JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY

Mysuru-570006.

Department of Instrumentation Technology

Bachelor of Engineering

In

Electronics & Instrumentation

SCHEME & SYLLABUS

III to VIII semesters

2017

JSS MAHAVIDYAPEETHA

JSS Science and Technology University

Sri Jayachamarajendra College of Engineering

DEPARTMENT OF INSTRUMENTATION TECHNOLOGY

Scheme of teaching and examination for B.E (E&I)

SEMESTER: III

Sl. No	Subject code	Course title	Teaching department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	TOTAL		CIE	SEE	Total	
1	MA310	Fourier Series, Integral Transforms & Applications	Maths	4	0	0	4	4	50	50	100	03
2	EI310	Transducers and Instrumentation I	IT	4	0	1	5	6	50	50	100	03
3	EI 320	Circuit Theory and Analysis	IT	3	1	0	4	5	50	50	100	03
4	EI 330	Analog Electronic Circuits	IT	4	0	1	5	6	50	50	100	03
5	EI 340	Logic Design	IT	3	1	1	5	7	50	50	100	03
6	EI 350	C++ and Data Structures	IT	4	0	1	5	6	50	50	100	03
7		Environmental studies	Envi. Engg.				---	2	50	-	50	
		Total		Total credits			28		Total marks		650	

SEMESTER: IV

Sl. No	Subject code	Course title	Teaching department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	TOTAL		CIE	SEE	Total	
1	MA410	Mathematics IV	Mathematics	4	0	0	4	4	50	50	100	03
2	EI 410	Transducers and Instrumentation II	IT	4	0	1	5	6	50	50	100	03
3	EI 420	Biomedical Instrumentation	IT	3	0	1	4	5	50	50	100	03
4	EI 430	Signal Conditioning Circuits	IT	4	0	1	5	6	50	50	100	03
5	EI 440	System Design Using HDL	IT	4	0	1	5	6	50	50	100	03
6	EI 450	Signals and Systems	IT	4	1	0	5	6	50	50	100	03
7		Constitution of India	Humanities				---	2	50	---	50	
		Total		Total credits			28		Total marks		650	

SEMESTER: V

Sl. No	Subject code	Course title	Teaching department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	TOTAL		CIE	SEE	Total	
1	EI 510	Linear Algebra	IT/Maths	3	0	0	3	3	50	50	100	03
2	EI 520	Control Systems	IT	4	1	0	5	6	50	50	100	03
3	EI 530	Industrial Communication	IT	4	0	0	4	4	50	50	100	03
4	EI 540	8051 & AVR Microcontroller	IT	4	0	1	5	6	50	50	100	03
5	EI 550	Digital Signal Processing	IT	4	0	1	5	6	50	50	100	03
6	EI 56X	Elective – I	IT	4/3	0	0/1	4	4/5	50	50	100	03
		Total		Total credits			26		Total marks		600	

	Elective-I
EI 561	Aircraft Instrumentation (4:0:0)
EI 562	Product Design Technology (3:0:1)
EI 563	Operating systems (4:0:0)
EI 564	Java programming (3:0:1)

SEMESTER: VI

Sl. No	Subject code	Course title	Teaching department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	TOTAL		CIE	SEE	Total	
1	EI 610	Process Control	IT	3	0	1	4	4	50	50	100	03
2	EI 620	Advanced Control Systems	IT	3	1	0	4	5	50	50	100	03
3	EI 630	Digital Image Processing	IT	3	0	1	4	5	50	50	100	03
4	EI 640	Python Programming and Raspberry Pi	IT	3	0	1	4	5	50	50	100	03
5	EI 650	DSP Architecture	IT	3	0	1	4	5	50	50	100	03
6	EI 66X	Elective – II	IT	4/3	0	0/1	4	4/5	50	50	100	03
7	EI 67P	Mini Project (self study)	IT	0	0	2	2	-	50	--	50	--
		Total		Total credits			26		Total marks		650	

	Elective-II
EI 661	Analytical Instrumentation (4:0:0)
EI 662	Automobile Instrumentation (4:0:0)
EI 663	Computer networks (3:1:0)
EI 664	Artificial Intelligence (4:0:0)

SEMESTER: VII

Sl. No	Subject code	Course title	Teaching department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	TOTAL		CIE	SEE	Total	
1	EI 710	Automation in Process Control	IT	3	0	1	4	5	50	50	100	03
2	EI 720	CMOS Integrated Circuit Design	IT	4	0	0	4	5	50	50	100	03
3	EI 73X	Elective - III	IT	4	0	1	5	6	50	50	100	03
4	EI 74X	Elective - IV	IT	4	0	0	4	4	50	50	100	03
5	EI 75L	Real time signal & image processing Lab	IT	0	0	1	1	2	50	-	50	
6	EI 76X	Foreign Language		2	0	0	2	2	50	50	100	03
				Total credits			20		Total marks		550	

	Elective-III
EI 731	Industrial Instrumentation (4:0:1)
EI 732	Machine Learning (4:0:1)
EI 733	Big Data Analytics (4:0:1)
EI 734	Pattern Recognition (4:0:1)

	Elective-IV
EI 741	Micro and Smart System Technology (4:0:0)
EI 742	Robotics (4:0:0)
EI 743	Fuzzy Logic and applications (4:0:0)
EI 744	Medical Imaging (4:0:0)

SEMESTER: VIII

Sl. No	Subject code	Course title	Teaching department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	TOTAL		CIE	SEE	Total	
1	EI 810	Entrepreneurship and Management	IT	4	0	0	4	4	50	50	100	03
2	EI 82X	Elective-V	IT	4/3	0	0/1	4	4/5	50	50	100	03
3	EI 83X	Elective-VI	IT	4/3	0	0/1	4	4/5	50	50	100	03
4	EI 84P	Project work	IT	0	0	10	10	-	100	100	200	03
		Total		Total credits			22		Total marks		500	

	Elective-V
EI 821	Photovoltaic Theory and Design (4:0:0)
EI 822	Laser and Optical Instrumentation (4:0:0)
EI 823	Cloud Computing (4:0:0)
EI 824	Speech Signal Processing (3:0:1)

	Elective-VI
EI 831	IoT and Smart Sensors (3:0:1)
EI 832	Low power VLSI (4:0:0)
EI 833	Cryptography and Network security (4:0:0)
EI 834	Bio Medical Signal processing (3:0:1)

TRANSDUCERS AND INSTRUMENTATION - I

Sub code: EI310 **Credit Pattern: 4:0:1**
Total Hours: 52 Hrs +2Hrs/Week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisite: Electronic Devices and Circuits.

Course Objective : To gain knowledge of measurement concepts and transducers that can be used for measurement of different physical and electrical parameters.

Course Outcomes:
Students will be able to,

1. Explain fundamentals of measurement, errors associated with measurement and methods of minimization of errors.
2. Discuss the working principle of various types of sensors.
3. Identify the appropriate sensor for the measurement of parameters.
4. Analyze the sensor output and do the appropriate/ necessary conversions.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to test transducers and instruments

Generalized configurations & functional descriptions of measuring instruments: Functional elements of an instrument, Measurement Errors**:** Gross errors and systematic errors, Absolute and relative errors, I/O configuration of measuring instruments & instrument system- methods of correction for interfering & modifying inputs. **08 Hrs**

Generalized performance characteristics of instruments: Static characteristics: Meaning of static calibration, accuracy, precision and bias, Static sensitivity, linearity, threshold, resolution, hysteresis and dead space. Scale readability, Span, generalized static stiffness & input impedance, Basics of Dynamic characteristics. **06 Hrs**

Measurement of Resistance, Inductance, Capacitance and Q factor: Wheatstone bridge, sensitivity analysis, limitations, Kelvin double bridge, Maxwell bridge, Schering bridge, sources and detectors, shielding of bridges, Q meters. **08 Hrs**

Measurement of displacement: Principle of measurement of displacement, resistive potentiometers, Resistance strain gage, variable inductance & variable reluctance pickups, LVDT, capacitance pickup, Laser displacement sensor. **06 Hrs**

Force, torque & shaft power Measurement: Principle of measurement of force, torque, Shaft power standards and calibration: basic methods of force measurement; characteristics of elastic force transducer- bonded strain gauge, differential transformer, piezo-electric transducer,

variable reluctance/ FM- Oscillator digital systems, loading effects; torque measurement on rotating shafts, shaft power measurement (dynamometers). **06 Hrs**

Contact type Temperature measurement: Standards & calibration; thermal expansion methods-bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers thermoelectric sensor (thermocouple)- common thermocouples, reference junction consideration, special materials, configuration & techniques; electrical resistance sensors- conductive sensor (resistance thermometers), bulk semiconductors sensors (thermistor), junction semiconductor sensors(AD590) and Digital thermometers. **10 Hrs**

Non- contact type Temperature measurement: Radiation methods- radiation fundamentals, radiation detectors, automatic null balance radiation thermometers, optical pyrometers. Two color radiation thermometers, black body-tipper fiber optic radiation thermometer, IR imaging systems, fluor-optic temperature measurement. **8 Hrs**

LIST OF EXPERIMENTS:

1. Measurement of sensitivity of Wheatstone bridge.
2. Measurement of Low resistance by Kelvin double Bridge
3. Measurement of Self- inductance by Maxwell Bridge.
4. Measurement of unknown capacitance by Schering's bridge
5. Characteristic of Displacement transducer using potentiometer and LVDT
6. Characteristics of Capacitive transducer.
7. Characteristics of thermistor & RTD
8. Characteristics of thermocouple & AD590.

MINI PROJECT: Propose, design a physical quantity sensing and indication circuit, and successfully work on the project in a team and give an oral and written report.

TEXT BOOKS:

1. **Measurement Systems,** Ernest O Doebelin, 6th Edition,TMH, 2007
2. **Electrical &Electronic Measurement and Instrumentation,** A.K.Sawhney, 10th Edition, DhanpatRai & sons, Delhi.

REFERENCE BOOKS:

1. **Instrument Engineers Hand book (Process Measurement.)**, B G Liptak, 3rd Edition, Chilton book, 1995.
2. **Instrumentation Devices and Systems, Rangan Sharma Mani**, 2nd Edition, TMH.
3. **Transducers and Instrumentation,** Murthy.D.V.S. 2nd Edition, PHI, 2008.

LEARNING MATERIAL:

http://nptel.ac.in/courses/112103174/3

CIRCUIT THEORY AND ANALYSIS

Sub code: EI320 **Credit Pattern: 3:1:0**
Total Hours: 39 Hrs + 2Hrs/Week Tutorials **Contact Hours: 05 Hrs/Week**

Pre-requisites: Basic Electronics, Elements of Electrical engineering.

Course Objective: To introduce various circuit analysis methods.

Course Outcomes:
Students will be able to,

1. Recall the fundamentals of electrical circuits and simplify the given circuits.
2. Solve for the circuit parameters by reducing the given circuit.
3. Illustrate the behavior of circuit elements and analyze the behavior of the given circuits.
4. Analyze the given circuits using different methods of analysis.
5. Determine the performance parameters of the given circuits.

Basic concepts: Introduction, Network terminologies, Review of KVL & KCL, Energy sources – ideal & practical, Source Transformations, Mesh Analysis of DC & AC circuits, Nodal analysis of DC & AC circuits, Star – Delta transformations. **10 Hrs**

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. **6 Hrs**

Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions using differential equations of circuits with AC and DC excitation. **8 Hrs**

Resonance: Series resonance, resonant frequency, reactance curves, voltage & current variable with frequency, Selectivity & bandwidth, Q – factor, circuit magnification factor Selectivity with variable C & variable L Parallel resonance, resonant frequency, impedance, selectivity, bandwidth Maximum impedance conditions with C, L, & f variable, current & Q – factor. **6 Hrs**

Circuit Analysis using Laplace Transforms: Step response of RL, RC & RLC circuits, Circuit analysis with LT using partial fraction expansion. **6 Hrs**

Two Port parameters: Short circuit admittance parameters, Open circuit impedance parameters, Transmission parameters, Hybrid parameters, relationships between parameters. **3 Hrs**

TEXT BOOK:

1. **Basic Engineering Circuit Analysis,** J. David Irwin, R. Mark Nelms, 8th edition, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1. **Engineering Circuit Analysis,** William H.Hayt, Jr, Jack E.Kimmerly, Steven M.Durbin**,** 6th edition, Tata McGraw-Hill, 2002.
2. **Networks and Systems,** D. Roy Choudhury**,** New Age International, Reprint 2005. .
3. **Network Analysis,**M.E.VanValkenburg, 3rd edition, Pearson/ PHI, Reprint 2006.

LEARNING MATERIAL:

http://nptel.ac.in/courses/108102042/.

ANALOG ELECTRONIC CIRCUITS

Sub code: EI330 **Credit Pattern: 4:0:1**
Total Hours: 52 Hrs +2Hrs/Week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisite: Electronic Devices and Circuits.

Course Objective: To introduce the basic concepts of electronic circuits and their analysis.

Course Outcomes:

Students will be able to,

1. Explain the working principles of various types of amplifiers and oscillators.
2. Design amplifier and oscillator circuits
3. Analyze the designed circuits.
4. Determine the performance parameters of the circuits.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to build and test analog circuits.

BJTs Small Signal Analysis : Collector current and transconductance, base current and input resistance at base, emitter current and input resistance at emitter, voltage gain, separating the signal and the DC quantities, the hybrid π model, the T-model, application of the small signal equivalent circuits. The basic structure of single stage BJT amplifier, characterization of BJT amplifiers, common emitter amplifier with and without emitter resistance, common base amplifier, common collector amplifier, comparisons. Junction capacitances, high-frequency hybrid π model. The three frequency bands of CE amplifier, high-frequency response, low-frequency response. **10 Hrs**

MOS Field-Effect Transistor (MOSFETs) : Device structure, operation, derivation of i_D -v_{DS} relationship, i_D –v_{DS} characteristics, output resistance in saturation, the body effect, temperature effect, breakdown & input protection, MOSFET circuit at DC. Large signal operation transfer characteristics, operation as a switch, operation as a linear amplifier. Biasing by fixing V_{GS}, biasing by fixing V_G and connecting a resistance in the source, biasing using a drain to gate feedback resistor, constant-current-source biasing (using current mirror). **08 Hrs**

MOSFETs Small Signal Analysis : DC bias point, signal current in the drain terminal, voltage gain, small-signal equivalent-circuit models, transconductance, T equivalent circuit model. The basic structure of single stage MOS amplifier, characterizing MOS amplifiers, common Source and common drain amplifier with and without source resistance, common gate amplifier, common drain amplifier. Gate capacitance effect, junction capacitances, high-frequency model,

unity gain frequency. The three frequency bands CS amplifier, high-frequency response, low-frequency response. **10 Hrs**

MOS Differential Pair: Operation with a common-mode input voltage and differential input voltage. Differential gain and common mode rejection ratio (CMRR). Input offset voltage of the differential pair, input common-mode range. Differential-to-single-ended conversion, active-loaded MOS differential pair, differential gain of the active loaded MOS pair, common mode gain and CMRR. Analysis of the resistive-loaded and active loaded MOS amplifier. **10 Hrs**

Feedback Amplifiers: General feedback structure, properties of negative feedback, four basic feedback topologies-Series-Shunt, Series-Series, Shunt-Shunt & Shunt-Series amplifier (Qualitative analysis). **05 Hrs**

Power Amplifiers: Introduction, classification, Class A operation, transfer characteristics, power dissipation, power conversion efficiency, transformer coupled power amplifiers, Class B operation, transfer characteristics, power dissipation, power conversion efficiency, reducing cross-over distortion, Class AB operation, output resistance, biasing using diodes and V_{BE} multiplier. **05 Hrs**

Oscillators: Oscillator operation, Phase shift, Wien Bridge, Tuned and Crystal oscillator. **04 Hrs**

LIST OF EXPERIMENTS:

1. Design and testing of single stage RC coupled amplifier-using BJT.
2. Design and testing of BJT Darlington emitter follower.
3. Design and testing of an amplifier using FET.
4. Design and testing of feedback amplifier.
5. Design and testing of power amplifier.
6. Design and testing of Colpitt's oscillator.
7. Design and testing of RC phase shift oscillator.
8. Design and testing of Crystal oscillator.

MINI PROJECT: Simulation of analog circuits using Tina TI / P-spice.

TEXT BOOK:

1. **Microelectronic Circuits, Theory and Applications**, Adel S. Sedra Kenneth C. Smith, 6th Edition, Oxford International student edition, 2009.

REFERENCE BOOKS:

1 **Fundamentals of Microelectronics**, Behzad Razavi, 2nd Edition, Wiley, 2006.

