Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade
BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. ..... *Date :* .....

Department of Electronics and Instrumentation Engineering

New Courses introduced in Last five years 2017-2021				
Sl no.	**Name of the Course**	**Course Code**	**Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development**	**Nature of Employability**
1	Digital System Design Using HDL	EI 44	Employability	Hardware, VLSI
2	HDL Lab	EI L46	Employability	Hardware, VLSI
3	Measurements And Virtual Instrumentation Lab	EI L57	Employability	Industrial Process control
4	VLSI Design	EI 71	Skill development	Hardware, VLSI
5	PLC and SCADA	EI 61	Skill development	Industrial Process control
6	Robotics and Automation	EI 731	Employability	Automation
7	VLSI Lab	EI L76	Employability	Hardware, VLSI
8	Wireless Communication	EI 813	Employability	Hardware, communication
9	Lasers & Optical Instrumentation	EI 822	Skill development	Hardware, communication
10	ARM Processor	EI64	Employability	Hardware, Embedded system
11	ARM Lab	EI L67	Employability	Hardware, Embedded system
12	DCS and Industrial safety system	EI 72	Employability	Industrial Process control
13	Micro Systems and Nanotechnology	EI 741	Employability	Hardware, VLSI
14	Low Power VLSI	EI 812	Skill development	Hardware, VLSI
15	Power Plant Instrumentation	EI662	Skill development	Industrial Process control
16	Embedded Systems & RTOS	EI 741	Employability	Hardware, Embedded system
17	Digital System Design	18EI32	Employability	Hardware, VLSI
18	Sensors & Applications	18EI35	Employability	Hardware, VLSI
19	Digital System Design Lab	18EIL37	Employability	Hardware, VLSI
20	Microcontroller and Applications	18EI43	Employability	Hardware, Embedded system
21	Linear IC's & Applications	18EI45	Employability	Hardware, VLSI

BOS Chairman **Principal**

Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade

BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. .....

Date : .....

22	Sensors and Signal Conditioning Circuits Lab	18EIL46	Employability	Hardware, VLSI
23	Communication Technology	18EI52	Employability	Software
24	Process Automation and Control	18EI53	Employability	Industrial Process control
25	C++ and Data Structures	18EI54	Employability	Software
26	Control systems and simulation Lab	18EIL57	Employability	Industrial Process control
27	Virtual Instrumentation	18EI562	Skill development	Industrial Process control
28	Embedded Systems using ARM Controller	18EI62	Employability	Hardware, Embedded system
29	Machine Learning using Python Programming	18 EI 643	Employability	Software
30	Robotics and Applications	18EI652	Employability	Automation
31	Embedded System Design Lab	18EIL66	Employability	Hardware, Embedded system
32	Industry Internship	18 EII69	Skill development	All domains
33	IoT and Wireless Sensor Network	18EI71	Skill development	Hardware & Software, IoT Communication

BOS Chairman

Principal

Subject Title : **Digital System Design Using HDL**		
Sub Code : **EI 44**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 52

Course Objectives:

This course introduces the student to

1. To provide knowledge on the design of digital logic circuits using hardware description language using VHDL and verilog.
2. Understand the concepts of dataflow, behavioral and structural description
3. Design and develop the VHDL and verilog code for both combinational and Sequential circuits using procedure, task and function

Unit No	Syllabus	No of hours
1	**Introduction:** Need for HDL, A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Brief comparison of VHDL and Verilog **Data –Flow Descriptions:** Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors.	**10 Hours**
2	**Behavioral Descriptions:** Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable – Assignment Statement, sequential statements**.**	**10Hours**
3	**Structural Descriptions**: Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements	**12Hours**
4	**Procedures, Tasks, and Functions:** Highlights of Procedures, tasks, and Functions, Procedures and tasks, Functions. **Mixed type Description:** VHDL user defined types, VHDL packages,	**10 Hours**
5	**Mixed Language Description:** How to invoke one language from the other. Designing with programmable gate arrays and complex programmable logic devices .	**10 Hours**

NOTE: Unit numbers: **3 &** 4 **will** have internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course Outcomes:

Upon completion of the course, student should able to

1. Understand the concepts of dataflow, behavioral and structural description.
2. Design the digital logic circuits using hardware description language in both VHDL and Verilog.
3. Design and develop the VHDL and Verilog code for both combinational and sequential circuits using procedure task and function.
4. Utilize VHDL to design and analyze digital systems (including arithmetic units and state machines)
5. Simulate and implement final digital logic system designs on to FPGAs (by interfacing FPGA kits)
6. Ability to identify and solve engineering problems related to digital systems using the descriptive language.

COs	Mapping with POs
CO1	PO1
CO2	PO1,PO2,PO3
CO3	PO1,PO2,PO3
CO4	PO1,PO2,PO3,PO4,PO5
CO5	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO9,PO12
CO6	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO10,PO11,PO12

TEXT BOOKS:

1. **HDL Programming (VHDL and Verilog**)- Nazeih M.Botros- Dreamtech Press, (Available through John Wiley – India and Thomson Learning) 2007 Edition
2. **Digital Systems Design Using VHDL**, Charles H. Roth, 2nd Edition, Thomson Learning

REFERENCE BOOKS:

1. **"VHDL: Programming Examples"**-Douglas perry-Tata McGraw-Hill 4th edition 2004
2. **Circuit Design with VHDL**-Volnei A.Pedroni-PHI 2nd edition 2004
3. **Fundamentals of Digital Logic with verilog Design Stephen Brown and Zvonko Vranesic** Tata McGraw-Hill 2nd edition 2007

Subject Title : **HDL LAB**		
Sub Code : **EI L46**	No of credits : 1.5=0:0:1.5 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs		Total no. of contact hours: 13

Note: Programming can be done using any compiler. Download the programs on a FPGA/CPLD boards.

Course Objective:

To prepare students for the design of practical digital hardware systems using VHDL and Verilog

Unit No	Syllabus
1	Write a HDL program for the following 1. All basic gate operations, 2. Half Adder, 3. Full Adder, 4. 4-bit ripple carry adder using Structural Description.
2	Write a HDL program for the following combinational designs a. 2 to 4 decoder b. 8 to 3 (encoder without priority & with priority) c. 8 to 1 multiplexer d. Multiplexer, de-multiplexer, comparator. e. 4 bit binary to gray converter and vice versa f. Binary to excess3 and vice versa
3	Write a HDL code to describe the functions of a 4 bit Adder/Subtractor using 4-bit carry look Ahead adder with Carry and Overflow indication.
4	Develop the HDL code for the following flip-flops, D, JK, SR,T.
5	4-bit Universal Shift register using any flip flop
6	Design a 4 bit Synchronous and Asynchronous any sequence counters
7	Design a Finite state machine for any specified application
	INTERFACING (at least four of the following must be covered using VHDL/verilog)
1	Write HDL code to display messages on the given seven segment display
2	Write HDL code to control speed, direction of DC.
	Write HDL code to control speed, direction of Stepper motor
3	Write HDL code to accept 8 channel Analog signals, Temperature sensors and display the data on LCD panel or Seven segment display.
4	Write HDL code to generate different waveforms (Sine, Square, Triangle, Ramp etc.,) using DAC change the frequency and amplitude.
5	Write HDL code to simulate Elevator operations
6	Write HDL code to control external lights using relays.
7	Demonstration of open ended project using the concept of above mentioned Experiments

Course Outcome:

Upon completion of this course the students should be able to

1. Describe, design, simulate, and synthesize computer hardware using VHDL and Verilog hardware description language.
2. Synthesis the designed code using Field-Programmable Gate Arrays.

Subject Title : **Measurements And Virtual Instrumentation Lab**		
Sub Code : **EIL 57**	No of credits : 1.5=0:0:1.5	No of hrs/week : 03
Exam duration : 3hrs	Exam Marks : 100	

Course Objectives:

It is designed to achieve the following objectives:

1. It provides new concepts towards measurement and automation.
2. It imbibes knowledge about how to control an external measuring device by interfacing a computer.
3. To become competent in data acquisition and instrument control.

Expt No	Syllabus
1	Determination of the Characteristics of LVDT, capacitive transducer: variable area type, variable distance type
2	Determination of the Characteristics of LDR-Variable illumination, variable distance, Optocoupler
3	Measurement of Resistance by Wheatstone bridge and its bridge sensitivity measurement, Kelvin double bridge
4	Measurement of self- inductance using Maxwell bridge Measurement of unknown capacitance using Desauty's bridge
5	Calibration of voltmeter and ammeter using DC potentiometer.
6	Introduction to NI LabVIEW (structures, arrays, numeric and boolean functions)
7	Introduction to Virtual Instruments using LabVIEW
8	Acquisition of real world parameters like temperature thermistor, RTD, LM35, thermocouple, pressure, vibration using NI LabVIEW
9	Time domain and Frequency Domain Measurements of real world signals
10	VISA and Serial Communication using LabVIEW
11	Design PID controller using LabVIEW & control design toolkit or maths script interface node
12	Design a real time batch processing using LabVIEW
13	Demonstration of open ended project using the concept of Experiments 1-12

Course Outcomes:

At the end of the course, the student will be able to

1. Determine the characteristics of various transducers and sensors
2. Determine the various electrical parameters using bridge techniques
3. Calibrate voltmeter and ammeter
4. Apply virtual instrumentation for data acquisition and instrument control confidently.
5. Identify salient traits of a virtual instrument and incorporate these traits in their projects.s
6. Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

Subject Title : **PLC and SCADA**		
Sub Code : **EI 61**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 52

Course Objectives:

The objective of this course is to

1. Understand the fundamentals and importance of industrial automation systems.
2. Learn to develop a PLC program for an automatic control system and its applications
3. Understand the mechanism, architecture, working principles and applications of SCADA

Unit No	Syllabus	No of Teaching hours
1	**Automation:** Fundamentals of Industrial Automation, Need and role of Automation, Evolution of Automation, and Elements of process control loop, Current Trends. **Programmable Logic Controller:** Controllers, Hardware, Internal Architecture. Input−output devices Mechanical switches, Proximity switches, Photoelectric sensors and	**10 Hours**

	switches, Encoders, Output devices Relay Directional control valves, Motors, Stepper motors, Examples of applications	
2	PLC Programming Languages: Stds of PLC programming IEC 61131-3 Ladder and functional block programming: Ladder diagrams, Logic functions, Latching, Multiple outputs, Function blocks, Program examples, Instruction lists, Sequential function charts, Structured text, Internal relays, Ladder programs, One-shot operation, Set and reset, Jump and call: Jump, Subroutines.	**12 Hours**
3	Timers: Types of timers, Programming timers, Off-delay timers, Pulse timers, Programming examples, Counters, Timers with counters, Sequencer, Data handling	**08 Hours**
4	Supervisory Control and Data Acquisition (SCADA) SCADA introduction, brief history of SCADA, elements of SCADA. Features of SCADA, Fundamental principles of modern SCADA systems, The SCADA software, and SCADA protocols Functions of RTU Comparison of the terms SCADA, DCS, PLC and smart Instrument.	**10 Hours**
5	**SCADA systems, hardware and firmware:** Remote terminal units, Application programs, PLCs used as RTUs, Troubleshooting and maintenance, Troubleshooting the telemetry system, Maintenance tasks, The maintenance unit system	**12 Hours**

