Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Contents (Syllabus) for

Third Year B. Tech.
(Electronics Engineering)
Sem – V to VI

AY 2020-21

Professional Core (Theory)

Title of the Course: 4EN 301 Digital Signal Processing	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Signals and Systems

Textbooks:

1. "Digital Signal Processing: A Computer Based Approach", Sanjit K. Mitra, 4th Edition, Tata McGraw-Hill Publication.

2. "Discrete Time Signal Processing", Oppenheim & Schafer,2nd Edition, Pearson education.

References:

1. "Digital Signal Processing", J. G. Proakis, Prentice Hall India

Course Objectives :

1. To illustrate the fundamental concepts of Signal Processing.

2. To explain the different techniques for design of filters and multirate systems.

3. To enable the students for the design and development of DSP systems.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Solve Discrete Fourier Transform in efficient manner	III	Apply
CO2	Analyze the structures for Discrete Time systems	IV	Classify
CO3	Design the FIR, IIR Digital Filters for given specifications.	VI	Create
CO4	Describe the fundamentals of Multirate DSP and Wavelet Transform	II	Explain

CO-PO Mapping :

	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													**2**
CO2		3												**2**
CO3				2										**2**
CO4	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
ISE 1	10
MSE	30
ISE 2	10
ESE	50

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 :**Discrete Fourier Transform and its Computation**	**Hrs.**
Introduction, The Discrete Fourier Series and its Properties, The Fourier Transform of Periodic signals, Sampling of the Fourier Transform, The Discrete Fourier Transform and its Properties, Efficient Computation of the Discrete Fourier Transform, Decimation-in-Time FFT Algorithms, Decimation-in-Frequency FFT Algorithms, Implementation of FFT Algorithms for IIR Systems.	10 Hrs

Module 2 :**Structures for Discrete-Time Systems**	**Hrs.**
Introduction, Block Diagram Representation of Difference Equations, Signal Flow Graph Representation of Difference Equations, Basic Structures of FIR Systems, Basic Network structures	6 Hrs
Module 3 :**Filter Design Techniques-FIR Filters**	**Hrs.**
Introduction, Design of FIR Filter by Windowing, Properties of commonly used windows, Linear Phase property of FIR Filter, Kaiser Window Filter design, Discrete Time Differentiator	6 Hrs
Module 4: Filter Design Techniques-IIR Filters	**Hrs.**
Introduction, Design of Discrete-time IIR Filters from Continuous-time Filters, Filter Design by Impulse Invariance, Filter Design by Bilinear Transformation, Frequency Transformations of Low pass IIR Filters	6Hrs
Module 5:Multirate Digital Signal Processing	**Hrs.**
Introduction, Decimation and interpolation, Sampling rate conversion, Multistage Implementation of Sampling rate conversion, Sampling rate conversion for Bandpass signals, Sampling rate conversion by arbitrary factor, Applications of Multirate DSP	6 Hrs
Module 6: Introduction to Wavelet Transform	**Hrs.**
STFT, Wavelets representation, Haar Wavelet, Daubachis Wavelet, Filter Bank Representation	6 Hrs

Module wise Measurable Students Learning Outcomes :

Module 1: Students will become familiar with efficient computation of Discrete Fourier Transform.

Module 2: Students will get introduced to basic structures for Discrete-Time systems

Module 3: Students will be able to design FIR filter for given specifications

Module 4: Students will be able to design IIR filter for given specifications

Module 5: Students will know fundamentals of Multirate Digital Signal Processing

Module 6: Students will be able to explain fundamentals of Wavelet transform

Title of the Course:	L	T	P	Cr
4EN302 Embedded System Design	3	0	0	3

Pre-Requisite Courses: : Microcontroller, Peripherals and Interfacing 4EN224

Textbooks:

1. NXP, LPC 2148 data sheet, NXP inc., NA, 2011

2. NXP, LPC 2148 user manual, NXP inc., NA, 2012

References:

1. ARM inc, ARM Reference Manual, ARM, inc., NA, 2011

2. Andrew Sloss, ARM System Developer's Guide, Elsevier India, 2005

3. Computer Organization and Design, ARM Edition, Elsevier, 2010

Course Objectives :

1. To illustrate the features of ARM7 architecture.
2. To provide the knowledge of different hardware peripherals and programing of different peripherals of ARM7 based controller, LPC2148.
3. To empower the students for the design and development of embedded system.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**illustrate** architecture and operation of internal peripherals of ARM7 LPC2148 microcontroller.	*II*	Applying
CO2	**write** assembly and C program to configure and use internal peripherals of LPC2148 microcontroller.	*III*	Applying
CO3	**analyze** program and find operating parameters of peripheral in LPC2148 microcontroller.	*IV*	Analyzing
CO4	**design and develop** small embedded system using embedded C programming and LPC2148 microcontroller.	*VI*	Creating

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CO-PO Mapping :

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

3 - H, 2 - M, 1 – L

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 : ARM7 Architecture	**Hrs.**
ARM7 Architecture, Memory organization, Programmers model, Pipelining, Memory, Register Structure, Current Program Status Register, Exception Modes, System buses and peripherals, Memory Accelerator module, Compare features / architecture of ARM7 with 8051.	**7**
Module 2 : Embedded C language programming	**Hrs.**

Introduction to ARM7 programming example, Software documentation method, Development Tools, ARM C Programming, Startup code, LPC2148 pin layout, PLL configuration, Pin Connect block, I/O programming, boot-loader, In Application Programming.	**8**
Module 3 : Interrupt Structure of ARM7 LPC2148	**Hrs.**
Interrupt system in ARM7, VIC, FIQ, IRQ, Non-vectored interrupt, Software interrupt, Interrupt latency, Nested interrupts, External interrupts, Interrupt configuration and Programming examples.	**7**
Module 4 : Peripherals of ARM7 LPC2148	**Hrs.**
Block diagram of Timers, role of prescaler, Capture and Match facility of timer and confirmation of it using registers, Pulse Width Modulator, RTC operation and Programming, Watch dog timer, Analog to digital converter, Digital to analog converter and their programming.	**8**
Module 5 : Communication Protocols	**Hrs.**
On chip serial ports, Serial port programming, Setting baud rate, Using UART buffer, printf for serial data transfer, interrupt based serial port handling, I2C protocol, Using I2C for interfacing external EEPROM, SPI protocol and programming.	**6**
Module 6 : Application Development	**Hrs.**
Finite state machine in designing Embedded Systems, Design considerations for embedded system design, Design of a simple general purpose ARM7 kit, Case studies of some ARM based applications. Introduction to ARM cortex core	**3**

Module wise Measurable Students Learning Outcomes :

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

Module 1: **illustrate** operating modes, exception and addressing modes of ARM7.

Module 2: **write** assembly and C programs for LPC2148 microcontroller.

Module 3: **write** C program for LPC2148 microcontroller to handle interrupts.

Module 4: **write** C program for LPC2148 microcontroller to configure peripherals.

Module 5: **use** communication protocols.

Module 6: **design and develop** a small embedded system.

4HS 307 Fundamentals of Management and Economics for Engineers

Professional Core (Lab)

Title of the Course: 4EN351 Digital Signal Processing Lab	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: Signals and Systems

Textbooks: 1. "Digital Signal Processing", Sanjit K. Mitra ,4th Edition,Tata McGraw-Hill Publication

2. "Discrete Time Signal Processing", Oppenheim & Schafer, 2nd Edition, Pearson education.

References: 1. "Digital Signal Processing", J. G. Proakis, Prentice Hall India.

Course Objectives :

The objective of the course is to work out for the convolution, correlation, DFT, IDFT, Block convolution, Signal smoothing, filtering of long duration signals, and Spectral analysis of signals using MATLAB simulation

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Illustrate the basic operations of Signal processing	III	Solve
CO2	Analyze the spectral parameter of window functions	IV	Explain
CO3	Create IIR, and FIR filters for band pass, band stop, low pass and high pass filters	VI	Design
CO4	Demonstrate multirate DSP and wavelet transform	II	Describe

CO-PO Mapping :

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

Assessments :

Teacher Assessment: Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing

Assessmen	Based on	Conducted by	Conduction and Marks Submission	Marks

t				
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Course Contents:

1. Generation of different signals using MATLAB
2. Calculate FFT AND plot Magnitude and Phase response for the same
3. Find circular convolution of given sequences
4. Implementation of Moving average filter
5. Implementation of Median filter
6. Overlap and save method illustration
7. Design of simple filter
8. Design of FIR filter
9. Observe the effect of length of filter on the magnitude response of a filter
10. Design of FIR filter using different window functions
11. Design of FIR filter using Kaiser window
12. Illustration of up sampling of signal
13. Illustration of down sampling of signal
14. Use of Wavelet transform for data compression
15. Use of Wavelet transform for de noising

Module wise Measurable Students Learning Outcomes :

1. Experiments 1 to 3 :Learning Outcome is demonstration of DSP basics
2. Experiments 4 to 7 : Learning Outcome is illustration of time domain filters in DSP
3. Experiments 7 to 11 :Learning Outcome is demonstration frequency domain filtering
4. Experiments 12 to 15: Learning Outcome is demonstration of multi rate DSP and Wavelet transform

Title of the Course:	L	T	P	Cr
4EN352 **Embedded System Design Lab**	0	0	2	1

Pre-Requisite Courses: Microcontroller, Peripherals and Interfacing theory and lab

Textbooks:

1. NXP, LPC 2148 data sheet, NXP inc., NA, 2011
2. NXP, LPC 2148 user manual, NXP inc., NA, 2012
3. MD2148 kit manual

References:

1. ARM inc, ARM Reference Manual, ARM, inc., NA, 2011
2. Andrew Sloss, ARM System Developer's Guide, Elsevier India, 2005
3. Internet resources related to this topic for mini-project

Course Objectives :

1. Write, simulate and debug assembly and C programs for LPC2148 microcontroller.
2. Write, simulate, download and test C programs for LPC2148 microcontroller in LPC2146 kit.
3. Develop C program for implementing given or required system operation.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**apply** programming skills to integrate hardware peripherals of ARM7 based controller, LPC2148.	*III*	Applying
CO2	**test** and **debug** programs for LPC2148 microcontroller	*IV*	Analyzing
CO3	**develop** and **demonstrate** small embedded systems using ARM C programming and hardware peripherals for ARM7 based processor, LPC2148.	*VI*	Creating

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**3**				**1**							
CO2		**3**										

CO3			**3**								**3**

3 - H, 2 - M, 1 – L

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Course Contents:

Following experiments will be conducted and the reports (journal) be submitted as documentation of

the experiments.

1. Introduction of the development tools and kit

2. Simple assembly language program and study of startup.s file

3. GPIO Programming

4. PLL Programming

5. Interrupt programming (IRQ and NV-IRQ)

6. FIQ programming

7. Programming Timer as Timer

8. Programming Timer as Counter

9. Programming Timer to perform capture operation and match facility of timer

10. Programming Timer to perform match operation

11. Programming PWM

12. Programming ADC

13. Programming DAC

14. Programming UART

15. Programming RTC

16. Study of power saving modes

17. Mini-Project Demo

Measurable Students Learning Outcomes :

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

1. Use the embedded software development tools.

2. Write C program for using GPIOs in LPC2148

3. Write C program to use the peripherals in LPC2148

4. Design a small embedded system such as temperature indicator

Title of the Course: **4EN353 Mini Project**	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses:

Textbooks:

1. Electronics Projects For Dummies, by by Earl Boysen and Nancy Muir, Published by Wiley Publishing, Inc., 2006
2. Make: Electronics, by Charles Platt, Published by Maker Media, 2015

References:

1. A. E. Ward, J.A.S. Angus, "Electronic Product Design", Stanley Thrones (Publishers) Limited, 1996.
2. Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 1989

Course Objectives :

1. To provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc thereby enhancing the skill and competency part of technical education
2. To create an Industrial environment and culture within the institution.
3. To inculcate innovative thinking and thereby preparing students for main project.
4. To set up self-maintenance cell within departments to ensure optimal usage of infrastructure facilities.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Choose, Initiate and manage a minor project.	I	Remembering
CO2	Propose research problem and present them in a clear and distinct manner through different oral, written and design techniques.	VI	Creating
CO3	Construct, Comment and Evaluate Mini Projects' undertaken/ implemented by other students.x	VI	Creating

CO-PO Mapping :

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

1- Low , 2 – Medium, 3 – High

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Mini Project Description

A project group shall consist of *not more than 3 students* per group. The mini project will involve the design, construction, and debugging of an electronic system approved by the department. Each student should conceive, design develop and realize an electronic product. The electronic part of the product should be an application of the analog & digital systems covered up to the 4th semester. The schematic and PCB design should be done using any of the standard schematic capture & PCB design software. . The realization of the product should include design and fabrication of PCB.