2. **Electronic Devices and Circuit Theory,** Robert L. Boylestad and Louis Nashelsky, 10th Edition, PHI, 2007

LEARNING MATERIAL:

http://nptel.ac.in/courses/117101106/

LOGIC DESIGN

Sub code: EI340 **Credit Pattern: 3:1:1**

Total Hours: 39 Hrs+2Hrs/week Tutorials+2Hrs/Week lab session

Contact Hours: 07 Hrs /Week

Pre-requisite: Electronic Devices and Circuits.

Course Objective: To introduce the basic concepts of digital circuits and design of digital systems, sequential circuits.

Course Outcomes:
Students will be able to,

1. Recall the fundamentals of Boolean algebra to simplify and realize digital circuits using universal gates.
2. Apply different simplification techniques for solving the Boolean expression.
3. Build truth table and Boolean expression for an application, and propose a cost effective circuit.
4. Design simple combinational and sequential circuits.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to build and test digital circuits.

Boolean Algebra and Combinational Networks: Principle of Duality, Min/Max terms, Canonical formulas, Complements of equations, Universal Gates, Combinational network. **3 Hrs**

Simplification of Boolean Expressions: Prime implicants, Prime Implicates, Two, Three, four variables Karnaugh Maps, Sum of Products, Product of Sums, The Quine –McCluskey method, the binary method, the decimal method of obtaining prime implicants, The Variable Entered Maps. **6 Hrs**

Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Carry Lookahead adder, Decimal adders comparators Decoders, Logic design using decoders, Encoders, Multiplixers, logic design using Multiplixers, Programmable Logic Devices: PROMs, PLAs, PALs, Study of ICs 7483,7485,74153,74139. **10 Hrs**

Flip Flops and Applications: SR Flip Flop, RS Flip Flop, Switch debouncer, Gated SR, Gated D Flip Flops, JK Flip Flops, Master Slave Flip Flops, Race around condition, Shift Registers, Unidirection/Bidirection Shift registers, Universal shift register, Counters, Binary ripple counters

Mod N counters, ring counter, Johnson counter, Synchronous Binary counters using T, SR, JK, D Flip Flops,Study of ICs 7495, 74190, 74193. **12 Hrs**

Synchronous Sequential Networks: The Mealy model, the Moore model, The excitation and Transition equations, the excitation and transition tables, state tables, state diagrams. **8 Hrs**

LIST OF EXPERIMENTS:

1. Simplification and realization of Boolean expressions using universal gate. Realization of half/full adder and subtractor using logic gates .
2. Realization of parallel adder/ subtractor using 7483 IC.
3. Arithmetic circuits and code converters using Multiplexer and Decoder IC's
4. Realization of one/two bit comparators and study of 4 bit magnitude comparator (7485).
5. Use of decoder chip to drive LED display and Priority encoder.
6. Demonstrate SR, T, D, JK, JK master slaveFlip Flops using logic gates.
7. Realization of 3 bit counters as sequential circuit and Mod N counter design-using 7476,7490,74192,74193.
8. Study of Shift Register 7495 and Johnson and ring counter using 7495 IC.

MINI PROJECT: Propose, design the digital circuit for an application and successfully work on the project in a team and give an oral and written report.

TEXT BOOKS:

1. **Digital Principles and Design,** Donald D.Givone, TMH, 2002.
2. **Digital Logic Applications & Design,** John M Yarborgh, Thomson learning, 2001.

REFERENCE BOOKS:

1. **Fundamental of Logic design,** Charles H Roth Jr, Thomson learning, 2004
2. **Digital Systems Principles and Applications,** Ronald J Tocci, PHI, 2001.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/117106086/1
2. https://swayam.gov.in/course/1392-digital-circuits-and-systems

C++ AND DATA STRUCTURES

Sub code: EI350 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs +2Hrs/Week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisite: Programming in C.

Course Objective: To gain the knowledge of developing and analyzing C++ programs to handle structured data and perform more complex tasks.

Course Outcomes:
Students will be able to,

1. Recall procedural systems and compare OOPs (Object oriented programming) terminology with procedure oriented programming.
2. Demonstrate the use of various OOPs concepts with the help of programs.
3. Develop programs based on the concepts of operator overloading, polymorphism, inheritance and pointers.
4. Explain different types of data structures, operations, algorithms and implement them using C++ language.
5. Select and apply appropriate concepts for solving computing problems and demonstrate it in the laboratory.

C++ programming Basics: Need of object oriented programming, procedural languages, characteristics of OOPs, preprocessor directives, data types, manipulators, Type Conversion. Structures: Structures, enumerated data types, Boolean type, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions, Default Arguments variable and storage classes. **09 Hrs**

Objects and classes: objects as data types, constructors, destructors, Objects as Function Arguments, Returning Objects from Function. Arrays: Arrays as class member data types, passing arrays, arrays as objects, strings, arrays of strings. **05 Hrs**

Operator overloading: overloading of unary operators, binary operators, Data conversion. **05 Hrs**

Inheritance: Inheritance, derived class and base class, derived class constructors, overriding member functions, scope resolution, inheritance in the English distance class, class hierarchies, public and private inheritance, levels of inheritance, multiple inheritance, ambiguity in multiple inheritance. **06 Hrs**

Pointers: pointers to objects, virtual functions, static functions, files and streams, Linked List, input/output operations. **09 Hrs**

Data structures: Linear List - Array representation, Linear List – Linked representation, Arrays and matrices and their applications. **08 Hrs**

Stacks: Array representation, linked representation, queues array representation, linked representation, skip lists and hashing, binary trees and their applications. **10 Hrs**

LIST OF EXPERIMENTS:

Write C++ programs,

1. On Basics of OOPs and functions
   a) Count the number of words in a phrase typed in by the user.
   b) Implement Different Function Call Mechanisms,
      i) Call by reference. ii) Call by value
   c) Implement
      i) Function overloading ii) Default arguments
   d) Show the effect of declaring a variable as automatic external and static.
2. On Classes and Objects
   a) Constructor and destructor.
   b) Pass and Return an object from function.
   c) Software stack.
3. On Operator overloading and data conversion.
   a) Overload Unary operators.
   b) Overload Binary Operators.
   c) Conversion between basic type and user defined type.
   d) Conversion between objects of two different classes.
4. On Inheritance
   a) Inheritance and Function Overriding.
   b) Multiple inheritances.
   c) Multilevel inheritance.
   d) Access Specifiers.
5. On Pointers
   a) **S**ort an array of integer using pointers
   b) Implement pointer to an object using ‘New’ and ‘delete’ operator.
   c) Show the effect of declaring a function as static.
   d) Show the effect of declaring a function as Virtual.
   e) Read/Write data from/to a file.
   f) Implement Linked List.

6. To implement
    a) Linear List
    b) Stack
7. To implement
    a) Queue
    b) Skip list
8. To implement
    a) Hash Table
    b) Binary tree

MINI PROJECT: By applying OOPs concepts develop programs for solving real world problems.

TEXT BOOKS:

1. **Object oriented programming in TURBO C++,** RobertLafore, 4th edition, Galgotia Publications, 2014.
2. **Data Structures, Algorithms and Applications in C++,** SartajSahni, 2nd edition, TataMcGrawHill Publications, 2009.

REFERENCE BOOKS:

1. **Object Oriented Programming with C++,** E Balaguruswamy, 3rd edition, TMH, 2006.
2. **C++ the complete reference,** Herbert Schildt, 4thedition, TMH, 2003.
3. **Data Structures using C++,**D.S.Malik, 2nd editionThomson learning, 2003.
4. **Data Structures Using C and C++,**Tanenbaum A. M, 2nd edition, Pearson Education, 2007.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/106106127/
2. http://nptel.ac.in/courses/106103069/

TRANSDUCERS AND INSTRUMENTATION-II

Sub code: EI410 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs +2Hrs/Week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisite: Transducers and instrumentation-I.

Course Objective: To gain the knowledge of transducers for measurement of different physical quantities (pressure, flow, sound and level) and appropriate data conversion methods.

Course Outcomes:
Students will be able to,

1. Explain the construction and working of various types of Sensors & Transducers.
2. Identify a suitable transducer for measurement of the physical quantity.
3. Discuss the construction and working of the transducer used for measurement.
4. Choose appropriate data conversion technique for better presentation of the transducer output.
5. Demonstrate theoretical and practical skills by working in the laboratory to build and test data converter circuits and physical quantity detection and indication circuits.

Pressure and Acoustic Measurement: Standards & calibration; basic methods of pressure measurement; dead weight gauges & manometer, manometer dynamics; elastic transducers, high pressure measurement; low pressure (vacuum) measurement- McLeod gage, Knudsen gage, momentum-transfer (viscosity) gages, thermal conductivity gages, ionization gages, Sound – Level meter**,** microphones, acoustic intensity, acoustic emission. **10 Hrs**

Flow Measurement: Local flow velocity, magnitude and direction. Flow visualization. Velocity magnitude from pitot static tube. Velocity direction from yaw tube, pivoted vane, servoed sphere, dynamic wind vector indicator. Hot wire and hot film anemometer, Hot film shock-tube velocity sensors, Laser Doppler velocimeter. **10 Hrs**

Gross flow rate and level Measurement: Gross volume flow rate; Constant-area, variable-pressure-drop meters (Obstruction meters). Averaging pitot tubes. Constant pressure-drop, variable area meters (Rotameters), turbine meters, positive displacement meters. Metering pumps. Electromagnetic flow meters. Drag force flow meters. Ultrasonic fowl meters, vortex-shedding flow meters. **06 Hrs**

Level Measurement: Capacitance probe; conductivity probes; diaphragm level detector, deferential pressure level detector, radiation level sensors, level transmitter, ultrasonic level detector. **04 Hrs**

Data acquisition systems: Introduction to data acquisition systems, Analog switches, high and low level analog multiplexers, principle, accuracy and stability of Sample and Hold circuits. **06 Hrs**

Digital to analog converters (DACs): Classification, R-2R, Weighted resistor DACs and inverted ladder DACs, Multiplying DACs, Discussions on DAC0800 & AD7542 Monolithic DACs, applications of DACs. **06 Hrs**

Analog to digital converters(ADCs): General classification of ADCs, Counter, Successive approximation, Ramp comparison, Dual slope, Voltage to frequency, Voltage to time and Flash type ADCs, Discussions on ADC 0816 and ICL 7109 monolithic ADCs, concepts of Delta-Sigma Converters. **10 Hrs**

LIST OF EXPERIMENTS:

1. Level indication based on conduction method.
2. Sound detection & obstacle detection circuits.
3. Pressure indicator using piezoelectric transducer.
4. Sample and hold circuit using Integrated circuit.
5. Demonstration of working of Analog multiplexers.
6. 4 bit Binary weighted and R-2R ladder network DAC.
7. Digital to analog converter using DAC 0800.
8. Analog to Digital converter using ADC 0804.

MINI PROJECT: Propose, design a physical quantity sensing and indication circuit, and work on the project in a team and give an oral and written report.

TEXT BOOKS:

1. **Measurement Systems Application and Design,** Ernest O Doebelin, 6th Edition,TMH, 2007.
2. **Instrument Engineers Hand book (Process Measurement.),** B G Liptak, 3rd Edition, Chilton book, 1995.
3. **Hand book of A/D & D/A converters,** HNATEK , John Wiley, 1976.

REFERENCE BOOKS:

1. **Basics of Instrumentation**, NJATC , Cengage learning, 2008
2. **Principles of data conversion system design,**Behzadrazavi, IEEE press, 1995.
3. **PC based Instrumentation: Concepts and practice,**N.Mathivanan,PHI, 2007.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/108105064/
2. http://nptel.ac.in/courses/112103174/10
3. https://swayam.gov.in/courses/4523-mechanical-measurement-system
4. https://swayam.gov.in/course/3764-industrial-instrumentation

BIOMEDICAL INSTRUMENTATION

Sub code: EI 420 **Credit Pattern: 3:0:1**

Total Hours: 39 Hrs+2Hrs/Week lab session. **Contact Hours: 05 Hrs/Week**

Pre-requisite: Transducers and Instrumentation.

Course Objective : To gain the knowledge of biomedical instruments for measurement of biomedical signals**.**

Course Outcomes:
Students will be able to,

1. Explain the origin of various biological signals that are useful for diagnostic purpose.
2. Measure and record physiological parameters using different types of instruments.
3. Explain the importance of invasive and non-invasive techniques used for measuring biomedical signals.
4. Apply safety measures and precautions during design and use of biomedical instruments.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to test biomedical instruments

Fundamentals: Sources of biomedical signals, Basic medical instrumentation system, Consumer and portable medical equipment, Implantable medical devices, Micro-Electro-Mechanical systems, General constraints in design of biomedical instrumentation systems. **04 Hrs**

Bioelectric Signals and Electrodes: Origin of bioelectric signals-ECG EEG EMG, Recording electrode-Electrode-Tissue interface, Polarization, Skin contact impedance, Motion artifacts, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG. **05 Hrs**

Biomedical Recorders: Electrocardiograph : Block diagram of an ECG machine, Block diagram of an isolation preamplifier commonly used in modern ECG machine, ECG Leads,Multi-channel ECG machine. Electroencephalograph : Block diagram description of an Electroencephalograph, 10-20 electrode system, Electromyograph, other biomedical recorders . **07 Hrs**

Patient Monitoring System: bedside patient monitoring systems, central monitors, measurement of heart rate – instantaneous heart rate meter (cardio tachometer), measurement of pulse rate, measurement of blood pressure – direct & indirect method, oscillometric method, ultrasonic doppler shift method, measurement of respiration rate – impedance pnuemography, co2 method, apnea detectors, pulseoximeters. **08 Hrs**

Blood Flow and Cardiac Output Measurement: Electromagnetic blood flow meters, Square wave electromagnetic blood flow meters, Ultrasonic blood flow meters – Doppler shift flow

velocity meters, Range gated pulsed Doppler flow meters, Cardiac Output Measurement : Measurement of continuous cardiac output derived from the aortic pressure waveform. **07 Hrs**

Therapeutic equipments: Cardiac Pacemakers, Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, Defibrillators : DC defibrillators. Ventilators: Artificial ventilation, ventilators, ventilator terms, Patient Safety: Electric shock hazards, Leakage currents. **08 Hrs**

LIST OF EXPERIMENTS:

1. ECG Simulation & arrhythmia analysis using Biokit.
2. Real time ECG acquisition and analysis.
3. EEG simulation using Biokit.
4. Real time EEG acquisition and analysis.
5. EMG simulation using Biokit.
6. Real time EMG acquisition and analysis.
7. Blood pressure recording.
8. Recording of Heart sounds using phonocardiogram.

TEXT BOOK:

1. **Handbook of Biomedical Instrumentation,** R. S. Khandpur, 3rdEdition, Tata McGraw-Hill Publishing Company Limited, 2014.

REFERENCE BOOKS:

1. **Biomedical Electronics & Instrumentation,** S. K. Venkata Ram, 3rd Edition, Galgotia Publications Pvt. Ltd., 2009.
2. **Principles of applied biomedical instrumentation,** Lesely Cromwell & others, 2ndEdition, John Wiley and sons,
3. **Encyclopedia of medical devices and instrumentation,** J. G. Webster, John Wiley, 1999.

SIGNAL CONDITIONING CIRCUITS

Sub code: EI430 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs +2Hrs/Week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisites: Analog Electronic Circuits, Circuit theory and Analysis.

Course Objective: To introduce the applications of analog IC's and develop signal conditioning circuits using op-amp.

Course Outcomes:
Students will be able to,

1. Explain the basic principles and configuration of op-amp, timer and phase locked loop (PLL).
2. Analyze the working of negative and positive feedback amplifiers, timer and PLL.
3. Construct different types of linear and nonlinear circuits using op-amp, timer and PLL.
4. Develop and analyze the higher level applications using op-amp, timer and PLL.
5. Design signal conditioning circuits for the outputs of temperature transducers and strain gauge.