Note: Unit numbers: 2& 4 will have internal choice
Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course outcomes:
Upon completion of this course the students should be able to

1. Understand the basic industrial automation
2. Develop a PLC program for an automatic control system of a medium degree of complexity.
3. Understand the mechanism and applications of SCADA
4. An ability to identify, formulate, and solve engineering problems related to Industrial automation design using project-based learning approach
5. An ability to use the techniques and skills, necessary for engineering practices

COs	**Mapping with POs**
CO1	PO1, PO2
CO2	PO1, PO2, PO3
CO3	PO1, PO2
CO4	PO1, PO2, PO3, PO4, PO5
CO5	PO1, PO2, PO3, PO4, PO5

Text Books:

1. Programmable Logic Controller W Bolton 5th Edition ISBN: 978-1-85617-751-1, Elsevier Publication 2009
2. 'Instrument Engineers' Handbook, Process Control Bela G. Liptak 4th Edition
3. Practical SCADA for industry David Bailey Edwin Wright ISBN:0750658053, Elsevier Publication 2003

Reference Books:

1. **Understanding Distributed Processor Systems for Control.** Samuel M. Herb ISA Publication, 1999 .
2. **Computer control of processes** - M.Chidambaram, Narosa publishing, Reprint 2010 .
3. **Programmable Logic Controller** Frank D. Petruzella Third Edition TaTa McGraw-Hill Edition, 2010
4. **Computer Based Industrial control**- Krishna Kant, Prentice Hall of India. 6th Edition, 2004.
5. **Distributed computer control for industrial automation** popovic and bhatkar Publication by Marcel Dekker, Inc. New York, NY, USA ©1990

Subject Title : **ARM Processor**		
Sub Code : **EI 64**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 52

Course Objective:

The objective of the course is to:

1. Understand ARM design philosophy and ARM processor architecture and fundamentals
2. learn the ARM Instruction set of ARM microcontroller and to learn the assembly programming
3. understand Thumb instructions of ARM controller
4. Understand Various Interrupts and exception handling in ARM controller
5. Learn interfacing and to write C-program for LED, Keyboard, LCD, DC motor, Stepper motor

Unit No	Syllabus	No of Teaching hours
1	**ARM embedded systems:** The RISC design philosophy, The ARM design philosophy, embedded system hardware, embedded system software.ARM Architecture. **ARM processor fundamentals:** Registers, current program status register, pipeline, core extensions, Architecture revisions, ARM processor families	**10 Hours**
2	**Introduction to ARM instruction Set:** Data Processing Instructions, Branch Instructions, Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, and Conditional Execution.	**10 Hours**
3	**Introduction to the THUMB Instruction set:** Thumb register Usage, ARM-Thumb Interworking, other branch instructions, Data Processing Instructions, Single register Load – store Instructions, Multiple register Load Store Instructions, Stack Instructions, and Software Interrupt Instruction.	**12 Hours**
4	**Interrupts & Exception Handling:** Exceptions, Exception Handling**,** Interrupts, Interrupt handling schemes, vector table.	**10 Hours**
5	**LPC 2148:** Design of system using GPIO's Blink a group of 8 LEDs with a delay, Stepper motor control, DC motor control LCD interface, 4 x 4 Keypad, Timers, ADC, DAC, UART	**10 Hours**

Note: Unit numbers: 1 & 5 will have internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course outcome:

After successful completion of the course the student is able to:

1. Design a system, component or process as per needs and specifications using ARM controller.
2. Identify formulae and solve engineering problems using ARM controller.
3. Participate and try to succeed in competitive examinations.
4. Design and conduct experiments, analyze and interpret data.

COs	Mapping with POs
CO1	Po1, po2, po3
CO2	Po1, po2, po3, po4, po5, po6, po7, po8, po9, po10, po11, po12, po13
CO4	Po1, po2, po3, po4, po5, po6, po7, po8, po9, po10, po11, po12, po13

Text Books:

1. ARM system Developers Guide, Andrew N.Sloss, Elsevier, 2008
2. LPC 2148 User Manual

Reference Books:

1. ARM Assembly Language – Fundamentals and Techniques, William Hohl, CRC Press,2009
2. ARM Assembly language An Introduction, J.R.Gibson, Cengage Learning, 2010

Course Outcomes:

After completion of this course the student is able to:

1. Understand the concept and operation of various Motors like servo motor, stepper motor
2. Understand the concept and operation of various converters

Cos	Mapping with Pos
CO1	PO1
CO2	PO1, PO2

Text Books:

1. P.C.Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2nd edition, 1989.
2. D.M.Considine, "Process/Industrial Instruments Hand book.
3. Control Valve Selection and SizingL.R. Driskell, Learning module ISA

Reference Books:

1. B.G. Liptak, "Instrument Engineers Hand book", 3rd edition.

1. Nagrath I.J and Gopal M, "Control System Engineering", PHI.
2. Control Valve Sizing Coefficients, Ismo Niemelä**,** Neles-Jamesbury 2nd edition Publisher Neles-Jamesbury, 1994

Subject Title : **Power Plant Instrumentation**		
Sub Code : **EI 662**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 39

Course objectives:

Explain the operation traditional power plants and describe the instruments that make up their measurement and control systems

1. Analyze the various instruments used in power plant control systems and make recommendations for improving the control processes
2. Explain the environmental impact of electricity generation and show how adequate control processes may reduce or eliminate these impacts

Unit No	Syllabus	No of Teaching hours
1	**Overview Of Power Generation :**Survey of methods of power generation hydro, thermal, nuclear, solar and wind power Importance of instrumentation in power generation Thermal power plant Building blocks Combined Cycle System Combined Heat and Power System	**08 Hours**
2	**Measurements In Power Plants:** Measurement of feed water flow, air flow, steam flow and coal flow, Drum level measurement, Steam pressure and temperature measurement Turbine speed and vibration measurement, Flue gas analyzer , Fuel composition analyzer.	**08 Hours**
3	**Hydroelectric Power Plant-** Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants, Types of Turbines for hydroelectric power plant, pumped storage plants, storage reservoir plants.	**08 Hours**
4	**Boiler Control:** Combustion of fuel and excess air, Firing rate demand Steam temperature control, Control of deaerator , Drum level control Single, two and three element control, Furnace draft control ,implosion flue gas dew point control ,Trimming of combustion air.	**07 Hours**
5	**Solar Energy:** solar resource, solar energy conversion systems: Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety. Nuclear Power Plant: Nuclear power generation, control station and reactor control	**08 Hours**

Note: Unit 1 and 4 will have the internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course Outcomes:

After completion of this course the student is able to:

1. Explain the operation traditional power plants and describe the instruments that make up their measurement and control systems
2. Analyze the various instruments used in power plant control systems and make recommendations for improving the control processes
3. Explain the environmental impact of electricity generation and show how adequate control processes may reduce or eliminate these impacts

Cos	Mapping with Pos
CO1	PO1,
CO2	PO1, PO2, PO3
CO3	PO1

Text Books:

1. Boiler Control Systems Engineering, by G.F. Gilman, 2005, ISA Publication
2. Power plant engineering, P.K.Nag, 3rd edition, 2010. McGraw Hill.

Reference Books:

1. "Power Plant Engg.", Domkundwar 5th Edition Arora, Domkundwar,1990,Dhanpat Rai & Co.1990
2. "Non-conventional energy resources", by B. H. Khan, McGraw Hill, New Delhi, 2009
3. "Renewable energy Technologyî, Chetan Singh Solanki, Prentice Hall Publication 2011

Subject Title : **ARM LAB**		
Sub Code : **EIL67**	No of credits : 1.0=0:0:1.0	No of hrs/week : 02
Exam duration : 3hrs	Exam Marks : 100	

Course objectives:

1. To understand and program the LPC2148 microcontroller using assembly and C- Programming techniques
2. To understand the concepts and principles of built in peripheral devices like LCD, Timer
3. To understand the concepts and principles of communication and its use in serial programming.
4. To understand and analyze the function of memory Management unit in ARM microcontroller
5. To learn Interfacing of LED, LCD, UART, I2C to the ARM microcontroller.

Expt No	Assembly Programs
1	Write assembly program to move a block of 10 data stored in one memory to another block
2	Write an assembly program to Exchange block of 10 data
3	Write an assembly program to find the smallest number out of 10 data stored in memory
4	Write an assembly program to sort 10 data stored in Memory
5	Write an assembly program to add two 64 bit numbers
6	Write an assembly program to multiply two 32 bit numbers
7	Write an assembly program to divide a 32 bit numbers and store quotient and remainder.
8	Write an assembly program to find factorial of given number using recursive procedure.
9	Write an assembly program to convert 3 digit Hexadecimal to BCD
10	Write an assembly program to switch to THUMB mode from ARM core mode and find the length of the string
Interfacing Programmes	
1	Interface LED to LPC2148 and write C program to blink 8 LED's which are connected to P0.0 to P0.8
2	Interface switch & LED to LPC2148. Write C program to read the status of switch and display same on LED

3	Interface 2 *16 LCD and write C program to display a string
4	Interface LED & write program to implement binary up-counter(8-bit). The counter should increment for every one second. Use internal timer
5	Write C - Program to convert Hexadecimal to Decimal and Display the same on 7 -segment display
6	Interface 4 x 4 keyboard and write C program to identify the key pressed
7	Write C- program for serial transmission and reception of string by polling method and verify the output on serial monitor
8	Interface ADC and write program to convert analog voltage to digital and display the result on LED
9	Demonstration of the communication process using Zigbee protocol with LPC 2148
10	Demonstration of signal acquisition, control and display.

Course Outcomes:

After completion of this course the student is able to:

1. Describe the programmer's model of ARM processor to create and analyze Assembly level and Embedded C-programming.
2. Develop a program and analyze the various built in peripheral devices.
3. Demonstrate various communication techniques between the kit and external peripheral modules
4. Identify and analyze the function of memory Management unit of ARM.
5. Interface ARM microcontroller with external peripherals.