Each student must keep a project notebook/logbook. The project notebooks will be checked periodically throughout the semester, as part of in-semester-evaluation. The student should submit a soft bound report at the end of the semester. The final product as a result of mini project should be demonstrated at the time of examination.

Broad Areas of Mini Project

The Mini Projects may be from the following areas/domains, but not limited to:

- Embedded Systems
- Electronic Control Systems
- Electronic Communication Systems
- Biomedical Electronics
- Power Electronics
- Robotics and Mechatronic Systems
- Electric Vehicles
- Artificial Intelligence and Machine Learning
- Applications of Electronics to Agriculture

ASSESSMENT

A demonstration and oral examination on the mini project **shall be conducted at the** end of the semester. The examination will consist of demonstration and viva voce on the mini project.

Professional Electives (Theory)

Professional Elective-1

Title of the Course: 4EN311 Biomedical Engineering	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses: Electronics Measurement and Instrumentation

Textbooks: (NOT MORE THAN 3)

1. "Medical Instrumentation", John. G. Webster , John Wiley, 2009
2. "Principles of Applied Biomedical Instrumentation", Goddes& Baker, John Wiley, 2008
3. "Biomedical Instrumentation & Measurement", Carr & Brown, Pearson, 2004

References: (NOT MORE THAN 3)

1. Hand book of Medical instruments by R.S. Khandpur –TMH, New Delhi, 1987.
2. Medical Electronics and Instrumentation by Sanjay Guha – University Publication, 200.
3. Introduction to Biomedical electronics by Edwand J. Bukstein –sane and Co. Inc, 1973

Course Objectives :

1. To explain the basics body cell structure and different types of transducers
2. To explain the different types of patient monitoring system
3. Understand the design concept of different Medical instruments
4. To demonstrate different medical instruments

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Understand CNS-PNS and Cardio pulmonary system	II	Understanding
CO2	Apply proper sensors for sensing biomedical signals to biomedical instrumentation setup	III	Applying
CO3	Design ECG,EEG and EMG amplifier	VI	Creating
CO4	Explain block diagram of patient monitoring systems, X-ray machine, CT scan and Ultrasonography machine.	II	Understanding

CO-PO Mapping :

PO	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2
CO1	3											2	
CO2					3	2						2	
CO3			3									2	
CO4									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
ISE 1	10
MSE	30
ISE 2	10
ESE	50

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

	Hrs.
Module1: Fundamentals of Medical Instrumentation Physiological Systems of the body, Sources of Biomedical signals, Basic Medical Instrumentation system, Micro-Electro-Mechanical System (Mems), Wireless Connectivity in Medical Instruments, General Constraints in design of Medical Instrumentation Systems	**8**
Module2: The Origin of Bio potentials, Bio potential Electrodes & Biosensors Electrical activity of Excitable Cells, Functional Organization of the Peripheral Nervous System,Electrocardiogram(ECG),Electromogram(EMG), Electroencephalogram(EEG),	**5**

Electroretinogram(ERG) and their recording system, Biomedical signal Analysis and Processing Techniques.	
Module3: Patient Monitoring Systems System Concepts, Cardiac Monitor, Bedside patient Monitoring Systems, Central Monitors, Measurement of Heart rate, Measurement of Temperature, Measurement of respiration Rate, Biomedical Telemetry Systems	**8**
Module4: Modern Imaging Systems X-ray machines And Digital Radiography, X-ray Computed Tomography, Nuclear Medical Imaging Systems, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems and Thermal Imaging Systems.	**10**
Module5: Assisting and Therapeutic Equipment's Cardiac Pacemakers, Defibrillators, Diathermy, Hemodialysis Machines, Ventilators	**7**
Module6: Laser Application in Biomedical Field The Laser, Types of Lasers, Laser Application, Laser Safety	**3**

Module wise Measurable Students Learning Outcomes :

Module 1 Explain CNS-PNS system and various types of transducers

Module 2 Describe different Bio signals and their recording systems

Module 3 Explain bio signal and recording system

Module 4 Explain Patient Monitoring system

Module 5 Demonstrate the X-Ray machine

Module 6 Explain therapeutic equipments

Title of the Course: 4EN312 Microelectronics	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses:

Textbooks:

1. B.G. Streetman, S. K. Banerjee, " Solid State Electronic Devices ", 7th edition, Pearson India Education Service Pvt. Ltd., 2017.

References:

1. S. M. Sze, "Physics of Semiconductor Devices", 2nd Edition, PHI, 2005.
2. Donald. A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 3rd Edition, McGraw Hill Higher Education, 2003.

Course Objectives :

1. To provide students with a sound understanding of existing semiconductor devices to give meaning to their studies of electronic circuits and systems.
2. To ***explain*** carrier transport phenomena in solids on the basis of energy band theory and Boltzmann transport equation which forms the basis of electrical characteristics of semiconductor devices.
3. To ***develop*** capability in students to learn on their own about the new researched devices as they keep emerging in the market in future and lay the foundation for of their a constant career updating and self education.
4. To ***prepare*** the students for GATE in order to motivate them for higher studies.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Explain** the formation of bandgaps in solids, formation of depletion-diffusion layer capacitance in p-n junction diodes and characteristics of illuminated p-n junction, incoherent (LEDs) and coherent light sources (Lasers)	2	Understanding
CO2	**Apply** continuity equation and Poisson's equation to derive time dependence of carrier concentration on electric fields and potentials by considering band diagram of p-n junction in equilibrium.	3	Applying
CO3	**Model** the operation of bipolar junction transistor in three regions (cut-off, linear and saturation) using Ebers Moll coupled diode model.	3	Applying
CO4	**Analyze** BJT band diagram and explain current gain, base transport factor, and emitter injection efficiency.	4	Analyzing

CO5	**Interpret** C-V characteristics of MOS capacitor and I-V characteristics of JFETs, MOSFETs, with relevance to their electrical parameters like pinch-off voltage, threshold voltage etc.	5	Evaluating

CO-PO Mapping :

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

1 -Low , 2 -Medium, 3 -High

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Energy Bands and Charge Carriers in Semiconductors	**Hrs.**
Bonding forces and energy bands in solids, Charge carriers in semiconductors, Carrier concentration, drift of carriers in electric and magnetic fields, invariance of Fermi level at equilibrium.	**3**

Module 2: Excess Carriers in Semiconductors	**Hrs.**
Diffusion of carriers, Diffusion current, Drift current, Mobility of carriers, Recombination, Continuity equation, Quasi Fermi levels, Gradients in Quasi Fermi levels, resistivity of materials.	**4**
Module 3: Junctions	**Hrs.**
Formation of p-n junctions, Equilibrium conditions, Steady state conditions, Transient and AC conditions, deviations from simple theory, Metal-Semiconductor Junctions.	**4**
Module 4: Field Effect Transistors	**Hrs.**
JFET (characteristics), MOS capacitor (threshold voltage, C-V characteristics), MOSFET: I-V characteristics, Equivalent circuits for the MOSFET.	**6**
Module 5: Bipolar Junction Transistors	**Hrs.**
Minority carrier distributions and terminal currents, Generalized Biasing: The Coupled-Diode Model, Charge control analysis; switching, drift in base region, base narrowing, avalanche breakdown, thermal effects, Kirk effect.	**6**
Module 6: Optoelectronic Devices	**Hrs.**
Photodiodes: I-V characteristics in an illuminated junction, Solar Cells, Photodetectors; LEDs, Semiconductor Lasers.	**3**

Module wise Measurable Students Learning Outcomes :

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

1. ***Explain*** how bandgaps are formed in solids and calculate carrier concentration and current using Fermi-Dirac statistics.
2. ***Apply*** continuity equation to derive time dependence of carrier concentration.
3. ***Apply*** Poisson's equation to calculate electric fields and potentials by considering band diagram of p-n junction in equilibrium.
4. ***Explain*** the formation of depletion layer capacitance and diffusion capacitance and current flow components in an ideal diode. ***Interpret*** C-V characteristics of MOS capacitor and I-V characteristics of JFETs, MOSFETs, with relevance to their electrical parameters like pinch-off voltage, threshold voltage etc.
5. ***Analyze*** BJT band diagram and explain current gain, base transport factor, and emitter injection efficiency. ***Explain*** the operation of bipolar junction transistor in three regions (cut-off, linear and saturation) using Ebers Moll coupled diode model.
6. ***Explain*** the characteristics of an illuminated p-n junction, incoherent light sources (LEDs) and coherent light sources (Lasers) and relate those to their physical structures.

Tutorial: The problems based on the theoretical concepts explained/discussed in the theory class will be solved in the tutorial class. The Think-Pair-Share activity may be conducted while solving examples on p-n junction diode, BJT

and MOSFET. This will provide students further insight and better understanding about the working of solid state electronic (semiconductor) devices. The tutorial hour will be used to conduct short Quizzes, Seminar, and MCQs-type Tests.

Title of the Course : **4EN313 Linear Algebra and Statistics**	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses: Applied Mathematics I & II

Textbooks:

1. Introduction to Linear Algebra: 5th edition, Gilbert Strang, Wellesley-Cambridge Press, 2016
2. Introduction to Linear Algebra with Applications: Jim Defranza and Daniel Gagliardi McGraw Hill Education (India) Edition 2012
3. Introduction to Applied Linear Algebra: Stephen Boyd and Lieven Vandenberghe, Cambridge University Press, 2018

References:

1. Linear Algebra Theory and Applications: Ward Cheney and David Kincaid, Jones and Bartlett publishers, Indian Edition 2010
2. Linear Algebra and its Applications: David C. Lay, Steven R. Lay and Judi J. McDonald, Pearson, 5 edition, 2015

Course Objectives :

- To provide the students understanding of Linear transformations, Matrix algebra, Vector space, Inner product of vector space..
- To prepare students to solve systems of linear equations and counting problems,
- To illustrate applications of Linear Algebra in Electrical networks, Control systems and computer graphics.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Describe** vector and matrix algebra rules, vector space, inner product space, Eigen values and Eigen vectors	II	Understanding
CO2	**Solve** systems of linear equations, inner product space problems, problems of Eigen values and Eigen vectors	III	Applying
CO3	**Examine** linear algebra techniques to electrical and electronics circuits and	III	Applying

	data smoothing, Linear Transformations to Computer Graphics		

CO-PO Mapping :

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

2- Low , 2 – Medium, 3 - High

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Systems of Linear Equations	**Hrs.**
Vectors and Linear combinations, Solving systems of linear equations, Echelon and reduced echelon form, Matrices, Elimination using matrices, rules for matrix operations, the inverse of a matrix, characterization of invertible matrix, partitioned matrix, matrix factorization	**7**
Module 2 Vector Spaces	**Hrs.**
Vector spaces and subspaces, null space, Column and row spaces, Dual space, transformations, linearly independent sets, bases and dimension, coordinate systems, applications to Electrical circuits and data	**7**

smoothing	
Module 3 Inner product of Vector Spaces	**Hrs.**
Length and dot product in R^n, Inner product Spaces Orthonormal Bases: Gram-Schmidt Process, Mathematical models and Least squares analysis, Applications of Inner product spaces	**6**
Module 4 Linear Transformations	**Hrs.**
The Idea of a Linear Transformation, The Matrix of a Linear Transformation, Diagonalization and the Pseudo-inverse	**6**
Module 5 Eigen values and Eigen vectors	**Hrs.**
Eigen values and eigen vectors, characteristic equations, linear transformations, digonilzations, Applications to differential equations, complex Eigen values, orthgonality	**7**
Module 6 Applications	**Hrs.**
Matrices in engineering, ,single value decomposition, Computer Graphics, Least squares approximation,	**7**

Module wise Measurable Students Learning Outcomes :

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

Module 1: Solve systems of linear equations

Module 2: Describe vector spaces and **solve** problems

Module 3: Solve inner product space problems,

Module 4: **Examine** Linear Transformations to Computer Graphics

Module 5: Describe Eigen values and Eigen vectors and **solve** problems

Module 6: Examine linear algebra techniques in various fields

Tutorial: 5 to 6 tutorial to solve problems

Title of the Course: **4EN314** Automotive Electronics	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses: Basic Electronics, Control System

Textbooks:

1. Understanding Automotive Electronics An Engineering Perspective by William Ribbens, Butterworth-Heinemann is an imprint of Elsevier, 2017
2. Today's Technician™: Automotive Electricity and Electronics, 5th Edition by barry Hollembeak, Delmar, Cengage Learning, 2011.

