Fifth and Sixth semester syllabus 2018-19 Regulation (2022-23)

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION from Academic Year 2020-21

B.E Electronics and Instrumentation Engineering

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

V SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HS	18HS51/52	M&E / IPR (title as per BOS decision)	Hu	3	-	--	03	50	50	100	3
2	PC	18EI51	Digital Signal Processing	EI	3	2	--	03	50	50	100	4
3	PC	18EI52	Communication Technology	EI	3	-	--	03	50	50	100	3
4	PC	18EI53	Process Automation and Control	EI	3	--	--	03	50	50	100	3
5	PC	18EI54	C++ and Data Structures	EI	3	2	--	03	50	50	100	4
6	PE	18EI55X	Elective -1	EI	3	--	--	03	50	50	100	3
7	OE	18EI56X	Open Elective -A	-	3	--	--	03	50	50	100	3
8	PC	18EIL57	Digital Signal Processing Lab	EI	--	--	2	03	50	50	100	1
9	PC	18EIL58	Control systems and simulation Lab	EI	--	--	2	03	50	50	100	1
			TOTAL		**21**	**04**	**4**	**27**	**450**	**450**	**900**	**25**

Note: Hu: Humanities, PC: Professional Core, MC: Mandatory Course,

Electives

Course code	Professional Electives -1
18EI551	Biomedical Instrumentation
18EI552	Power Electronics and Drives
18EI553	Digital Image Processing
18EI554	Automotive Electronics

OPEN ELECTIVE-A

18EI561	Sensors& Applications
18EI562	Virtual Instrumentation

Open Elective –A

Students can select any one of the open electives (Please refer to consolidated list of Dr AIT for open electives) offered by any Department. Selection of an open elective is not allowed provided:

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Mentor.

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SCHEME OF TEACHING AND EXAMINATION from Academic Year2020-21

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VI SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory **Lecture**	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HS	18HS61/62	M&E/IPR	Hu	3	--	--	03	50	50	100	3
2	PC	18EI61	PLC and SCADA	EI	4	--	--	03	50	50	100	4
3	PC	18EI62	Embedded Systems using ARM Controller	EI	4	--	--	03	50	50	100	4
4	PC	18EI63	Advanced Control System	EI	3	--	--	03	50	50	100	3
5	PE	18EI64X	Professional Elective -2	EI	3	--	--	03	50	50	100	3
6	OE	18EI65X	Open Elective -B	-	3	--	--	03	50	50	100	3
7	PC	18EIL66	Embedded System Design Lab	EI	--	--	2	03	50	50	100	1
8	PC	18EIL67	Virtual Instrumentation Lab	EI	--	--	2	03	50	50	100	1
9	MP	18EIM68	Mini-project					03	50	50	100	2
10	INT	18 EII69	Industry Internship	(To be carried out during the intervening vacations of VI and VII semesters)				--	--	--	--	--
				TOTAL	**20**	**0**	**4**	**24**	**450**	**450**	**900**	**24**

Note: PC: Professional core, PE: Professional Elective, OE: Open Elective, MP: Mini-Project, INT: Internship.

Internship: All the students admitted to III year of BE have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. A University examination will be conducted during VIII semester and prescribed credit are added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent University examination after satisfy the internship requirements.

Electives

Course code	Professional Electives -2
18 EI 641	Aircraft Instrumentation
18 EI 642	Robotics and Automation
18 EI 643	Machine Learning using Python Programming
18 EI 644	VLSI Design
Open Elective –B	
18EI651	Air Craft Instrumentation
18EI652	Robotics and Applications

Open Elective –B

Students can select any one of the open electives (Please refer to consolidated list of Dr AIT for open electives) offered by any Department.

Selection of an open elective is not allowed provided,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Mentor.