Subject Title : **VLSI Design**		
Sub Code : **EI71**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 52

Course Objectives:

The objectives of the course is to-

1. Develop skills to analyze and use mathematical methods and circuit analysis models in MOS digital electronics circuits
2. Understand how to apply MOS technology specific layout rules in the placement and routing of transistors, interconnect, to verify the functionality, power, and parasitic effects.
3. To impart the knowledge on design of combinational, sequential logic at the transistor level, functional units including adders, multipliers, ROMs, SRAM cell including stick diagram

Unit No	Syllabus	No of Teaching hours
1	**INTRODUCTION TO MOS TECHNOLOGY:** Moores law, speed –power performance, nMOS fabrication, CMOS fabrication: nwell, pwell processes, BiCMOS, comparison of bipolar & CMOS. **BASIC ELECTRICAL PROPERTIES OF MOS & BICMOS CIRCUITS:** Drain to source current versus voltage characteristics, threshold voltage, transconductance, nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull-up, CMOS inverter, latch up.	**10 Hours**
2	**BASIC CIRCUIT CONCEPTS:** Sheet resistance, area capacitance calculation. Delay unit, inverter delay, estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers, propagation delays & wiring capacitances. **MOS AND BICMOS CIRCUIT DESIGN PROCESSES:** MOS layers stick diagrams, nMOS design style; CMOS design style, Design rules and layout, lambda based design.	**10 Hours**
3	**Scaling of MOS circuits:** Scaling factors for device parameters, limitations of scaling**.** **SUBSYSTEM DESIGN & LAYOUT:** Switch logic pass transistor, gate logic inverter, Nand gates, Nor gates, pseudo nMOS, dynamic CMOS example of structured design, parity generator, Bus arbitration, Multiplexers, logic function block.	**10 Hours**

4	Clocked sequential circuits, dynamic shift registers, bus lines. Subsystem design processes General considerations, 4 bit arithmetic processor, 4-bit shifter, a further consideration of adders, multipliers. **DESIGN PROCESS- COMPUTATIONAL ELEMENTS:** Regularity, design of ALU subsystem, ALU using adders, Carry look ahead adders	**12 Hours**
5	**MEMORY, REGISTER & ASPECTS OF TIMING:** 3 transistor dynamic RAM cell, dynamic memory cell, pseudo-static RAM, JK FF, D FF circuits, RAM arrays. Practical aspects and testability, CAD tools for design & Simulation.	**10 Hours**

Note: Unit 1 and 4 will have the internal choice

Course Learning Outcomes:

Students completing this course successfully will be able to:

1. Use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect
2. Apply MOS technology specific layout rules in the placement and Routing of transistors and interconnect, and to verify the functionality, power, and parasitic effects.
3. Design combinational, sequential logic at the transistor level, functional units including adders, multipliers, ROMs, SRAM cell including stick diagram

TEXT BOOK:

1. Basic VLSI design- Douglas A Pucknell, Kamaran Eshraghian, Prentice Hall of India publication, 3rd Edition, 2005.

REFERENCE BOOKS:

1. **CMOS Digital Integrated Circuits, Analysis and design**, 3rd Edition, Sung-Mo (steve) Kang, Yusuf Leblbici, Tata Mcgraw Hill.
2. **VLSI Technology,** 2nd Edition, S.M .Size, Tata Mcgraw Hill.

Cos	Mapping with Pos
CO1	PO1, PO2, PO3
CO2	PO1, PO2
CO3	PO1, PO2, PO3

Subject Title : **DCS and Industrial safety system**		
Sub Code : **EI72**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 52

Course objectives:

The main objective of the course is to

1. Understand the concept of automation
2. Provide basic knowledge on architecture and components of DCS
3. Provide knowledge on different algorithms and applications in DCS
4. Provide knowledge on different applications in DCS
5. Understand safety management system

Unit No	Syllabus	No of Teaching hours
1	**Introduction and Overview**: aims of plant automation, classical approach to plant automation, computer based plant automation concepts, distributed computer control **System Architecture :** evolution of hierarchical system structure, functional levels, data base organization, system implementation concepts, human interface	**10 Hours**
2	**System Elements :** field stations, intermediate stations, central computer station, monitoring and command facilities, Real time operating system, communication system,	**10 Hours**

	communication software, process oriented languages , application software, software configuration and parametrisation, knowledge based software	
3	**Algorithms :**data acquisition and signal processing algorithms, closed loop and sequential control, optimal and adaptive control, implementation examples, algorithms available within DCCS	**10 Hours**
4	**Applications:** power plants, iron and steel plants, chemical plants, cement plants, pulp and paper plants, glass making plants. Water and waste water treatment plants, oil and gas fields **State-of-the-Art and Future Trends**: mstate of the art in DCCS, state of the art in programmmble controllers, factors impacting technology development, artificial intelligence in process control.	**12 Hours**
5	**Safety Instrumentation and Machinery:** Introduction, Introduction to IEC 61511 and the safety lifecycle, SIS configurations for safety and availability targets, Selection of sensors and actuators for safety duties, Selection of safety controllers, System integration and application, software Programming, tools Machinery safety, Guide to Regulations and Standards. **Hazardous Areas and Intrinsic Safety:** Introduction, Zonal Classification, Area classification, Methods of explosion protection, Flameproof concept Ex d, Intrinsic safety, Increased safety, Certification (components) . Principles of testing, Non Sparking concept, Concept Ex p, Other protection concepts, Earthing & Bonding, Standards and codes of practice, Fault finding and repairs.	**10 Hours**

Note: Unit 3 and 5 will have the internal choice

Course Learning Outcomes:

At the end of this course the students is able to

1. Explain the concept of automation
2. Apply the concept of DCS in automation
3. Explain the architecture and components of DCS
4. Analyze the different algorithms used in DCS
5. Explain different and applications
6. Explain safety management system

TEXT BOOK:

1. **Distributed computer control for industrial automation** popovic and bhatkar Publication by Marcel Dekker, Inc. New York, NY, USA ©1990
2. **Pocket Guide on Industrial Automation For Engineers and Technicians** Rev 1.04 Edited by Srinivas Medida

REFERENCE BOOKS:

1. **Computer Aided Process Control-** S K Singh, Prentice Hall of India, 2008
2. **Understanding Distributed Processor Systems for Control.** Samuel M. Herb ISA Publication, 1999
3. **Computer control of processes** - M.Chidambaram, Narosa publishing, Reprint 2010
4. **Computer Based Industrial control**- Krishna Kant, Prentice Hall of India. 6th Edition, 2004

Cos	Mapping with Pos
CO1	PO1, PO2, PO3
CO2	PO1, PO2
CO3	PO1, PO2, PO3

Subject Title : **Robotics and Automation**		
Sub Code : **EI731**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 52

Course objectives:

The main objective of the course is to

1. Understand the generic technology and principles associated with robotics and automation systems
2. Understand the principles and operations of different sensors used for robotic applications
3. Understand the kinematics and dynamics aspects of robotic system

Unit No	Syllabus	No of Teaching hours
1	**Introduction :** robot definition, classification of robot, history, robot components, robot degrees of freedom, robot joints, coordinates, reference frames, asimov's laws of robotics, robot programming modes, characteristics, applications	**08 Hours**
2	**Robot drivers, sensors and vision:** drives for robots: electrical, hydraulic and pneumatic. Sensors: proximity and range, tactile force and torque End effectors, position and velocity measurement **Robot vision:** introduction to techniques, image acquisition and processing.	**12 Hours**
3	**Robot kinematics :** rotation matrix, homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles RPY representation, Direct and inverse kinematics for industrial robots for position and orientation	**12 Hours**
4	**Robot dynamics:** Langrangian formulation newton euler formulation, recursive newton euler algorithms	**10 Hours**
5	Introduction, General considerations on Trajectory planning, joint-interpolated Trajectories, calculation of a 4-3-4 Joint trajectory, Cubic Spline Trajectory.	**10 Hours**

Note: Unit numbers: 2 & 3 will have internal choice

Course outcomes:

At the end of this course the students is able to

1. Provide a generic technology and principles associated with robotics and automation systems
2. Understand and explain the principles and operations of different sensors used for robotic applications
3. Understand and explain the kinematics and dynamics aspects of robotic system

Text Books:

1. Introduction to robotics SK Saha Tata Mc Graw Hill **,** 2008.

2. Robotics control sensing Vision and Intelligence- K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.

Reference Books:

1. **Introduction to robotics** Saeed B Niku Prentice Hall of India 2005
2. **Robot Technology Fundamentals -** James G.Keramas, 1st Edition, Cengage learning Publishers, 1998
3. **Introduction to robotics** John J Craig third Edition pearson Education Inc., 2005

Cos	Mapping with Pos
CO1	PO1, PO2, PO3
CO2	PO1, PO2
CO3	PO1, PO2, PO3

Subject Title : **Embedded Systems & RTOS**		
Sub Code : **EI741**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 39

Course objectives:

It is designed to achieve the following objectives:

1. To introduce the basic concepts of Embedded Systems and the various techniques used for real time examples
2. How to design an embedded system and Partition a system to hardware and software parts efficiently.
3. To Get exposed to Real-Time Operating System
4. To Understand the purpose of Processor and Software architecture

Unit No	Syllabus	No of Teaching hours
1	**Introduction:** Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them. Survey of different embedded system design technologies, trade-offs. Custom Single-Purpose Processors, Design of custom single purpose processors. **Single-Purpose Processors I:** Hardware, Combinational Logic, Sequential Logic, RT level Combinational and Sequential Components, Optimizing single-purpose processors. Single-Purpose Processors: Software, Basic Architecture, Operation, Programmer's View, Development Environment, ASIPS.	**08 Hours**
2	**Single-Purpose Processors II:** Standard Single-Purpose Peripherals, Timers, Counters, UART, PWM, LCD Controllers, Keypad controllers, Stepper Motor Controller, A to D Converters, Examples. **Memory:** Introduction, Common memory Types, Compulsory memory, Memory Hierarchy and Cache, Advanced RAM. Interfacing, Communication Basics, Microprocessor Interfacing, Arbitration, Advanced Communication Principles, Protocols - Serial, Parallel and Wireless.	**08Hours**
3	**Interrupts:** Basics - Shared Data Problem - Interrupt latency. Survey of Software Architecture, Round Robin, Round Robin with Interrupts - Function Queues - scheduling - RTOS architecture.	**07 Hours**
4	**Introduction To Rtos:** Tasks - states - Data - Semaphores and shared data. More operating systems services - Massage Queues - Mail Boxes-Timers–Events-Memorymanagement.	**08 Hours**
5	**Basic Design Using RTOS, Principles-** An example, Encapsulating semaphores and Queues. **Hard real-time scheduling considerations –** Saving Memory space and power. Hardware software co-design aspects in embedded systems.	**08 Hours**

Note: Unit numbers: 1 & 2 will have internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course Outcomes:

After completion of this course the student is able to:

1. Design embedded system architectures for various applications and to learn the different techniques on embedded systems.
2. Identify, formulate, and solve engineering problems
3. Function on multidisciplinary teams
4. To discuss the basics o embedded systems and the interface issues related to it.
5. To discuss the real time models, languages and operating systems and to analyze real time examples

Cos	Mapping with Pos
CO1	PO1, PO2, PO3
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2

Text Books:

1.Embedded System Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John Wiley & Sons, Inc.2002

2.An Embedded software Primer - David E. Simon: Pearson Education, 1999

Reference Books:

1. **Embedded Systems: Architecture and Programming,** Raj Kamal, TMH. 2008
2. **Embedded Systems Architecture – A Comprehensive Guide for Engineers and Programmers**, Tammy Noergaard, Elsevier Publication, 2005.
3. **Embedded C programming**, Barnett, Cox & O'cull, Thomson (2005).

Subject Title : **Micro Systems and Nanotechnology**		
Sub Code : **EI742**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 39

Course objectives:

The objective of this course is to make the students to

1.To impart fundamental knowledge of Microsystems and their manufacturing.

2. To provide knowledge of fabrication process, modeling.

3. understand the integration of Microsystems and different packaging technologies.