References:

1. Automotive Electronics Design Fundamentals, by Najamuz Zaman, Springer International Publishing Switzerland 2015
2. Bosch Automotive electrics and electronics by Robert Bosch, Springer Vieweg, 2014

Course Objectives :

1. To learn the basic control system and sensor required Engine control
2. To learn basic of signal conversion circuit in Automotive system
3. To enhance skill of communication in automotive vehicle

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Classify various sensor system to control engine and its devices	II	Understanding
CO2	Apply knowledge of communication to device for controlling devices	III	Apply
CO3	Analyse a problem and identify the computing requirements for engine control instrumentation	IV	Analyze

CO-PO Mapping :

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

3- Low , 2 – Medium, 3 – High

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: The Basics of Electronic Engine Control	**Hrs.**
Motivation for Electronic Engine Control. Exhaust Emissions, Fuel Economy, Federal Government Test Procedures, Concept of an Electronic Engine Control System, Definition of Engine Performance Terms, Exhaust Catalytic Converters, Electronic Fuel Control System, Analysis of Intake Manifold Pressure, Idle Speed Control, Electronic Ignition	
Module 2: Sensors and Actuators	**Hrs.**
Automotive Control System Applications of Sensors and Actuators, Throttle Angle Sensor, Temperature Sensors, Typical Coolant Sensor, Sensors for Feedback Control, Knock Sensors, Angular Rate Sensor, LIDAR, Digital Video Camera, Flex-Fuel Sensor, Automotive Engine Control Actuators, Variable Valve Timing, Electric Motor Actuators, Stepper Motors, Ignition System	
Module 3: Digital Powertrain Control Systems	**Hrs.**
Digital Engine Control, Control Modes for Fuel Control, Discrete Time Idle Speed Control, EGR Control, Variable Valve Timing Control, Turbocharging, Direct Fuel Injection, Flex Fuel, Electronic Ignition Control, Integrated Engine Control System, Summary of Control Modes	

Module 4: Vehicle Motion Controls	**Hrs.**
Representative Cruise Control System, Cruise Control Electronics, Antilock Braking System, Electronic Suspension System, Electronic Suspension Control System, Four-Wheel Steering CAR	
Module 5: Automotive Instrumentation	**Hrs.**
Modern Automotive Instrumentation, Input and Output Signal Conversion, Display Devices, Fuel Quantity Measurement, Coolant Temperature Measurement, Oil Pressure Measurement, Vehicle Speed Measurement,	
Module 6: Vehicle Communications	**Hrs.**
IVN, CAN, Local Interconnect Network (LIN), FlexRay IVN, MOST IVN, Vehicle to Infrastructure Communication, Vehicle-to-Cellular Infrastructure, Short-Range Wireless Communications, Satellite Vehicle Communication, GPS Navigation, Safety Aspects of Vehicle-to-Infrastructure Communication	

Module wise Measurable Students Learning Outcomes :

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

Module 1: Relate the basic concepts of Engine control

Module 2: Classify the various sensors required for various control technique

Module 3: Understanding the engine control system

Module 4: Understand cruise control electronics

Module 5: Distinguish input output Signal Conversion

Module 6: Analyse vehicle communication technique

Tutorial:

Case Studies on Electronic Safety-Related Systems

Airbag Safety Device

Blind Spot Detection

Automatic Collision Avoidance System

Lane Departure Monitor

Tire Pressure Monitoring System

Enhanced Vehicle Stability

Professional Elective-2

Title of the Course: 4EN315 **Digital Communication Engineering**	L	T	P	Cr
	2	0	0	2

Pre-Requisite Courses: : Communication Engineering

Textbooks:

1. T.L. Singal, "*Analog and Digital Communication*",6th Edition, Mc Graw Hill, 2012

2. Roy Blake , "*Electronic Communication System*", Thomson Publications, 2nd Edition,2002

References:

1. Simon Hykin, "*Communication System*", 4th Edition, John Wiley & Sons, 2000

2. Bernard Sklar, "*Digital Communications - Fundamentals and Applications*", Pearson Publications, 2001

Course Objectives :

1. To equip the students with the advanced knowledge of digital communication.

2. To estimate the performance of modern digital communication in presence of noise

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**Explain** relevance of probability theory in digital communication	*II*	Understanding
CO2	**Apply** channel, source and error control coding techniques effectively	*III*	Applying
CO3	**Analyze** the performance of digital modulation schemes in presence of using AWGN	*IV*	Analyzing
CO4	**Discuss** the systems required for a software-defined radio.	*II*	Understanding

.

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	2													

CO2		3											
CO3			3									2	
CO4			2									2	

1 - L, 2 - M, 3 – H

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 : Probability and Random Process	**Hrs.**
Review of Probability concept, Random variables and it's types, CDF, PDF, Expectation, variance, movement generation function, Central limit theorem , Classification of Random Processes, Stationary; Time average; Ergodic Process; Wide sense stationary Process	**6**
Module 2 : Information Theory and Coding	**Hrs.**
Measure of Information. Avg. and Mutual Information. Joint and conditional entropy, Rate of Information, Channel capacity, Shannon's Theorem, Shannon-Hartley theorem, BE-SNR Trade off, Source to increase average information per bit—(Huffman , Shannon-Fano coding)	**6**
Module 3 : Error Control Coding	**Hrs.**
Rationale for coding, Discrete memory less channels, Linear Block Codes, Hamming codes, Convolutional	**7**

codes -Time domain approach, Transform domain approach, Turbo Code, Code tree, Code Trellis, Maximum likelihood decoding of convolutional codes: Viterbi algorithm.	
Module 4 : Detection and Estimation Theory	**Hrs.**
Model of Digital Communication System, Gram-Schmidt Orthogonalization Procedure, Geometric representation and interpretation of signals, Signal Constellation diagram, Conversion of continuous AWGN channel into a vector channel, Likelihood functions, Coherent detection of signals in noise : Maximum likelihood decoding.	**8**
Module 5 : Optimum Receivers for AWGN channel	**Hrs.**
Review of quadrature, M-ary modulation techniques, Probability of bit error rate, Demodulation : correlation demodulation, matched filter demodulation, Optimum Detection, Performance of optimum receiver for Binary and M-ary modulation schemes,	**7**
Module 6 : Introduction to Software Defined Radio	**Hrs.**
Foundation of software defined radio, Definition and potential benefits, Software radio architecture, Technology trade off and architecture implementation.	**6**

Module wise Measurable Students Learning Outcomes :

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

Module 1: Explain importance of probability theory in digital communication.

Module 2: Analyze performance of communication system using source and channel statistics.

Module 3: Apply error control coding techniques to improve performance of digital communication system.

Module 4: Apply detection and estimation algorithms to recover signal in presence of noise.

Module 5: Design optimum receivers for AWGN channel.

Module 6: Gain insight into software defined radio

Title of the Course: Object Oriented Programming 4EN316	L	T	P	Cr
	2	0	0	2

Pre-Requisite Courses: C programming

Textbooks:

4. Object Oriented Programming in C++, Robert Lafore, SAMS Publishing, Fourth Edition, ISBN: 0-672-32308-7
   (If needed the relevant language book will be referred).

References:

4. The C++ Programming Language, 4th Edition, Bjorne Stroustrup, Addison-Wesley Professional, ISBN: 978-0321563842
5. Web tutorials on C++ and Object Oriented programming
6. NPTEL lectures, Object-Oriented Programming by IITBx (free audit course)

Course Objectives :

5. To introduce the students the concepts of object oriented programming
6. To explain and illustrate the basic concepts of OOP, classes, objects etc.
7. To explain and illustrate the concepts of operator overloading etc.
8. To explain and illustrate the concepts of inheritance and polymorphism etc.
9. To facilitate practicing to solve problems using OOP approach.
   (The language will be mostly C++. However it can be decided based on the current trend in industry)

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply the understanding (of OOP) to identify how the problem can be solved using OOP approach (for a given situation)	3	Apply
CO2	Write a program to Illustrate the functioning of OOP facilities	6	Create
CO3	Analyze the give OOP program and identify the functionality	4	Analyze
CO4	Solve a given problem using object oriented approach. Write an object oriented program involving the usage of appropriate facilities in OOP.	6	Create

CO-PO Mapping :

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

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

OOP Programming Fundamentals: Need of Object oriented programming, Differences between procedural and OOP approach, Program Construction, input output and formatting, directives, data types, type conversion, library and header files, loops, decisions, logical operators, precedence, control constructs, structures, enumerations, functions, scope and storage classes, arrays, strings manipulation	**5 Hrs.**
Objects and Classes: Need of a class, real life examples of class, class and objects, class and data types, access specifiers, objects as function arguments, constructor, destructor, default constructor, copy constructor, scope resolution, UML Diagram of a class.	**5 Hrs.**
Operator Overloading: Need of Operator overloading, Overloading unary operators, overloading binary operator, data conversion between objects and basic types, Pitfalls of operator overloading and conversion	**4 Hrs.**
Inheritance and polymorphism: Base class and derived class, derived class constructor, overriding member functions, abstract base class, class hierarchy, public and private inheritance, avoiding ambiguity of multiple inheritance, polymorphism	**4 Hrs.**
Pointers: Address and pointers, Pointers and arrays, pointers and functions, strings, memory management using new and delete, pointers to objects, applications of pointers with objects, Linked list example, pointer to pointer	**4 Hrs.**
Virtual Functions and OOP development: Virtual functions, friend functions, static functions, this pointer, Stream class, stream errors, file I/O, error handling in file I/O, Multi-file project handling.	**4 Hrs.**

Module wise Measurable Students Learning Outcomes :

At the end of the semester, the students should be able to

Module1:

Explain the (C and C++) programming fundamental such as data types, constructs, input output, strings and array and illustrate the OOP approach.

Module2:

Write the (C++) programs for illustrating classes, objects, constructor, destructor facilities, drawing UML diagrams.

Module3:

Write (C++) programs for illustrating operator overloading and handling complex data type such as date, complex number etc.

Module 4:

Write (C++) programs for illustrating inheritance and its uses.

Module 5:

Write (C++) programs for illustrating Pointers and application of pointers to solve problems

Module 6:

Write multi-file programs to solve a given problem and to illustrate use of virtual functions.

Title of the Course: 4 EN 317 **Data Communication and Network**	L	T	P	Cr
	2	0	0	2

Pre-Requisite Courses: Analog and Digital Communication

Textbooks:

1. "Data Communication and Networking" ,TMH, B. Forouzan, 2013.
2. "TCP/IP Protocol Suite", TMH, B. Forouzan, 2010

References:

1. "Internetworking with TCP/IP", Pearson, Douglas Comer, Sixth Edition , 2016.

Course Objectives :

1. To explain concept of Data Communication
2. To provide function of different layers
3. To demonstrate and analysis of TCP/IP protocol suite and networking

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Illustrate** data communication and networking concepts	II	Understanding
CO2	**Apply** protocols and suggest design for specific applications	III	Apply
CO3	**Analyze** application layer protocols and perimeter security	IV	Analyzing

CO-PO Mapping :

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

4- Low , 2 – Medium, 3 - High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester

Examination (ESE) having 20%, 30% and 50% weights respectively.