Subject Title :Digital Signal Processing		
Sub Code :18EI51	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:

The objective of this course is to make the students to

1. Understand the concepts and advantages of digital signal processing techniques
2. To understand the frequency domain analysis techniques of discrete time signals using DFT
3. To determine DFT using FFT
4. To learn the design of Digital IIR and FIR filters using different techniques
5. Apply digital signal processing techniques for various applications

Unit No	Syllabus	No of Teaching hours	
		Theory	Tutorial
1	Introduction to DSP, IDFT, Properties of DFT	08Hours	04 Hours
2	**Computation of FFT:** Decimation in Time FFT, Decimation in Frequency FFT,IFFT	07Hours	06 Hours
3	**FIR Filters**: Properties, Filter Design using Windows (Rectangular, Hamming, Hanning and Kaiser Window), FIR Filter design using Frequency sampling technique.	08 Hours	06 Hours
4	**IIR Filters:** Specification and design techniques, Impulse Invariant and Bilinear Transformation techniques. Design of digital Butterworth and Chebyshev low pass filters using Analog filter design techniques, Transform of Low pass to High pass, Band pass and Band rejection filters, Comparison of IIR and FIR filters	09 Hours	06 Hours
5	**Applications:** Dual tone Multi frequency signal detection, Spectral analysis using DFT, Musical Sound Processing, and Digital FM Stereo generation, sampling rate conversion.	07Hours	04Hours

Text Books:

1. **Digital Signal Processing Principles, Algorithms and Applications**, John G Proakis and Manolakis, Pearson, Fourth Edition, 2014
2. **Digital Signal Processing**- S K MITRA, Mc Graw-Hill. Publication 4th Edition, 2010

Reference Books:

1. **Digital Signal Processing with Matlab Examples volume1**, Jose Maria Giron-Sierra, © Springer Science+Business Media Singapore 2017
2. **Digital Signal Processing Fundamentals and Applications,** Li Tan Purdue, Jean Jiang Second edition, Elsevier publication,2013.

3. **Theory and Application of DSP**- RABINAR L R and GOLD B, Prentice Hall of India, 1999.
4. **Digital Signal Processing**-ALAN V OPPENHEIM, Prentice Hall of India Publication. 2000.

Course Outcomes:

At the end of the course the student is able to

1. Understand the basics digital signal processing and properties of DFT implementation.
2. Implementation of FFT algorithms for efficient computation of the DFT.
3. Design and implement FIR filters using windows and frequency sampling techniques for the given specifications.
4. Design and implement digital IIR filters for the given specifications.
5. Apply the "MATLAB" functions for designing of FIR & IIR filters
6. Apply the digital signal processing concepts in different applications.

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

Low-1 Medium-2 High-3

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 :**Biomedical Instrumentation**		
Sub Code :18EI551	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 design and analyze a data acquisition system for bio-electrical signals.
2. To design methods for noise and interference cancellation in electro-physiological signals acquisition systems.
3. To design biomedical instrumentation amplifier suitable for ECG, EEG, EMG, EOG.
4. To study the instrumentation concerned with measuring the blood flow, blood pressure, heart rate, oxygen saturation etc.

1	**FUNDAMENTALS:** Sources of biomedical signals, Basic instrumentation system, General constraints in design of biomedical instrumentation systems **BIOELECTRIC SIGNALS AND ELECTRODES:** Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-Tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.	**08 Hours**
2	**ELECTROCARDIOGRAPH:** Electrical activity of the heart, Genesis & characteristics of Electrocardiogram (ECG), Block diagram description of an Electrocardiograph, ECG lead system, Multi-channel ECG machine. **ELECTROENCEPHALOGRAPH:** Block diagram description of an Electroencephalograph, 10-20 electrode systems, the behavior of the EEG signal ,the basic principles of EEG diagnosis.	**07Hours**
3	**BLOOD PRESSURE MEASUREMENT :** Direct & Indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method, Rheographic method, Oscillometric method, Ultrasonic Doppler shift method, Measurement of Respiration rate – Thermistor method, Impedance pneumography, CO2 method, Apnea detectors.	**08 Hours**
4	**Blood Flow Meters**: Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, and Laser Doppler blood flow meters. **Cardiac Pacemakers and Defibrillators**: Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator. Defibrillator electrodes, DC defibrillator with synchronizer.	**08 Hours**
5	**Pulmonary Function Analyzer**: Pulmonary function measurement, Spirometry, Pneumotachometer, Measurement of volume by Nitrogen washout technique. **Hemodialysis machines:** Function of kidneys, Artificial kidney, Dialyzers, Hemodialysis machine, Portable kidney machines.	**08 Hours**

TEXT BOOK:

1. **Handbook of Biomedical Instrumentation**-R. S. Khandpur, , Tata McGraw-Hill. 2nd Edition, 2003

REFERENCE BOOKS:

1. **Principles of applied biomedical instrumentation-** Lesely Cromwell & others., John Wiley and sons. 2nd Edition, 1989

2. **Encyclopedia of medical devices and instrumentation**-J. G. Webster, John Wiley, 1999

Course Outcome:

1. Remember and understand the basic concepts of a Biomedical instrumentation system
2. Explain the basic need of biomedical instrumentation, Purpose of biomedical instrumentation and working of different Biomedical Instruments
3. Explain the physiology of biomedical system and different methods and principles in the design of biomedical instruments

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

Low-1 Medium-2 High-3

Subject Title :**Power Electronics and Drives**		
Sub Code :18EI552	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 objective of this subject is to:

1. Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
2. Introduction to different types of Inverters, their principle of operation and waveform control
3. Detailed knowledge on Classifications, structure, operating principle of dc converters
4. Learn the basic concepts and operation of AC Motor Drives and DC Motor drives Overview on dc and ac drives and their control using power electronic circuits.
5. Give exposure to various topologies, working principle and analysis of controlled rectifiers and design of driver circuits.

Unit No	Syllabus	No of Teaching hours
1	**Introduction**: Power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects. **Power Semiconductor Diodes and circuits**: Semiconductor basics, Diode characteristics, Reverse recovery characteristics, Power diode types, Series and parallel connected diodes, Diodes with RC and RL loads, Diodes with LC and RLC	**08 Hours**
2	**Thyristors**: Introduction, characteristics, two transistor model, turn-on and turn off, di/dt and dv/dt protection, thyristor types, series and parallel operation of thyristors, thyristor firing circuits. **DC-DC converters:**Introduction, principle of step-down and step-up choppers, step-down chopper with RL loads, performance parameters, Switching mode regulators	**08 Hours**
3	**Inverter**: Introduction, principle of operation, performance parameters, single phase bridge inverters, Three phase inverters, voltage control of single phase inverters, current source inverter, variable DC link inverter.	**07 Hours**
4	**Drives: a) Fundamentals of Drives**: Introduction, Basic characteristics of DC motors, operating modes, Concept and requirement of drives, PWM technique (using IGBT/MOSFET) for control. **b) AC and DC Motor Drives:**Single phase drivers, Three phase drivers, Induction motor drivers, Synchronous motor drivers, Stepper motor drivers.	**08 Hours**
5	**Controlled Rectifiers:** Introduction, principle of phase controlled converter operation, single-phase semi converters, full converters and dual converters. **Gate and Base drive circuits:** DC-coupled drive circuits, electrically isolated drive circuits, Cascade connected drive circuits, thyristor drive circuits.	**08 Hours**

Text Books:

1. **Power Electronics** - M. H. Rashid, 2nd Edition, Prentice Hall of India Pvt. Ltd., (Pearson (Singapore -Asia)) New Delhi, 2010.
2. Power Electronics: Converters, Application and Design- Ned Mohan, tore M.undeland, William P.Robbins, 3rd -edition, Wiley-India

Reference Books:

1. P.S.Bimbhra, Power Electronics, Khanna Publishers, 2004.
2. **Thyristorized Power Controllers**- G. K. Dubey, S. R. Doradla, A. Joshi & R.M.K. Sinha, New Age International (P) Ltd. Publishers, 9th Reprint, 2009.
3. **Power Electronics**- M. D. Sing and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited, Reprint 2010.
4. **Power Electronics** - Cyril W.Lander, McGraw Hill 3rd Edition, 1993

Course Outcome:

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

1. Analyse the Power semiconductor diodes and circuits.
2. Solving numerical problems by using converter and DC choppers specifications.
3. Apply and analyse the concept of single and three phase inverter.
4. Designing the driver circuit for AC and DC motor.
5. Design the driver using converters and gate and base drive circuit and identify suitable switch choices for a given application.