4. To impart basic knowledge on various synthesis and characterization techniques involved in Nanotechnology.

Unit No	Syllabus	No of Teaching hours
1	**INTRODUCTION:** What are Microsystems. Feynman's vision. Micro machined transducers. Evolution of micro-manufacturing. Multi-disciplinary aspects. Applications areas. Commercial products. **MICROMANUFACTURING AND MATERIAL PROCESSING:** a) Silicon wafer processing, lithography, thin-film deposition, etching(wet and dry), wafer bonding, and metallization. b) Silicon micromachining: surface, bulk, moulding, bonding basedprocess flows. c) Thick-film processing: d) Smart material processing: e) Processing of other materials: ceramics, polymers and metals f) Emerging trends	**08 Hours**
2	**MODELLING:** a) Scaling issues. b) Elastic deformation and stress analysis of beams and plates. Residual stresses and stress gradients. Thermal loading. Heat transfer issues. Basic fluids issues. c) Electrostatics. Coupled electromechanics. Electromagnetic actuation. Capillary electro-phoresis. Piezoresistive modeling. Piezoelectric modeling. Magnetostrictive actuators. **INTEGRATION AND PACKAGING OF MICRO ELECTROMECHANICAL SYSTEMS:** Integration of microelectronics and microdevices at wafer and chip levels. Microelectronic packaging: wire and ball bonding, flip-chip. Low-temperature-cofired-ceramic (LTCC) multi-chipmodule technology. Microsystems packaging examples.	**08Hours**
3	**BASICS AND SCALE OF NANOTECHNOLOGY :** Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem – Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms – Surface energy and surface stress .**DIFFERENT CLASSES OF NANOMATERIALS :** Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon based nano materials (buckyballs, nanotubes and graphene)– Metal based nano materials (nanogold, nanosilver and metal oxides) -Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics -Biological nanomaterials.	**07 Hours**
4	**SYNTHESIS OF NANOMATERIALS Chemical Methods:** Metal Nano crystals by Reduction - Solvothermal Synthesis-Photochemical Synthesis - Sonochemical Routes-C:hemical Vapor Deposition (CVD) – Metal Organic Chemical Vapor Deposition (MOCVD) -**Physical Methods:**Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).	**08 Hours**

	FABRICATION OF NANOSTRUCTURES: Nanofabrication: Photolithography and its limitation - Electron beam lithography (EBL) - Nanoimprint – Softlithography patterning.	
5	**CHARACTERIZATION OF NANO STRUCTURES:**Field Emission Scanning Electron Microscopy (FESEM) – Environmental Scanning Electron Microscopy (ESEM) - High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)- X-ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy (AES) – Rutherford backscattering spectroscopy (RBS). **Applications:** Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics , applications in displays and other devices - Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology	**08 Hours**

Note: Unit numbers: 2&5 will have internal choice

Course Outcomes:

At the end of the course the student is able to

1. Understand the fundamental knowledge of Microsystems for varied applications
2. Understand the integration of various functions into a very small space from sub micrometres to some millimeters.
3. Understand the fundamentals of Nanotechnology.
4. Gainknowledge on various synthesis and characterization techniques involved in nanotechnology.
5. Get familiarized with nanotechnology potentialities.

Text Books:

1. **Micro and Smart systems**: G.K Ananhasuresh, K.J.Vinoy, S. Gopalakrishan, K.N Baht, Wiley India Publishers 1st edition 2010.
2. T. Pradeep, " *A Textbook of Nanoscience and Nanotechnology*", Tata McGraw Hill Education Pvt. Ltd., 2012.

Reference Books:

1. MEMS and Microsystems: design and manufacture-Tai-Ran Tsu, Tata McGraw-Hill, 6th reprint 2012
2. MEMS-NitaigourPremchandMahalik, Tata McGraw-Hill, 2007
3. Hari Singh Nalwa, "*Nanostructured Materials and Nanotechnology*", Academic Press, 2002.

Cos	Mapping with Pos
CO1	PO1, PO2, PO3
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2

Subject Title : **VLSILab**		
Sub Code : **EIL76**	No of credits : 1.5=0:0:1.5 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs		Total no. of contact hours: 13

Expt No	Syllabus
	Digital: PART - A : Design ASIC-Digital **Design Flow**
1	Write Verilog Code for the following circuits and their Test Bench for **verification**, observe the waveform and **synthesize** the code with technological library with given Constraints*. Do the initial timing verification with gate level simulation.
2	An inverter
3	A Buffer
4	Transmission Gate
5	Basic/universal gates

6	Flip flop -RS, D, JK, MS, T
7	Serial & Parallel adder
8	bit counter [Synchronous and Asynchronous counter]
9	Successive approximation register [SAR]
	PART – B: Analog Design
1.	Design an **Inverter** with given specifications*, completing the design flow mentioned below: a **Draw the schematic** and verify the following i)DC Analysis ii)Transient Analysis b. **Draw the Layout** and verify the DRC, ERC c. Check for LVS d. Extract RC and back annotate the same and verify the Design e. Verify & Optimize for Time, Power and Area to the given constraint***
2.	Design the following circuits with given specifications*, completing the design flow mentioned below: a. Draw the schematic and verify the following i)DC Analysis, ii)AC Analysis, iii)Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for LVS d. Extract RC and back annotate the same and verify the Design. i)A Single Stage differential amplifier ii)Common source and Common Drain amplifier
3.	Design an **op-amp** with given specification* using given differential amplifier Common source and Common Drain amplifier in library** and completing the design flow mentioned below: a. Draw the schematic and verify the following i)DC Analysis, ii). AC Analysis, iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for LVS d. Extract RC and back annotate the same and verify the Design.
4.	Design a **4 bit R-2R based DAC** for the given specification and completing the design flow mentioned using given op-amp in the library**. a. Draw the schematic and verify the following i)DC Analysis, ii) AC Analysis, iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for LVS d. Extract RC and back annotate the same and verify the Design.

Course outcomes:

At the end of the course, the student is able to

1. Understand the design process of Digital Integrated Circuits using CADENCE tool.
2. Implement the sequential and combinational circuits, Synthesise and testing power and area.
3. Developing schematic and layout of various digital CMOS logic circuits using CADANCE tool.
4. Design the CMOS analog circuit for various specification.

Subject Title : **Low Power VLSI**		
Sub Code : **EI 812**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 39

Course objectives:

The main objective of the course is to

1. To study the concepts on different levels of power estimation and optimization techniques.
2. Understand the Impact of Scaling technology and transistor sizing in chip design.
3. To provide the knowledge to analyze and estimate the power conception in the Architectural level

Unit No	Syllabus	No of Teaching hours
1	**Introduction:** Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices.**Device & Technology Impact On Low Power:** Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation	**08 Hours**
2	**Power Estimation, Simulation Power Analysis:** SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.	**08 Hours**
3	**Low Power Architecture & Systems:** Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.	**07 Hours**
4	**Low Power Clock Distribution:** Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co-design of clock network	**08 Hours**
5	**Algorithm & Architectural Level Methodologies:** Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis	**08 Hours**

Note: Unit numbers: 2 & 5 will have internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course outcomes:

At the end of the course, the student is able to

1. Understand the concepts on different levels of power estimation and optimization techniques
2. Understand and apply the knowledge on Scaling technology in chip design
3. Apply the knowledge to analyze and estimate the power conception in the Architectural level

Cos	Mapping with Pos
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1, PO2

Text Books:

1. **Practical Low Power Digital VLSI Design**-Gary K. Yeap, KAP, 2002
2. **Low power design methodologies Rabaey, Pedram**-Kluwer Academic, 1997.

Reference Book:

1. **Low-Power CMOS VLSI Circuit Design**-Kaushik Roy, Sharat Prasad, Wiley, 2000.

Subject Title : **Wireless Communication**		
Sub Code : **EI 813**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 39

Course objectives:

1. Is to introduce the student to the concepts of cellular communication. Various modulation techniques, Propagation methods, coding and multiple access techniques used in wireless Communication.
2. Study the second generation digital cellular networks in detail.

Unit No	Syllabus	No of Teaching hours
1	**Introduction**: Application and requirements of wireless services, History, types of services, requirements for services, Economical and social aspects. Spectrum limitations, limited energy, user mobility	**08 Hours**
2	**The Cellular concept**: System design fundamentals: Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trucking and Grade of service, Improving coverage and capacity in cellular system	**07 Hours**
3	**Mobile radio propagation**: Large scale path loss – Introduction to Radio wave propagation, free space propagation model, relating power to electric field, Reflection, Ground Reflection model, Diffraction, scattering. Small scale fading- small-scale multipath propagation, Impulse response model of a multipath channel, small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale fading	**08 Hours**
4	**Equalization and Diversity**: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in communication receiver, Survey of Equalization Techniques, Linear and non-linear equalization, Algorithms for Adaptive Equalization, Fractionally Spaced equalizers, Diversity techniques, RAKE receivers.	**08 Hours**
5	**Global System for Mobile communication**: System overview, The air interface, Logical and physical channels, synchronization, coding , circuit switched data transmission, Establishing a communication and handoff, Services and billing.	**08 Hours**

Note: Unit numbers: 3 & 4 will have internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course Outcomes:

After completion of this course the student is able to

1. Understand and explain the concepts of cellular communication techniques.
2. Understand and explain the various modulation techniques,
3. Explain the various propagation methods, coding and multiple access techniques used in wireless communication.
4. Analyze concept of second generation digital cellular networks in detail.

COs	Mapping with POs
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1,PO2
CO4	PO1, PO2, PO3

Text Books:

1. Wireless Communication- Andreas F Molish, Wiley Student, 2nd Edition (Units 1&5)
2. Wireless Communication- Principles and Practice, Theodre S Rapp port 2nd edition, Second Edition (Units 2, 3&4)

Reference Books:

1. **Mobile Communications engineering, Theory and applications**-2nd Edition, WILLIM C.Y. LEE, McGraw-Hill, 1997, Singapore.
2. **Introduction to Wireless and Mobile Systems**-Second edition, Dharma Prakash Agarwal, Qing An Zeng, 2nd Edition, THOMSON, 2007.

Electronic Communications systems Fundamentals through advanced-5th Edition, Wayne Tomasi, Pearson education 2007.

Subject Title : **Lasers & Optical Instrumentation**		
Sub Code : **EI 822**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs	CIE+ Assignment+ SEE 45+5+50=100	Total no. of contact hours: 39

Course Objectives:

1. To introduce the basic concepts of Lasers, Laser Instruments, optical Fibers and their applications in the field of Instrumentation.
2. To understand the basic principles of opto- electronic devices like photo transistor, photodiodes etc .
3. To understand the concepts of different optical fiber sensors like optic gyroscope, rotation sensors, polarimetric sensors

Unit No	Syllabus	No of Teaching hours
1	**Lasers:** Principles, classification, construction of Ruby, He-Ne, Nd-YAG, semiconductor, Argon and Carbon dioxide lasers. Characteristics of stabilization, Q-switching and mode locking, frequency stabilization, Line shape function, lasing threshold, application of lasers in engineering and medicine, safety with lasers.	**08 Hours**
2	**Laser Instruments:** Laser interferometry, laser strain gauges, velocimetry, pulse echo technique, beam modulation telemetry and holography, application of holography, laser welding, laser machining and laser spectroscopy	**08 Hours**
3	**Optoelectronic Devices And Components:** Photo diodes, PIN diodes, solar cells, LED's phototransistors, opto-isolators, photocouplers.	**07 Hours**
4	**Fiber Optics:** Light Modulation schemes, optical fibers, intermodal dispersion, graded index fiber, low dispersive fibers. Fiber losses, fiber materials, integrated optics, optical bistability, laser printing, optical multiplexers	**08 Hours**
5	**Optical Fiber Sensors:** Multimode passive and active fiber sensors, Phase modulated sensors, fiber optic gyroscope, Polarization: polarimetric sensors, polarization, and rotation sensors	**08 Hours**

Note: Unit numbers: 1 & 4 will have internal choice

Note: Two assignments are calculated for 5 marks: assignment 1 from units 1 and 2. Assignment 2 from units 3, 4 and 5.