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Introduction to data communication and Network, Communication tasks, Transmission media, Topology, Switching, Multiplexing, OSI Model, TCP/IP Model Comparison, Networking components.	**6**
Module 2	**Hrs.**
Data Link layer design issues, Logical Link Control, Medium Access Control, Elementary Data link layer protocols, Sliding window protocol , Medium access sub layer- Multiple access protocols.	**7**
Module 3	**Hrs.**
Logical Addressing, IPV4, Address space, Class-full Classless addressing, Internet protocol, fragmentation, Routing, Address Mapping (ARP, RARP), ICMP-Types of messages ,Message formats, Error Reporting, Query Routing, introduction to IPV6	**7**
Module 4	**Hrs.**
Duties of Transport layer, Process to Process delivery, User Datagram Protocol, Transmission Control Protocol TCP, Flow Control, Error Control, Congestion control in TCP, TCP Timers	**7**
Module 5	**Hrs.**
Domain Name System (DNS) - Name space, Distribution of Name space Resolution, Remote Login-TELNET, concept of Network Virtual Terminal (NVT), File Transfer Protocol (FTP), SNMP, Email SMTP, POP, IMAP.	**6**
Module 6	**Hrs.**

ntroduction to Multimedia traffic on network, protocol RTP, RTCP. Basics of security, Design issues, Network Security Firewall, Types, configurations, VPN	**6**

Module wise Measurable Students Learning Outcomes :

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

Module 1 Describe fundamentals of data communication and networking

Module 2 Explain Data link layer in detail

Module 3: Explain addressing and routing in networking.

Module 4 Explain TCP and UDP

Module 5Analyse Application layer Protocol

Module 6 Analysis of security and other industrial Protocol

Tutorial:

Professional Electives (Lab)

Professional Elective-2 Lab

Title of the Course: 4EN365 **Digital Communication Engineering Lab**	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: Communication Engineering

Textbooks:

1. George Kennedy , "Electronic Communication System", McGraw Hill, 4th Edition, 2009
2. Roy Blake , "Electronic Communication System", Thomson Publications, 2nd Edition,2002
3. Taub Schilling, "Principle of communication system", TMH publication, 4th Edition, 2013

References:

1. Wayne Tomasi ,"Adavnced Electronic Communications Systems", Pearson education, 5th Edition, 2014
2. Simon Hykin, "Communication System", 4th Edition, John Wiley & Sons, 2000
3. Manuals of Software Defined Radio, LabVIEW

Course Objectives :

10. To enable the students for design and development of applications of communication system.
11. To illustrate the different blocks used to improve performance of digital communication system.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze the performance of different modulation and demodulation schemes in terms of bandwidth, power requirement presence of noise.	IV	Analyzing
CO2	Compare the performance of different error control coding and decoding.	II	Understanding
CO3	Demonstrate a small communication system using software packages (MATLAB, Emona Datex board, Software Defined Radio)	III	Applying

CO-PO Mapping :

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

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

List of Experiments :

1. Digital Modulation Techniques
2. Delta Modulation and Demodulation
3. Adaptive Delta Modulation and Demodulation
4. Linear block coder and decoder
5. Convolutional Coder and Decoder
6. Design and comparison of optimum receivers for different modulation schemes using MATLAB
7. Detection and Estimation of signal in presence of AWGN using MATLAB
8. Introduction to Software Defined Radio
9. Implementation of digital modulation and demodulation schemes using GNU radio.

Title of the Course: 4EN366 Object Oriented Programming Lab	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: C programming

Textbooks:

5. Object Oriented Programming in C++, Robert Lafore, SAMS Publishing, Fourth Edition, ISBN: 0-672-32308-7
6. (If needed the relevant language book will be referred).

References:

7. The C++ Programming Language, 4th Edition, Bjorne Stroustrup, Addison-Wesley Professional, ISBN: 978-0321563842
8. Web tutorials on C++ and Object Oriented programming
9. NPTEL lectures, Object-Oriented Programming by IITBx (free audit course)

Course Objectives :

12. To introduce the students the concepts of object oriented programming
13. To explain and illustrate the basic concepts of OOP, classes, objects etc.
14. To explain and illustrate the concepts of operator overloading etc.
15. To explain and illustrate the concepts of inheritance and polymorphism etc.
16. To facilitate practicing to solve problems using OOP approach.
    (The language will be mostly C++. However it can be decided based on the current trend in industry)

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	Demonstrate use of at least one IDE for OOP program development and awareness of various other IDEs. Demonstrate use of helper utilities.	3	Apply
CO2	Write and Debug programs to illustrate the functioning of OOP facilities and demonstrate the working of programs.	6	Create
CO3	Prepare UML diagrams for given OOP based application.	4	Analyze
CO4	Implement a mini-project using object oriented approach using appropriate facilities in OOP and prepare related documents.	6	Create

CO-PO Mapping :

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

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings,

programming and other suitable activities, as per the nature and requirement of the lab course.

The experimental lab shall have typically 8-10 experiments.

Course Contents:

OOP Programming Fundamentals:

Expt 1: Revision of Procedural language-1 (based on language constructs, operators, argument passing and returning)

Expt 2: Revision of Procedural language-2 (based on Header files, Library, Array, string etc. facilities)

Objects and Classes:

Expt 3: Example OOP based programs. Program/s based on class, objects, member access specifiers etc)

Expt 4: Programs based on Constructor, Destructor, UML diagram components

Operator Overloading:

Expt 5: Program for illustration of operator overloading, operators

Expt 6: Program for operator overloading and data conversion, UML diagram for simple applications.

Inheritance and polymorphism:

Expt 7: Program for base and derived classes, overriding member functions,

Expt 8: Program for public and private inheritance, addressing ambiguity of multiple inheritance.

Pointers:

Expt 9: Programming related pointer, arrays, new and delete operators

Expt 10: Programs for pointers to objects, Linked list or related program, Pointer to pointer

Virtual Functions and OOP development:

Expt 11: Program for implementing Virtual functions, friend functions, static functions, this pointer,

Expt 12: Program to implement file I/O, multifile programs, Templates, UML for OOP based software architecture.

Expt 13: A mini project that uses all facilities in OOP. The problem statement is preferred to be relevant to industry needs.

Title of the Course: 4EN367 Data **Communication and Networking Lab**	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: Communication Engineering

Textbooks:

3. "Data Communication and Networking" ,TMH, B. Forouzan, 2013.
4. "TCP/IP Protocol Suite", TMH, B. Forouzan, 2010.

References:

4. "Internetworking with TCP/IP", Pearson, Douglas Comer, 2016.

Course Objectives :

4. To study layers and functions of Computer network
5. To implement socket programming
6. To demonstrate and analysis of TCP/IP protocol suite and networking

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze the performance of communication network.	IV	Analyzing
CO2	Compare the performance of different protocols at data link and Transport layer	II	Understanding
CO3	Demonstrate a small communication network system using software packages	III	Applying

CO-PO Mapping :

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

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

List of Experiments :

1. Implement UART serial communication
2. Study of different transmission media and LAN topologies
3. Demonstrate LAN communication using trainer
4. Demonstrate Data link layer protocols
5. Implement UDP socket
6. Implement TCP socket
7. Study of TCP timers
8. Using wire-shark capture packets for FTP, Telnet, DNS and study behavior
9. Study Firewall VPN security solutions of networks
10. Design and analyze network on various performance parameters

.

Open Elective Courses

Title of the Course: 4OE357 Electronic Systems	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Basic Electronics Engineering

Textbooks:

1. R. Boylestad and L. Nashelsky, "Electronics Devices and Circuits", 8th Edition, Prentice Hall International, 2005.
2. Anand Kumar, "Fundamentals of Digital circuits", 2nd Edition, PHI, 2009.
3. A. K. Sawhney, "Measurements and Instrumentation", Dhanpat Rai and Sons, 2013.

References:

10. R. P. Jain, "Modern Digital Design", Mc-Graw-Hill, 2008
11. Ramakant Gaikwad, "Op-amps and Linear Integrated Circuits", Pearson Education, 2011.
12. M.D. Singh and KB Khanchandani, "Power Electronics", 2nd Edition, McGraw-Hill, 2007.
13. *www.spoken-tutorial.org* ---IIT Bombay.

Course Objectives :

1. To ***explain*** the working of various components used in electronics systems.
2. To ***explain*** the working of analog and digital electronic circuits.
3. To ***illustrate*** the concept behind electronics systems and its application.
4. To ***explain*** the working of power semiconductor devices and its applications in power electronics.
5. To ***illustrate*** the implementation of Arduino based embedded systems.

Course Learning Outcomes:

COs	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	***Explain*** the working of components used in the electronic systems.	II	Understanding
CO2	***Develop*** a digital circuit for a given logic and ***build*** circuit for given specifications.	III	Applying
CO3	***Analyze*** the performance of Data Acquisition System and Power Electronics Circuits.	IV	Analyzing
CO4	***Build*** and ***Test*** an embedded system using Arduino board.	VI	Creating

CO-PO Mapping :

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

CO1	3													2
CO2	3		2											2
CO3		3												3
C04	3		2											3

1 -Low , 2 -Medium, 3 –High

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Electronic System Components	**Hrs.**
Transducers-Types, Classification, Characteristics: Signal Conditioning of inputs, Instrumentation Amplifiers, Capacitive type, Inductive type sensors, Limit switches, Temperature sensors: RTD, thermistor, Thermocouple, semiconductor diode sensor, piezoelectric transducer photovoltaic cell, LDR, Speed measurement using magnetic photoelectric pickup. Distance measurement: LVDT, capacitive transducers, Resistive, Glass scales, Magnetic scales. Concept of Quadrature output and index pulse.PH Sensors, Proximity Sensors, Motion Sensors.	**7**
Module 2: Operational Amplifier	**Hrs.**
Differential amplifier, Basic op-Amp configuration, Ideal op-amp analysis, Op-amp characteristics, Inverting and Non inverting amplifiers, Adder, Subtractor, voltage to current converters, current to	**8**

voltage converters, instrumentation amplifiers, Active filters. Voltage comparator, Comparator application, waveform generators: multivibrators, oscillators.	
Module 3: Digital Systems	**Hrs.**
Flip-flops, Counters, Up-counters, Down Counters, Mod-N counters, State diagram.	**5**
Module 4: Data Acquisitions System	**Hrs.**
Digital to Analog Converter (DAC), Analog to Digital converter (ADC), Data Acquisition System (DAS): introduction, objectives of DAS, single and multichannel, data conversion, sample and hold circuit, elements of DAS, interfacing of transducers-multiplexing.	**7**
Module 5: Power Semiconductor Devices and its Applications	**Hrs.**
SCR, TRIAC, DIAC, UJT, AC voltage regulator, Controlled rectifiers, Inverters, Speed control of AC and DC motors, SMPS,UPS, Electronics lamp ballast.	**8**
Module 6: Embedded Systems	**Hrs.**
Introduction to microcontroller based system: Arduino board, Arduino based systems, Simple Arduino program, interfacing display board to Arduino, Speed control of DC motor, motor driver IC: L293D.	**5**

Module wise Measurable Students Learning Outcomes :

1. ***Explain*** the working of various components used in electronics systems.
2. ***Explain*** the working of operational amplifier and ***analyze*** op-amp based circuits.
3. ***Analyze*** digital circuits using FSM
4. ***Explain*** uses of ADC- DAC in Data Acquisition System.
5. ***Explain*** the working of power semiconductor devices and ***analyze*** the performance of Power Electronics Circuits.
6. ***Explain*** microcontroller based systems and ***develop*** embedded systems using Arduino board.

T. Y. B. Tech. (Electronics Engineering) Sem VI AY 2020-21

Professional Core (Theory)

Title of the Course: : 4EN321 Electromagnetic Engineering	L	T	P	Cr
	3	1	0	4

Pre-Requisite Courses: Basic Electrical Engineering

Textbooks: (NOT MORE THAN 3)

1. "Engineering Electromagnetics", W. H. Hayt and J A Buck, 7th Edition, Tata McGraw-Hill, 2007.
2. "Elements of Electromagnetics", Matthew N. O. Sadiku, 3rd Edition, Oxford University Press, 2007
3. "Principles of Electromagnetics", S. C. Mahapatra and Sudipta Mahapatra, Tata McGraw-Hill, 2011.