Operational amplifier Basics & negative feedback amplifiers: Introduction to differential amplifiers, equivalent circuit of op-amp, Ideal and practical parameters of operational amplifiers, measurement of op-amp parameters. Inverting amplifier, non-inverting amplifier, Summing amplifier, Differential amplifier, instrumentation amplifier. Log and anti log amplifiers, Current to voltage and voltage to current converters. **12 Hrs**

Applications of Negative feedback amplifiers: Integrating and Differentiating circuits with frequency response, Precision rectifiers, Peak detectors, active filters I and II order butter worth filter (In detail). Problems Waveform generators**:** Principle, Sine wave oscillators, Wein Bridge and phase shift oscillator **10 Hrs**

Comparators & Positive feedback amplifiers and its applications: Inverting and non inverting comparators, ZCD, window detector, Schmitt trigger (design), monostable and astable multivbrators, triangular and sawtooth wave generator. **10 Hrs**

Phase locked loop & Timers: Operating principles, lock range, capture range, working of NE565. PLL as frequency multiplier, frequency synthesizer, frequency translation, 555 timer, astable ,monostable and Elementary design of specific applications **10 Hrs**

Design: Constant Current Source, Constant Voltage Source, design of high gain amplifiers with offset nulling. Signal conditioning and linearizing circuit for sensors using op-amp, (thermocouple, RTD, AD590, thermistor and strain gage), **10 Hrs**

LIST OF EXPERIMENTS:

1. Differential amplifiers & Instrumentation amplifiers for different gains.
2. Precision half wave and full wave rectifiers.
3. II order Low pass and High pass filters.
4. Comparators and Schmitt triggers.
5. Astable and monostable multivibrators using op-amp.
6. Astable and monostable multivibrators using 555 Timer.
7. Signal conditioning circuit for thermocouple and AD590.
8. Design of linearizing circuit for RTD & Thermistor.

MINI PROJECT: Design and develop signal conditioning circuits using op-amps, Timers and PLLs.

TEXT BOOKS:

1. **Linear Integrated Circuits & OPAMP,**Gayakwad, 3rd edition, PHI, 2002
2. **OPAMP and applications**, Coughlin and Driscoll, 4th edition, PHI,2000.

REFERENCE BOOK:

1. **Design of Operational Amplifiers & Analog IC's,** Sergio Franco, 3rd edition, McGraw Hill, 2002.

LEARNING MATERIAL:

http://nptel.ac.in/courses/117103063/26

SYSTEM DESIGN USING HDL

Sub code: EI 440 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs + +2Hrs/Week lab session **Contact Hours: 06 Hrs /Week**

Pre-requisites: Logic Design, Concepts of Computer Programming.

Course Objective: To provide the knowledge necessary to synthesize and simulate systems using hardware description languages (HDL's), FPGA programming and interfacing.

Course Outcomes:
Students will be able to,

1. Explain the concept of HDL as a software tool and programming language.
2. Develop combinational digital circuits with time constraints using different description styles.
3. Examine sequential circuits with behavioral and structural hardware description code.
4. Make use of programming skills to inculcate structured and modular design approach.
5. Demonstrate skills in programming of FPGA and interfacing of modules.

Introduction: Structure of HDL module, operators, data types, types of descriptions, simulation and synthesis, software for synthesis and simulation, brief comparison of VHDL and Verilog. FPGA architecture and circuit design, data flow descriptions, highlights of data-flow descriptions, structure of data-flow description, data type vectors, examples

10 Hrs

Behavioral Descriptions: Behavioral description highlights, structure of HDL behavioral description, VHDL variable assignment, signal assignment statement, sequential statements, examples, Structural descriptions, highlights of structural description, organization of the structural descriptions, binding, examples.

10 Hrs

Procedures, Tasks, and Functions: Highlights of procedures, tasks, and functions, procedures and tasks examples, functions examples, generate generic, and parameter statements. Advanced HDL descriptions, file processing procedures and tasks, examples of file processing.

10 Hrs

Mixed Type Descriptions: VHDL user-defined data types, VHDL packages, mixed type description examples, two dimensional array and matrix algebra in HDL, mixed language descriptions, highlights of mixed-language description, how to invoke one language from the other, mixed-language description examples, limitations of mixed-language description.

12 Hrs

FPGA Interfacing & Mini projects: Interface of switches and LEDs to FPGA, Interface of matrix keyboard and display units to FPGA, Interface of actuators to FPGA, stepper motor, DC motor, interface of DAC, development of simple applications using FPGA.

10 Hrs

LIST OF EXPERIMENTS:

1. Synthesis and simulation of logic gates, full adder, comparator.
2. Synthesis and simulation of encoder, multiplexer, simple 4 bit ALU.
3. Synthesis and simulation of flip flops(D,T, JK), counters(binary, BCD).
4. Interfacing of switches, LEDs and 7 segment display units to FPGA.
5. Interface of matrix keyboard, and LCD display to FPGA.
6. Interface of stepper motor to FPGA and control its operations.
7. Interface of DC motor to FPGA and control its operations.
8. Interface of DAC unit to FPGA and generation of waveforms.

MINI PROJECT: Develop and demonstrate HDL code for simple applications based on combinational and sequential digital circuits.

TEXT BOOKS:

1. **HDL Programming VHDL and Verilog**, Nazeih M. Botros, Thomson Learning, 2007.
2. **Principles of Digital Systems Design using VHDL**, Charles H Roth, Lizy Kurian John, Cengage Learning, 2009.

REFERENCE BOOKS:

1. **Digital Electronics and Design with VHDL**, Volnei A Pedroni, Elsevier, 2008.
2. **Fundamentals of Digital logic Design with VHDL**, second edition, Stephen Brown, Zvonko Vranesic, 2007.

LEARNING MATERIAL:

http://nptel.ac.in/courses/117108040/1

SIGNALS AND SYSTEMS

Sub code: EI450 **Credit Pattern: 4:1:0**

Total Hour: 52 Hrs +2Hrs/Week Tutorial **Contact Hours: 06 Hrs/Week**

Pre-requisite: Mathematics

Course Objective: To introduce the basic concepts of signals and systems in time and frequency domains.

Course Outcomes:
Students will be able to,

1. Recall the concepts of signals and systems.
2. Interpret the properties of the system.
3. Apply the knowledge of Z transform to analyze discrete time systems.
4. Analyze the system using Fourier representation.
5. Determine the response of the system in time domain.

Continuous time and discrete time signals and Systems: Classification of signals, Standard signals, Basic operations on signals, System, Classification of systems. **12 Hrs**

Analysis of systems: Convolution sum, differential equation representation of LTI systems, solution of differential equation, difference equation representation of LTI systems, solution of difference equation, Correlation and correlation coefficient. **10 Hrs**

Fourier Series and Fourier Transform of discrete time signals: Fourier series for discrete time periodic signals (DTFS), properties of DTFS, Fourier transform of discrete time non periodic signal, properties of DTFT, DTFT of periodic signals, analysis of LTI discrete time system using DTFT. **12 Hrs**

Z-Transform: Introduction, Z-transform, Properties of Z-transform, Pole zero model, Region of convergence, Inversion of Z-transforms, Analysis of LTI discrete time system using Z transform, stability and causality analysis. **10 Hrs**

Discrete Fourier Transform: Properties of DFT and IDFT, Analysis of LTI discrete time systems using DFT. **08 Hrs**

TEXT BOOKS:

1. **Signals and Systems,** Simon Haykin and Barry Van Veen, 2nd edition, John Wiley & Sons, 2007.
2. **Modern Digital Signal Processing,** V. Udayashankara, 3rd edition, PHI, 2015.

REFERENCE BOOKS:

1. **Signals and Systems,** Nagoor Kani, TMH, 2011.
2. **Signals and Systems**, Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, , 2nd edition, Pearson education Asia/PHI 1997, Indian Reprint 2002.
3. **Signals and Systems,** H P Hsu, R Ranjan, Scham's Outlines, TMH, 2006.
4. **Linear Systems and Signals,** B P Lathi, Oxford University Press, 2005.

LEARNING MATERIAL:

http://nptel.ac.in/courses/117104074/

LINEAR ALGEBRA

Sub code: EI510 **Credit Pattern : 3:0:0**

Total Hours: 39 Hrs **Contact Hours: 03 Hrs/Week**

Pre-requisite: Mathematics.

Course Objective: To introduce concepts of linear equations, vector spaces and matrices.

Course Outcomes:

Students will be able to,

1. Explain the concepts of linear equations, vector equations and matrix operations.
2. Solve linear equations, vector equations, matrix equation and factorization.
3. Analyze vector spaces, Eigen values and linear transformation.
4. Solve Eigen values, orthogonality and least squares problems.
5. Evaluate diagonalization of symmetric matrices and SVD.

Linear Equations: System of linear equations, Row reduction and echelon forms, Vector equations, Matrix equations, Solution sets of linear systems, matrix operations, inverse of a matrix, Matrix factorization **10 Hrs**

Vector Spaces: Vector spaces and subspaces; Linearly independent sets, bases, coordinate systems, dimension of a vector space, Rank, Change of basis **08 Hrs**

Linear Transformations: Linear transformations, Eigen vectors and Eigen values, characteristic equation, diagonalization, Eigen vectors and linear transformation **08 Hrs**

Orthogonality and Least Squares: Inner products, length and orthogonality, orthogonal sets, orthogonal projections, Gram-Schmidt process, QR-factorization, least-squares problems **07 Hrs**

Symmetric Matrices and Quadratic Forms: Diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition. **06 Hrs**

TEXT BOOK:

1. **Linear Algebra and its Applications**, David C. Lay, 5th Edition, Pearson Education (Asia) Pvt. Ltd, 2015.

REFERENCE BOOKS:

1. **Linear Algebra and its Applications**, Gilbert Strang, 4th Edition, Thomson Learning Asia, 2007.
2. **Introductory Linear Algebra with Applications**, Bernard Kolman and David R. Hill, 7th edition, Pearson Education (Asia) Pvt. Ltd, , 2003.

LEARNING MATERIAL:

http://nptel.ac.in/courses/111106051/

CONTROL SYSTEMS

Sub code: EI520 **Credit Pattern: 4:1:0**

Total Hours: 52Hrs +2Hrs/week tutorial session **Contact Hour: 06 Hrs/Week**

Pre-requisites: Mathematics, Signals and Systems.

Course Objective: To introduce the basic concepts of control systems, feedback systems and their representation and analysis.

Course Outcomes:

Student will be able to,

1. Explain the concepts of control system.
2. Model electrical, mechanical and electromechanical systems.
3. Determine the transfer function of a system from different types of representation.
4. Explain the characteristics of the system in time domain and frequency domain.
5. Investigate the stability of the system in time domain and frequency domain.

Introduction to control systems: Definition, open loop and closed loop systems, types of feedback. **04 Hrs**

Mathematical modeling of systems: Modeling of electrical, mechanical, and electromechanical systems, differential equations of physical systems. **06 Hrs**

Block diagrams and Signal flow graphs: Transfer function, block diagram representation and reduction, signal flow graph representation and reduction using Mason's gain formula. **07 Hrs**

Time response of feedback control systems: Standard test signals, steady state error analysis, unit step response of first and second order systems, time domain specifications and transient response of a prototype second order system. **07 Hrs**

Stability Analysis: Bounded input and bounded output stability, zero input and asymptotic stability, methods of determining stability, Routh-Hurwitz criterion. **06 Hrs**

Root -Locus techniques: Basic properties and construction. **07 Hrs**

Frequency domain analysis: Bode plots, gain and phase cross over points, polar plot, Nyquist stability criterion, relative stability using polar plot and Bode plot, frequency domain specifications – resonant peak, resonant frequency and bandwidth, effect of adding a zero or pole to the forward path transfer function. **15 Hrs**

TEXT BOOKS:

1. **Control Systems Engineering,** I J Nagarath and M Gopal, 5th edition, New age international publishers, 2008.
2. **Modern Control Engineering,** D Roy Choudhury, 1st edition, PHI, 2005

REFERENCE BOOK:

1. **Automatic Control System,** Kuo B C, 8th edition, John-Wiley and Sons Publications, 2002.

LEARNING MATERIAL:

http://nptel.ac.in/courses/108101037/1

INDUSTRIAL COMMUNICATION

Sub code: EI 530 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Electronic Devices and circuits

Course Objective: To introduce the basic concepts of data communication, serial communication standards and Industrial protocols.

Course Outcomes:
Students will be able to,

1. Explain the various methods of data communication.
2. Define different serial communication standards
3. Identify the importance of Serial communication standards.
4. Analyze the working of various protocols used for data communication.
5. Determine the role of Cabling and effect of noise in communication system

Basics of Communication System: Communication, Communication systems, Modulation, Bandwidth requirement. Channel Capacity, Baud Rate, Data Rate. Amplitude modulation**:** Time-Domain Description, Frequency domain description, Generation and detection of AM waves, FDM. Angle modulation: Basic Concepts, frequency modulation, Spectrum analysis of sinusoidal FM wave, NBFM, WBFM, **08 Hrs**

Pulse modulation: Sampling theorem for low pass and band pass signal, statement and proof, PAM, Channel bandwidth for a PAM signal, Natural Sampling, Flat-Top sampling, Signal recovery though Holding, Quantization of Signals, Quantization error, PCM, Electrical representations of Binary digits, The PCM Systems, DPCM, Delta Modulation, ADM.
09 Hrs

Digital modulation: Introduction, Binary Shift Keying, DPSK, QPSK, Type D flip-flop, QPSK Transmitter, Non-offset QPSK, The QPSK receiver, Signal space representation, BFSK, Spectrum, Receiver for BFSK, Geometrical Representation of Orthogonal BFSK, line codes, TDM, Problems **08 Hrs**

Data Communication: Data communication principle, Communication modes, Synchronous and asynchronous system, Error detection, Transmission Characteristics, Data coding, UART.
04 Hrs

Serial Communication Standard: Serial data communication interface standards, Balanced and unbalanced transmission lines, RS 232 interface standard, Troubleshooting serial data

communication circuits, Test equipment, RS 422 Standard, RS 485 Standard, Troubleshooting and testing with RS 485, 20 mA Current loop, GPIB,USB. **10 Hrs**

Industrial Protocols: Introduction to protocols, Profi Bus, Modbus protocol, HART Fieldbus and DeviceNet system **06 Hrs**

Noise and Interference : Definition of noise, External and Internal noise, Noise calculation, Noise Figure, Noise Temperature, , Frequency analysis of noise, Source of electrical noise, Electrical coupling of noise, Shielding, Cable ducting, Cable spacing, Earthling and grounding requirement, Suppression techniques. Signal to noise ratio, AM receiver model **07Hrs**

TEXT BOOKS:

1. **Analog and digital communication**- Simon Haykin, John willey. 2007
2. **Principles of communication systems**. Taub and Schilling, 3rd edition. TMH, 2009.
3. **Practical Data Communications for Instrumentation and Control**, John Park, 1st Edition, Elsevier, 2003

REFERENCE BOOK:

1. **Instrument Engineers Hand book (Process Measurement.)**, B G Liptak, 3rd Edition, Chilton book, 1995.

8051 AND AVR MICROCONTROLLER

Sub code: EI540 **Credit Pattern: 4:0:1**
Total Hours: 52 Hrs + 2 Hrs/Week Lab Session **Contact Hours: 06 Hrs/Week**

Pre-requisites: Logic Design, Basic C Programming.

Course Objective: To introduce architecture, programming and interfacing concepts of microcontrollers.

Course Outcomes:

Students will be able to,

1. Compare different types of architectures.
2. Illustrate the working of the microcontroller with simple programs.
3. Develop programs to perform specific operation.
4. Design systems using built – in peripherals and by interfacing external devices.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to solve real world problems using microcontrollers.

Fundamentals: Introduction, comparison between microprocessors and microcontrollers, RISC & CISC CPU architectures, Von-Neumann & Harvard architecture. architecture of 8051, pin diagram of 8051, memory organization, ports, **08 Hrs**

8051 Instruction Set: Introduction, instruction syntax, data types, addressing modes: immediate addressing , register addressing, direct addressing, indirect addressing, relative addressing, absolute addressing, long addressing, indexed addressing, bit inherent addressing, bit direct addressing. instruction set: instruction timings, data transfer instructions, arithmetic instructions, logical instructions, branch instructions, subroutine instructions, bit manipulation instruction. assembly language programs (ALP). **11 Hrs**

8051 Timers/counters, Serial Communication & Interrupts: Introduction to timers and counters, 8051 timers/counters, timer/counter modes, data communication, basics of serial data communication, 8051 serial communication, serial communication modes. basics of interrupts, 8051 interrupt structure, programming in assembly and C. **11 Hrs**

8051 Interfacing and Applications: Basics of I/O concepts, interfacing 8051 to seven segment display, LCD, keyboard, ADC, DAC, stepper motor and DC motor, programming in assembly and C. external memory interfacing. **10 Hrs**

ATmega328B Microcontroller: Features, architecture of ATmega328B, pin out of ATmega328B, registers, port functions ATmega328B, power management, timer/counter, serial ports, ADC. **12 Hrs**

LIST OF EXPERIMENTS:

1. ALP to perform Arithmetic & Logical operations.
2. ALP to perform Array operations & Code conversions.
3. Programs to perform Timer/Counter operations.
4. Programs to perform Serial Communication.
5. Programs to interface LED and Keypad.
6. Programs to interface Stepper motor & DC Motor.
7. Programs to interface DAC & ADC.
8. Programs to interface seven segment display and LCD.