Course Outcome:

At the end of the course, the student is able to

1. Distinguish the different types of Lasers and laser instruments
2. To apply laser in Instrumentation and Biomedical applications

Cos	Mapping with Pos
CO1	PO1,
CO2	PO1, PO2

Text Books:

1. **Optoelectronics**-Wilson & Hawkes, Prentice Hall of India 2003
2. **Laser principles and applications**-Wilson and Hawkes, Prentice Hall of India 1983

Reference Books:

1**. Essentials of Opto Electronics with Applications-** A.J.Rogers, CRC Press.
2. **"Optical Fiber Communications Principles and Systems"** A. Selvarajan, S Kar and T Srinivas. Tata Mcgraw Hill, 2006
3. Solar Energyî, by S. P. Sukhatme, Tata McGraw Hill, New Delhi,1996

Subject Title : **Digital System Design**		
Sub Code : **18EI32**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs		Total no. of contact hours: 52

Course Objectives:

This course introduces the student to

1. Make the students to understand the principles of Boolean algebra and simplification using K-maps and Quine- McCluskey techniques.
2. Analyze and design the digital systems like decoders, Multiplexers, Encoders, and Comparators etc.
3. Understand the operation of flip-flops, counters, registers, and register transfers and to design and analyze the operation of sequential circuits using various flip-flops
4. Understand the concepts of HDL-Verilog dataflow, behavioral and structural description
5. Design and develop the verilog code for both combinational and Sequential circuits using procedure, task and function

Unit No	Syllabus	No of hours
1	**Principles of combinational logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey minimization technique **Introduction to Verilog:** Structure of Verilog module, Operators, data types, Styles of description- Data flow description, Behavioral description, Implement logic gates, half adder and full adder using Verilog data flow description.	**10**
2	**Combinational Functions:** Arithmetic Operations: Adders and subtractors cascading full adders, Look ahead carry, Binary Comparators -2bit and 4 bit, two bit Multiplier, Verilog Description of for above circuits. Multiplexers, Demultiplexers & its Applications **Verilog Behavioral description:** Structure, variable assignment statement, sequential statements, loop statements, Verilog behavioral description of Multiplexers (2:1,4:1,8:1) and De-multiplexers (1:2,1:4,1:8)	**12**
3	**Analysis and design of combinational logic:** Decoders: Binary – Gray vice versa, BCD – Excess 3, BCD – Decimal, BCD – Seven segment, Seven segment display. Encoders: Realization of Priority Encoders, **Verilog behavioral description of Encoders (**8 to 3 with priority and without priority), Decoders (2 to 4).	**10**
4	**Sequential Logic Circuits:** Latches and Flip-Flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip- flop Master slave FF, Registers and Shift Registers: PISO, PIPO, SISO, SIPO, Right shift and left shift, Universal Shift register. **Verilog behavioral description** of latches (D-latch, SR latch) and flip-flops (D, T, JK, SR flip-flops).	**10**
5	**Counters, design and their applications:** Counters, Binary ripple counters, Synchronous binary counters, Modulo N counters, Synchronous and Asynchronous counters. **Verilog behavioral description** of Synchronous and Asynchronous counters, sequential counters.	**10**

TEXT BOOKS:

1. "Digital Logic Applications and Design", John M Yarbrough, Thomson Learning, 2001.(units 1,2,3,4,5-logic design)
2. "HDL Programming VHDL and Verilog"- Nazeih M.Botros, 2009 reprint, Dreamtech press(units 1,2,3,4,5-verilog description)

REFERENCE BOOKS:

1. Fundamentals of logic Design", Charles H Roth, Jr Cengage learning
2. "VHDL: Programming Examples"-Douglas perry-Tata McGraw-Hill 4th edition 2004
3. "Fundamentals of HDL" by Cyril P R Pearson/Sanguin 2010

Course Outcomes:

Upon completion of the course, student should able to

CO1: Simplify Boolean functions using k-map and Quine-Mc.Cuskey minimization technique.

CO2: Utilize the Verilog code to analyze, design and write Verilog code for combinational circuits (MUX, De-MUX, adder, subtractor and comparator circuits)

CO3: Design and analyze code converters, encoders and decoders.

CO4: Analyze and design synchronous sequential circuits.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO2	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO3	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**

Low-1 Medium-2 High-3

Subject Title : **Sensors & Applications**		
Sub Code : **18EI35**	No of credits : 4=4:0:0(L:T:P)	No of Lecture hours/week:4
Exam Duration: 3 hrs		Total no. of contact hours: 52

Course Objectives:
In this course students will be able to:

1. To impart the principles and working modes of various types of Inductive, Capacitive, Laser, Ultrasonic, Radar sensors.
2. To give an idea about the applications of various transducers and selection criteria of a transducer
3. To develop a knowledge on the principles and applications of self generating sensors.

Unit No	Syllabus	No of Teaching hours
1	Definition of a sensor and transducer, sensor classification, block diagram, Active and Passive Transducers, Primary and secondary Transducers, Advantages of Electrical Transducers, Selection of Transducers **Static characteristics of measurement system:** Definition, static calibration, true value, types of error- Gross error, systematic error, random error, static error, static correction, scale range and span, Reproducibility, drift, repeatability, accuracy & precision, linearity, Hysteresis, threshold, Dead time & dead zone, Resolution & discrimination, problems **Dynamic characteristics:** Definition, Speed of response, measuring lag, fidelity, Dynamic error, dead time, zero order measurement systems, first order measurement systems, second order measurement systems	**10**
2	**Inductive, capacitive, optical, Sensors and limit switches:** Inductive proximity sensors and its working principle. Different types like flush, non flush, ring type. Various industry applications (like end travel sensing, metal sensing). Capacitive type proximity sensors and its working principle, various industry applications (like bottle filling etc.,) Limit switches and its industry applications (like Conveyor Belts). Photo sensors (diffused beam, through beam, slotted sensor) working principle and industry application.	**12**
3	**Laser, Ultrasonic, Radar type Sensors:** Ultrasonic sensor working principle and its Applications involving ultra sonic detection, Laser and Radar sensor working principle and its Applications, Advantage and disadvantages. Conventional conductive sensor used in water tanks for level measurement. Touch sensors and its working principles, Types of Touch sensors and its application.	**10**
4	**Linear variable Differential transformer(LVDT)**: Advantages, disadvantages, uses of lvdt's, Rotary variable differential transformer **Piezo-electric Transducers**- modes of operation od piezo-electric crystals, properties, equivalent circuit of Piezo-electric Transducers, loading effects and frequency response, impulse response of Piezo-electric crystals, uses of Piezo-electric materials and transducers Optical transducers, photo emissive cells, photo conductive cells, photo diodes, photo transducers, photo voltaic cells **Digital Encoding transducers**: classification of encoders, construction of	**10**

	encoders-brush type, optical displacement transducers, shaft encoder, coding limitations, brush type encoders.	
5	**Self-generating sensors:** Thermo electric sensors, piezo electric sensors, pyro electric sensors, photovoltaic sensors, Intelligent sensors **Other sensing methods:** sensors based on semiconductor junctions, sensors based on MOSFET transistors, charge coupled and CMOS image sensors, fiber optic sensors, ultrasonic based sensors, biosensors **Applications:** weather monitoring systems, water monitoring systems, Battery monitoring systems	**10 Hours**

Text books:

1. Electrical & Electronic Measurements & Instrumentation, A.K.Sawhney. Dhanphat Rai 11th edition, PHI 2014
2. Electronic Instrumentation & Measurements, H S. Kalsi, II edition, 2010

Reference Books:

1. Doebelin, E.O., Measurement Systems, McGraw-Hill Book Co., 1998.
2. Neubert, H.K.P. Instrument Transducers, Clarenden Press, Oxford, 1988.
3. Patranabis, D, Sensors and Transducers, Wheeler Publishing Co., Ltd. New Delhi, 1997.
4. Murthy, D.V.s., Transducers and Instrumentation, Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
5. Ranganathan, S., Transducer Engineering, Allied Publishers, Chennai, 1999.

Course Outcomes:

After completion of the course the students is able to

CO1: Remember and understand the basic principles of sensors and transducers.

CO2: Apply the knowledge of transducers and sensors in selecting the proper instrumentation systems.

CO3: Analyze and evaluate the performance of different sensors, transducers and converters for various applications.

CO4: Design and create a system using appropriate sensors for a particular application.

CO-PO MAPPING												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	-	1	-	-	-	1	1	1	2
CO2	1	2	2	1	2	-	-	-	1	1	-	2
CO3	2	2	2	1	3	-	-	-	1	1	-	2
CO4	2	2	2	2	3	-	-	-	1	1	-	2

Low-1 Medium-2 High

Subject Title : **Digital System Design Lab**		
Sub Code :**18EI L37**	No of credits : 1.0=0:0:1.0(L:T:P)	No of Lecture hours/week: 2
Exam Duration: 3 hrs		Total no. of contact hours: 13

Laboratory Experiments:

Note: (1) Use discrete components to test and verify the logic gates.

(2) Use FPGA/CPLD kits for down loading the Verilog code and test the output**.**

Expt No	Syllabus
1	Simplification, realization of Boolean expressions using logic gates/Universal gates
2	To design and implement a. Adder/Subtractor – Full/half using logic gates. b. 4-bit Parallel Adder/ subtractor using IC 7483.
3	To realize using IC 7483 a. BCD to Excess-3 code conversion and vice versa b. Binary to Gray code conversion and vice versa
4	To realize a. 4:1 Multiplexer ,8x1 Mux b. 1:8 Demux c. Priority encoder and 3:8 Decoder using IC74138 d. Two bit comparator
5	To verify the truth table of following flip-flops using IC (a) T type (b) JK Master slave (c) D type
6	To realize the 3-bit counters as a sequential circuit and Mod-N Counter design (7476, 7490, 74192, 74193)
7	Adder/Subtractor – Full/half using Verilog data flow description
8	Code converters using Verilog Behavioral description a. Gray to binary and vice versa b. Binary to excess3 and vice versa
9	Combinational designs using Verilog Behavioral description a. 8:1 mux, 3:8 decoder, 8:3 encoder, Priority encoder b. 1:8 Demux and verify using test bench c. 2-bit Comparator using behavioral description
10	Flip-flops using Verilog Behavioral description a) JK type b) SR type c) T type and d) D type
11	Binary any-sequence UP/Down 4-bit counter using Verilog behavioral description
12	Interface experiments: (a) Stepper motor (b) Waveform generation using DAC

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**3**	**2**	**2**	-	-	-	**1**	**1**	-	**2**
CO2	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**	-	**2**
CO3	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**	-	**2**
CO4	**3**	**2**	**3**	**2**	**3**	-	-	-	**1**	**1**	-	**2**
CO5	**3**	**2**	**3**	**2**	**2**				**1**	**1**	-	**2**

Subject Title : **Microcontroller and Applications**		
Sub Code : **18EI43**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs		Total no. of contact hours: 52

Course objectives:

1. To understand the basic concepts of embedded systems.
2. To understand the architecture of 8051 microcontrollers
3. To understand the architectural features and application capabilities of MSP430.