References: (NOT MORE THAN 3)

1. "Electromagnetic Waves and Radiating Systems", E. C. Jordan & K. Balman, 2nd edition, PHI, 2007
2. "Field and Wave Electromagnetics", David K. Cheng, Pearson Education, 2015
3. "Electromagnetics with Applications" Kraus & Fleisch, 5th Edition, McGraw Hill International Edition, 1999.

Course Objectives :

Electromagnetics is the foundation for telecommunications. This course provides an introduction to electromagnetic theory and principles. The applications of electromagnetics include antennas, radio wave propagation, radar sensors, microwave and RF circuitry.

17. To understand the Electric fields, electric energy and potential.
18. To understand the Magnetic flux and forces, energy stored in magnetic field.
19. To develop in-depth understanding of time-varying fields and electromagnetic waves.
20. To study the electromagnetic wave transmission methods like transmission lines, antennas and waveguides.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Explain** the principles of static and time-varying electric and magnetic fields.	II	Understanding
CO2	**Compare** the behavior of electromagnetic waves in free space and guided medium like two-wire transmission line.	II	Understanding
CO3	**Solve** problems on static and time-varying electromagnetic fields.	III	Applying
CO4	**Analyze** the effects of electromagnetic radiation and electromagnetic interference.	IV	Analyzing

CO-PO Mapping :

	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		2											**2**	
CO2		2		1									**2**	
CO3	3												**2**	
CO4	3			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
ISE 1	10
MSE	30
ISE 2	10
ESE	50

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Electrostatics:	**8 Hrs.**
Review of vector analysis and coordinate systems. Coulomb's Law, electric field intensity, field due to line charge, sheet charge; electric flux density, Gauss's Law and it's applications, divergence theorem; energy and potential, potential gradient, electric dipole; energy density in electrostatic field.	
Module 2 : Conductors, Dielectrics and Capacitance:	**5 Hrs.**
Current and current density, continuity of current, conductor properties and boundary conditions; boundary conditions for perfect dielectric materials, Poisson's and Laplace's	

equations; Capacitance.	
Module 3 : Steady Magnetic Field:	**7 Hrs.**
Magnetic field intensity, Biot-Savart Law, Ampere's circuital Law, Stokes' theorem, magnetic flux and magnetic flux density; scalar and vector magnetic potential; Force on a moving charge, force between differential current elements, properties of magnetic materials, energy stored in magnetic field, forces on magnetic materials, inductance, magnetic boundary conditions.	
Module 4 : Time Varying Fields and Maxwell's Equations:	**5 Hrs.**
Faraday's Law, displacement current, Maxwell's equations in point (differential) form and integral form, time varying potentials, time-harmonic fields.	
Module 5 : Uniform Plane Electromagnetic Waves :	**8 Hrs.**
Wave propagation in free space and dielectrics, Power flow in uniform plane wave, Poynting's theorem, wave propagation in conductors: skin depth, reflection of plane waves, standing wave ratio, polarization of uniform plane waves.	
Module 6: Transmission Lines :	**7 Hrs.**
Types of two-conductor transmission lines, equivalent circuit, transmission line parameters, transmission line equations, lossless propagation, wave reflection, standing waves and voltage standing wave ratio, reflection coefficient, Smith Chart.	

Module wise Measurable Students Learning Outcomes :

1. Comprehend the principles of electrostatics.
2. Apply the fundamentals of electrostatics to solve boundary value problems.
3. Explain the existence and effects of magnetic field.
4. Compare and contrast difference between static and time- varying electromagnetic fields.
5. Understand the behavior uniform plane electromagnetic waves in free space and dielectrics.
6. Evaluate the performance of a two-wire transmission line in terms of characteristic impedance, input impedance, propagation constant, reflection coefficient, VSWR using analytical methods and graphical methods-Smith Chart.

Title of the Course: **4EN322 FPGA Based System Design**	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Pre-Requisite Courses: Digital Design (S,Y.), Microcontroller (S.Y.)

Textbooks:

1. FPGA Based Digital Design : Wayne Wolf, Pentice Hall, 2012

References:

1. Digital System Design using VHDL, Charles H. Roth, PWS Publishing, a branch of Thomson Learning
2. FPGA product catalog from Xilinx and Altera,

Course Objectives :

1. To expose the students to the various FPGA fabrics in terms of FPGA architectures,
2. To explain how combinational logic is modeled using hardware description language.
3. To illustrate with example combinational network delays.
4. To illustrate the difference between behavioral simulation, post-synthesis simulation and post-implementation simulation.
5. To demonstrate sequential machine design process using register transfer models and finite state machine,
6. To explain the design of a microprocessor using memory unit, control unit and data path blocks.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Compare various types of FPGA architectures with justification	V	Compare
CO2	Model combinational and sequential components by developing synthesizable and optimized (for delay) HDL code.	III	Model
CO3	Analyze the given HDL code to generate synthesized RTL	IV	Analyze
CO4	Design a sequential block using state table and register transfer model for the implementation in FPGA.	VI	Design
CO5	Design a n-bit processor by developing its instruction set and various hardware blocks viz. I/O unit, ALU, memory and control unit .	VI	Design

CO-PO Mapping :

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1				2										**2**
CO2	**3**													**2**
CO3		**3**												**2**
CO4			2											**2**
CO5			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. This is for submitting to Exam Cell for the final grade of that course. However teacher will have cumulative assessment of all Cos from all assessment tools used by him throughout the semester.

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

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

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

ESE: Assessment is based on 10% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents

Module Contents	No of Hours
Module 1: FPGA Architectures, SRAM based FPGAs, Permanently programmed FPGAs (Anti-fuse type), Chip I/O,FPGA fabric, Interconnect architectures, logic element parameters	5
Module 2: Modeling combinational logic with HDL, combinational network delays, Gate and wire delays, Fanout, path delay, power optimization by glitching analysis ,	5
Module 3: Sequential Machines, Sequential Machine Design process, Sequential Machine Design Styles, Rules for clocking, Clock skew, timing parameters	7
Module 4: Fast arithmetic logic blocks (Adders, Multipliers, ALUs), Data path controller architecture, Scheduling and Allocation, Pipelining,	8
Module 5: Memory units, ROM, SRAM, DRAM, Virtual Memory,Cache memories, Paging, Memory organization	7
Module 6: Design of a n-bit processor by developing its instruction set and integrating memory units, ALU, control unit .	8

Module wise Measurable Students Learning Outcomes :
After the completion of each module the student should be able to:

Module 1: Understand FPGA architecture, fabrics and logic implementation parameters

Module 2: Model combinational logic circuit and analyze path delay

Module 3: Model sequential logic circuit and analyze parameters

Module 4: Understand fast arithmetic logic block

Module 5: Understand memory and organization

Module 6: Design n-bit processor, instruction

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Professional Core (Lab)

Title of the Course: **4EN371 Mini Project**	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses:

Textbooks:

3. Electronics Projects For Dummies, by by Earl Boysen and Nancy Muir, Published by Wiley Publishing, Inc., 2006
4. Make: Electronics, by Charles Platt, Published by Maker Media, 2015

References:

1. A. E. Ward, J.A.S. Angus, "Electronic Product Design", Stanley Thrones (Publishers) Limited, 1996.
2. Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 1989

Course Objectives :

5. To provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc thereby enhancing the skill and competency part of technical education
6. To create an Industrial environment and culture within the institution.
7. To inculcate innovative thinking and thereby preparing students for main project.
8. To set up self-maintenance cell within departments to ensure optimal usage of infrastructure facilities.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Choose, Initiate and manage a minor project.	I	Remembering
CO2	Propose research problem and present them in a clear and distinct manner through different oral, written and design techniques.	VI	Creating
CO3	Construct, Comment and Evaluate Mini Projects' undertaken/ implemented by other students.x	VI	Creating

CO-PO Mapping :

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

5- Low , 2 – Medium, 3 – High

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Mini Project Description

A project group shall consist of *not more than 3 students* per group. The mini project will involve the design, construction, and debugging of an electronic system approved by the department. Each student should conceive, design develop and realize an electronic product. The electronic part of the product should be an application of the analog & digital systems covered up to the 5^{th} semester. The schematic and PCB design should be done using any of the standard schematic capture & PCB design software. . The realization of the product should include design and fabrication of PCB.

Each student must keep a project notebook/logbook. The project notebooks will be checked periodically throughout the semester, as part of in-semester-evaluation. The student should submit a soft bound report at the end of the semester. The final product as a result of mini project should be demonstrated at the time of examination.

Broad Areas of Mini Project

The Mini Projects may be from the following areas/domains, but not limited to:

- Embedded Systems
- Electronic Control Systems
- Electronic Communication Systems
- Biomedical Electronics
- Power Electronics
- Robotics and Mechatronic Systems
- Electric Vehicles
- Artificial Intelligence and Machine Learning
- Applications of Electronics to Agriculture

ASSESSMENT

A demonstration and oral examination on the mini project **shall be conducted at the** end of the semester. The examination will consist of demonstration and viva voce on the mini project.

<table>
<tr><td colspan="3">Title of the Course: 4EN372 FPGA Based System Design Lab</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td colspan="3"></td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>References:</td><td colspan="6">Text Books:

1. FPGA Based Digital Design: Wayne Wolf, Pentice Hall, 2012
Reference Books:

1. Digital System Design using VHDL, Charles H. Roth, PWS Publishing, a branch of Thomson Learning, 2008
2. FPGA product catalog from Xilinx and Altera,</td></tr>
<tr><td>Course Objectives :</td><td colspan="6">1. Demonstrate the flow of Xilinx EDA tools for designing and simulating FPGA based digital systems by modelling the components in HDL
2. Explain the terms functional simulation, timing simulation, synthesis, translate and technology mapping,
3. Demonstrate how to write and use constraint files.
4. Demonstrate how to download the bit streams of the designs in FPGAs and test by inputting the data and observing the outputs.
5. Prepare the students for good documentation discipline.</td></tr>
<tr><td rowspan="2">Course Learning Outcomes</td><td>CO</td><td colspan="3">At the end of the course, student will be able to</td><td colspan="2">Bloom’s Cognitive</td></tr>
<tr><td></td><td colspan="3"></td><td>Level</td><td>Descriptor</td></tr>
<tr><td rowspan="7"></td><td>CO1</td><td colspan="3">Develop error free HDL code for the components of the system and then for the main design entity by integrating the tested components</td><td>III</td><td>Applying</td></tr>
<tr><td>CO2</td><td colspan="3">Demonstrate the complete flow of Xilinx tools from HDL design entry to functional simulation, synthesis, and implementation with final download in chosen FPGA device.</td><td>II</td><td>Understanding</td></tr>
<tr><td>CO3</td><td colspan="3">Justify the superiority of structural architecture over Datapath architecture and behavioral architecture with few examples.</td><td>V</td><td>Evaluating</td></tr>
<tr><td>CO4</td><td colspan="3">Apply the user constraints for speed, power, group of ports etc by defining user constraint files.</td><td>III</td><td>Applying</td></tr>
<tr><td>CO5</td><td colspan="3">Design systems by developing the codes as well as calling the available IP cores from Xilinx sites and evaluate those</td><td>III</td><td>Applying</td></tr>
<tr><td>CO6</td><td colspan="3">Exhibit following technical and professional skills.

i. Hands on skills of using modern EDA tools
ii. Communication Skills
iii. Collaborative work spirit
iv. Research Skills
v. Lifelong learning attitude
vi. Ethical behavior</td><td colspan="2">VI

Related with psychomotor and affective domain and</td></tr>
</table>

			assessed thr' rubric on a scale of 1 to 5

Professional Electives (Theory)

Elective Foundation Course in Humanities

Professional Elective-3

Title of the Course: 4EN331 Introduction to Machine Learning	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses: probability & statistics

Textbooks:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to machine learning by Ethem Alpaydin., 2nd edition, The MIT Press, 2004

References:

1. Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan, Cambridge University Press 2008.
2. Pattern Recognition and Machine Learning by Christopher Bishop, Springer, 2006.