MINI PROJECT: Application development using ATmega328B AVR microcontroller (ARDUINO)

TEXT BOOKS:

1. **The 8051 Microcontroller and Embedded Systems – using assembly and C**, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006.
2. **8051 Micrcontroller-Hardware, Software and Applications**, V. Udayashankara and M.S. Mallikarjunaswamy, Tata McGraw-Hill, 2009.
3. **Technical Datasheets**, ATmega328B AVR Microcontroller

REFERENCE BOOKS:

1. **The 8051 Microcontroller and embedded systems**, Kenneth J. Ayala and Dhananjay V.Gadre, Cenegage learning. 2004.
2. **The 8051 Microcontroller Based Embedded Systems,** Manish K. Patel, McGraw Hill Education (India) Pvt. Ltd., 2014.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home1_1.htm
2. http://nptel.ac.in/courses/108105102/
3. http://www.keil.com/c51/
4. https://www.arduino.cc

DIGITAL SIGNAL PROCESSING

Sub code: EI550 **Credit Patter: 4:0:1**

Total Hours: 52 Hrs + 2Hrs Lab session/Week **Contact Hours: 06 Hrs/Week**

Pre-requisite: Signals and systems.

Course Objective: To gain the knowledge in design & implementation of basic DSP algorithms

Course Outcomes:
Students will be able to,
1. Explain basic concepts of the signals in frequency domain and filtering
2. Develop algorithms for transformation of signals from time domain to frequency domain and vice versa.
3. Analyze and build the different forms of filter structures.
4. Design and implement FIR and IIR filters.
5. Explain multirate signal processing and adaptive filters.

Computation of FFT: Radix-2 Decimation in Time FFT, Radix-2 Decimation in Frequency FFT, inverse FFT Algorithm. Introduction to DCT, DCT-2 and IDCT-2 algorithm, The Goertzel and Chirp Z transform algorithms. **08 Hrs**

Digital Filter Realization: Basic IIR filter structures: Direct form (I & II), Parallel, Cascade form and lattice form. Basic FIR Filter structures: Direct and cascade form structure and lattice form. **10 Hrs**

FIR filters: Properties, Filter Design using Windows (Rectangular, Hamming, Hanning and Kaiser Window), Filter design using Frequency sampling technique, **09 Hrs**

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, **12Hrs**

Multirate digital signal processing: Introduction, decimation by a factor D, interpolation by a factor I, application of multirate signal processing: Interfacing of digital systems with different sampling rate, implementation of digital filter banks, DFT filter banks, Quadrature mirror filter banks. **08 Hrs**

Adaptive filters: Adaptive filters, LMS adaptive algorithms, Recursive least square algorithms, Applications of adaptive filters. **05 Hrs**

LIST OF EXPERIMENTS:

Implementation of following using Scilab /Matlab,

1. FFT & IFFT
2. DCT and IDCT
3. FIR filters using windows
4. FIR filters using Frequency sampling
5. Butterworth IIR filter
6. Chebyshev IIR filter
7. Realization of digital filters structures
8. LMS/RLS Algorithms

MINI PROJECT: Design the system for processing bio-signals.

TEXT BOOKS:

1. **Digital Signal Processing,** Proakis and Manolakis, 3rd Edition. PHI/Pearson, 2015
2. **Modern digital signal processing,** Dr.V.Udayashankara, 3nd Edition, PHI, 2015.

REFERENCE BOOKS:

1. **Theory and Application of DSP,** Rabinar L R and Gold B, PHI, 1999.
2. **Introduction to digital signal processing,** Johnson, Prentice Hall of India 1999.
3. **Digital Signal Processing,** by Alan V. Oppenheim and Ronald W. Schafer, Pearson.

LEARNING MATERIAL:

http://nptel.ac.in/courses/117102060/

AIRCRAFT INSTRUMENTATION

Sub code: EI561 **Credit Pattern : 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisites: Basic Electronics, Transducers & Instrumentation.

Course Objective: To introduce the fundamentals of aircraft and the instrumentation involved in aircraft system.

Course Outcomes:
Students will be able to,

1. Explain the basics of Aircraft systems.
2. Demonstrate the principles of basic instruments and the directional systems.
3. Analyze the gyroscopic instruments.
4. Show functions of fuel flow and fuel quantity measuring system.
5. Explain safety measures for an aircraft.

Aircraft Basics: Introduction, basic components of aircraft, forces involved in flight, Newton laws Bernoulli's principle applicable to flight. Aircraft Instruments, Introduction, Instruments grouping, Instrument Displays, Quantitative and Qualitative displays, Director Displays, Cockpit Layout, Standard atmosphere **10 Hrs**

Air data Instruments: basic air data system, pitot static probe, heating circuit arrangement, Air speed indicator, square law characteristics, Mach/airspeed indicator, Altimeters, Effects of atmospheric temperatures, Vertical airspeed indicators, Instantaneous vertical airspeed indicator, Air temperature indicator **10 Hrs**

Warning systems: Air data Alerting system, Mach warning system, Altitude alert system. Direct reading compasses: Terrestrial Magnetism, Compass construction, Errors in indication, Acceleration error, and compensation. **10 Hrs**

Gyroscopic Flight Instruments: The gyroscope and its properties, determining direction of precession, limitations of gyroscopes, operating gyroscopic flight instruments, Gyro horizon, Erection systems for gyro horizons, errors due to acceleration and turning, Direction Indicator, Turn and bank indicator. **10 Hrs**

Engine Instruments: Pressure measurement, Indicating systems, pressure switches, Temperature measurement, Indicating systems, Fuel quantity Indicating Systems: Capacitance type system, indicating system, Effects of fuel temperature changes, Measurement of fuel quantity by weight, Engine power and control instruments: RPM measurement, Generator and

indicating system, Tacho probe and indicator system, Exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement system. **12 Hrs**

TEXT BOOK:

1. **Aircraft Instruments and Integrated Systems,** EHJ Pallet, Longman Scientific & Technical, 1992.

REFERENCE BOOKS:

1. **Aircraft Instrument Design,** WH Coulthard, Pitman & sons 1981.
2. **Aircraft Instruments,** C A Williams, Golgotia Publications, New Delhi.

PRODUCT DESIGN TECHNOLOGY

Sub code: EI562 **Credit Pattern: 3:0:1**

Total Hours: 39 Hrs + 2Hrs/Week Lab Session **Contact Hours: 05 Hrs/Week**

Pre-requisite: Electronic devices and Circuits

Course Objective: To create awareness about the basic requirements of a user friendly product and introduce the manufacturing process to meet the target specifications.

Course Outcomes:
Students will be able to,

1. Analyse the product design and development processes in manufacturing industry.
2. Define the components and their functions in product design and development processes.
3. Analyse, evaluate and apply the methodologies for product design, development and management.
4. Make use of a methodical approach to the management of product development to satisfy customer needs.
5. Work in the laboratory to design and present a product that meets ergonomical and industrial requirements.

Introduction: Development process and Organizations: characteristics of successful product development, duration and cost of product development, challenges of product development. **06 Hrs**

Generic development process, concept development: Front-end process, adapting the generic product development process. **05 Hrs**

Identifying Customer needs and Establishing Product specifications: Defining scope, gathering data from customers, establishing relative importance of needs. Target specifications & refining specifications. **05 Hrs**

Concept generation: Five-step methodology of concept generation, with a case study of any electronic instrument. **05 Hrs**

Human Engineering Considerations in product Design: Anthropometry, the design of controls, the design of displays, man/machine information exchange. **05 Hrs**

Concept Embodiment: Overview, basic methods, advanced methods, case study-computer monitor with reference to ergonomics and esthetics. **05 Hrs**

PCB Technology: Introduction, types, applications, base materials, design methods and fabrication processes. **08 Hrs**

LIST OF EXPERIMENTS:

1. PCB design using open source software – 2sessions
2. Designing a product as per required target specifications -2sessions
3. Ergonomical design of a product -2sessions
4. Design of the front panel of the final module design -2sessions

MINI PROJECT: Design and Implement a project considering all design criteria.

TEXT BOOKS:

1. **Product Design and Development**, Karl T Ulrich, Steven D Eppinger, 3rd edition, Tata McGraw Hill.
2. **Printed Circuit board Design and Technology**, Walter C Boshart, McGraw International.

REFERENCE BOOKS:

1. **Product design and manufacturing**, AK. Chitale and RC Gupta, Prentice Hall.
2. **Product Design,** Kevin Otto, Kristin Wood, 2nd edition, Pearson Education.

OPERATING SYSTEMS

Sub code: EI563 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Programming in C.

Course Objective: To introduce the concepts and design of operating system and services provided by it.

Course Outcomes:
Students will be able to,

1. Explain the functions, structures and history of operating systems.
2. Explain various process management concepts including scheduling, synchronization, and deadlocks and select appropriate concept.
3. Discuss the concepts of memory management including virtual memory and disk management.
4. Analyze design issues associated with operating systems
5. Apply different techniques to avoid unauthorized access to the system.

Introduction to operating systems: Concepts, OS objectives, OS functions, OS views, OS design issues, OS supports & services, evolution of system structure. **09 Hrs**

Process management: Concept, process models, threads: thread states, types of threads, thread priority, multithreading, Scheduling: short-term scheduler types of schedulers, non-preemptive & preemptive strategies.

08 Hrs

Interprocess synchronization: concepts, critical section problem, Peterson's solution, synchronization hardware, semaphores, bounded buffer problem, readers-writers problem, dining philosophers problem. Deadlocks: deadlocks & starvation, conditions for deadlocks, deadlock detection, deadlock prevention, deadlock recovery, deadlock avoidance, starvation.

09 Hrs

Memory management: Key Characteristics, memory management functions, some fundamental responsibilities, management schemes: contiguous memory allocation & non contiguous memory allocation, virtual memory: Basic concepts, paging, segmentation, cache memory design issues.

10 Hrs

Device & file management: Device Characteristics, Types, Device controller, Types of operations, buffering & types of buffering, clock, disk, management, disk arm scheduling policies, RAID, File system, server, management, design, organization, directory, sharing, blocking, management, allocation, file system reliability **10 Hrs**

Security & Protection: Overview, goals, security threats, attacks, design issues, protection structure, intruders, authentication, malicious programs. Encryption: symmetric encryption, public key encryption. **06 Hrs**

TEXT BOOKS:

1. **Operating Systems, A concept–based evolutionary approach**, **P** Chakraborty, Jaico publishing house,2011.
2. **Operating System Principles,** Abraham Silberschatz, Peter Galvin, Greg Gagne, 8th Edition Wiley-India, 2015.

REFERENCE BOOKS:

1. **Modern Operating Systems,** Andrew S Tanenbaum,. 3rd Edition, PHI. 2009.
2. **Operating Systems,** Harvey M. Deitel Paul J. Deitel David R. Choffnes , 3rd Edition , PHI.
3. **Operating Systems, Internals & design principles,** William Stallings, 7th Edition, PHI, 2012.

LEARNING MATERIALS:

http://nptel.ac.in/downloads/106108101/

JAVA PROGRAMMING

Sub code: EI564 **Credit Pattern: 3:0:1**

Total Hours: 39 Hrs + 2Hrs/Week Lab Session **Contact Hours: 05 Hrs /Week**

Pre-requisite: C Programming.

Course Objective: To provide the basics of Java programming and knowledge of application development using JAVA.

Course Outcomes:

Student will be able to,

1. Explain the concepts of java programming.
2. Analyze concepts such as variables, conditional and iterative execution methods etc.
3. Apply Java language syntax and semantics to write Java programs.
4. Develop graphical interface and java applets for web programming.
5. Demonstrate concepts and features of SWINGS and database connectivity in JAVA.

Introduction: Java and java applications, java development kit (JDK),java is interpreted, byte code, JVM, object-oriented programming, simple java programs. data types and other tokens: Boolean variables, int, long, char, operators, arrays, white spaces, literals, assigning values; creating and destroying objects, access specifiers, operators and expressions: arithmetic operators, bitwise operators, relational operators, the assignment operator, the ? operator, operator precedence, logical expression, type casting, strings. control statements: selection statements, iteration statements, jump statements.

08 Hrs

Classes, Inheritance, Exceptions, Applets : Classes: Classes in Java, Declaring a class, Class name, Super classes, Constructors, Creating instances of class, Inner classes. Inheritance: Simple, multiple, and multilevel inheritance, Overriding, overloading. Exception handling**:** Exception handling in Java.

08 Hrs

The APPLET Class: Two types of applets, applet basics, applet architecture, an applet skeleton, simple applet display methods, requesting repainting, using the status window, the html applet tag passing parameters to applets, getdocumentbase( ) and getcodebase( ), apletcontext and showdocument( ), the audioclip interface, the applet stub interface, output to the console.

08 Hrs

Multi Threaded Programming, Event Handling: Multi threaded programming: what are threads? how to make the classes threadable, extending threads; implementing runnable, synchronization, changing state of the thread, bounded buffer problems, read-write problem,

producer-consumer problems. **event handling:** two event handling mechanisms; the delegation event model, event classes; sources of events, event listener interfaces, using the delegation event model, adapter classes, inner classes.

08 Hrs

SWINGS: Swings: the origins of swing,two key swing features, components and containers,the swing packages, a simple swing application, create a swing applet, JLabel and imageicon, JTextfield, the swing buttons, JTabbedpane, JScrollpane; JList, JComboBox, JTable. **servlets:** background, the life cycle of a servlet, using tomcat for servlet development, a simple servlet, the servlet api, the Javax.servlet package, reading servlet parameter, the javax servlet HTTP package handling HTTP requests and responses, using cookies, session tracking.**JSP, RMI.**

07 Hrs

LIST OF EXPERIMENTS:

Using Java software (Netbeans/JDK)

1. Write a Java Program to define a class, describe its constructor, overload the Constructors and instantiate its object.
2. Write a Java Program to define a class, define instance methods for setting and Retrieving values of instance variables and instantiate its object.
3. Write a Java Program to define a class, define instance methods and overload them and use them for dynamic method invocation.
4. Write a Java Program to demonstrate use of sub class and nested class.
5. Write a Java Program to implement array of objects.
6. Write a Java program to practice using String class and its methods.
7. Write a Java program to practice using String Buffer class and its methods.
8. Write a Java Program to implement Vector class and its methods.

TEXT BOOKS:

1. **Java The Complete Reference -**Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. **J2EE The Complete Reference -**Jim Keogh, Tata McGraw Hill, 2007.

REFERENCE BOOKS:

1. **Introduction to JAVA Programming -**Y. Daniel Liang, 6th Edition, Pearson Education, 2007.
2. **The J2EE Tutorial -**Stephanie Bodoff , 2nd Edition, Pearson Education, 2004.

LEARNING MATERIALS:

1. Java basics: textofvideo.nptel.ac.in/106106147/lec1.pdf
2. Java Applets: nptel.ac.in/courses/106105084/28

PROCESS CONTROL

Sub code: EI610 **Credit Pattern: 3:0:1**

Total Hours: 39Hrs + 2Hrs/Week Lab Session **Contact Hours: 05 Hrs/Week**

Pre-requisites: Transducers and Instrumentation, signal conditioning circuits, control systems.

Course Objective: To impart knowledge about process control, controller design, annunciator systems and tuning concepts.

Course Outcomes:

Students will be able to,

1. Explain the basic principles & importance of process control in process plants.
2. Select the required instruments and control elements for a process control application.
3. Design and tune process controllers.
4. Explain the importance and application of good instrumentation for monitoring, diagnosis and control of a process.
5. Evaluate the performance of various controller modes in the laboratory.

Introduction to Process Control: Process control block diagram, Identification of elements in process control loops – examples. **2 Hrs**

Final Control: Introduction to final control operation, signal conversions, actuators, control elements. **7 Hrs**

Controller principles: Introduction, process characteristics, control system parameters, discontinuous control modes, continuous control modes, and composite control modes. **8 Hrs**

Analog controllers: Introduction, general features, electronic controllers, pneumatic controllers, design considerations. **6 Hrs**

Digital Controllers: Introduction, digital electronics methods, computers in process control. **3 Hrs**

Discrete-State Process Control: Introduction, definition and characteristics of discrete state process control, examples for defining control system as discrete state system. **3 Hrs**

Control-loop characteristics: Introduction, control system configuration, multivariable control systems, control system quality, stability, and process loop tuning. **8 Hrs**

Control drawings: P& ID symbols and Diagrams: Introduction, Typical Instrumentation symbols for temperature, flow and level. **2 Hrs**

Self Study: Case studies of five to six process industries right from raw material to finished product.