Unit No	Syllabus	No of Teaching hours
1	**Introduction:** Microcontrollers and Embedded systems, Overview of the 8051, Architecture of the 8051, Addressing modes, assembly programming, Programming the 8051.	**10**
2	MSP430x5x series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller; Sample embedded system on MSP430 microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming.	**11**
3	Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.	**11**
4	Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.	**10**
5	Parallel Ports, Lighting LEDs, Flashing LEDs, Read Input from a Switch, Toggle the LED state by pressing the push button, 7-segment Display Interfacing, LCD interfacing. Stepper motor, DC motor Interfacing., IR Sensor, LDR Sensor Interfacing.	**10**

Text Books:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication.
2. John H Davies, MSP430 Microcontroller Basics, Newnes Publications, Elsevier,2008.

References:

1. Chris Nagy, Embedded Systems Design using TI MSP430 Series, Newnes Publications, Elsevier, 2003.
2. User Guide from Texas Instruments

Course Outcomes: On completion of the course, students will be able to

CO1: Explain the concept and applications of Embedded Systems and 8051 microcontroller architecture and simple programming
CO2: Apply the architecture, addressing modes and Analyze instruction set of MSP430 and develop programs for control applications using assembly language and embedded C.
CO3: Use RTC, Timers, ADC and comparator for simple applications.
CO4: Demonstrate Serial communication protocols and programming.
CO5: Interface devices and peripherals to microcontroller and write program

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	2	**3**	-	**3**	-	-	-	**1**	**1**	**1**	**2**
CO2	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**	-	**2**
CO3	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**	-	**2**
CO4	**3**	**2**	**3**	**2**	**3**	-	-	-	**1**	**1**	-	**2**
CO5	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**		**2**

Low-1 Medium-2 High-3

Subject Title : **Linear IC's & Applications**		
Sub Code : **18EI45**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs		Total no. of contact hours: 39

Course Objectives:

The main objectives of the course is to equip the students with the knowledge on

1. The fundamentals of Operational Amplifiers (OPAMP)
2. The principles and functioning of signal conditioning circuits using OPAMP
3. The Design of various signal generation circuits using OPAMP
4. The Linear and non-linear applications of operational amplifiers.

Unit No	Syllabus	No of Teaching Hours
1	**Operational Amplifier Fundamentals**: Basic Op-Amp circuit, Op-Amp parameters, Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations Op-Amps as DC Amplifiers, Biasing Op-Amps, Voltage Follower, Direct coupled Non-inverting Amplifiers, Inverting amplifiers.	**8**
2	**Characteristics of OPAMP:** Ideal OP-AMP characteristics **Frequency response of OP-AMP**- Circuit stability, Frequency and phase response, Frequency compensating methods, Band width, Slew rate effects, Z_{in} Mod compensation, and circuit stability precautions	**7**
3	**OP-AMP Applications I:** Inverting, Non-inverting Amplifier, summer, differentiator, integrator, comparators, Differential amplifier, Instrumentation amplifier, V/I & I/V converters. Voltage sources, current sources and current sinks, first and second order active filters, Clippers, Clampers, Peak detector.	**8**
4	**OP-AMP Applications II:** Schmitt trigger, waveform generators- square wave generator, triangular wave generator, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using OPAMPs, Oscillators- phase shift oscillator, Wein bridge oscillator.	**8**
5	**Specialized IC Applications: Voltage** Regulators - Fixed voltage regulators , Adjustable voltage regulators , Switching regulators, 555 as manostable, Astable multivibrater Phase locked loops - operating principles, monolithic phase looked loops, 565 PLL Applications, VCO.	**8**

TEXT BOOKS:

1. "Op-amps and Linear Integrated Circuits" Ramakant A. Gayakward, 4th Edition, Pearson Education, 2003 / PHI. 2000.
2. "Operational Amplifiers and Linear IC's", David A. Bell, 6th edition, PHI/Pearson, 2004

Reference Books:

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain**,** 2nd edition, Reprint 2006
2. "Op-amps & Linear Integrated Circuits Concepts & Applications "Fiore,Cengage,2010.

3. “Fundamentals of Analog Circuits”, Floyd , Buchla,” Pearson, 2013.

Course Outcome:

On successful completion of the course the student is able to:
CO1: Understand the fundamental principles of operational amplifiers
CO2: Design and analyze the signal conditioner circuits like Amplifiers, filters, ADC, DAC using operational amplifiers for various applications.
CO3: Design and analyze the signal generator circuits for the given specification
CO4: Use OPAMP for various applications like waveform generation, PLL, Voltage regulator etc
CO5: An ability to identify, formulate, and solve engineering problems related to analog and digital system design using project-based learning approach
CO6: An ability to use the techniques and skills, necessary for engineering practices

Subject Title : **Sensors and Signal Conditioning Circuits Lab**		
Sub Code :18**EIL46**	No of credits : 1.0=0:0:1.0	No of hrs/week : 2
Exam duration : 3hrs	Exam Marks : 100	

OBJECTIVE:

- Developing adequate knowledge on various Transducers and sensors, To Emphasis Knowledge on filtering techniques
- To Emphasis Knowledge on amplifiers and waveform generators
- Learn to identify and simulate the analog circuits using software tools.

Expt No	**Syllabus**
1	To measure the resistance using wheat stone bridge and kelvin double bridge
2	To measure the characteristics of LVDT and Capacitance transducer.
3	To study the characteristics of LDR and Optocoupler.
4	Temperature measurement using thermistor
5	Study the following Op amp parameters a. Input offset current b. Input bias current c. Slew rate d. CMRR
6	Design the following circuits using Op-amp (μA741) for the given specification Inverting amplifier, non- inverting amplifier & Schmitt trigger circuit
7	Design the following circuits using Op-amp (μA741) for the given specification a. Adder b. Subtractor, c. Comparator
8	Design the following circuits using Op-amp (μA741) for the given specification a. Integrator, b. Differentiator
9	Design a low-pass and High pass filters (Butterworth I & II order) for different cutoff frequency
10	Design an Instrumentation amplifier for different gains using Opamp and verify using Use any software tool.
11	Design of Astable and Monostable multivibrator using 555 timer
12	Design a suitable signal conditioning circuit to display temperature using RTD
13.	**Add on Experiment:** Demonstrate the working of Proximity Sensor, Limit Switch, Optical Sensor.
14	Demonstration of open ended project using the concept of Experiments 1- 12

Course Outcomes

At the end of the course students will be able to

CO1: Determine the performance characteristics of transducers and sensors.

CO2: Identify the tools for analysis and simulation.

CO3: Design analog circuits using OP Amp and Timer

CO4: Apply statistical procedure to verify the experimental results.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO2	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO3	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**

Subject Title :**Communication Technology**		
Sub Code :18EI52	No of credits : 3=3:0:0(L:T:P)	No of Lecture hours/week:3
Exam Duration: 3 hrs		Total no. of contact hours: 39

Course objective:

1. To discuss the principles and working of various analog and digital modulation techniques and their Spectral representation
2. To analyze the different methods involved to obtain and to recover modulated signal.
3. To solve the problem related to analog and digital modulation techniques.
4. To discuss fundamentals of Broadcasting & Multiple Access Techniques and Satellite communication and cell phone technologies.

Unit No	Syllabus	No of Teaching hours
1	**Analog Communication :** Amplitude modulation :Time domain description, frequency domain description, generation of AM, detection of AM; **DSBSC, SSBSC :** Time domain description, frequency domain description, generation and detection, comparison of AM techniques, AM transmitter & Receiver, AM receiver model, Signal to noise rations for coherent reception,	08 Hours
2	**Angle modulation: B**asic concept, frequency modulation, phase modulation, NBFM,WBFM, power & bandwidth of FM wave, generation of FM wave, Phase lock loop of FM. FM receiver model, noise in FM reception, pre-emphasis and de-emphasis in FM systems	07 Hours
3	**Pulse modulation:** sampling theorem for low pass and band pass signal- statement & proof, , natural sampling , flat top sampling, signal recovery through holding, , quantization of signals, quantization error ,electrical representation of binary digits PAM, PWM, PPM,PCM system, DPCM, Delta modulation, adaptive delta modulation.	08 Hours
4	**Digital modulation techniques:** Introduction, ASK, BSK, BFSK, FSK, PSK, DPSK, QPSK, , Multiplexing and multiple access technique- TDM, FDM ; Multiple Access Techniques - ,FDMA, TDMA, CDMA.	08 Hours
5	**Introduction to satellite communication:** Satellite Orbits, Satellite communication systems, satellite subsystems, ground stations, satellite applications, Global positioning System; **Cell Phone technology**: cellular concept, frequency allocation, frequency reuse, 2G,3G and 4G cell phone systems.	07Hours

Course Outcome:

After the successful completion of the course, the student is able to:

1. Describe the needs and the principles and working of various analog and digital modulation
2. Apply the (demodulation) techniques to recover the signal
3. Determine the values of signal parameters analog & digital communication
4. Analyzethe advancement in multiple access and Satellite communication techniques

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

TEXT BOOKS:

1." **Analog and Digital communication**- Simon Haykin, John Willey. 2nd Edition Jan 2012

2. "**Principles of Electronics Communication Systems**- Louis E. Frenzel Jr., fourth edition, McGrawHill Education 2016.

REFERENCE BOOKS:

1. **Electronic Communication Systems**- George Kennedy, Blake, Thomson publishers 2nd Edition, 2002
2. "**Digital and analog communication systems."** K.SAM SHANMUGAM".2009

Subject Title :**Process Automation and Control**		
Sub Code :18EI53	No of credits : 3=3:0:0(L:T:P)	No of Lecture hours/week:3
Exam Duration: 3 hrs		Total no. of contact hours: 39

Course Objectives:

1. To introduce the terminology, concepts and practices in process modelling and automatic process control.
2. To impart knowledge in the design of control systems and PID controller tuning for processes.
3. In addition, the subject also introduces about discrete state process control and Batch process.