Course Objectives :

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Apply knowledge of computing and mathematics to machine learning problems, models and algorithms	III	Apply
CO2	Analyse a problem and identify the computing requirements appropriate for its solution	IV	Analyse
CO3	Design, implement, and evaluate an algorithm to meet desired needs	4	Design

CO-PO Mapping :

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

1- Low , 2 – Medium, 3 - High

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Machine Learning	**Hrs.**
Introduction, Supervised Learning, Learning a Class from Examples, Learning Multiple Classes, Regression, Dimensions of a Supervised Machine Learning Algorithm, Bayesian Decision Theory, Discriminant Functions, Association Rules	**6**
Module 2: Parametric, Multivariate and Nonparametric Methods	**Hrs.**
Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Multivariate Data, Multivariate Normal Distribution, Multivariate Classification, Multivariate Regression, Nonparametric Density Estimation, Nonparametric Classification, Nonparametric Regression: Smoothing Models	**6**
Module 3 Dimensionality Reduction, Clustering and Decision Trees	**Hrs.**
Principal Components Analysis, Factor Analysis, Linear Discriminant Analysis, Locally Linear Embedding, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Supervised Learning after Clustering, Hierarchical Clustering, Univariate Trees, Rule Extraction from Trees,	**8**

Learning Rules from Data, Multivariate Trees	
Module 4 Linear Discrimination and Multilayer Perceptrons	**Hrs.**
Generalizing the Linear Model, Geometry of the Linear Discriminant, Parametric Discrimination Revisited, Gradient Descent, Logistic Discrimination, Discrimination by Regression, The Perceptron, Training a Perceptron, Learning Boolean Functions, Multilayer Perceptrons, Backpropagation Algorithm, Training Procedures, Bayesian View of Learning, Dimensionality Reduction, Learning Time	**6**
Module 5 Kernel Machines and Bayesian Estimation	**Hrs.**
Optimal Separating Hyperplane, The Nonseparable Case: Soft Margin Hyperplane, v-SVM, Kernel Trick, Vectorial Kernels, Multiple Kernel Learning, Multiclass Kernel Machines, Kernel Machines for Regression, Estimating the Parameter of a Distribution, Bayesian Estimation of the Parameters of a Function, Gaussian Processes	**6**
Module 6 Hidden Markov Models and Graphical Models	**Hrs.**
Discrete Markov Processes, Hidden Markov Models, Three Basic Problems of HMMs, Evaluation Problem, Finding the State Sequence, Learning Model Parameters, Model Selection in HMM, Canonical Cases for Conditional Independence, Example Graphical Models, d-Separation, Belief Propagation, Undirected Graphs: Markov Random Fields, Learning the Structure of a Graphical Model, Influence Diagrams	**8**

Module wise Measurable Students Learning Outcomes :

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

Module 1: Relate the basic concepts and methods of machine learning.

Module 2: Classify estimation technique

Module 3: Contrast classification using clustering technique

Module 4: Choose training and back propagation algorithm for classification

Module 5: Distinguish kernel machines for regression

Module 6: Evaluate Hidden Markov model for learning and classification

Tutorial:

Title of the Course: 4EN332 Optical Communication	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses:

Textbooks: (NOT MORE THAN 3)

7. Optical Fiber Communications by Gerd Keiser, 4th Edition , Mc Graw Hill , 2017.
8. Optical Fiber Communication by John M. Senior , PHI/Pearson, 2009

References: (NOT MORE THAN 3)

14. Fiber optical communication Technology by Djafar Mymbaev & Lowell L, Scheiner, Pearson, 2000.
15. Fiber optic Communication Systems by G. Agrawal, John Wiley and sons, 2010.

Course Objectives :

21. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
22. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors. Design optimization of SM fibers, RI profile and cut-off wave length.
23. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.
24. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
25. To learn fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Relate light waves into small optical components with high precision from sources and detectors.	I	Knowledge
CO2	Calculate the attenuation and signal degradation due to intermodal and intramodal distortion, and power coupling losses	IV	Analysis
CO3	Compute the modes in step index fiber and graded index fiber.	III	Application

CO-PO Mapping :

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		**3**											**2**	
CO2			3										**2**	
CO3			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
ISE 1	10
MSE	30
ISE 2	10
ESE	50

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: INTRODUCTION	**Hrs.**
Introduction, Ray theory transmission, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Electromagnetic mode theory of optical propagation, EM waves, modes in Planar guide, phase and group velocity, cylindrical fibers, SM fibers.	**5**
Module 2: TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS	**Hrs.**
Attenuation, Material absorption losses in silica glass fibers, Linear and Non linear Scattering losses, Fiber Bend losses, Midband and farband infra red transmission, Intra and inter Modal Dispersion, Over all Fiber Dispersion, Polarization, non linear Phenomena. Optical fiber	**7**

connectors, Fiber alignment and Joint Losses, Fiber Splices, Fiber connectors, Expanded Beam Connectors	
Module 3: SOURCES AND DETECTORS	**Hrs.**
Optical Sources : Semiconductor Physics background, Light emitting diode (LEDs)- structures, materials, Figure of merits, characteristics & Modulation. Laser Diodes -Modes & threshold conditions, Diode Rate equations, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, Spectral width , temperature effects, and Light source linearity. Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties, Comparison of performance, Photo detector noise -Noise sources , Signal to Noise ratio , Detector response time.	**7**
Module 4 :Coupling and Receiver operation	**Hrs.**
Power Launching and Coupling : Source to fiber power launching, Lensing schemes, fiber-to-fiber joints, LED coupling to single mode fibers, fiber splicing, Optical fiber connectors. Optical Receiver Operation : Receiver operation, Preamplifier types, receiver performance and sensitivity, Eye diagrams, Coherent detection, Specification of receivers	**7**
Module 5 :Optical Transmission System	**Hrs.**
Transmission Systems : Point –to-point link –system considerations, Link power budget and rise time budget methods for design of optical link, BER calculation Optical Amplifiers : Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers	**7**
Module 6: Measurements and Advances in Optical Fiber Systems	**Hrs.**
Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements Principles of WDM, DWDM, Telecommunications & broadband application, SONET/SDH, MUX, Analog & Digital broadband, optical switching	**7**

Module wise Measurable Students Learning Outcomes :

Module 1 Students are able to understand optical transmission theory

Module 2 Students are able to discuss optical fiber characteristics

Module 3 students are able to differentiate the sources and detectors

Module 4 students are able to understand principle of coupling operation

Module 5 students are able to design optical link budget

Module 6 Students are able to measures the various parameter

Tutorial:

1. Design of fiber modes
2. Calculation of NA and modes of various fibers
3. Design link for single mode fiber.
4. Design of link for multimode fiber
5. Development of fiber measurement setup
6. Capacity calculation of fiber modes

Title of the Course: 4EN333 Design and Analysis of Algorithm	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses: Data Structure and Algorithms

Textbook:

1. *"Fundamentals of Computer Algorithms",* Ellis Horowitz, Sartaj Sahani, Sangutherar Rajasekaran., Galgotia Pubication Ltd, 2010

2. *"Design and Analysis of Parallel Algorithms",* Selim G. Aki, PH Publication, 1989.

3. *"Analysis of Computer Algorithms",* Horowitz and Sahni, Galgotia Publishers., 2007

References:

1. *"Foundation of Algorithms",* Richard E. Neapolita & Kumarss Naimipour (Northeastern Illinois University), D.C. Heath and Company, Publication, 1996.

2. *"Data Structures and Program Design in C",* Robert L. Kruse & Brunce P. Leung et. Al, PHI Publication, 1984.

3. *"Data Structures and Algorithms, Sorting and Searching",* Kurt Mehlhorn, Springer, Verlag publication, 1984

4. *"Sorting and Searching: The Art of Computer Programming Vol-3",* Knuth D.E., Vol.3. Addison-Wesley, Reading HA (1977).

Course Objectives :

1. To provide different algorithm approaches like static, dynamic, iterative and recursive techniques.

2. To explain Comparative features of algorithms on the basis of space, time computational complexities,

3. To explain the selection criteria for identifying, formulating and applying a typical algorithm for given problem.

Course Outcomes :

		Bloom's Cognitive	
CO	**After the completion of the course the student should be able to -**	Level	Descriptor
CO1	Interpret different algorithm approaches like static, dynamic,	II	Applying

	iterative and recursive techniques.		
CO2	Compare the different algorithms on the basis of space, time computational complexities	IV	Analyzing
CO3	Identify the optimum algorithm for given problem.	IV	Analyzing

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

Assessments :

Teacher Assessment:

Two components of In Semes Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) havin 0%, 30% and 50% weights respectively.

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

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

Course Contents:

1 Introduction (6)

Static and dynamic structures, stacks, queues, dynamic memory allocation and pointers, linked stacks and queues, trees and recursion, Hashing:- Sparse-table, hash function, collision resolution with open

addressing and collision resolution by chaining, hashing analysis.

2 Searching and Sorting Algorithms(4)

Sequential search, Binary search, Comparison of trees, Insertion sort, Selection sort (Heap sort), Shell sort. Computational Complexity, lower bound, & comparison of searching and sorting algorithm

3 Divide and Conquer (8)

Merge sort, quick sort (portioning), strassen's matrix multiplication algorithm, Detection Thresholds, Limitation of divide and conquer. Computational complexity of divide and conquer algorithms and their

comparisons

4 Dynamic Programming & Greedy Approach(8)

Binomial Coefficients, Floyd's algorithm for shortest path, Chain matrix multiplication, optimal binary search trees and the traveling salesperson problem, Dynamic programming approach to 0-1 knapsack problem, Minimum spanning traces algorithms (Prim's and Kruskal's) and their Comparison, Dijkstra's algorithm for shortest path. Scheduling. Greedy approach for knapsack 0-1 problem. Comparison between Greedy approach for knapsack 0-1 problem

5 Back Tracking & Branch and Bound(8)

Back tracking techniques, the n-queens problem, Back tracking algorithm's efficiency using Monte Carlo algorithm. Graph coloring, the Hamiltomnian circuits' problem. Backtracking Algorithm for 0-1 Knapsack problem and its comparison with dynamic programming approach. 0-1 Knapsack problem:- Breadth – First search with Branch-and-bound pruning and Best first search with Branch – and – Bound pruning, the Traveling sales person problem.

6 Theory of NP (6)

Intractability, the three general categories of problems. The sets P & NP. NP complete problems, NP-Hard, NP-easy, NP – Equivalent problems, NP Hard problems – Traveling sales person problem and Bin packing problem.

Module wise Measurable Students Learning Outcomes :

After completion of respective modules, Students will be able to -

Module 1: Compare advantages and disadvantages of static and dynamic structures.

Module 2: Implement searching and sorting techniques.

Module 3: Understand divide and conquer approach.

Module 4: Compare performance of dynamic programming with greedy approach

Module 5 & Module 6: Analyze different real time problems and technique to find solutions

Professional Elective 4

Title of the Course: 4EN334 Mobile Communication Engineering	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Probability Theory and statistics, Digital Communication Engineering

Textbooks:

1. T.S.Rappaport*,"Wireless Communications Principles and Practice"*, II Ed. PHI, Publications, 1995
2. Prashant Kumar Patra, Sanjit Kumar Dash, "*Mobile Computing*", 2nd Edition, Scitech, 2014
3. V.K.Garg, J.E.Wilkes, "*Principle and Application of GSM*" Pearson Education, 1999.

References:

1. William C. Y. Lee, *"Mobile Communication Engineering: Theory and Applications"*,2nd Edition, McGraw Hill Publication, 1997
2. Mischa Schwartz, "*Mobile Wireless Communication*", 1st Edition, Cambridge University Press, 2009.

