating systems.
2. To illustrate the concept of process and thread management.
3. To Analyze the scheduling of processes and threads.
4. To summarize the concept of concurrency control mechanisms.
5. To Explain the concept of I/O and File management.
6. To Compare various Memory Management techniques.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Define the basic components services of an operating system	I	Remembering
CO2	Analyze Process synchronization mechanisms and concurrency control	IV	Analyzing
CO3	Summarize the key issues related to the memory management.	II	Understanding
CO4	Explain the Internal structure of files in the UNIX system	V	Evaluating

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	2	1		1	1							2	1	1
CO2	2	2		2	1							2	1	1
CO3	1	1		1	1							1	1	1
CO4	2	1		2	2							2	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	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:--- FUNDAMENTALS OF OS AND SYSTEM SOFTWARE

Overview of all system software Operating system, OS services and system calls, multitasking, multiprogramming, time sharing, buffering, spooling, architecture of Unix OS, Introduction to

4 Hrs.

Unix Kernel	
Unit 2:--- PROCESS AND THREAD MANAGEMENT Concept of process and threads , process states process management context switching , interaction between processes and OS , multithreading	7 Hrs.
Unit 3:-- CONCURRENCY CONTROL Concurrency and race conditions, mutual exclusion requirements , s/w and h/w solutions, semaphores, monitors, classical IPC problem and solutions, Dead locks - characterization , detection ,recovery, avoidance and prevention.	7 Hrs.
Unit 4:--- MEMORY MANAGEMENT Memory partitioning , swapping, paging, segmentation, virtual memory - Concepts, Overlays, Demand paging, Performance of demand paging , page replacement algorithm, Allocation algorithms	6 Hrs.
Unit 5:--- I/O SYSTEMS Principles of I/O hardware - I/O devices - device controller - direct memory access Principles of I/O software – Goals - interrupt handlers - device drivers- device independent I/O software secondary-storage structure - Disk structure - Disk scheduling - Disk Management - Swap-space management - Disk reliability - Stable storage implementation	6 Hrs.
Unit 6:--- Unix File System Internal Representation of Unix File system,- Inodes, structure of a regular file, directories, conversion of a path name to inode, superblock, allocation of disk blocks , system calls for File system	6 Hrs.
Textbooks: 1. Maurice J. Bach “The Design of the Unix Operating System”, PHI	
References: 1. Achyut S. Godbole,” Operating Systems” II nd Edition, Tata Mc Graw Hill. 2. William Stallings ,”Operating System: Internals & Design Principles”, Prentice Hall of India. 3. Flynn & Metioes ,”Understanding Operating System” IV th Edition, Thomsan publication. 4. Silberschatz& Galvin,” Operating System Concepts”,VII th Wiley 2000. 5. MilmanMilenkovic,” Operating Systems, Concept & Design 6. P.balkrishna Prasad,” Operating Systems” II nd Edition, SciTech Publication 7. Flynn /McHoes,” Operating Systems” Cengage Learning (India Edition)	
Unit wise Measurable Students Learning Outcomes: 1. To introduce basic concepts and functions of modern operating systems. 2. To explain services of operating system. 3. To illustrate the concept of process and thread management. 4. To analyze the scheduling of processes and threads. 5. To list the concept of concurrency control mechanisms. 6. To explain the concept of I/O and File management. 7. To compare various Memory Management techniques.	

Title of the Course: Medical Electronics	L	T	P	Credit
Course Code: UECO0601	3	0	0	3

Course Pre-Requisite: Structure of Human Body.

Course Description: Course deals with study of physiological parameters both electrical and non electrical. Study various devices used in hospitals for taking care of our health.