Unit No	Syllabus	No of Teaching hours
1	**Introduction To Process Control:** process control block diagram. Final control**:** introduction to final control operation, signal conversions, actuators, control elements**.** Alarm and annunicators, control drawing: P & ID symbols and diagrams, flow sheet symbols, inter logic symbols, graphic symbols.	08 Hours
2	**Controller Principles:** Introduction, process characteristics, discontinuous control modes, continuous control modes, and composite control modes. **Analog Controllers:** Introduction, general features, electronic controllers, designs considerations.	08 Hours
3	**Discrete-State** Process Control: Introduction, definition and characteristics of discrete state process control. Control-loop characteristics: Introduction, control system configuration. control system quality, stability, and process loop tuning	08 Hours
4	**Process control Applications:** Building conditioning control, batch control description and terminology, batch and their automation, boiler control, water treatment control, steam turbine controls.	08Hours
5	**Introduction to Safety Instrumented systems** - Safety Lifecycle , Introduction to Functional Safety, Difference between BPCS and SIS, Functions of different personnel's, Major fire hazards–Acronyms- Overview of Standards and Regulations	07Hours

Text Books:

1. **Process Control Instrumentation Technology**-C D Johnson, PHI Publication. 8th Edition, 2009
2. **Safety Instrumented Systems Verification**- Practical Probalistic Calculation, William M Goble

Reference Books:

1. **Chemical Process Control an Introduction to theory and practice,** George Stephanopoulos, PHI, sixth reprint.1998,
2. **Computer Aided Process Control**- S K Singh, Prentice Hall of India, 2008
3. **Instrument Engineers Handbook-(Vol 1 & 2)-**B G Liptak,Chilton Book Company, 3rd edition 1995

Course outcomes:
On successful completion of the course the student is able to

1. Identify and Draw the P& I diagrams for the process system
2. Select suitable controller among P,I,D and composite controllers for process control systems
3. Design a suitable controllers indicated in CO2 for the given specification using OPAmps
4. Analyze and apply the controller tuning techniques for process control system
5. Choose the proper control system for the automatic control system
6. Apply proper safety norms in process industry

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**1**	-	-	-	-	-	**1**	**1**	**2**	**2**
CO2	**1**	**3**	**3**	**3**	-	**1**	-	-	**3**	**1**	**2**	**3**
CO3	3	**3**	**3**	**2**	-	**1**	-	-	**1**	**1**	**2**	**3**
CO4	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**3**
CO5	**1**	**3**	**3**	**3**	-	**1**	-	-	**3**	**1**	**2**	**3**
CO6	3	**3**	**3**	**2**	-	**1**	-	-	**1**	**1**	**2**	**3**

Subject Title :C++ and Data Structures		
Sub Code :18EI54	No of credits : 4=3:2:0(L:T:P)	No of Lecture hours/week:5
Exam Duration: 3 hrs		Total no. of contact hours: 65

Course Objectives:

In this course students willbe able to:

1. Explain OOPs concepts, C++ functions.
2. Illustrate the concepts of overloaded operators , inheritance, polymorphism
3. Demonstrate the ability to overload operators in C++ and use of file handling operations.
4. Explain different types of data structure

Unit No	Syllabus	No of Teaching hours	Tutorial
1	**C++ Programming Basics:**Need for object orienting programming, procedural languages, characteristics of OOP, preprocessor directives, header files and library files, compiling and linking, data types,Enumerated data types, Boolean type symbolic constants, variables, operators, control statements and loops. **Functions:**function prototype, argument passing, call and return by reference, recursion,function overloading, three steps of overloaded resolution, inline functions.	**08Hours**	**04 Hours**
2	**Classes and Objects:**Class definition and declaration, member functions, static data members and functions, Arrays of objects, functions returning objects. **Constructors and Destructors**: Constructors, parameterized constructors, multiple constructors in a class, copy constructor, Destructors and its characteristics constructors. Create a program for Banking applications. **Operator Overloading:** Overloadingof unary operatorsand binary operators, overloading binary operators using friend function, rules for overloading, operators which cannot be overloaded, Type casting.	**08 Hours**	**06 Hours**
3	**Inheritance:**Types, public, private and protected inheritance, derived class constructors, virtual base class. Model a program for class complex. **Pointers, virtual functions and polymorphism:** pointers to objects, this pointer, pointers to derived classes, virtual functions, pure virtual functions, Abstract class,programs based on real time applications.	**07 Hours**	**06 Hours**
4	**Managing I/O operations:**C++ streams, C++ stream classes, unformatted I/O operation, formatted console I/O operation, Managing output with manipulator. **Working with files:** introduction, classes for the stream operators, opening and closing files, detecting end –of-file, file modes. Programs based on file opeartions.	**08 Hours**	**04 Hours**
5	**Data Structures:** Data Representation- Binary and Decimal Integers Abstract Data types, Algorithm, Analysis,Stacks, Queues, Linked Lists, Trees – Binary Trees, Tree Traversal, Sorting – Bubble Sort & Insertion Sort, Searching – Linear Search, Binary Search. programs based on real time applications	**08 Hours**	**06 Hours**

Text Books:

1. **Object oriented programming in TURBO C++** Robert Lafore, Galgotia Publications, 7th Edition, 2017, ISBN: 978-8131722824.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 3rd Edition Pearson Education Asia, 2007.

Reference Books:

1. **C++ the complete reference**, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
2. **Object oriented programming with C++,** E Balaguruswamy, Tata McGraw Hill Publicarions, 6th edition, 2013, ISBN: 978-1259029936
3. **Data structuers using C and C++** YedidyahLangsam, Moshe J. Augenstein ,Aaron M.Tenenbaum, PHI, 2th edition 2012
4. **Data structures, Algorithms and Applications in C++:** SartajSahni, Tata McGrawHillPublications, 2nd Edition,2017

Course outcomes:

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

1. Remember and understand the basic concepts of OOPs and functions.
2. Apply the concepts of OOPs to realize a program for various situations.
3. Analyze the real world problems and solve them by implementing the features of data structures.
4. Design, implement, test, debug and document the programs in C++.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO2	**1**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO3	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**

Low-1 Medium-2 High-3

Subject Title :**Control systems and simulation Lab**		
Sub Code :18EIL57	No of credits : 1=0:0:1(L:T:P)	No of Lecture hours/week:2
Exam Duration: 3 hrs		Total no. of contact hours: 26

Course Objective

The objective of the lab is to design a system and calculate the transfer function, analyzing the stability of the system (both open and closed loop, with positive and negative feedback) with time domain approach and frequency response analysis, using MATLAB/ Modelica

Expt No	Syllabus
1	Study the operation of Sample and Hold circuits using discrete components and IC.
2	Transfer Function Of DC Motor
3	Time Domain Analysis Of Second Order System using discrete components
4	Verify the function of programmable gain amplifier using analog multiplexer.
5	Design relay driving circuits using photo devices (LDR & Optocouplers).
6	To study the unipolar and Bipolar analog Multiplexer
7	Frequency Response Analysis Of Lead Compensating network
8	Frequency Response Analysis Of Lag Compensating Network
9	Mathematical Modeling of Physical Systems
10	Root Locus Plot Using Matlab
11	Bode Plot And Nyquist Plot
12	Study the PID controller and its effects on the feedback loop response

Course Outcome:

Upon the completion of Control Systems practical course, the student will be able to attain the following:

1. Model a mechanical (masses, dampers and springs) and electrical system (inductors, resistors, capacitors) in the form of a transfer function.
2. Analyse the effect of P, PI, PD and PID controllers on a control system
3. Perform time response analysis of a second order control system using MATLAB

4. Analyse and interpret stability of the system through Root Locus, Bode plot and NY Quist plot.
5. Design Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB.

CO-PO MAPPING												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	-	-	-	3	2	-	2
CO2	2	2	2	2	3	-	-	-	3	2	-	2
CO3	2	2	2	2	3	-	-	-	3	2	-	2
CO4	2	2	1	2	3	-	-	-	3	2	-	2
CO5	2	2	1	2	3	-	-	-	3	2	-	2

Subject Title :**Embedded Systems using ARM Controller**		
Sub Code :18EI62	No of credits : 4=4:0:0(L:T:P)	No of Lecture hours/week:4
Exam Duration: 3 hrs		Total no. of contact hours: 52

Course Objective:

The objective of the course is to:

1. Understand ARM design philosophy and ARM processor architecture and fundamentals
2. Learn the ARM Instruction set of ARM microcontroller and to learn the assembly programming
3. understand Thumb instructions of ARM controller
4. Understand Various Interrupts and exception handling in ARM controller
5. Learn interfacing and to write C-program for LED, Keyboard, LCD, DC motor, Stepper motor

Unit No	Syllabus	No of Teaching hours
1	**Introduction to Embedded systems:** Definition of Embedded system, Embedded VS General computing system, classification of embedded systems, Major application areas **ARM embedded systems:** The RISC design philosophy, The ARM design philosophy, embedded system hardware, embedded system software.ARM Architecture **ARM processor fundamentals:** Registers, current program status register, pipeline, core extensions, ARM processor families	**11 Hours**
2	**Introduction to ARM instruction Set:** Data Processing Instructions, Branch Instructions, Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, and Conditional Execution. Thumb register usage, ARM-Thumb interworking.	**11 Hours**
3	**Interrupts & Exception Handling:** Exceptions, Exception Handling**,** Interrupts, Interrupt handling schemes, vector table.	**08 Hours**
4	**LPC 2148: -** Salient features, applications, block diagram, memory mapping GPIO-Features, Design of system using GPIO's Blink a group of 8 LEDs with a delay, Stepper motor control, DC motor control LCD interface, 4 x 4 Keypad, Timers, ADC, DAC, UART	**10 Hours**
5	**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques.	**12 Hours**

Text Books:

1. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited; 2009
2. Andrew N Sloss, Dominic System and Chris Wright, ARM System Developers Guide, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008,ISBN: 1758608745

Reference Books:

1. LPC 2148 User Manual
2. Furber S, ARM System on chip Architecture, Addison Wiley, 2nd Edition 2008, ISBN:978-0201675191
3. ARM Assembly language An Introduction, J.R.Gibson, Cengage Learning, 2010

Course outcome:

After successful completion of the course the student is able to:

1. Understand the features of embedded systems, architecture of ARM7 and applications.
2. Apply the ARM instruction set in assembly programming for different applications.
3. Understand the exception, interrupts and interrupt handling schemes
4. Apply the knowledge of hardware and software requirements to various applications of embedded system.
5. To become acquainted with RTOS based embedded system design concepts

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	-	-	-	1	-	-	1	1	1
CO2	2	2	3	2	2	2	1	-	1	2	-	2
CO3	2	2	3	2	2	2	1	-	1	1	2	2
CO4	2	2	3	3	2	2	2	-	1	2	1	2
CO5	2	2	3	2	2	2	2	-	1	2	1	2

Subject Title : **Machine Learning using Python Programming**		
Sub Code :18EI643	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs		Total no. of contact hours: 39

Course Objective:

1. Develop the skills of using machine learning software for solving practical problems.
2. Discover how to derive mathematical formulation with appropriate machine learning methods to solve an application
3. Analyse a problem and evaluate a machine algorithm to meet the desired needs.
4. Demonstrate awareness and a fundamental understanding of various applications of artificial neural network techniques

Unit No	Syllabus	No of Teaching hours
1	**The Machine Learning Landscape,** What Is Machine Learning?, Why Use Machine Learning?, Examples of Applications, Types of Machine Learning Systems, Main Challenges of Machine Learning, Testing and Validating, **Classification,** MNIST, Training a Binary Classifier, Performance Measures, Multiclass Classification, Error Analysis, Multilabel Classification, Multioutput Classification.	**08Hours**
2	**Training Models**, Linear Regression, Gradient Descent, Polynomial Regression, Learning Curves, Regularized Linear Models, Logistic Regression, **Support Vector Machines**, Linear SVM Classification, Nonlinear SVM Classification, SVM Regression, Under the Hood.	**08Hours**
3	**Decision Trees**, Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy? ,Regularization Hyper parameters, Regression, Instability, **Ensemble Learning and Random Forests**, Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting, Stacking,	**08Hours**
4	**Dimensionality Reduction,** The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Kernel PCA, LLE, Other Dimensionality Reduction Techniques, **Unsupervised Learning Techniques,** Clustering, Gaussian Mixtures.	**07 Hours**
5	**SELF-STUDY** **Introduction to Artificial Neural Networks with Keras,** From Biological to Artificial Neurons, Implementing MLPs with Keras, Fine-Tuning Neural Network Hyperparameters.	**08Hours**

Course Outcome:

1. Develop an understanding of basic machine learning algorithms, their efficient implementations and their applicability to different tasks.
2. Illustrate the ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.