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

Low-1 Medium-2 High-3

Subject Title :**Digital Image Processing**		
Sub Code :18EI553	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 objectives of the course are to equip the students with the knowledge on:

1. The basic concepts of digital image processing
2. The concepts of different image filtering and restoration techniques
3. The different color models and compression methods

Unit No	Syllabus	No of hours
1	**Fundamentals of Image processing:** Introduction, Fundamental steps in digital image processing, components of Digital Image Processing, Elements of Visual Perception, Structure of the Human Eye, Image Formation in the Eye, A simple image formation model, Image sampling and quantization,Linear vs. Coordinate Indexing, Spatial and Intensity Resolution, Image Interpolation, Basic relationship between pixels.	**06 Hours**
2	**Intensity transformation and spatial filtering:** Basics of Intensity Transformations and Spatial Filtering, Some Basic Intensity Transformation Functions, Histogram Processing, Histogram Equalization, Histogram Matching (Specification), Local Histogram Processing, Using Histogram Statistics for Image Enhancement, Fundamentals of Spatial Filtering, The Mechanics of Spatial Filtering, Smoothing Spatial Filters, Smoothing Linear and non-linear filters, Sharpening Spatial Filters, Using the Second Derivative for Image Sharpening-The Laplacian, Using First-Order Derivatives for (Nonlinear) Image Sharpening.	**09 Hours**
3	**Image Enhancement In Frequency Domain:** Background of 1D and 2D DFT, The Basics of Filtering in the Frequency Domain, Additional Characteristics of the Frequency Domain, Frequency Domain Filtering Fundamentals, Correspondence Between Filtering in the Spatial and Frequency Domains, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, The Laplacian in the Frequency Domain, Unsharp Masking, Highboost Filtering, High-Frequency Emphasis Filtering-Homomorphic Filtering.	**08 Hours**
4	**Image Restoration and Reconstruction:**A Model of the Image Degradation/Restoration Process, Noise Models, Spatial and Frequency Properties of Noise, Some Important Noise Probability Density Functions, Restoration in the Presence of Noise Only-Spatial Filtering, Mean Filters, Order-Statistic Filters, Adaptive Filters, Periodic Noise Reduction by Frequency Domain Filtering, Band-reject Filters, Bandpass Filters, Notch Filters, Optimum Notch Filtering, inverse filtering, minimum mean square error (Wiener) filtering.	**08 Hours**
5	**Color Image Processing:** Color Fundamentals, Color Models, The RGB Color Model, The CMY and CMYK Color Models, The HSI Color Model, Pseudo-color Image Processing, Intensity Slicing, Intensity to Color Transformations, Basics of Full-Color Image Processing, Color Transformations, Formulation, Color Complements, Color Slicing. **Image Compression:**Fundamentals, Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information, Measuring Image Information, Fidelity Criteria, Image Compression Models,	**08 Hours**

	Image Formats, Containers, and Compression Standards, Some Basic Compression Methods-Huffman Coding, Arithmetic Coding, LZW Coding, Run-Length coding, Wavelet Coding.	

Text Books:

1. **Digital Image Processing** - Rafael C. Gonzalez & Richard E. Woods, Fourth Edition **2018,** Pearson International Edition.
2. **Fundamentals of Digital Image Processing –** Anil K.Jain, Pearson Education (Asia) Ltd./Prentice Hall of India 2004.

Reference Books:

1. **Digital Image Processing, analysis and computer Vision**- First edition, Milan Sonka, Cenage Learning, 2008.
2. **Digital image processing, First edition, S**.Jayaraman, S.Esakkirajan, J.Veerakumar, TMH-2008.
3. **Digital Image Processing using MATLAB** - Rafael C. Gonzalez & Richard E. Woods, Fourth Edition 2018, Pearson International Edition.

Course Outcome:

Students who complete this course will be able to:

1. Understand the concepts of digital image processing
2. Identify and apply different filtering techniques in both the spatial and frequency domains and restoration techniques.
3. Understand and explain the different color image processing models and compression techniques.

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

Low-1 Medium-2 High-3

Subject Title :**Automotive Electronics**		
Sub Code :18EI554	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 understand, design and model various **automotive** control systems using Model based development technique. ..
2. To describe various communication systems, wired and wireless protocols used in vehicle networking.
3. To understand Safety standards, advances in towards autonomous vehicles.