Course Objectives:

- To gain knowledge about the various physiological parameters both electrical and non electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Know the human body electro- physiological parameters and recording of bio-potentials	Understanding	Know
CO2	Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.	Evaluating	Comprehend
CO3	Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators	Evaluating	Interpret
CO4	Comprehend physical medicine methods eg. Ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods	Applying	Comprehend
CO5	Know about recent trends in medical instrumentation	Analyzing	Know

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	3								1		1	2	
CO2	1	3								1		1	1	
CO3	1	3								1		1	1	
CO4	1	3	2							1		1	1	
CO5	1	3	2							1		1	1	

Assessments :

Teacher Assessment:

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

Course Contents:

Unit 1:--- ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDIN Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics	6 Hrs.
Unit 2:--- BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT pH, PO ₂ , PCO ₂ , Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.	6 Hrs.
Unit 3:-- ASSIST DEVICES Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.	6 Hrs.
Unit 4:--- PHYSICAL MEDICINE AND BIOTELEMETRY Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.	6 Hrs.
Unit 5:--- RECENT TRENDS IN MEDICAL INSTRUMENTATION Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, MEMS in medical.	6 Hrs.
Unit 6: PATIENT SAFETY: Electric shock hazards ,Leakage currents ,Safety Codes for Electro medical Equipment ,Electrical Safety Analyzer, Test instruments for checking safety parameters of biomedical equipment	6 Hrs
Textbooks: 1) Leslie Cromwell, —Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi, 2007.	
References: 1) Khandpur, R.S., —Handbook of Biomedical Instrumentation, TATA Mc Graw-Hill, New Delhi, 2003. 2) John G.Webster, —Medical Instrumentation Application and Design, 3rd Edition, Wiley India Edition, 2007 3) Joseph J.Carr and John M.Brown, —Introduction to Biomedical Equipment Technology, John Wiley and Sons, New York, 2004.	
Unit wise Measurable students Learning Outcomes: After the completion of the course the student should be able to 1) Explain the human body electro- physiological parameters and recording of bio-potentials 2) Illustrate the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc. 3) Explain the various assist devices used in the hospitals. 4) Know about recent trends in medical instrumentation	

Title of the Course: Design Thinking	L	T	P	Credit
Course Code:UECA0601	2	0	0	0

Course Pre-Requisites: Student should have engineering background of first year engineering.

Course Description: Companies are increasingly looking for employees with training in Design Thinking and innovation. The world and its challenges demand a new breed of professional—those who are trained to drive innovation, irrespective of the situation, industry, or problem. Design Thinking is a process that derive methods from engineering and design, and combines them with ideas from the arts, tools from the social sciences, and insights from the business world

Course Objectives:

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Discuss basics design thinking	2	Understand
CO2	Practice design thinking approaches	3	Analyze
CO3	Offer solutions by design thinking	6	Create
CO4	Design a product	6	Create

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		3				2								
CO2			3											
CO3				3										
CO4			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
ESE	100

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: Basics of Design Thinking Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test	6 Hrs.
Unit 2: Being Ingenious & Fixing Problem Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving	6Hrs.
Unit 3: Process of Product Design Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design	8 Hrs.
Unit 4: Prototyping & Testing What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example , Test Group Marketing	8 Hrs

Unit 5: Design Thinking & Customer Centricity Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design	
Unit 6: Feedback, Re-Design & Re-Create Feedback loop, Focus on User Experience, Address “ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – “Solving Practical Engineering Problem through Innovative Product Design & Creative Solution”.	
Textbooks: <ol style="list-style-type: none"> 1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company. 2. Designing for growth: A design thinking tool kit for managers, (Jeanne Liedtka and Tim Ogilvie., 2011, ISBN 978-0-231-15838-1) 3. The design thinking playbook: Mindful digital transformation of teams, products, services, businesses and ecosystem (by Michael Lewrick, Patrick Link, Larry Leifer., 2018, ISBN 978-1-119-46747-2) 4. Presumptive design: Design provocations for innovation (Leo Frishberg and Charles Lambdin., 2016, ISBN: 978-0-12-803086-8) 	
References: <ol style="list-style-type: none"> 1. The Mechanism of Mind – Edward de Bono, Vermilion Published 2nd July 2015 2. Designing for Emerging Technologies - Jonathan Follett, Editor (O’Reilly) 3. Designing of Everyday Things – Don Norman 4. Lateral Thinking – (Edward de Bono, HARPER & ROW, PUBLISHERS, New York) 	
Unit wise Measurable students Learning Outcomes: U1: Present case studies analysis where design thinking adapted U2: Demonstrate use of empathy map for their engineering mini projects U3: Adapt use design thinking approaches to bring innovation for their engineering mini projects U4: Adapt robust design in their engineering mini projects	