LIST OF EXPERIMENTS:

1. Control of temperature, with various controller modes.
2. Control of flow, with various controller modes.
3. Control of level with various controller modes.
4. Basic operations using lab view.
5. Execution of simple programming structure using lab view.
6. Design of a CRO using VI and measurement of frequency and amplitude.
7. Design of a digital multimeter using VI and measurement of voltage and current.
8. Design variable function generator using VI (sine, square and triangle).

TEXT BOOKS:

1. **Process Control Instrumentation Technology,** C D Johnson, PHI, 8th edition,2009.
2. **Instrument Engineers Handbook (Vol 1 & 2)**, B G Liptak, 3rd edition, Chilton Book Company, 1995

REFERENCE BOOK:

1. **Chemical process control: an introduction to theory and practice**, Stephanopoulos, PHI, 2006.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/103103037/

ADVANCED CONTROL SYSTEMS

Sub code: EI620 **Credit Pattern: 3:1:0**

Total Hours: 39 Hrs + 2Hrs/week tutorial **Contact Hours: 05 Hrs/Week**

Pre-requisite: Control systems

Course Objective: To introduce the basic concepts of modeling and analysis of continuous and discrete time control systems.

Course Outcomes:

Students will be able to,

1. Recall the concepts of state space representation and nonlinearities of the system.
2. Interpret the characteristics of the system using different methods.
3. Analyze state space models of linear time invariant systems.
4. Evaluate the system in z-domain.
5. Design various kinds of compensators.

Discrete time control systems and the Z-Transform method: Introduction to discrete systems, pulse transfer function, stability analysis in the Z-plane. **07 Hrs**

State space analysis of control systems: State space representation of systems, solving the time invariant state equations, transfer matrix, linear time invariant systems, state space representation of discrete time systems and solving discrete time state equation. **09 Hrs**

Pole Placement: Controllability, Observability for continuous time systems, Pole placement design and State Observabilities. **06 Hrs**

Describing function analysis of Nonlinear Control systems: Introduction to nonlinear systems, describing function analysis of nonlinear control systems, stability of nonlinear control system. **07 Hrs**

Compensation Techniques: Lead, lag, lead lag network and compensator design using Bode/Root locus techniques. **10 Hrs**

TEXT BOOKS:

1. **Modern Control Engineering,** Katsuhiko Ogata, 5th edition, PHI, 2006
2. **Discrete time Control Systems,** Katsuhiko Ogata, 2nd edition, PHI, 2015.

REFERENCE BOOKS:

1. **Digital control and state variable methods,** Madan Gopal, 4th edition, McGrawHill publications, 2012.
2. **Modern Control Engineering,** Roy Choudhury, 1st edition, PHI, 2009.

LEARNING MATERIALS:

http://nptel.ac.in/courses/108103008/10

DIGITAL IMAGE PROCESSING

Sub code: EI630 **Credit Pattern: 3:0:1**

Total Hours: 39 Hrs + 2Hrs/Week Lab Session **Contact Hours: 05 Hrs /Week**

Pre-requisites: Signals and systems, Digital signal processing.

Course Objective: To introduce the fundamentals of digital image processing, image enhancement, compression, restoration and edge detection techniques.

Course Outcomes:
Students will be able to,

1. Explain the basic concepts of digital image processing
2. Make use of spatial domain and frequency domain techniques for improving image quality.
3. Analyze the images in spatial domain and frequency domain.
4. Choose suitable techniques for reducing image data size.
5. Test different methods for extracting useful information from the image.

Fundamentals: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing fundamentals and models. **5 Hrs**

Image Transforms: Basic theory, Fourier transform, Hadamard transform, Discrete cosine transform, Applications of discrete image transforms. **4 Hrs**

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, The Laplacian, The Gradient, **6 Hrs**

Image Enhancement in Frequency Domain: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpass filters, Sharpening frequency domain filters – Ideal highpass filters, Butterworth highpass filters, Gaussian highpass filters, Homomorphic filtering, **6 Hrs**

Image Restoration: Image degradation/restoration model, Noise models, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter, Noise filtering by frequency domain filtering – Band reject

filters, Band pass filters, Notch filters, Inverse filtering, Minimum mean square error (Wiener) filtering. **6 Hrs**

Image Compression: Fundamentals, Variable length coding, LZW coding, Bit plane coding, Run length coding, Lossless predictive coding, Lossy predictive coding, Transform coding. **6 Hrs**

Image Segmentation: Introduction, Thresholding – Threshold detection methods, Optimal thresholding, Multi-spectral thresholding, Edge-based segmentation – Edge image thresholding, Border tracing, Hough transform, Region-based segmentation – Region merging, Region splitting, Splitting & merging. **6 Hrs**

LIST OF EXPERIMENTS:

1. Write programs to (a) read an image file (b) Convert image from one format to another.
2. Write a program to find the distance between two pixels and neighbours of a pixel.
3. Write programs for intensity transformations and arithmetic operation on images.
4. Write a program to perform spatial domain filtering.
5. Write a program to perform bit plane slicing of an image.
6. Write programs to perform DFT /DCT of an image.
7. Write a program to perform Frequency domain filtering of an image.
8. Write programs to perform image compression and image segmentation.

TEXT BOOK:

1. **Digital Image Processing**, Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.

REFERENCE BOOKS:

1. **Fundamentals of Digital Image Processing**. Anil K. Jain, Prentice Hall of India.
2. **Image Processing, Analysis and Machine Vision**, Milan Sonka, Vaclav Hlavac & Roger Boyle, Second Edition, Thomson Publication.

PYTHON PROGRAMMING AND RASPBERRY PI

Sub code: EI640 **Credit Pattern: 3:0:1**

Total Hours: 39 Hrs + 2 Hrs/Week Lab Session **Contact Hours: 05 Hrs/Week**

Pre-requisites: Logic Design, Basic C Programming, Microcontrollers.

Course Objective: To introduce basics of Python programming, architecture of Raspberri Pi and programming Raspberry Pi using Python.

Course Outcomes:
Students will be able to,

1. Explain the fundamental concepts of Python programming.
2. Develop programs using Python to solve specific problems.
3. Explain the components of Raspberry Pi and demonstrate its working.
4. Design Raspberry Pi based systems.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to solve real world problems using Raspberry Pi.

Basics of Python: Data types, arithmetic, bitwise and logical operations on numerical types, string operations, control flow operator (if, for, while, range, break/continue, pass statements), functions. **8 Hrs**

Data structures and I/O: Creating lists, list operations, creating dictionaries, dictionary operations, set operations, frozen sets, tuples, reading and writing files **9 Hrs**

Raspberry Pi Architecture: Raspberry Pi Hardware, features of ARM processor, ARM architecture, GPIO, RCA, audio out, USB, HDMI, power, SD card slot, ethernet. **7 Hrs**

Python on Raspberry Pi: Installing and setting up Raspbian, writing to the SDcard, booting the Pi for the first time, python development tools,simple python scripts. **7 Hrs**

A**ccessing the GPIO Pins and Internet**: Single LED output. 7 segment display, PWN output, multiple outputs, basic switch, switch using interrupt, Communication interfaces (UART, SPI), extracting data from internet. **8 Hrs**

LIST OF EXPERIMENTS:

Write Python Programs to,

1. Understand numerical data types, String Operations
2. Implement
    a) List
    b) Tuples
3. Implement
    a) Sets
    b) Dictionary
4. Understand Control Flow
5. Understand Functions
6. Interface input devices to Raspberry Pi
7. Interface output device to Raspberry Pi
8. Perform data transmission

MINI PROJECT: Develop Python program to design a simple instrumentation system using Raspberry Pi.

TEXT BOOK:

1. **Getting Started with Python and Raspberry Pi**, Dan Nixon, Packt Publishing. 2015

REFERENCE BOOKS:

1. **Python Programming for the Absolute Beginner**, Michael Dawson, 3rd Edition, Cengage Learning, 2010
2. **Python Programming with Raspberry Pi,** Sai Yamanoor, Srihari Ymanoor, Packt Publishing, 2017
3. **Learning Python with Raspberry Pi,** Alex Bradbury, Ben Everard, John – Wiley and Sons, 2014

LEARNING MATERIALS:

1. http://www.python.org
2. http://www.raspberrypi.org
3. http://nptel.ac.in/courses/115104095/
4. http://nptel.ac.in/courses/106105166/28

DSP ARCHITECTURE

Sub code: EI650 **Credit Pattern : 3:0:1**

Total Hours: 39 Hrs+2Hrs/Week lab session **Contact Hours : 05 Hrs/Week**

Pre-requisites: Signals and systems, Digital signal processing.

Course Objective: To introduce the basic concepts of digital signal processor and implementation of DSP algorithms on digital signal processor TMS320C5416 and TMS 320C6713.

Course Outcomes:

Students will be able to,

1. Recall the basic concepts of Digital signal processing devices.
2. Explain the architectural features of DSP devices TMS 320C5416 & TMS 320C6713.
3. Discuss Addressing modes and Programming of TMS320C5416 and TMS 320C6713.
4. Design circuits to interface devices with TMS320C5416.
5. Implement DSP algorithms on TMS320C5416 & TMS320C6713 and applications of DSP devices.

Data formats, arithmetic operations and errors in digital signal processors: Introduction, Fixed and floating point DSP, Data formats, Fixed and floating point arithmetic operations, Dynamic range, precision and resolution, sources of errors in DSP. **4 Hrs**

Introduction to digital signal processing devices: Architectural features of DSP, Bus architecture, DSP Computational building blocks, On-chip memory, Special function instructions, Special addressing modes, parallel move support and pipelining. **4 Hrs**

Architecture of TMS 320c54xx processor: Features, architecture, Interrupts, Internal memory organization, On-chip peripherals. **4 Hrs**

Addressing modes and instruction set of TMS 320c54xx processor: Addressing modes, Instruction set. **4 Hrs**

TMS 320VC5416 Assembly language programming: DSP System Design kit, Assembly language programming. **8 Hrs**

Interfacing with TMS 320c54xx processor: Memory space organization, External memory interface, Parallel I/O interface, Serial I/O interface. **5 Hrs**

TMS 320C6713 Architecture: Features, architecture, Addressing modes, Programming, Applications of DSP devices. **10 Hrs**

TEXT BOOKS:

1. **Modern Digital Signal Processing,** V. Udayashankara, Third edition, PHI, 2015.
2. **Digital Signal Processing,** Avtar Singh and S Srinivasan, Thomson Publishing, 2004, Singapore.

REFERENCE BOOKS:

1. **Digital Signal Processing- A Practical Approach,** Emmanuel C Ifeachor and B W Jervis, Pearson Education, New Delhi.
2. **Digital Signal Processors,** B Venkataramani and M Bhaskar, Tata-McGraw Hill, New Delhi, 2002.
3. **DSP and applications with TMS320C6713,** Wiley IEEE press, 1/e, 2008
4. **TMS320C67x/C67x+ DSP CPU and Instruction Set Reference Guide,** literature number SPRU733A, 2006.
5. **Data sheets of TMS320C6713B Floating-Point Digital Signal Processor,** literature number: SPRS294B, 2005.

LIST OF EXPERIMENTS:

1. Implementation of Assembly language programs using TMS320C5416.
2. Implementation of Assembly language programs (ALP) linear convolution and correlation on TMS320C5416.
3. Implementation of ALP of Circular convolution on TMS320C5416.
4. Implementation of ALPs of FIR & IIR filters on TMS320C5416.
5. Implementation of ALP interpolation concepts using TMS320C5416.
6. Implementation of ALP decimation concepts using TMS320C5416
7. Implementation of C programs of linear convolution and correlation on TMS320C5416.
8. Implementation of C programs of FIR & IIR filters and FFT on TMS320C5416

MINI PROJECT: Implementation of filters to process biomedical and speech signals.

LEARNING MATERIALS:

http://nptel.ac.in/courses/108102045/9

ANALYTICAL INSTRUMENTATION

Sub code: EI661 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Basic sciences.

Course Objective: To gain the knowledge of applying analytical techniques to perform qualitative and quantitative analysis of given sample.

Course Outcomes:
Students will be able to,

1. Explain the fundamental principles of analytical science from multi disciplinary perspective.
2. Compare UV, Visible, IR spectrometer for quantitative and qualitative applications.
3. Discuss Mass spectrometer and Flame photometers for quantitative and qualitative applications.
4. Distinguish gas and liquid chromatography for quantitative and qualitative applications.
5. Explain appropriate analytical technique to solve a given real world problem

Visible ultraviolet spectrophotometers: Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, spectrophotometers. **07 Hrs**

Infrared spectrophotometers infrared spectroscopy theory, Basic components of infrared spectrophotometers, Types of infrared spectrophotometers, Sample handling techniques. **07 Hrs**

Flame photometers: Principle of flame photometers constructional details of flame photometers, accessories of flame photometers, interference in flame photometry and determinations. **08 Hrs**

Fluorimeters & phosphorimeters: Principle of fluotrscence, measurement of fluotrscence, spectro fluotrscence, microprocessor based spectro fluotrscence, Measurement of Phosphorescence. **08 Hrs**

Mass spectrometer & NMR spectrometer: Basic concept, types of mass spectrometer, components of mass spectrometer, resolution and applications. Principle of NMR, constructional details, sensitivity enhancement for analytical NMR spectroscopy. Use of computers with NMR spectrometers. **10 Hrs**

Chromatography: Gas chromatograph- basic concepts, parts of gas chromatograph. Method of peak areas, liquid chromatography- basic concepts, types if liquid chromatography, the liquid chromatography. **12 Hrs**

TEXT BOOK:

1. **Hand book of analytical Instruments** by R. S. Khandpur, TMH Publications 1st Edition, 1989, New Delhi.

REFERENCE BOOKS:

1. **Instrumental methods of analysis** , H. H. Willard, L. L. Merritt & J. A. Dean, CBS Publications 7th Ed., 1988.
2. **Principles of Instrumental analysis** , S. J. Holler & T. A. Nilman Saunders college Publications 5st Ed., 1998.

AUTOMOBILE INSTRUMENTATAION

Sub code: EI662 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Transducers & Instrumentation

Course Objective: To introduce the principles, performance & applications of instrumentation in automobile.

Course Outcomes:

Students will be able to,

1. Explain the working of electrical and electronic systems in modern vehicles.
2. Define the role of electronic components and sensors in a vehicle.
3. Develop stability and safety systems using sensors/transducers.
4. Determine the role of control units and mechatronics in automobile engineering.
5. Analyze the requirement of sensors and actuators for automobile applications.

Electrical and electronic systems in the vehicle: Overview, Motronic-engine management system, Electronic diesel control (EDC), Electronic stability program (ESP), Adaptive cruise control (ACC), Occupant protection systems **12 Hrs**

Architecture of electronic systems: Overview, vehicle system architecture, Electronic components in the vehicle**:** Basic principles of semiconductor technology, passive components, semiconductor components, manufacture of semiconductor components and circuits.

10 Hrs

Mechatronics: Mechatronics systems and components, development methods, outlook: Control units: Operating conditions, design, data processing, digital modules in the control units, control unit software **10 Hrs**

Automotive sensors: Basics and overview, automotive applications, details of the sensor market, features of vehicle sensors, sensor classification, error types and tolerance requirements, reliability, main requirements, trends, overview of the physical effects for sensors, overview and selection of sensor technologies, Actuators**:** Electromechanical actuators, fluid mechanical actuators, electrical actuators.

10 Hrs

Sensor measuring principles: Position sensors, speed and rpm sensors, acceleration sensors, pressure sensors, force and torque sensors, flowmeters , gas sensors and concentration sensors, imaging sensors (video). **10 Hrs**

TEXT BOOK:

1. **Automotive electrics Automotive electronics,** 5th Edition, Robert Bosch GmbH. John-Wiley, 2007

REFERENCE BOOK:

1. **Understanding Automobile electronics,** William B Ribbon, 6th Edition, Elsevier Science. 2003

COMPUTER NETWORKS

Sub code: EI663 **Credit Pattern: 3:1:0**

Total Hours: 39 Hrs +2 Hrs/Week lab session **Contact Hours: 05 Hrs/Week**

Pre-requisite: Industrial communication.

Course Objective: To introduce the concepts and techniques used in the area of computer networks and issues related to networking technologies.