3. Apply the knowledge of computing and mathematics to machine learning problems, models and algorithms.
4. Articulate the basic principles of artificial neural networks towards problem solving, inference, perception, knowledge representation, and learning.

CO-PO MAPPING												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-

Text Book

1. AurélienGéron, **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems",** 2nd Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-1492032649.

Reference Book

1. Andreas C. Müller and Sarah Guido,**"Introduction to Machine Learning with Python: A Guide for Data Scientists",** 1st Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019.ISBN-13: 978-9352134571.
2. François Chollet, **"Deep Learning with Python**", 1st Edition, Manning Publications, 2017. ISBN-13: 978-1617294433
3. Sebastian Raschka and Vahid Mirjalili, **"Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2"**, 3rd Edition, Packt Publishing Limited, 2019.ISBN-13: 978-1789955750.
4. Stuart J Russell and Peter Novig, **"Artificial Intelligence",** 3rd Edition, Pearson Education India, 2015.ISBN-13: 978-9332543515.

Subject Title :Embedded System Design Lab		
Sub Code :18EIL66	No of credits : 1=0:0:1(L:T:P)	No of Lecture hours/week:2
Exam Duration: 3 hrs		Total no. of contact hours: 26

Course objectives:

1. To understand and program the LPC2148 microcontroller using assembly and C-Programming techniques
2. To understand the concepts and principles of built in peripheral devices like LCD, Timer
3. To understand the concepts and principles of communication and its use in serial programming.
4. To understand and analyze the function of memory Management unit in ARM microcontroller
5. To learn Interfacing of LED, LCD, UART, I2C to the ARM microcontroller.

Expt No	**Assembly Programs**
1	Write assembly program to move a block of 10 data stored in one memory to another block
2	Write an assembly program to Exchange block of 10 data
3	Write an assembly program to find the smallest number out of 10 data stored in memory
4	Write an assembly program to sort 10 data stored in Memory
5	Write an assembly program to add two 64 bit numbers
6	Write an assembly program to multiply two 32 bit numbers
7	Write an assembly program to divide a 32 bit numbers and store quotient and remainder.
8	Write an assembly program to find factorial of given number using recursive procedure.
9	Write an assembly program to convert 3 digit Hexadecimal to BCD
10	Write an assembly program to switch to THUMB mode from ARM core mode and find the length of the string

	Interfacing Programmes
1	Interface LED to LPC2148 and write C program to blink 8 LED's which are connected to P0.0 to P0.8
2	Interface switch & LED to LPC2148. Write C program to read the status of switch and display same on LED

3	Interface 2 *16 LCD and write C program to display a string
4	Interface LED & write program to implement binary up-counter(8-bit). The counter should increment for every one second. Use internal timer
5	Write C - Program to convert Hexadecimal to Decimal and Display the same on 7 -segment display
6	Interface 4 x 4 keyboard and write C program to identify the key pressed
7	Write C- program for serial transmission and reception of string by polling method and verify the output on serial monitor
8	Interface ADC and write program to convert analog voltage to digital and display the result on LED
9	Demonstration of the communication process using Zigbee protocol with LPC 2148
10	Demonstration of signal acquisition, control and display.

Course Outcomes:

After completion of this course the student is able to:

1. Describe the programmer's model of ARM processor to create and analyze Assembly level and Embedded C-programming.
2. Develop a program and analyze the various built in peripheral devices.
3. Demonstrate various communication techniques between the kit and external peripheral modules
4. Identify and analyze the function of memory Management unit of ARM.
5. Interface ARM microcontroller with external peripherals.

CO-PO MAPPING												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	-	-	-	3	2	-	2
CO2	2	2	2	2	3	-	-	-	3	2	-	2
CO3	2	2	2	2	3	-	-	-	3	2	-	2
CO4	2	2	1	2	3	-	-	-	3	2	-	2
CO5	2	2	2	2	3	-	-	-	3	2	-	2

Subject Title : **IoT and Wireless Sensor Networks**		
Sub Code : **18EI71**	No of credits : 4=4:0:0 (L:T:P)	No of Lecture hours/week: 4
Exam Duration: 3 hrs		Total no. of contact hours: 52

Course Objective:

The objective of the course is to:

1. Understanding the need for migrating towards software defined networks and integrating time series data from wireless sensor networks.
2. Know about communication protocols, Hardware platforms and operating systems commonly used in IoT systems.
3. Describe different modules in a wireless sensor node and design of wireless sensor networks for different applications

Unit No	Syllabus	No of Teaching hours
1	**Overview of Internet of Things:** Introduction to Internet of Things Introduction-Definition & Characteristics of IoT , IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT,M2M communication, Difference between IoT and M2M,Examples of IoT, Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway	11 Hours
2	**Architecture and Design Principles for IoT:** Internet connectivity, Internet-based communication, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports. **Data Collection, Storage and Computing using a Cloud Platform:** Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing	10 Hours
3	**Prototyping and Designing Software for IoT Applications: prototyping embedded devices and Designing Software for IoT Applications Embedded platforms for prototyping, things always connected to internet /cloud** Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE	10 Hours
4	**Overview and Architectures of Wireless Sensor Networks:** Introduction: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts	10 Hours

5	**Communication Protocols:** MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA,PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA). **Applications Of WSN:** WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications **IoT Case study**: smart homes, smart city streetlights control and monitoring.	11 Hours

Course outcome:

After successful completion of the course the student is able to:

1. Analyze various M2M and IoT architectures (Analyze)
2. Apply design concept to IoT solutions (Apply).
3. Designing software and programming embedded devices.
4. Illustrate the concept of WSN node Architecture and Network Architecture
5. Explore MAC and Routing protocols of WSNs

CO-PO MAPPING												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	3	3	1	1							
CO3	2	2	3	2	2							
CO4	2	2	2	1								
CO5	2	2	2	1	-							

Low-1 Medium-2 High-3

Text Books:

1. Raj Kamal, ‖Internet of Things-Architecture and design principles‖, McGraw Hill Education.
2. Holger Kerl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Network”, JohnWiley and Sons, 2005 (ISBN: 978-0-470-09511-9)

Reference Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, VPT, 2014
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, A press Publications, 2013
4. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011
5. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier publications, 2004

Subject Title :**Robotics and Applications**		
Sub Code :**18EI652**	No of credits : 3=3:0:0 (L:T:P)	No of Lecture hours/week: 3
Exam Duration: 3 hrs		Total no. of contact hours: 39

Course objectives:

The main objective of the course is to

1. Understand the generic technology and principles associated with robotics and automation systems
2. Understand the principles and operations of different sensors used for robotic applications
3. Understand the kinematics and dynamics aspects of robotic system

Unit No	**Syllabus**	**No of Teaching hours**
1	**Introduction :** robot definition, classification of robot, history, robot components, robot degrees of freedom, robot joints, coordinates, reference frames, asimov's laws of robotics, robot programming modes, characteristics, applications	**8 Hours**
2	**Robot drivers, sensors and vision:** drivers for robots: electrical, hydraulic and pneumatic. **Sensors:** proximity and range, tactile force and torque End effectors, position and velocity measurement.	**8 Hours**
3	**Robot kinematics :** rotation matrix, homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles RPY representation, Direct and inverse kinematics for industrial robots for position and orientation	**8 Hours**
4	**Robot dynamics:**Langrangian formulation and newton Euler formulation	**7Hours**
5	**Motion planning:**Introduction, General considerations on Trajectory planning, joint-interpolated Trajectories, calculation of a 4-3-4 Joint trajectory, Cubic Spline Trajectory.	**8 Hours**

Course outcomes:

At the end of this course the students is able to

CO1: Demonstrate the technology and principles associated with robotics and automation systems

CO2: Identify components, advantages, disadvantages, applications of robots.

CO3: Solve direct and inverse kinematics of simple robot manipulators.

CO4: Apply spatial transformation and mathematical equations to obtain the forward kinematic equation of robot manipulators and path planning.

Text Books:

1. **Robotics control sensingVision and Intelligence**- K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.
2. **Introduction to robotics** Saeed B Niku Prentice Hall of India 2005

Reference Books:

1. **Robot Technology Fundamentals -** James G.Keramas, 1st Edition, Cengage learning Publishers, 1998
2. **Introduction to robotics** John J Craigthird Editionpearson Education Inc., 2005
3. **Introduction to robotics** SK SahaTata McGraw Hill **,** 2008

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

Subject Title :**Virtual Instrumentation**		
Sub Code :**18EI562**	No of credits : 3=3:0:0(L:T:P)	No of Lecture hours/week:3
Exam Duration: 3 hrs		Total no. of contact hours: 39

Course objectives:

1. To introduce the concept of virtual instrumentation.

2. Introducing the basics of LabVIEW and programming concepts.

3. Analyzing the basics of data acquisition and learning the concepts of data acquisition with LabVIEW.

4. To understand Various Analysis Tools of Virtual Instrumentation

Unit No	**Syllabus**	**No of Teaching hours**
1	**Virtual Instrumentation** - Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI,	**8**
2	**VI programming techniques** - VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.	**8**
3	**Basics of Data Acquisition:** Introduction to data acquisition Classification of Signals, Resolution and sampling frequency – Multiplexing of analog inputs – Single- ended and differential inputs – Different strategies for sampling of multi-channel analog inputs, digital I/O, counters and timers, **Introduction**: Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants	**8**
4	**Analysis Tools and Simple Application in VI** Fourier transform – Power spectrum – Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – PID controller – CRO emulation –Simulation of a simple second order system – Generation of HTML page.	**8**
5	**Simulation of systems using VI:** Development of Control system, Image acquisition and processing, Motion control.	**7**

Course Outcomes: On completion of the course, students will be able to

CO1: Explain the concept of Virtual Instrumentation

CO2: Use and implement various types of structures used in LabVIEW.

CO3: Analyze and design different type of programs based on data acquisition.

CO4: Create a VI system to solve real time problems.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	2	**3**	-	**3**	-	-	-	**1**	**1**	**1**	**2**
CO2	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**	-	**2**
CO3	**3**	**2**	**3**	**1**	**3**	-	-	-	**1**	**1**	-	**2**
CO4	**3**	**2**	**3**	**2**	**3**	-	-	-	**1**	**1**	-	**2**

Low-1 Medium-2 High-3

Text Book

1. Sanjay Gupta & Joseph John**,** Virtual Instrumentation Using Lab View, 2ND Edition, Tata McGraw Hill Publisher Ltd. ,New Delhi, 2010

Reference Books:

1.Garry M. Johnson**, "**LabVIEW Graphical Programming", 1s Edition, Tata McGraw-Hill, 1997

2. Lisa. K. Wills**, "**LabVIEW for Everyone**"** Prentice Hall of India, 2nd Edition, 1996.
3. National Instruments,Labview Basics I and II Manual, 1st Edition, 2003
4. Jovitha Jerome, "Virtual instrumentation Using LabVIEW", 4th Edition, PHI Learning Pvt.Ltd., 2010, ISBN: 978-8120340305.