Unit No	Syllabus	No of Teaching hours
1	**Automotive Fundamentals Overview –** Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System, Starter Battery –Operating principle	**07 Hours**
2	**The Basics of Electronic Engine Control –** Motivation for Electronic EngineControl – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition. **Control Systems -** Automotive Control System applications of Sensors and Actuators – Typical Electronic Engine Control System, Variables to be measured	**06 Hours**
3	**Automotive Sensors –** Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor. **Automotive Actuators –** Solenoid, Fuel Injector, EGR Actuator, Ignition System	**08 Hours**
4	**Digital Engine Control Systems –** Digital Engine control features, Controlmodes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics. **Control Units –** Operating conditions, Design, Data processing, Programming, Digital modules in the Control unit, Control unit software.	**08 Hours**
5	**Automotive Networking –**	**08 Hours**

	Bus Systems–Classification, Applications in thevehicle, Coupling of networks, Examples of networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, FlexRay, Diagnostic Interfaces. 6 hours **Vehicle Motion Control –** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)	

Text Books:

1. William B.Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and AutomotiveElectronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.

Course Outcomes

Students who complete this course will be able to:

1. Explain the electronics systems used for control of automobiles
2. Select a suitable sensors, actuators and control systems for automobiles
3. Identify the faults in the systems and sub systems of the automobile

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

Low-1 Medium-2 High-3

Subject Title :**Digital Signal Processing Lab**		
Sub Code : **EIL56**	No of credits : 1.0=0:0:1.0	No of hrs/week : 02
Exam duration : 3hrs	Exam Marks : 100	

Course objectives:
The objective of this course is to make the students to

To study andimplement digital signal processing algorithms using TMS320C6713 processor and MATLAB software.

Expt No	**Syllabus**
1	Write a program to verify the sampling theorem and aliasing effects with various sampling frequencies
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Determine the linear convolution of two given point sequences using FFT algorithm.
4	Determine the correlation using FFT algorithm.
5	Determine the spectrum of the given sequence using FFT
6	Design and test FIR filter using Windowing method (Hamming window and Kaiser window) for the given order and cut-off frequency.
7	Design and test FIR filter using frequency sampling method.
8	Design and test Butterworth 2nd order low pass & high pass filter.
9	Design and test Chebyshev 2nd order low pass& high pass filter.
10	Generation and detection of DTMF signal using MATLAB
11	Implementation of Real-time echo generation.
12	Realization of real time data acquisition system for audio signal.
13	Demonstration of open ended project using the concept of above mentioned Experiments.

Course Outcomes:

At the end of the course the student is able to

1. Learn to represent analog signals in digital format and understand frequency-domain representation of the signals.
2. Apply their knowledge of signal processing to solve the real time problems associated with convolution theorems, filter designs
3. Realize and Design FIR and IIR filters,DFT,IDFT.
4. Analyze and Implement program for generation and detection of DTMF signals

Reference Books

1. Proakis &Monalakis, "Digital signal processing, Principles Algorithms & Applications", Pearson education, 4th Edition, New Delhi, 2007, ISBN: 9780131873742.
2. Modern Signal Processing, V Udhayashankara, First Edition PHI publication 2012.

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

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 :**PLC and SCADA**		
Sub Code :18EI61	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:

The objective of this course is to make the graduates to

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

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 **PLC Programming Languages:** Standards of PLC programming IEC 61131-3 Ladder and functional block programming: Ladder diagrams, Logic functions, Latching, Multiple outputs, Function blocks, Program examples	10 Hours
2	**PLC Programming:** Sequential function charts, Structured text, Internal relays, Ladder programs, One-shot operation, Set and reset. **Jump and call:** Jump, Subroutines, Shift Register, Data handling.	12 Hours
3	**Advanced Programming Techniques:** Introduction, Ladder Program Execution Sequence, Flip Flops, Counters, Sequencers, Timers.	10 Hours
4	**Applications:** Temperature Control, Valve Sequencing, Conveyor Belt Control, Control of a Process. **Wiring Techniques:** Introduction, PLC Power Connection, Input Wiring, Inputs Having a Single Common, Output Wiring, Relay Outputs, Solid State Outputs.	10 Hours
5	**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

Text Books:

1. Programmable Logic Controller W Bolton 5th Edition ISBN: 978-1-85617-751-1, Elsevier Publication 2009
2. Programmable Logic Controllers: Programming Methods and Applications, John R. Hackworth and Frederick D. Hackworth, Jr.
3. Practical SCADA for industry David Bailey Edwin Wright ISBN:0750658053, Elsevier Publication 2003

Reference Books:

1. Programmable Logic Controllers, Garry Dunning, Third Edition, Delmer Learning, 2011
2. Programmable Logic Controller Frank D. Petruzella Third Edition TaTa McGraw-Hill Edition, 2010
3. Programmable Logic Controllers: Principles and Applications, John W Wbb, Ronald A Reis, Printice Hall, 2003
4. Programmable Controllers, George Batten, George L Batten, McGraw-Hill

Course outcomes:

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

1. Identify different components of industrial Automation, PLC, SCADA, RTU
2. Construct ladder diagram, instruction list, Structured text, sequential function chart for digital circuits
3. Develop the PLC program for an automatic control system using Ladder diagram
4. Design a ladder diagram and Instruction list for simple control application
5. Apply the knowledge of Timer, counter, shift register data handling to implement digital circuits.

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

Low-1 Medium-2 High-3

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 :**Advanced Control System**		
Sub Code :18EI63	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:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

Unit No	Syllabus	No of Teaching hours
1	**State Variable Analysis and Design:** State Variable Analysis: concept of State Variables & State Models, State model for Linear Continuous Time Systems, State-Space Representation Using Physical Variables, State-Space Representation Using Phase Variables	**08Hours**
2	**State Variable Analysis and Design(Cont):** Diagonalization, Jordan Canonical Form, Solution of State Equations, Properties of State Transition Matrix, Computation of State-Transition Matrix (Using Laplace Transformation, Cayley-Hamilton Theorem).	**07 Hours**
3	**State feedback controller design:** Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.	**08Hours**
4	**State observer**: Introduction to state observer, Full order to state observer, Dual problem, Necessary & sufficient condition for state observation ,Effects of the addition of the observer on a closed loop system, Minimum order observer, Design of regulator system with observer, Design of control system with observer, Quadratic optimal regulator systems.	**08 Hours**
5	**Compensator design**: Realization of compensators – lag, lead and lag-lead. Design of compensator using root locus. Design of P, PI and PID controller using Ziegler-Nichols tuning method	**08 Hours**

Text Books:

1. **Modern Control Engineering**-K. Ogata, Prentice, Hall of India publication 5th Edition, 2010
2. **Control system engineering**- I.J. Nagarath and M. Gopal, New age international publishers, 5th edition, 2007

Reference Books:

1. **Advanced control theory**- A. Nagoorkani. RBA Publication. 2 nd edition, 1999
2. **Digital control and state variable methods**-Madan Gopal, Prentice Hall of India. 2nd Edition, 2003
3. **Modern Control Engineering-**Roy Choudhury, Prentice Hall of India.2005

.**Course outcomes:**

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

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

1. Discuss state variable approach for linear time invariant systems in both the continuous and discrete time systems.
2. Apply vector and matrix algebra to find the solution of state equations for linear continuous – time and discrete – time systems.
3. Define controllability and observability of a system and test for controllability and observability of a given system.
4. Design pole assignment and state observer using state feedback.

Subject Title :**Aircraft Instrumentation**		
Sub Code :18EI641	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:

This course is designed

1. To understand qualitative and quantitative displays of an aircraft.
2. Gain knowledge on air data instruments and how they are incorporated in an aircraft.
3. To develop the knowledge of safety aspects of an aircraft such as warning systems.
4. To learn more about gyroscope and its related flight instruments. Give better view of engine instruments and ways to improve its efficiency.

Unit No	Syllabus	No of Teaching hours
1	**AIRCRAFT INSTRUMENTS:** Introduction-Qualitative and quantitative displays, basic T grouping of instruments, basics of Attitude Director Indicator (ADI) & Horizontal Situation Indicator, flight deck of modern aircraft, glass cockpit. **AIR DATA INSTRUMENTS:** pneumatic type and air data computers, International Standard Atmosphere (ISA), basic pneumatic air data system, combined pitot-static probe, separate static probe, air speed indicator, altimeters and instantaneous vertical speed indicator	**08 Hours**
2	**AIR DATA WARNING SYSTEM:** Mach warning system, altitude alerts system, airspeed warning system. Directional Systems: Earth's total magnetic field, horizontal and vertical components of total field direct reading compass and its limitations, fluxgate detector units.	**07 Hours**
3	**GYROSCOPIC FLIGHT INSTRUMENTS:** Types of gyros-Conventional Mechanical spinning wheel , Vibrating gyro, Ring laser gyros, Fiber optic gyros, basic mechanical gyro and its properties, Gyro horizon, Turn and bank indicator, Gyro stabilized direction indicating systems.	**08 Hours**
4	**ENGINE INSTRUMENTS:** Introduction, Engine Speed measurement- Electrical Tacho Generator, Optical Tachometer, Hall Effect sensor, torque measurement- Hydro mechanical Transducer, Electronic Torque Meter, Pressure measurement (EPRI), Temperature measurement (EGT), Vibration measurement.	**08 Hours**
5	**ENGINE FUEL INDICATORS:** Fuel quantity indicator(FQI)- volumetric FQI, Densitometer, Fuel flow rate Indicator- Rotating vane flow meter, Integrated flow meter **AIRCRAFT SAFETY:** Introduction, Stall Warning System, Ground Proximity Warning System, Traffic collision avoidance system	**08 Hours**