Course Objectives :

1. To introduce the concepts and techniques associated with Wireless Cellular Communication systems.
2. To familiarize with state of art standards used in wireless cellular systems.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to -**	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply fundamentals of cellular system design to improve performance of cellular network	III	Applying
CO2	Distinguish between different multiple access technology	IV	Analyzing
CO3	Study evolution of mobile communication generation standards	IV	Analyzing
CO4	Analyze the different internetworking challenges to provide solutions in wireless mobile networks.	IV	Analyzing

CO – PO Mapping :

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

Assessments :

Teacher Assessment:

Two components of In Semes Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) havin 0%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:		
Module 1 : The Cellular Concept – System Design Fundamentals	**Hrs.**	
Introduction of Cells, Channel Reuse, SIR Calculations, Traffic Handling Capacity: Erlang Performance, Cellular system design, Co channel interference ratio, Co channel interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment, concepts of cell splitting, handover in cellular system.	**7**	
Module 2 : Multiple Access Technologies	**Hrs.**	
Frequency Division Multiple access (FDMA), Time Division Multiple access (TDMA), Code Division Multiple access (CDMA), spectral efficiency calculations, comparison of T/F/CDMA technologies based on their signal separation techniques, advantages, disadvantages and application areas.	**6**	
Module 3 : GSM Architecture and Interfaces	**Hrs.**	
Introduction to GSM subsystems, GSM Interfaces, GSM architecture, details of following blocks in GSM (Mobile station, Base station systems, Switching subsystems, Home location registers, Visiting location registers, Equipment identity register, Echo canceller), Mapping of GSM layers onto OSI layers, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM. Mobile Management: Handoff, Location and Paging	**8**	
Module 4 : Higher Generation Cellular Standards	**Hrs.**	
2.5 G Standards: High speed Circuit Switch Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE, 3G CDMA 2000, 3G W-CDMA, IMT-2000, Wi-Max, 4G LTE, 5G technology	**6**	
Module 5 : Mobile Ad-hoc Network (MANET)	**Hrs.**	
Introduction, properties, applications, architecture, routing in MANET, proactive and reactive routing protocols, hybrid protocol	**7**	
Module 6 : Mobile Security	**Hrs.**	
Introduction, security in wireless network, information security, security techniques and algorithms, Security protocols .	**6**	

Modulewise Measurable Students Learning Outcomes :
After completion of respective modules, Students will be able to -
Module 1: gain insight into methods to improve overall performance and capacity of cellular networks.
Module 2: get introduced to multiple access technologies for wireless network.
Module 3: understand various concepts in GSM architecture.
Module 4: compare performance of mobile communication generation standards.
Module 5 & Module 6: analyze different mobile networks and security standards.

Title of the Course: 4EN335 CMOS VLSI Design	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Digital Electronics, Electronic Circuits Analysis and Design, Microelectronics

Textbooks:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits-A Design Perspective", 2nd Edition, Prentice-Hall India Learning Pvt. Limited/ Pearson Education, 2014.
2. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, McGraw-Hill Education (India) Pvt. Ltd., 2015.

References:

1. Neil Weste, Kamran Eshraghian, "Principles of CMOS VLSI Design: Analysis and Design", Addison Wesley/Pearson Education, 2008
2. William Dally and John Poulton, "Digital System Engineering", Cambridge University Press, Reprint 2007.

Course Objectives :

1. ***Explain*** the long and short channel MOS transistor models with emphasis on unified model.
2. ***Explain*** the considerations in optimizing the physical dimensions of MOS transistors in obtaining the tradeoff between area, speed and power
3. ***Explain*** the steps involved in manufacturing process of MOS devices.
4. ***Develop*** the logical and design skills of CMOS combinational and sequential circuits.

Course Learning Outcomes:

COs	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Explain** the basic steps with theoretical principles involved in the process of manufacturing of CMOS devices.	2	Understanding
CO2	**Model** sub-micron and deep submicron MOS transistors.	3	Applying
CO3	**Analyze** the fundamental principles involved with MOS devices and interconnects to design CMOS circuits to meet the area, speed and power requirements of CMOS based systems.	4	Analyzing
CO4	**Demonstrate** the logical skills to design submicron MOS transistor based circuits and **Design** static and dynamic CMOS circuits by considering the performance parameters like area, speed and power.	6	Creating

CO-PO Mapping :

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

CO3		3	2											2
CO4	2		3							2				2

1 -Low , 2 -Medium, 3 -High

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: MOS transistor theory	**Hrs.**
MOS under static conditions, Secondary effects, MOS SPICE Models, Technology Scaling.	**5**
Module 2: Manufacturing Process for CMOS ICs	**Hrs.**
Photolithography, Design Rules, Packaging ICs, Thermal considerations in Packaging.	**4**
Module 3: CMOS Inverter	**Hrs.**
Static and Dynamic behavior of CMOS inverter, Power and Energy-Delay, Impact of technology scaling on inverter.	**8**
Module 4: CMOS Combinational Logic Circuits	**Hrs.**
Static CMOS Design, Dynamic CMOS Design, Comparison between the two design styles.	**8**
Module 5: CMOS Sequential Logic Circuits	**Hrs.**
Static Latches and Registers, Dynamic Latches and Registers, Pulse Registers, Non-bistable Sequential	**7**

Circuits.	
Module 6: Interconnect and Semiconductor Memories	**Hrs.**
Electrical models of wires, Lumped RC Model, Distributed rc line, Transmission Line; Memory Classification, Memory Architectures and Building Blocks, Memory Core: ROM, RAM.	**7**

Module wise Measurable Students Learning Outcomes :

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

1. ***Explain*** the working of MOS transistor and ***analyze*** the performance of MOS transistor.
2. ***Explain*** the steps involved in manufacturing process for CMOS ICs.
3. ***Analyze*** static and dynamic behaviour of CMOS inverter.
4. ***Analyze*** and ***design*** CMOS combinational logic circuits.
5. ***Analyze*** and ***design*** CMOS sequential logic circuits.
6. ***Analyze*** the effects of on-chip interconnect (wire) on speed (propagation delay) and power dissipation in CMOS circuits. ***Explain*** the semiconductor memory classes and their implementations.

Tutorial:

Title of the Course: 4EN336 Digital Image Processing	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Digital Signal Processing

Textbooks:

1. Digital Image Processing", R.C. Gonzalez and R.E. Woods, 3rd Edition, Prentice-Hall,
2. Pratt, W.K., Digital Image Processing, John Wiley and Sons, New York, 1978.

References:

1. Fundamentals of Digital Image Processing - A.K. Jain
2. M Sonka, V Hlavac and R Boyle, Image Processing, Analysis and Machine Vision, PWS 1999

Course Objectives :

- To develop an overview of the field of image processing.
- To illustrate the fundamental algorithms and their implementation.
- To apply image processing algorithms for real problems.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply digital image enhancement techniques for gray scale images and colour images	III	Demonstrate
CO2	Analyze various image segmentation techniques	IV	Compare
CO3	Explain image restoration, de noising and image compression techniques	II	Summarize
CO4	Identify image representation and description techniques	I	Write

CO-PO Mapping :

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

Tutorial:----

Professional Elective-4 Lab

Title of the Course: 4EN384 **Mobile Communication Engineering Lab**	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: Advanced Digital Communication Engineering

Textbooks:

4. T.S.Rappaport,"Wireless Communications Principles and Practice", II Ed. PHI, Publications, 2010.
5. Prashant Kumar Patra, Sanjit Kumar Dash, "Mobile Computing", 2nd Edition, Scitech.2013.
6. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM" Pearson Education, 2007

References:

5. William C. Y. Lee, "Mobile Communication Engineering: Theory and Applications",2nd Edition, McGraw Hill Publication. 2014
6. Mischa Schwartz, "Mobile Wireless Communication", 1st Edition, Cambridge University Press, 2009.
7. NetSim online resources

Course Objectives :

26. To introduce the concepts and techniques associated with Wireless Cellular Communication systems.
27. To familiarize with state of art standards used in wireless cellular systems.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze the performance of different mobile generation standards in terms of different performance measure	IV	Analyzing
CO2	Estimate the performance of different mobile ad-hoc networks and security standards.	V	Evaluating

CO-PO Mapping :

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

Assessments :

Teacher Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

List of Experiments :

1. Study of GSM system

2. Understanding 3G communication system

3. Understanding 4G/ LTE communication system.

3. Introduction to NetSim

4. Modeling and Simulation of simple network using NetSim

5. Study of GSM network for different performance measure parameters

6. Study how the throughput of LTE network varies as distance between ENB and UB varies.

7. Study how the throughput of LTE network varies as the channel bandwidth changes.

8. Analysis of LTE handover

9. Analyzing the performance of MANET

Title of the Course: 4EN385 CMOS VLSI Design Laboratory	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: Digital Electronics, Electronic Circuits Analysis and Design, Microelectronics

Textbooks:

3. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits- A Design Perspective", 2nd Edition, Prentice-Hall India Learning Pvt. Limited/ Pearson Education, 2014.
4. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, McGraw-Hill Education (India) Pvt. Ltd., 2015.

References:

3. Cadence Manual.
4. Microwind Manual.

Course Objectives :

1. Demonstrate the flow of EDA tools (Cadence/ Microwind) for designing CMOS digital circuits. a) Cadence Tools (Schematic entry to simulation) b) Microwind for designing digital circuits.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	**Design** and **Simulate** schematics of CMOS circuits using Cadence/ Microwind tools.	VI	Creating
CO2	**Design** and **Simulate** physical layouts with optimum area for gates, pass-Transistors, Transmission gates using Cadence/ Microwind tools.	VI	Creating

CO-PO Mapping :

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

1 -Low , 2 -Medium, 3 -High

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Course Contents:

This laboratory course develops professional skills of using EDA (CAD) tools from Cadence and/or Microwind to design the physical layouts with constraints of design rules and simulating CMOS digital circuits for performance. In this laboratory course, students will be able to understand about models and model parameters of MOS transistor, CMOS Inverter etc. which are suited for CMOS Digital IC design.

List of Experiments: (Minimum 8 experiments)

Using Cadence Design Tools:

1. MOS Transistor (NMOS and PMOS) characterization
2. Implementation of CMOS inverter and its characterization for VTC and power for equal area and equal delay approach
3. Implementation of 2-input NAND and NOR gate
4. Implementation of AND gate and OR gate using pass transistors logic and transmission logic

Using Microwind Design Tools:

1. Demonstration of Microwind tool for layout by explaining DRC and simulation.
2. Implementation of inverter, 2 input NAND gate and any other circuit for practice.
3. 1-bit RAM/ ROM using MOS transistors.
4. Implementation of Ring oscillator.

Module wise Measurable Students Learning Outcomes : **After the completion of the course the student should be able to:**		
Tutorial:		

Title of the Course: 4EN386 Digital Image Processing Lab	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses: Digital Signal Processing

Textbooks:

3. "Digital Image Processing", R.C. Gonzalez and R.E. Woods, 3rd Edition, Prentice-Hall Publications

References:

3. Fundamentals of Digital Image Processing - A.K. Jain

Course Objectives :

Ability to learn digital image processing techniques and apply in practical problems using MATLAB/ Python

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply image enhancement algorithms for gray scale and colour images	III	Demonstrate
CO2	Analyze spatial and frequency domain filters	IV	Compare
CO3	Develop programs for image restoration and Image segmentation purpose	VI	Compose

CO-PO Mapping :

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

CO3				2									2
CO4	2												2

Assessments : Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.

The experimental lab shall have typically 8-10 experiments.