Course Outcomes:

Students will be able to,

1. Explain the fundamental principles of computer networking.
2. Analyze data transmission theory and key transmission technologies used in computer networks.
3. Discuss the protocols used for reliable and efficient communication between machines.
4. Determine appropriate method to design, install, configure and operate local area networks and wide area networks.
5. Apply analysis tools and problem solving methods to Diagnose and resolve network issues and demonstrate it.

Introduction: Uses of computer networks, network hardware, network software, reference models, example networks, network standardization. **06 Hrs**

The physical layer: Theoretical basis for data communication guide transmission media, wireless transmission, communication satellites, public switched telephone network, mobile telephone system. **07 Hrs**

The data link layer: Data link layer design issues, error detection and correction, elementary data link protocols, sliding window protocols, protocol verification. **06 Hrs**

The medium access control sub layer: The channel allocation problem multiple access protocols, Ethernet, wireless LANS, broadband wireless. **04 Hrs**

The network layer: Network layer design issues, routing algorithms-the optimality principle, shortest path routing, flooding, distance vector routing, congestion control algorithms, internet: working, the network layer in the network. **07 Hrs**

The transport layer: The transport service, sample transport protocol, the internet transport protocol (TCP and UDP), performance issues. **05 Hrs**

The application layer: domain name system (DNS), electronic mail, worldwide web, multimedia. **04 Hrs**

LIST OF EXPERIMENTS:

1. Introduction to Packet Tracer
   Use of TCP/IP and OSI model in Packet Tracer

2. Study of different types of Network cables
   Study of Network Devices and Study of network IP
   Part 1: Examine HTTP Web Traffic
   Part 2: Display Elements of the TCP/IP Protocol Suite

3. Configure Hosts and Services
   Examining a Device's Gateway using Packet tracer
   Ping and Trace
   Interpreting Ping and Traceroute Output

4. Investigate Unicast, Broadcast, and Multicast Traffic
   To assign IP address to various network devices in Cisco Packet Tracer
   Skills integration challenge-planning subnets and configuring IP addresses
   Performing Integration Challenge-Data Link Layer Issues

5. Simple wireless LAN model
   Observing the effects of collision in a shared media environment

6. Skills Integration Challenge: Network Planning and Interface Configuration
   Describe how hosts on separate subnets communicate to share resources.

7. Examining Network Address Translation (NAT)
   Performing an Initial Router Configuration
   Placing ACLs
   Observing Static and Dynamic Routing
   Configuring a Cisco Router as a DHCP Server

8. C program implementation
   Character stuffing and destuffing
   Bit stuffing and destuffing
   Distance vector routing algorithm
   Router Configuration

TEXT BOOK:

1. Computer Networks, Andrews S. Tanenbaum, 4th Edition, Pearson Education.

REFERENCE BOOKS:

1. **Data communication and Networking** . Behrouz A. Forouzan, , 4th Edition, Tata McGraw – Hill, 2011.
2. **Computer Networks: A Systems Approach** Larry L. Peterson, Bruce S. Davie, Fifth Edition, Morgan Kaufmann Publishers, 2011.
3. **ATM Protocols concepts,** Hondel and Fluber, AdditionWesley,…..
4. **Data and Computer Networks**, W Stallings 5th Edition Prentice Hall of India 1998

LEARNING MATERIAL:

http://nptel.ac.in/downloads/106105080/

ARTIFICIAL INTELLIGENCE

Sub code: EI664 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Programming in C

Course Objective: To introduce AI concepts and algorithms to solve real-world problems.

Course Outcomes:
Students will be able to,

1. Illustrate the fundamentals of knowledge representation, inference and theorem proving.
2. Analyze simple knowledge based systems.
3. Design various AI Search algorithms
4. Apply working knowledge of reasoning in the presence of incomplete and /or uncertain information.
5. Explain knowledge representation, reasoning, and machine learning techniques to real-world problems.

Introduction: Introduction to Agents and environment; Rationality; the nature of environment; the structure of agents. Problem solving: Problem-solving agents; Example problems; Searching for solution; uninformed search strategies. Informed Search and Exploration: Informed search strategies; Heuristic functions; Constraint Satisfaction: Backtracking search for CSPs. **11 Hrs**

Knowledge and Reasoning: Logical Agents: Knowledge-based agents; The wumpus world as an example world; Logic; propositional logic: A very Simple Logic: Reasoning patterns in propositional logic; Effective propositional inference; Agents based on propositional logic. First-Order Logic, Inference in First-Order Logic – 1: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic; Knowledge engineering in first-order logic.

9 Hrs

Inference in First-Order Logic – 2: Propositional versus first-order inference; Unification and lifting forward chaining; backward chaining; Resolution. **5 Hrs**

Knowledge Representation: Ontological engineering; Categories and objects; Actions, situations, and events; Mental events and mental objects; The Internet shopping world; Reasoning systems for categories; Reasoning with default information; Truth maintenance systems. **6 Hrs**

Planning: The problem; Planning with state-space approach; planning graphs; Planning with propositional logic. Uncertainty: Acting under certainty; Inference using full joint distributions; Independence; Bayes' rule and its use. Probabilistic Reasoning: Representing knowledge in an uncertain domain; the semantics of Bayesian networks; efficient representation of conditional distributions; exact inference in Bayesian networks. **11 Hrs**

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Learning: Learning from Observations: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory.AI: Present and Future: Agent components; Agent architectures; Are we going in the right direction? What if AI does succeed?

10 Hrs

TEXT BOOK:

1. **Artificial Intelligence A Modern Approach:** Stuart Russel and Peter Norvig, 2nd Edition, Pearson Education, 2003.

REFERENCE BOOKS:

1. **Artificial Intelligence**: Elaine Rich, Kevin Knight**,** 3rd Edition, Tata McGraw Hill, 2009.
2. **Principles of Artificial Intelligence**: Nils J. Nilsson**,** Elsevier, 1980.

LEARNING MATERIAL:

http://nptel.ac.in/courses/106105077/

AUTOMATION IN PROCESS CONTROL

Sub code: EI710 **Credit Pattern: 3:0:1**

Total Hours: 39Hrs+ 2Hrs/Week Lab Session **Contact Hours: 05 Hrs/Week**

Pre-requisites: Logic design, Process control.

Course Objective: To introduce the concepts of Industrial Automation, PLC, PLC Programming & SCADA.

Course Outcomes:
The students will be able to,

1. Recall the basic concepts of industrial automation, PLC and SCADA.
2. Explain hardware and programming instructions of PLC, SCADA mechanism.
3. Develop ladder diagram programs for automated control systems.
4. Solve engineering problems related to industrial automation.
5. Design automation techniques for practical applications.

Introduction: Definition of automation, types &application of automation to industry processors, basic concepts of PLC, PLC in industry, components, I/O configuration, introduction to PLC operation, binary data representation, the input and output status files, sixteen point I/O modules, PLC memory. **07 Hrs**

PLC Hardware: Input modules: Discrete input modules, Discrete AC and DC input modules output modules: Discrete & solid state output module switching, relay output modules. **08 Hrs**

Basics of PLC Programming: PLC programming languages, logic functions, bit or relay instruction, OSR instruction, output latching instructions, negated output instruction, internal bit type instruction, understanding relay instructions and the programmable controller input modules- interfacing start stop pushbutton and motor to PLC, developing ladder diagram with analytical problems. **10 Hrs**

Special programming Instructions: Timer and Counter instructions: on delay and off delay and retentive timer instructions, PLC counter up and down instructions, combining counters and timers. Program control & data manipulation instructions: data handling instructions, comparison instructions, sequencer instructions, programming sequence output instructions. **6 Hrs**

Introduction to Supervisory Control and Data Acquisition (SCADA): Brief history of SCADA, elements of SCADA, features of SCADA, fundamental principles of modern SCADA systems, SCADA software and SCADA protocols, comparison of the terms SCADA, DCS,PLC and smart instrument. **8 Hrs**

TEXT BOOKS:

1. **Introduction to Programmable Logic Controllers,** Garry Dunning, 2nd Edition, Thomson Learning,2006
2. **Practical SCADA for Industry,** David Bailey, Edwin Wright, Elsevier Publication 2003.

REFERENCE BOOKS:

1. **Instrumentation Engineers Hand Book,** Process Control, Bela G Liptak, Chilton Book Company, Pennsylvania.
2. **Programmable Logic Controller,** W Bolton, 5th edition, Elsevier Publication 2009
3. **Industrial Control and Instrumentation,** W.Bolton, Universities Press.
4. **Industrial Electronic Control**: Including PLC, Paul.B. 2nd edition, Prentice Hall India
5. **Computer Based Industrial control,** Krishna Kant, Prentice Hall of India

LIST OF EXPERIMENTS:

The following Allen Bradley PLC experiments are solved using ladder diagram,

9. Basic Instructions, Basic Gates, Universal Gates, Adders & Subtractors
10. Multiplexers, De- Multiplexers, Latching and Unlatching
11. On Delay Timers, Off Delay Timers
12. Up Counters, Down Counters, and Up/Down Counters
13. Data Handling Instructions, Comparison instructions and Sequential Control Instructions.
14. Solving application problems
15. Interfacing of Bottle filling unit to PLC
16. Interfacing of Elevator to PLC

MINI PROJECT: Solving application problems using Allen Bradley PLC.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/112102011/11
2. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Industrial%20Automation%20control/New_index1.html

CMOS INTEGRATED CIRCUIT DESIGN

Sub code: EI720 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Logic design.

Course Objective: To provide the basic knowledge of VLSI fabrication, circuit elements and design issues of CMOS circuits.

Course Outcomes:

Student will be able to,

2. Explain the developments in IC Technologies and concepts of CMOS VLSI design.
3. Analyze constraints in the VLSI design like power dissipation, noise margin, operating frequency, in CMOS circuits.
4. Estimate the delay of nMOS, CMOS circuits and make use of design rules.
5. Develop alternate forms of CMOS circuits and apply scaling issues to device parameters.
6. Design modules of nMOS/CMOS circuits using structured design approach.

Introduction to MOS technology: Moores law, speed –power performance, nMOS fabrication, CMOS fabrication: nwell, pwell processes, BiCMOS technology, comparison of bipolar and CMOS. Basic electrical properties of MOS & BICMOS circuits: Drain to source current versus voltage characteristics, threshold voltage, transconductance, MOS transistor figure of merit, pass transistor **12 Hrs**

Inverters: 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, MOS transistor circuit model, BiCMOS inverters, latch up. **10 Hrs**

Basic circuit concepts: Sheet resistance, area capacitance calculation. Delay unit, inverter delay, and estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers, propagation delays and wiring capacitances. Design rules: nMOS design style; CMOS design style, Design rules and layout. **10 Hrs**

Scaling of MOS circuits: scaling factors for device parameters, limitations of scaling**. Alternate CMOS logics,** Switch logic, pass transistor logic, gate logic, pseudo nMOS, dynamic CMOS, Clocked sequential circuits, dynamic shift registers **10 Hrs**

Structured design: Design methodology, structured design techniques, FPGA architecture, cell based design parity generator, Bus arbitration, Multiplexers, logic function block, code converter, Array Subsystems: SRAM, DRAM, circuit design.

10 Hrs

TEXT BOOKS:

1. **Basic VLSI design**, 3rd Edition Douglas APucknell, KamaranEshraghian, Prentice Hall of India publication, 2005.
2. **CMOS VLSI design, A Circuit and Systems Perspective, 3rd edition, Neil H. Weste, David Harris, Ayan Banerjee, Pearson, 2012**

REFERENCE BOOKS:

1. **CMOS Analog Circuit Design, 2nd edition, Phillips E. Allen, Douglas R Holberg, Oxford University Press**
2. **Analog Systems for CMOS VLSI Systems**, Franco Maloberti, Springer International Edition, 2011

LEARNING MATERIAL:

nptel.ac.in/courses/117101058/

INDUSTRIAL INSTRUMENTATION

Sub code: EI731 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs + Industrial Visit **Contact Hours: 04 Hrs/Week**

Pre-requisite: Transducers and instrumentation.

Course Objective: To introduce fundamentals of instrumentation systems used in various industries.

Course Outcomes:
Students will be able to,

1. Explain the basics and functions of instrumentation in industries.
2. Describe the manufacturing process in various industries.
3. Explain the basics of process industries.
4. Demonstrate air flight simulation instrumentation.
5. Discuss safety issues in an industrial Environment.

Instrumentation practices in process industries: Department functions and responsibilities, development, process analysis, maintenance, standardization, economics of process instrumentation. **4 Hrs**

Steel production instrumentation: Selection of instruments, black furnace instrumentation, open-hearth process instrument, End product measurement, continuous casting of steel. **8 Hrs**

Food industry instrumentation: Instrumentation in brewing, canning industry, baking, dairy industries. **8 Hrs**

Steam power plant instrumentation: Instrument selection, primary and secondary plant measurement, **4 Hrs**

Electric power generation & Distribution: General characteristics of interconnected systems, classification of economy dispatch control systems, Digital computer for economy dispatch applications. **8 Hrs**

Paper and pulp instrumentation: Different types of pulping, pulp bleaching, pulp blending, wet end and drier instrumentation **8Hrs**

Nuclear reactor instrumentation: Nuclear reactor dynamics, reactor instrumentation, reliability aspects of protective systems. **5 Hrs**

Air space instrumentation: Air craft's and aerospace vehicle instrumentation, air flight simulation instrumentation. **7 Hrs**

Practicals: Students will be taken for industry visit related to industrial instrumentation . Finally students have to submit the report and presentation.

TEXT BOOK:

1. **Hand book of applied instrumentation,** Considine and Ross, Publisher McGraw-Hill's 1964.

REFERENCE BOOKS:

1.**Industrial instrumentation** Donald P. ECKMAN, John Wiley
2.**Industrial Instruments** K.Krishnaswamy, S.Vijayachitra, New age international publishers
3.**Food Processing Principles & Applications,** J.S.Smith, University press(US)2004.

MACHINE LEARNING

Sub code: EI732 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisites: Signals and systems, Digital signal processing, Linear Algebra.

Course Objective: To introduce the concepts of learning, linear regression, classification and evaluation hypothesis.

Course Outcomes:

The students will be able to,

1. Choose the learning techniques with basic knowledge.
2. Discuss linear regression and classification techniques.
3. Apply efficient learning rules for appropriate applications.
4. Compare using evaluation measures and understand hypothesis testing.
5. Demonstrate theoretical and practical skills by working in the laboratory to write and test machine learning algorithms.

Introduction, Concept Learning And Decision Trees: Learning Problem, Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias, **12 Hrs**

Decision Tree learning- Introduction, Representation, learning Algorithm, decision and hypothesis , Heuristic Space Search **10 Hrs**

Bayesian And Computational Learning: Bayes Theorem, Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorith, Probably Learning, Sample Complexity for Finite and Infinite Hypothesis Spaces, Mistake Bound Model.

10 Hrs

Neural Networks: Neural Network Representation, Problems, Perceptrons, Multilayer Networks and Back Propagation Algorithms, evaluating hypothesis. **10 Hrs**

Instant Based Learning And Learning Set Of Rules K: Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rule, Learning Sets of First Order Rules, Induction as Inverted Deduction, Inverting Resolution **10 Hrs**

LIST OF EXPERIMENTS:

1. Classification using Decision tree and studying the classifier performance.
2. Classification using Bayes optimal technique studying the classifier performance.
3. Classification using Naive Bayes technique studying the classifier performance.
4. Problems on expectation maximum algorithm.
5. Neural network classifier for 2 level classifications.
6. neural network classifier for multi level classification.
7. Implementation of k-nearest (kNN) neighbor classifier.
8. Problems on Radial basis functions.

TEXT BOOK:

1. **Machine Learning**, Tom M. Mitchell, McGraw-Hill Education (INDIAN EDITION), 2013.

REFERENCE BOOKS:

1. **Introduction to Machine Learning**, Ethem Alpaydin, 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. **Pattern Recognition and Machine Learning,** Christopher M. Bishop, Springer, 2006
3. **The Elements of Statistical Learning,** T. Hastie, R. Tibshirani, J. H. Friedman, Springer; 1st edition, 2001.

LEARNING MATERIALS:

1. http://www.nptel.ac.in/courses/106105152/
2. https://swayam.gov.in/course/3823-introduction-to-machine-learning

BIG DATA ANALYTICS

Sub code: EI733 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs +2Hrs/Week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisites: High level Programming Language, Operating Systems.

Course Objective: To provide understanding of Big Data Platform and its cases.

Course Outcomes:
The students will be able to,

1. Recall about Big Data, Data Analysis, Data Streams, Clustering & frameworks.
2. Explain Analytical Scalability, Stream computing and its applications.
3. Make use of different Frame works and Visualization techniques.
4. Analyze different clustering techniques.
5. Develop cases involving big data analytics in solving practical problems.