TEXT BOOK:

1. **Aircraft Instruments and Integrated Systems**- EHJ Pallet, Longman Scientific & Technical, McGraw-Hill, 1992.
2. **Aircraft Instrumentation and Systems**- S.Nagabhushana , L.K Sudha, I.K.International Publishing House Pvt.Ltd. 2010.

REFERENCE BOOKS:

1. **Aircraft Instruments**- C A WilliamsGalgotia Publications, New Delhi, 1973

2. **Aircraft Propulsion-** Bhaskar Roy, Elsevier publications, New Delhi., 2011

Course Outcome:

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

1. Understand the concept of different types of instrument, displays and indicators.
2. Appraise the elements of Aircraft Instrumentation and Integration of the system to meet the control Navigation and operational requirements of the Aircrafts
3. Analyse and evaluate the performance of Aircraft control system and interpret the results.
4. Interpreted Case Studies with the theory learnt and hence develop a system concept operational in latest aircraft instrumentation.

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

Subject Title : **Robotics and Automation**		
Sub Code :18EI642	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	**07 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.	**08 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	**08 Hours**
4	**Robot dynamics:** Langrangian formulation and newton Euler formulation	**08 Hours**
5	**Robot Path Planning:** Introduction, General considerations on Trajectory planning, joint-interpolated Trajectories, calculation of a 4-3-4 Joint trajectory, Cubic Spline Trajectory.	**08 Hours**

Text Books:

1. **Robotics control sensing Vision 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 Craig third Edition pearson Education Inc., 2005
3. **Introduction to robotics** SK Saha Tata Mc Graw Hill **,** 2008

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.

CO-PO MAPPING												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	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
CO5	2	2	2	2	2	-	-	-	1	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 :**VLSI Design**		
Sub Code :18EI644	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 objectives of the course is to-

1. Explain VLSI design and Need, Advantages & Applications of VLSI technology.
2. Analyze the performance of MOS/CMOS transistors ,using mathematical methods and circuit analysis models, including logic components and their interconnect
3. To implement the schematic of CMOS logic, specific layout rules in the placement and Routing of transistors and interconnect, and to verify the functionality, power, and parasitic effects.
4. Design combinational, sequential logic at the transistor level, functional units.
5. Analyze and evaluate memory cells including stick diagram

Unit No	Syllabus	No of Teaching hours
1	**Introduction**: overview of VLSI design methodologies-VLSI design flow-Design Hierarchy- concepts of regularity, modularity, and locality-VLSI Design styles- Design quality-computer aided design technology.**Fabrication of MOSFETS**- fabrication process flow-Basic steps-layout design rules-CMOS n well process-full-custom mask layout design.	**07**
2	**MOS Transistor Theory**:n MOS / p MOS transistor, threshold voltage equation, body effect, latch up ,MOS device design equation, sub threshold region ,Channel length modulation. mobility variation, Tunneling, punch through, hot electron effect MOS models, small signal AC Characteristics, CMOS inverter, ßn / ßp ratio, noise margin, static load MOS inverters, differential inverter, transmission gate, tristate inverter, BiCMOS inverter**.**	**08**
3	**CMOS Process Technology**:Lambda Based Design rules, scaling factor, semiconductor Technology overview, basic CMOS technology, p well / n well / twin well process. Current CMOS enhancement (oxide isolation, LDD.refractory gate, multilayer inter connect), Circuit elements, resistor, capacitor,interconnects, sheet resistance & standard unit capacitance concepts delayunit time, inverter delays, driving capacitive loads, propagate delays, MOSmask layer, stick diagram, design rules and layout, symbolic diagram, mask feints, scaling of MOS circuits**.**	**09**
4	**Combinational and sequential MOS logic circuits:** MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, CMOS transmission Gate, Behavior of Bistable Elements , SR Latch Circuit, Clocked Latch and Flipflop Circuits, CMOS D latch and Edge Triggered FlipFlop**.**	**08**
5	**Dynamic CMOS circuit Techniques**: CMOS transmission gate logic-dynamic CMOS(precharge evaluate logic, Domino CMOS logic **Semiconductor memories:** equivalent circuits of memory cells, DRAM cells – configurations, three-transistor and one-transistor, flash memory, ferroelectric Random access memory.	**07**