Course Contents:

Lab Experiments are as follows

1. **To study and develop programs for Image Operations in spatial domain using following**

techniques

- Brightness Enhancement
- Brightness Suppression
- Contrast Manipulation
- Histogram Equalization
- Determination of Image Negative
- Threshold Operation
- Gray level slicing without preserving background
- Gray level slicing with preservation of background
- Logarithmic Transformation
- Power Law Transformation
- Spatial domain Filtering
- Noise minimization using averaging filter
- Noise minimization using median Filter
- Un-sharp masking
- Bit-plane slicing

2. **To study and develop programs for following Image Operations in Frequency domain**

- Low pass filter
- High pass filter
- Band pass filter

3. **To write programs for implementing the Image Arithmetic for following operations**

- Addition
- Subtraction
- Multiplication
- Division

4. **To study Image Restoration and de noising techniques by developing programs for the following**

- Create motion blur
- Inverse filtering
- Psudo inverse filter
- Wiener filter

5. **To study various Colour Image Processing concepts by developing programs for following**

- Extraction of Red Green and Blue Components of colour image
- Removal of RGB Plane
- Histogram of a colour image
- Histogram equalization of a colour image
- Various types of filtering of a colour image
- Pseudo-colouring Operation

Module wise Measurable Students Learning Outcomes :

5. Students will be able to demonstrate image enhancement and image filtering operations in spatial domain
6. Students will be able to exhibit image filtering operations in frequency domain
7. Students will be able to reveal Image Arithmetic
8. Students will be able to illustrate image restoration techniques
9. Students will be able to apply image processing techniques for colour images

Open Elective Courses

Open Elective-2

Title of the Course: 4OE366 Biomedical Engineering	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Electronics Measurement and Instrumentation

Textbooks: (NOT MORE THAN 3)

9. "Medical Instrumentation", John. G. Webster , John Wiley
10. "Principles of Applied Biomedical Instrumentation", Goddes& Baker, John Wiley
11. "Biomedical Instrumentation & Measurement", Carr & Brown, Pearson

References: (NOT MORE THAN 3)

16. Hand book of Medical instruments by R.S. Khandpur –TMH, New Delhi, 1987.
17. Medical Electronics and Instrumentation by Sanjay Guha – University Publication, 200.
18. Introduction to Biomedical electronics by Edwand J. Bukstein –sane and Co. Inc, 1973

Course Objectives :

28. To explain the basics body cell structure and different types of transducers
29. To explain the different types of patient monitoring system
30. Understand the design concept of different Medical instruments
31. To demonstrate different medical instruments

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Understand CNS-PNS and Cardio pulmonary system	II	Understanding
CO2	Select proper sensors for sensing biomedical signals to be applied to biomedical instrumentation setup	III	Applying
CO3	Design ECG,EEG and EMG amplifier	VI	Creating
CO4	Explain block diagram of patient monitoring systems and X-ray machine, CT scan and Ultrasonography machine.	II	Understanding

CO-PO Mapping :

PO	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2
CO1	3											2	
CO2					3	2						2	
CO3			3									2	
CO4									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
ISE 1	10
MSE	30
ISE 2	10
ESE	50

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

	Hrs.
Module1: Fundamentals of Medical Instrumentation Physiological Systems of the body, Sources of Biomedical signals, Basic Medical Instrumentation system, Micro-Electro-Mechanical System (Mems), Wireless Connectivity in Medical Instruments, General Constraints in design of Medical Instrumentation Systems	**8**
Module2: The Origin of Bio potentials, Bio potential Electrodes & Biosensors Electrical activity of Excitable Cells, Functional Organization of the Peripheral Nervous System,Electrocardiogram(ECG),Electromogram(EMG), Electroencephalogram(EEG),	**5**

Electroretinogram(ERG) and their recording system, Biomedical signal Analysis and Processing Techniques.	
Module3: Patient Monitoring Systems System Concepts, Cardiac Monitor, Bedside patient Monitoring Systems, Central Monitors, Measurement of Heart rate, Measurement of Temperature, Measurement of respiration Rate, Biomedical Telemetry Systems	**8**
Module4: Modern Imaging Systems X-ray machines And Digital Radiography, X-ray Computed Tomography, Nuclear Medical Imaging Systems, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems and Thermal Imaging Systems.	**10**
Module5: Assisting and Therapeutic Equipment's Cardiac Pacemakers, Defibrillators, Diathermy, Hemodialysis Machines, Ventilators	**7**
Module6: Laser Application in Biomedical Field The Laser, Types of Lasers, Laser Application, Laser Safety	**3**

Module wise Measurable Students Learning Outcomes :

Module 1 Explain CNS-PNS system and various types of transducers

Module 2 Describe different Bio signals and their recording systems

Module 3 Explain bio signal and recording system

Module 4 Explain Patient Monitoring system

Module 5 Demonstrate the X-Ray machine

Module 6 Explain therapeutic equipments

Value added Professional cores

Title of the Course: Automotive Hardware Devices	L	T	P	Cr
	2	0	0	2

Pre-Requisite Courses: Microcontroller, Embedded Systems

Textbooks:

1. Automobile Electrical & Electronic Equipments - Young, Griffitns - Butterworths, London.
2. Williams. B. Ribbens: "Understanding Automotive Electronics", 6th Edition, Elsevier Science, Newnes Publication, 2003

References:

1. Understanding Automotive Electronics, Wiliam B. Ribbens, 5th Edition, Newnes, Butterworth–Heinemann.
2. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
3. Understanding Automotive Electronics – Bechfold SAE 1998
4. Automobile Electronics by Eric Chowanietz SAE.

Course Objectives :

1. To understand basic concepts of Automotive Hardware and it's evolution.
2. To develop understanding about role of Microcontrollers in ECU design and choice of appropriate Hardware and Software
3. To describe various communication systems, wired and wireless protocols used in vehicle networking.
4. To understand Safety standards and 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	Understand automotive components, subsystems, design, communication protocols and safety systems employed in today's automotive industry	*Understand*	Understand
CO2	Demonstrate interfacing of automotive sensors and actuators with microcontrollers	*Explain*	Demonstrate
CO3	Develop, simulate and integrate control algorithms for ECUs with hardware	*Applying*	Apply
CO4	Apply the knowledge for solution building	*Creating*	Design

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CO-PO Mapping :

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1														H

CO2													M	
CO3					M									
CO4			H											

1 - H, 2 - M, 3 – L

Assessments :

Teacher Assessment:

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

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

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

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

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 : E/E Architecture of IC Engine and increasing trends of Hybridisation	**Hrs.**
E/E Architecture of typical IC engine passenger car, E/E Architecture of Micro, Mild, Series, Parallel, Plug-in Hybrid Vehicles, Electronic Components of typical automobile and distribution in domains- Body, Powertrain, Chassis etc. Introduction to major Electronic components in Electric Vehicles	**4**
Module 2 :Commonly used Tools and methods in Automotive Industry	**Hrs.**
DFMEA : Design for Failure, Low End microcontroller platform- NXP S32K and KEA families, Mid Range microcontroller platform- Renesas F1K family, High End microcontroller platform -Infineon Aurix	**4**
Module 3 : Communication Interfaces and I/O Interfaces	**Hrs.**
Communication Interfaces - CAN, LIN, SPI, UART- focus on physical layer and Transceivers, System Basis Chips, Watchdog and Power Management IC, Wireless interfaces - Bluetooth, ISM band Applications	**7**

Interfacing Switches (active high /low / potentiometric / dust resistances/ diagnostics), Interfacing Analog inputs, Interfacing Relays, solenoids, Interfacing crystal, oscillator, watchdog, voltage supervisory devices, High Side, Low Side Drivers, Half bridge, Full bridge Drivers	
Module 4 : Test and Measurement Instrumentation	**Hrs.**
Introduction to commonly used instrumentation- Oscilloscope, LCR, Meter, Spectrum Analyser, Network Analyser, Thermal Camera, LISN Selection of Power Switching Devices - MOSFETs/IGBTs/SiC/GaNFETs, Gate Driver Design, Power Loss Calculations, Thermal management, Design Considerations for High Voltage Applications	**7**
Module 5 : Electromagnetic Compatibility and Protection	**Hrs.**
Introduction to various regulatory requirements and International electrical and EMC standards, Understanding Origin of pulses, disturbances, circuit, and PCB layout design techniques to meet EMC, Protection techniques- protection from over-voltage, reverse polarity, Electrostatic Discharges	**4**
Module 6 : Design for Manufacturability and Testability	**Hrs.**
PCB layout considerations, dependencies on HW developers, Introduction and examples for Design for Manufacturability, Design for Testability (DFM and DFT), Manufacturing Interfaces and process flow- ICT , AOI, and EOL testing, Visit to PCB Assembly House (TBD)	**5**

Module wise Measurable Students Learning Outcomes :

Module 1:Explain IC Engine and increasing trends of Hybridisation

Module 2:Demonstrate Commonly used Tools and methods in Automotive Industry

Module 3:Illustrate methods of interfacing and communication in Automotive

Module 4: Introduction of testing and measurement techniques

Module 5: Explain Electromagnetic Compatibility and Protection

Module 6: Describe methods of design for testability

Course Name: Python Programming **Course Code:**	**L**	**T**	**P**	**Cr**
	2	0	2	3

Pre-Requisite Courses: Programming basics and Computer Programming for Electronics Engineering , Data Structure and Algorithm Laboratory

Textbooks:

1. Dr. Charles R. Severance, "Python for Everybody ", Creative Commons Attribution-Non Commercial Share Alike 3.0.
2. T R Padmanabhan, "Programming with Python", Springer, 2016

References:

1. Yashavant Kanetkar, " Let Us Python ", BPB Publication, 2009
2. C.H. Swaroop, "A Byte of Python", Creative Commons Attribution-Share Alike 4.0 International License.

Course Objectives:

- To develop and improve skills in programming in a systematic way and preparing the students for application development using advanced programming
- To make the students understand basics of python programming and advantages of it over other programming languages
- To analyze and compare various methods to solve the problem and to develop various algorithms

Course Learning Outcomes:

COs	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	**Identify and use** basic concepts of python programming in various data structure	*III*	Applying
CO2	**Write** program to implement algorithms and applications	*III*	Applying
CO3	**Design and develop** small applications using python	*VI*	Creating

CO-PO Mapping:

PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO**
CO1	1	1		1	1									
CO2	1	1		1	1									
CO3	1	1		1	1	2			2					2

1 - H, 2 - M, 3 – L

Assessments:

Teacher Assessment:

50% ISE and 50% ESE. ISE will be based on continuous assessment based on lab performance, quiz related with experiments, mini project / application program given in groups and oral at the end of semester. External oral with performance will be conducted for ESE.

Assessment	Marks	Assessment

ISE	50	Continuous Performance Evaluation based on declared tests /quizzes /mini project /seminar/ assignments etc.
ESE	50	Based on External practical and oral examination.

Course Contents:	
Module 1:Review of programming and introduction to python programming	**Hours**
Review of programming concepts: flow charts, algorithm and pseud code, loops, functions, decision making blocks Python introduction: why python? advantages of python over other programming languages, python versions, installing and using python	**4**
Lab session: Lab session to install python, use of terminal to run code / script, installation use of source code editor to prepare script Programs to understand python programming	**4**
Module 2: Basics of Python	
Data Types, Variables, Basic Input-Output Operations, Basic Operators, Logic and bit operations in Python, Expressions, storing - retrieving and calculating information from computer memory using python	**4**
Lab session: Programs to study data types, variables and constants in python programming and understanding memory mapping Programs to study python operations, expression evaluation and type conversion	**4**
Module 3: Function, conditional code, loops and iterations, lists in python	
Writing functions, returning a result from a function, scopes in Python conditional code, loops and iterations in python, Lists, Sorting simple lists - the bubble sort algorithm, Lists in advanced applications	**5**
Lab session: Program to implement python functions Program to study conditional code, loops and iterations Program to perform list operations	**6**
Module 4: String, Tuples and dictionaries in python	
String: Operations, library, conversion, indexing, slicing, comparison, looping through strings with for and while, concatenating, stripping white spaces. Dictionaries: Lists verses dictionaries, constant, common words, dictionary loops, use of get ( ) method, dictionary sorting. Tuples: Tuple syntax, immutability, comparability, sorting, Tuples in assignment statements, Sorting dictionaries by either key or value.	**5**
Lab session: Programs to study string Programs to dictionaries Programs to tuples	**6**
Module 5: Files, Modules and Packages python	
Files: Secondary storage, file handle, file structure, reading a file line by line with a for loop, searching in file, dealing with files Modules: What is a Module? Create and use module, Variables in Module.	**5**
Lab Session : Programs to study file operations Programs to modules	**4**
Module 6: Applications of Python	

Overview / demonstration / case study of some python applications like python in web development, web scrapping, machine learning and Artificial inelegance, audio and video applications.	**3**
Lab sessions: Programs to implement small application using python	**2**
Computer Usage / Lab Tool: Windows / Linux based system, python source code editor	
Module wise Measurable Students Learning Outcomes: After the completion of the course the student should be able to Module 1: **Understand** the working principle of a computer and identify the purpose of a computer programming language Module 2: **demonstrate** operations of python Module 3: **implement** algorithm to sort list Module 4: **understand and use** string, tuples and dictionaries Module 5: **understand and use** files, modules and packages Module 6: **develop and demonstrate** application using python	