Introduction: Introduction to big data, risks of big data, structure of big data, exploring big data, filtering big data effectively, mixing big data with traditional data, need for standards-today's big data is not tomorrow's big data, web data: the original big data, web data overview web data in action, cross-section of big data sources and the value they hold. **12 Hrs**

Data Analysis: Evolution of analytic scalability, convergence, parallel processing systems, cloud computing , grid computing , map reduce , enterprise analytic sand box, analytic data sets analytic methods ,analytic tools ,cognos ,micro strategy , pentaho, analysis approaches , statistical significance, business approaches , analytic innovation , traditional approaches. **8 Hrs**

Mining Data Streams : Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, real time analytics platform(RTAP) applications, case studies, real time sentiment analysis, stock market predictions. **10 Hrs**

Frequent itemsets and Clustering : Mining frequent itemsets ,market based model ,apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream ,clustering techniques ,hierarchical ,k- means ,clustering high dimensional data ,clique and proclus , frequent pattern based clustering methods , clustering in non-Euclidean space ,clustering for streams and parallelism. **12 Hrs**

Frameworks and Visualization: Mapreduce , Hadoop, Hive, Mapr, Sharding , Nosql databases Hadoop distributed file systems, Visualizations - visual data analysis techniques, interaction techniques; systems and applications. **10 Hrs**

LIST OF EXPERIMENTS:

1. To understand the overall programming architecture using Map Reduce API.
2. Store the basic information about students such as roll no, name, date of birth, and address of student using various collection types such as List, Set and Map.
3. Basic CRUD operations in MongoDB.
4. Retrieve various types of documents from student's collection.
5. To find documents from Students collection.
6. Develop Map Reduce Work Application.
7. Creating the HDFS tables and loading them in Hive.
8. Learn joining of tables in Hive.

TEXT BOOKS:

1. **Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Stream with advanced analytics,** Bill Franks,John Wiley & sons, 2012.
2. **Mining of Massive Datasets**, Anand Rajaraman and Jef rey David Ulman, Cambridge University Press, 2012.

REFERENCE BOOKS:

1. **Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data: Analytics for Enterprise Class Hadoop and Streaming Data**, Paul Zikopoulos, Chris Eaton, McGraw Hill Professional, 2011.
2. **Intelligent Data Analysis**, Michael Berthold, David J. Hand, Springer, 2007.
3. **Making Sense of Data**, Glenn J., Myatt John Wiley & Sons, Pete Warden, Big Data Glossary, O"Reilly.
4. **"Hadoop in Practice",** Alex Holmes, Manning Press, Dreamtech Press.
5. "**Making Sense of NoSQL**" – A guide for managers and the rest of us, Dan McCreary and Ann Kelly Manning Press.
6. "**Hadoop in Action**", Chuck Lam, Dreamtech Press.

LEARNING MATERIALS:

1. https://www.tutorialspoint.com/big_data_analytics/index.htm
2. https://drive.google.com/file/d/0B-Sglyltyo4jbjRYSmFmbE1LLU0/view

PATTERN RECOGNITION

Sub code: EI734 **Credit Pattern: 4:0:1**

Total Hours: 52 Hrs+ 2 Hrs/week lab session **Contact Hours: 06 Hrs/Week**

Pre-requisites: Signal & Systems, Digital Image Processing, Linear Algebra.

Course Objective: To provide the basics of statistical techniques commonly used in pattern recognition systems and to introduce parametric, nonparametric decision making.

Course Outcomes:

Student will be able to,

1. Explain the basics of pattern recognition, feature extraction, design cycle, Bayesian techniques and statistical decision making.
2. Evaluate Bayesian classification and algorithms.
3. Analyze error rate of classifier, different methods and performance evaluation.
4. Develop algorithms of non parametric decision making systems.
5. Illustrate clustering algorithms and compare hierarchical and partitional algorithms.

Introduction: Pattern recognition overview, typical pattern recognition system, patterns and feature extraction examples, classification, post processing, design cycles, training, supervised learning. **06 Hrs**

Statistical decision making: Bayes theorem, continuous densities, decision regions, multiple features, conditionally independent features, Bayesian classifiers: decision boundaries, two dimensional examples, d-dimensional decision boundaries in matrix notation, examples **12 Hrs**

Estimation of error rates: unequal costs of error, estimation of error rates, model based estimates, simple counting, fractional counting, characteristic curves, Confusion matrices, examples, estimating the composition of populations **12 Hrs**

Nonparametric decision making: Introduction, histograms, Kernel and Window estimators, nearest neighbor classification technique, nearest neighbor error rates, adaptive decision boundaries, algorithm, examples, adaptive discriminant functions, examples, and minimum squared error discriminate function, examples. **12 Hrs**

Clustering: Introduction, Hierarchical clustering, agglomerative clustering algorithms, single linkage algorithm, complete linkage algorithm, average linkage algorithm, Wards method, examples, Partitional clustering, Forgy's algorithm, k-means algorithm, examples. **10 Hrs**

LIST OF EXPERIMENTS:

1. Write a program to perform Bayesian classification for a two feature sample space, when the class probability, mean and covariance are given.
2. Write a program to determine the optimal decision boundary between two simple bivariate normal classes when the features are independent in each class (assume equal covariance)
3. Write a program to compute the confusion matrix when the training set is provided
4. Write a program to classify samples using nearest neighbor approach
5. Write a program to find a decision boundary to classify samples using adaptive decision boundary algorithm
6. Write a program to perform the hierarchical clustering when the feature values of samples are provided
7. Write a program to perform clustering using Ward's method
8. Write a program to perform Partitional clustering using Forgy's or K-means algorithm when the feature values of samples are provided

TEXT BOOK:

1. **Pattern Recognition and Image Analysis,** Earl Gose, Richard Johnsonbaugh, and Steve Jost, 2nd edition, PHI, 2002

REFERENCE BOOK:

1. **Pattern Classification,** Richard O Duda, Peter E Hart and David G stork, John Wiley and sons, 2nd ed. 2001

LEARNING MATERIAL:

nptel.ac.in/courses/106106046/

MICRO AND SMART SYSTEMS TECHNOLOGY

Sub code: EI741 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisites: Transducers and Instrumentation, CMOS integrated circuit design**.**

Course Objective: To introduce the basics of MEMS, smart sensors and systems and microfabrication.

Course Outcomes:

The students will be able to,

1. Discuss the importance of micro and smart systems.
2. Explain the principles of the microsensors and microacuators.
3. Describe the stages involved in microfabrication processes.
4. Choose the suitable approaches for integration of components and packaging.
5. Explain Microsystem design using CAD

Introduction: MEMS & Microsystems, Microsystems & Microelectronics, Multidisciplinary nature of Microsystems, Advantages and Applications **6 Hrs**

Working Principles of Microsystems: Micro sensors: Silicon Capacitive Accelerometer, Piezo-Resistive Pressure, Sensor, Biomedical Sensors, Blood Analyzer, Conductometric Gas Sensor, Fiber-Optic Gyroscope And Surface-Acoustic-Wave Based Wireless Strain Sensor. Micro actuators: Silicon Micro-Mirror Arrays, Piezo-Electric Based Inkjet Print-Head, Electrostatic Comb-Drive, Magnetic Micro Relay, Shape-Memory-Alloy Based Actuator, Electro-Thermal Actuator, Microgrippers, Micromotors, Microvalves, Micropumps. **8 Hrs**

Microsystem Fabrication Processes: Introduction, Silicon Structure, Silicon Wafer Processing Method, Thin Film Deposition Processes: Physical Vapor Deposition, Chemical Vapor Deposition, Epitaxial Growth, Thermal Oxidation. Lithography: Photolithograpy, Lift off Technique. Silicon Micromachining: Bulk Micromachining, Surface Micromaching, Advanced MEMS Fabrication Processes: Wafer Bonding Techiniques, LIGA Process. Etching: Wet Etching, Dry Etching, Isotropic & Anisotropic Etching, Etch Stops. **10 Hrs**

Microsytem Integration And Packaging: Introduction, Important Considerations, Objectives of Packaging, Special Issues, Integration of microelectronics and microdevices, Three Levels of Packaging, Interfaces in Packaging: Biomedical, Optical, Mechanical, Electromechanical, Microfluidic. Essential Packaging Technologies: Die Preparation, Surface Bonding, Wire Bonding, Sealing. Pressure Sensor Packaging Case Study. **10 Hrs**

Computer-Aided Simulation And Design: Background To The Finite Element Element Method. Simulation of Microfabrication Process: Surface Micromachining, LIGA, Bulk Micromachining. Computer Aided Design. **10 Hrs**

Modelling : Elastic Deformation And Stress Analysis Of Beams And Plates. Thermal Issues. Basic Fluids Issues. Electrostatics. Electromagnetic Actuation. Capillary Electro-Phoresis. Piezoresistive Modeling. Piezoelectric Modeling. Magnetostrictive Actuators. **8 Hrs**

TEXT BOOKS:

1. **MEMS & Microsystems: Design and Manufacture,** Tai-Ran Hsu, Tata Mc-Graw-Hill Publication.
2. **Micro and Smart Systems,** G.K. Ananthasuresh, K.J. Vinoyet.al., Wiley India.

REFERENCE BOOKS:

1. **The MEMS Handbook – Design and Fabrication**, Mohamed Gad – el – Hak. 2nd Edition, CRC Taylor & Francis.
2. **Microsystem Design**, Stephen D. Senturia MIT, Springer

ROBOTICS

Sub code: EI742 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Mathematics

Course Objective: To introduce the fundamentals of robotic systems, sensors, transformation, kinematic analysis and motion planning.

Course Outcome:
Students will be able to,

1. Explain the key components of robotic technologies.
2. Solve problems in spatial transformation and kinematics.
3. Generate joint trajectories for motion planning.
4. Explain the applications of Robots in various fields.
5. Formulate path planning and robot control techniques to navigate the robots in a given environment.

Concepts: Definition of robotics, classification of robotics, degrees of freedom ,Links-Joints-rigid body manipulator, various subsystems of robotics, power sources, hydraulic, pneumatic, electric drives. **10 Hrs**

Internal and External Sensors: Internal sensors, Position sensors, incremental encoder, absolute encoder, resolver velocity sensors, tachometer and Hall Effect sensor, acceleration and forces sensors, hall effect, touch sensors, proximity sensors, ultrasonic sensors, laser sensors for range measurements-machine vision sensors. **10 Hrs**

Transformation: Rotation matrix, composite rotation matrix, Rotation matrix with Euler angles representation, homogenous transformation matrix, DH representation, homogenous transformation for various arm configurations. **10 Hrs**

Kinematics: Direct and inverse kinematics, forward position analysis , inverse position analysis Jacobian matrix , acceleration analysis. **12 Hrs**

Motion planning: Joint space planning, Cartesian space planning, Position and Orientation trajectories, Point-to-point Planning, continuous path generation, collision avoidance algorithms**.**

10 Hrs

TEXT BOOKS:

1. **Introduction to Robotics**, S.K.Saha, Tata McGraw Hill, 2008
2. **Robotics,** K.S.Fu, R.C.Gonzalez, C.S.G.Lee, Tata McGraw Hill, 2008

REFERENCE BOOKS:

1. **Industrial Robotics** , Mikell P, Weiss G M , Nagel R N, McGraw Hill 1996
2. **Control in Robotics and Automation: Sensors based integration**, Ghosh, Allied publishers ,1998
3. **Robotics Technology and flexible automation,** Deb S R, John Wiley 1992
4. **Robots and manufacturing automation,** Asfahl C. R. John Wiley 1992
5. **Robotic Engineering – An integrated approach ,** Klafter R D, Chimielewski T A, PHI,1994

FUZZY LOGIC AND APPLICATIONS

Sub code: EI743 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04Hrs/Week**

Pre-requisite: Engineering Mathematics, Logic Design

Course Objective: To introduce the importance of fuzzy sets, fuzzy relations and fuzzy measures and its applications in engineering and biomedical field.

Course Outcomes:
Students will be able to,

1. Define crisp sets and fuzzy sets.
2. Discuss the different operations performed on fuzzy sets.
3. Explain the different operations performed on fuzzy relations.
4. Explain the different operations performed on fuzzy measures.
5. Apply knowledge of fuzzy in engineering and medical applications.

Crisp sets and fuzzy sets: Introduction, crisp sets, the notion of fuzzy sets, Basic concepts of fuzzy sets, classical logic, fuzzy logic. **7 Hrs**

Operations on fuzzy sets: General discussion, fuzzy complement, fuzzy union, fuzzy intersection, and combinations of operations **7 Hrs**

Fuzzy relations: Crisp and fuzzy relations, Binary relation, Binary relations on a single set, equivalence and similarity relations, compatibility or tolerance relations, ordering morphism, fuzzy relations equations. **12 Hrs**

Fuzzy measures: General discussion, Belief and plausibility measures, probability measures, possibility and necessity measures, relationship among classes of fuzzy measures. **14 Hrs**

Applications: General discussion, natural life and social sciences, engineering, medicine, management and decision-making, computer science and systems science **12 Hrs**

TEXT BOOKS:

1. **Fuzzy sets, Uncertainty and information**, Klein and Folger, Prentice Hall, 1987.

2. **Fuzzy logic with engineering applications,** Timothy. J. Ross, McGraw Hill International edition, 1997.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/106105173/2
2. https://www.youtube.com/watch?v=H9SikB7HbSU

MEDICAL IMAGING

Sub code: EI 744 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Engineering physics, Engineering Mathematics.

Course Objective: To introduce the concept of different medical imaging modalities, reconstruction algorithms and applications.

Course Outcomes:
Students will be able to,

1. Explain the concepts related to medical imaging system sources (X-Ray, CT, Gamma ray, ultrasound).
2. Explain the technology behind instrumentation used in medical imaging systems.
3. Discuss the different modes of operation and algorithms used in medical imaging machines.
4. List the advantages and limitations of available equipment and systems to provide a safe radiographic examination.
5. Illustrate the applications of the different imaging modalities.

X-Rays: Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers, X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, Dynamic spatial reconstructor, X-Ray image characteristics, Biological effects of ionizing radiation. **12 Hrs**

Computed Tomography: Conventional tomography, Computed tomography principle, Projection function Generations of CT machines, Electron beam CT, Reconstruction algorithms, Helical CT. **6 Hrs**

Ultrasound Imaging: Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging. **8 Hrs**

Magnetic Resonance Imaging: Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences, Block of a magnetic resonance imager, Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety. **12 Hrs**

Radionuclide Imaging: Interaction of nuclear particles and matter, Nuclear sources, Radionuclide generators, Nuclear radiation detectors, Rectilinear scanner, scintillation camera, SPECT, PET. **8 Hrs**

Thermal Imaging: Medical thermography, Infrared detectors, Thermographic equipment, Pyroelectric vidicon camera. **6 Hrs**

TEXT BOOKS:

2. **Principles of Medical Imaging,** Kirk shung, Academic Press,1992
3. **Medical Imaging Signals and Systems,** Jerry L Prince and Jonathan M Links, Pearson Prentice Hall Bioengineering, 2nd edition 2014.

REFERENCE BOOKS:

1. **Handbook of Biomedical Instrumentation,** Khandpur, Tata McGraw-Hill Publishing Company Ltd., Second edition, 2003.
2. **Fundamentals of medical Imaging,** Zhong Hicho and Manbir singh, John Wiley1993.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/108105091/2
2. https://www.mooc-list.com/course/introduction-biomedical-imaging-edx

REAL TIME SIGNAL AND IMAGE PROCESSING LAB

Sub code: EI75L **Credit Pattern: 0:0:1**

Total Hours: 2Hrs/ Week **Contact Hours: 02 Hrs/Week**

Pre-requisite: Digital signal processing

Course Objective: To introduce the students to realize basic DSP algorithms using TMS320C6713 processor and image processing applications using TMS320DM6437 processor.

Course Outcomes:
Students will be able to,

1. Apply fundamental knowledge of DSP algorithms for a given problem.
2. Design filters to meet the given specifications.
3. Develop programs to meet the design.
4. Demonstrate the working of the program efficiently.
5. Analyze and evaluate the results obtained.