TEXT BOOK

1. Sung Mo Kang &YosufLederabic Law, "CMOS Digital Integrated Circuits: Analysis and Design", McGraw-Hill (ThirdEdition)

2. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective," 2ndedition, Pearson Education (Asia) Pvt.. Ltd., 2000.

REFERENCE BOOKS:

1. Douglas A Pucknell& Kamran Eshragian ,"Basic VLSI Design" PHI 3rdEdition (original Edition – 1994)

2. VLSI Technology- 2nd Edition, S.M .Size, Tata Mcgraw Hill.

Course Outcome:

Students completing this course successfully will be able to:

1. Explain the VLSI design flow, characteristics and fabrication process of MOS transistors.
2. Analyze the performance of MOS/CMOS transistors ,using mathematical methods and circuit analysis models, including logic components and their interconnect
3. Apply MOS technology specific layout rules in the placement and Routing of transistors and interconnect, and to verify the functionality, power, and parasitic effects.
4. Design,combinational, sequential logic, memory cells at the transistor level.
5. Analyse and evaluate memory cells including stick diagram.

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

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 :Virtual Instrumentation Lab		
Sub Code :18EIL67	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:

Gaining skills at using LabVIEW software for instrument control, measurement, data acquisition and data handling.

<table>
<tr><th>Expt No</th><th>Syllabus</th></tr>
<tr><td>1</td><td>Basic operations, simple programming structure using LabVIEW.
a. Basic arithmetic operations
b. Boolean operations
c. Sum of n numbers using for loop
d. Sorting even numbers using while loop in an array</td></tr>
<tr><td>2</td><td>To explore the following programming tools in LabVIEW;
a. Creating a Sub VI
b. Working with Formula Nodes & Expression Nodes
c. Working with Loops & CASE structures
d. Usage of Charts and Graphs</td></tr>
<tr><td>3</td><td>To explore the following programming tools in LabVIEW;
a. Shift Registers
b. Arrays
c. String handling
d. File I/O</td></tr>
<tr><td>4</td><td>Design a VI for programmable Function Generator for the following functionalities.
a. Waveform generating options for generating – Sine, Triangle, Saw tooth & Square Waveforms.
b. Digital Display for Magnitude & Frequency
c. Graphical chart for analog waveform.</td></tr>
<tr><td>5</td><td>Using VISA and serial communication, Design a VI for the following programmable Instrument with couple of LED indicators.
<table>
<tr><th>ASCII Command</th><th>Functionality</th></tr>
<tr><td>A</td><td>LED Indicator 1 - ON</td></tr>
<tr><td>B</td><td>LED Indicator 1 – OFF</td></tr>
<tr><td>C</td><td>LED Indicator 2 - ON</td></tr>
<tr><td>D</td><td>LED Indicator 2 - OFF</td></tr>
</table></td></tr>
<tr><td>6</td><td>To develop a VI to communicate with programmable Instruments using Ethernet.</td></tr>
<tr><td>7</td><td>To develop a VI to interface USB DAQ 6008 with LabVIEW and perform the following Operations:
a. Analog Read
b. Analog Write
c. Digital Read</td></tr>
</table>

	d. Digital Write
8	Time domain and frequency domain measurement of Real-world signal using LabVIEW
9	Real Time Temperature measurement and Control using Virtual Instrumentation
10	Real time sequential control of bottle filling system
11	Design a real time batch processing using LabVIEW.
12	Design a PID controller using LabVIEW.

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

CO1: Recognize the components of Virtual instrumentations and use them for PC Based Measurement.

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	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