LIST OF EXPERIMENTS:

9. Implementation of linear convolution and correlation on TMS320C6713 using C program
10. Implementation of FIR Filters on TMS320C6713 using C program
11. Implementation of IIR Filters on TMS320C6713 using C program
12. Implementation of FFT on TMS320C6713 using C program
13. Implementation of FIR Filters using codec of TMS320C6713.
14. Implementation of Object tracking through background estimation on TMS320DM6437.
15. Implementation of Edge detection in Image on TMS320DM6437.
16. Implementation of Video Compression & Encryption on TMS320DM6437

TEXT BOOK:

1. **Modern digital signal processing:** V.Udayashankara, PHI, Third Edition, 2015

ENTREPRENEURSHIP AND MANAGEMENT

Sub code: EI810 **Credit Pattern: 4:0:0**

Total Hrs: 52 Hrs **Contact Hrs: 04 Hrs/Week**

Course Objective: To provide the knowledge of roles and responsibilities of management and entrepreneur to meet the special challenges to start new ventures.

Course Outcomes:

Students should be able to,

1. Explain the role of an entrepreneurship and management in building a sustainable organization
2. Discuss the two major components of a new enterprise development namely, (1) the legal issues involved while setting up an enterprise and (2) Managing Finances
3. Apply the knowledge, skills and tools and techniques needed to become an entrepreneur.
4. Analyze entrepreneurial environment impacted by the ethical, social, economic and cultural conditions to meet the competitive environment.
5. Develop sustainable "business model" for building enterprise that can make a difference.

1. The early career dilemmas of an Entrepreneur **10 Hrs**

The Entrepreneur's Role, Task and Personality; A Typology of Entrepreneurs: Defining Survival and Success; Common Myths About Entrepreneurs; Entrepreneurship as a Style of Management; The Entrepreneurial Venture and the Entrepreneurial organization

2. Choosing a direction **8 Hrs**

Opportunity recognition and entry strategies: New Product, Franchising, Partial Momentum, Sponsorship and Acquisition; The strategic window of Opportunity: Scanning, Positioning and Analyzing; Intellectual Property: Creation and Protection; Want Help Fine-Tuning a Business Idea? Find a Mentor

3. Opening the Window: Gaining Commitment **10 Hrs**

Gathering the Resources you don't have; The Business Plan as an Entrepreneurial Tool; Industry Types and the Opportunities They Offer; Financial Projections: how to do them the right way; Debt, Venture Capital and other forms of Financing; Financial Objectives of a Firm; The Process of Financial Management; Sources of External Support; Development Entrepreneurial Marketing: Competencies, Networks and Frameworks; The Importance and Diversity of Business Models

4. **Technological Entrepreneurship** **10 Hrs**

   Characteristics and special needs; Business / Project Planning; Implementation Process (B. Plan);Planning Support Systems (Enterprise Operation);Segmenting the Market; Selecting a Target Market; Establishing a Unique Position; Legal Issues (Licensing, Patents, Contracts etc.);

5. **Closing the Window: Sustaining Competitiveness** **8 Hrs**

   Available regular programs / models; Difficulties with these programs; Identifying Competitors; Maintaining Competitive Advantage; The Changing Role of the Entrepreneur: Mid-Career Dilemmas; Harvesting Strategies verses Go for Growth; Strategic Alliances and Joint Ventures; The Roles of the Board of Directors

6. **Women Entrepreneurs, General legal aspects, Social, Economic and Cultural Conditions (Operating Environment)** **8 Hrs**

   Challenges to women Entrepreneurs; Achievements of Women Entrepreneurs; Role Models of Women Entrepreneurs; Available Options; Evaluations of options; Ethical and Environmental Challenges; Establishing a Strong Ethical Culture for a Firm

7. **Management** **10 Hrs**

   Types of ownership in the organization ; Differences between Management and Administration; Management as a science and as an art; Leadership Models.; Functions of Management, Planning, Organizing, Staffing, Directing and Controlling;

TEXT BOOKS &:

1. **Management – A Global Perspective**, Heinz Weihrich & Harold Koontz, 11th edition 2006.
2. **Management and Entrepreneurship**, Veerabhadrappa Havinal, New Age International Publication.

REFERENCE BOOKS

1. **Entrepreneurship - Successfully Launching New Ventures**, Bruce R. Barringer and R. Duane Ireland, 4th edition.
2. **Innovation and Entrepreneurship**, Peter F Drucker.
3. **MANAGEMENT –Challenges for tomorrow's leaders**, Pamela S. Lewis, Stephen H.Good Patricia M.Fanc, 4th edition.

LEARNING MATERIALS

Small Case or scenario to additional reading for students

- How a Lack of Passion and Too Few Customers Can Kill a Business
- Clearly Canadian: What Happens When You Don't Deliver on Your Promises
- e-Bay Drop-Off Stores: How Feasible Were They?
- What StyleHop Learned About the Value of Planning the Hard Way
- Eclipse Aviation: Sometimes an Industry Can't Be Revitalized
- Joost: Why It's Important to Be Sensitive to All Aspects of Your Business Model
- How Legal and Management Snafus Can Kill a Business
- Be Careful What You Wish For: How Growing Too Quickly Overwhelmed One Company's Cash Flow
- Devver: How Miscues in Regard to the Composition and Management of a New-Venture Team Can Kill a Start-up
- How One Start-Up Caught the Attention of VCs, Raised Money, and Still Failed
- How Failing to Establish a Clear Position in the Marketplace Forced an Adorable Robotic Dinosaur to Fall Silent
- Dippin' Dots: Why the USPTO Invalidated Its Patent and It Now Has Two New Competitors
- How Trying to Build Out Its Own Capabilities in a Key Area Contributed to the Failure of a Promising Firm
- Be Careful What You Wish For: How StumbleUpon's Founder Sold His Company to eBay and Two Years Later Bought It Back Again

Other Reading

- The 7 Habits of Highly Effective People
- My Philosophy for Successful Living by Jim Rohn
- The Entrepreneur Mind by Kevin D. Johnson
- The $100 Startup by Chris Gillebeau
- Thinking, Fast and Slow by Daniel Kahneman
- Rich Dad, Poor Dad by Robert Kiyosaki and Sharon Lechter
- Who Moved My Cheese? An Amazing Way to Deal with Change in Your Work and in Your Life by Spencer Johnson
- How to Win Friends and Influence People by Dale Carnegie
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LIST OF STUDENT ACTIVITIES FOR SELF LEARNING

- Prepare project proposal to develop a product from household waste.
- Download product development and innovative films from internet.
- Prepare a collage for "Traits of successful entrepreneurs."
- Interview at least four entrepreneurs or businessman and identify charms of entrepreneurship and characteristics of successful entrepreneurs.
- Identify your hobbies and interests and convert them into business idea.
- Mock Business Model- Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, and television), jingle, packing, packaging, and label for it.
- Develop your own website. Share your strengths and weakness on it. Declare your time bound goals and monitor them on the website.
- Choose any product/ advertisement and analyze its good and bad points/ cost sheet/ supply chain etc.
- Study schemes for entrepreneurship promotion of any bank.
- Visit industrial exhibitions, trade fairs, GIM and observe nitty-gritty of business.
- Conduct a market survey for a project. Collect data on machinery specifications, price, output/hr, power consumption, manpower requirement, wages, raw material requirement, specification, price, competitor's product price, features, dealer commissions, marketing mix etc.
- Select a social cause, set objectives, plan and work for its accomplishment. Find details about at least one NGO.

PHOTOVOLTAICS THEORY AND DESIGN

Sub code: EI821 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Basic Electronics

Course Objective: To expose fundamentals of semiconductor materials, principle of solar cells, design of solar cells and Photo Voltaic (PV) modules.

Course Outcomes:

Students will be able to,

1. Explain the fundamentals of solar energy.
2. Discuss the basic principles & configuration of solar cell
3. Construct photovoltaic cell using series and parallel connections
4. Analyze the solar cell parameters and its losses
5. Design of solar PV module for required specifications

Fundamentals of Semiconductors and charge carriers and their motion: semiconductors as solar materials, arrangements of electronics in atom, formation of energy bands, charge carriers in semiconductors, carrier concentration and distribution, carrier motion in semiconductors, electrical field and energy band bending, generation of carries and recombination of carriers. **8 Hrs**

Introduction to Solar Cells: Introduction to P-N junction equilibrium condition, non-equilibrium condition, P-N junction under illumination: solar cell **6 Hrs**

Design of Solar Cells: Upper limits of Cell Parameters, losses in solar cells, solar cell design, Design of High I_{sc}, V_{oc} and FF. analytical techniques. **8 Hrs**

Solar photovoltaic modules: Solar PV modules from solar cells, mismatch in series connection, mismatching in parallel connection, PV module power plants. **8 Hrs**

Balance of Solar PV systems: Basics of electromechanical cell, factors affecting battery performance, batteries for PV systems, DC to DC converters, Charge controllers, DC to Ac converter, MPPT **12 Hrs**

Photovoltaic system design and applications: introduction to Solar PV systems, design methodology of PV systems, Hybrid PV systems, grid-connected PV systems, simple playback period, life cycle costing. **10 Hrs**

TEXT BOOK:

1. **Solar Photovoltaics, Fundamentals, technologies and applications,**Chetan Singh Solanki, second edition, PHI 2011.

REFERENCE BOOKS:

1. **Applied Photo voltaics,** Stuart R Wenhem, earth scan, 2007.
2. **Solar electric hand book, Photo voltaic fundamentals and applications,** Solar energy international.

LEARNING MATERIAL:

http://nptel.ac.in/courses/117108141/

LASERS AND OPTICAL INSTRUMENTATION

Sub code: EI 822 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Engineering Physics.

Course Objective: To introduce the principles and applications of lasers.

Course Outcomes:

Students will be able to,

1. Explain the basic concepts of lasers and its types.
2. Illustrate the different concepts of enhancing laser energy.
3. Construct laser instruments used for different applications.
4. Analyze the working of optoelectronic devices, components and their operations.
5. Discuss the working of fiber optic principles and its applications.

Lasers: Principles, classification, construction of Ruby, He-Ne, Nd-YAG, semiconductor, Argon and Carbon dioxide lasers. **7 Hrs**

Characteristics of stabilization, Q-switching and mode locking, frequency stabilization. **6 Hrs**

Line shape function, lasing threshold, application of lasers in engineering and medicine, saety with lasers. **6 Hrs**

Laser instruments: Laser interferometer, laser strain gauges, velocimetry, pulse echo technique, beam modulation telemetry and holography, application of holography, laser welding, laser machining and laser spectroscopy. **7 Hrs**

Optoelectronic devices and components: Photo diodes, PIN diodes, solar cells, LED's phototransistors, opt-isolators, photo-couplers. **6 Hrs**

Fiber optics: Light Modulation schemes, optical fibers, intermodal dispersion, graded index fiber, low dispersive fibers. **7 Hrs**

Fiber losses, fiber materials, integrated optics, optical instability, laser printing, optical multiplexers. **6 Hrs**

Optical fiber sensors: Multimode passive and active fiber sensors, phase modulated sensors, fiber optic gyroscope, Polarization: polar metric sensors, polarization, and rotation sensors.

7 Hrs

TEXT BOOKS:

2. **Optoelectronics, an introduction ,**Wilson & Hawkes, Prentice Hall of India ,1983.
3. **Laser principles and applications,** Wilson and Hawkes, Prentice Hall of India,1987.

REFERENCE BOOKS:

1. **Essentials of Opto Electronics with Applications**, A.J.Rogers, CRC Press.
2. **Principles of Optical Communication & Opto Electronics,** I.Ravikuamar, Bala N.Saraswathi, Lakshmi Publications.
4. **Optoelectronics Devices & Systems,** Guptha, Prentice Hall of India.

LEARNING MATERIAL:

https://onlinecourses.nptel.ac.in/noc17_cy07/preview

CLOUD COMPUTING

Sub code: EI823 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04Hrs/Week**

Pre-requisites: Operating systems, Computer networks.

Course Objective : To introduce cloud architecture, model and design of trusted cloud computing system.

Course Outcomes:

Students should be able to,

1. Illustrate the fundamentals and essentials of cloud computing.
2. Analyze different cloud computing models.
3. Identify appropriate design methods for solving cloud computing problems.
4. Measure the various parameters of cloud system.
5. Discuss cloud virtualization technologies.

Introduction: Business and IT perspective, Cloud and virtualization, Cloud services requirements, cloud and dynamic infrastructure, cloud computing characteristics, cloud adoption. **10 Hrs**

Cloud models: Cloud characteristics, Measured Service, Cloud models, security in a public cloud, public verses private clouds, cloud infrastructure self service. **10 Hrs**

Cloud at a service: Gamut of cloud solutions, principal technologies, cloud strategy, cloud design and implementation using SOA, Conceptual cloud model, cloud service demand. **10 Hrs**

Cloud solutions: Cloud ecosystem, cloud business process management, cloud service management, cloud stack, computing on demand, cloud sourcing. **03 Hrs**

Cloud offerings: Cloud analytics, Testing under cloud, information security, virtual desktop infrastructure, Storage cloud. **04 Hrs**

Cloud management: Resiliency, Provisioning, Asset management, cloud governance, high availability and disaster recovery, charging models, usage reporting, billing and metering**.**

04 Hrs

Cloud virtualization technology: Virtualization defined virtualization benefits, server virtualization, virtualization for x 86 architecture, Hypervisor management software, Logical partitioning, VIO server, virtual infrastructure requirements**,** storage virtualization, storage area networks, network attached storage, cloud server virtualization, virtualized data center.

06 Hrs

Cloud and SOA: SOA journey to infrastructure, SOA and cloud, SOA defined, SOA defined, SOA and IAAS, SOA based cloud infrastructure steps, SOA business and IT services. **05 Hrs**

TEXT BOOK:

1. **Cloud Computing** by Dr. Kumar Saurabh, 2nd edition, Wiley India, 2011.

REFERENCE BOOKS:

1. **Cloud Computing: Web based applications that change the way you work and collaborate online**, Michael Miller, Que publishing , August 2009.
2. **Cloud Computing Best Practices for Managing and Measuring Processes for On Demand computing applications and data Centers in the Cloud with SLAs**, Haley Beard, Emereo Pty Limited, July.

LEARNING MATERIAL:

http://nptel.ac.in/courses/106105167/

SPEECH SIGNAL PROCESSING

Sub code: EI824 **Credit Pattern: 3:0:1**

Total Hours: 39 Hrs+2Hrs/Week lab session **Contact Hours: 05 Hrs/Week**

Pre-requisites: Signals and systems, Digital signal processing.

Course Objective: To introduce digital models of speech production, analysis and synthesis of speech signals.

Course Outcomes:

Students will be able to,

1. Develop the digital model for speech signals.
2. Compare different types of quantization of speech signals.
3. Analyze the speech signal in Time and Frequency domain.
4. Discuss Spectrogram, Cepstrum and LPC analysis of speech signals.
5. Explain principles and different methods of speech synthesis, speech enhancement, speech and speaker recognition techniques.

Digital models for speech signals: Process of Speech Production, Acoustic phonetics, Digital models for Speech signals. **6 Hrs**

Digital representations of the speech waveform: Sampling speech signals, Instantaneous quantization, Adaptive Quantization, General theory of differential quantization, Delta modulation. **5 Hrs**

Time domain models for speech processing: Time dependent processing of speech, Short time Energy and average magnitude, Short time average zero crossing rates, Speech Vs silence discrimination using energy and zero crossing. Pitch period estimation using a parallel processing approach, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function. **5 Hrs**

Short time fourier analysis: Definition, Linear filtering interpretation, Filter bank summation method, Design of digital filter banks, Spectrographic displays. Cepstrum analysis. **4 Hrs**

Linear predictive coding of speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Applications of LPC parameters**.** **6 Hrs**

Speech synthesis: Principles of Speech synthesis, Synthesis based on waveform coding, analysis synthesis method, speech production mechanism, Synthesis by rule, Text to speech conversion. **3 Hrs**

Speech Enhancement: Principles of Speech enhancement, Evaluation of speech intelligibility, Speech enhancement algorithms: Spectral subtraction, Adaptive filtering: LMS and RLS algorithm **5 Hrs**

Speech recognition: Principles of Speech recognition, Classification to speech recognition, approaches to speech recognition, speech recognition on pattern recognition approach, Dynamic time warping (DTW), vector quantization. **3 Hrs**

Speaker recognition: Principles of Speaker recognition, Speaker recognition methods. **2 Hrs**

LIST OF EXPERIMENTS:

1. Study of Non stationary nature, estimation of pitch and formants of speech signals using Prat.
2. Study of wideband & narrow band spectrogram of speech signals using Prat.
3. Study of short time energy and short time average magnitude.
4. Study of short time zero crossing rate and short time autocorrelation of speech signals.
5. Study of LPC analysis and synthesis of speech signals.
6. Study of Cepstrum analysis of speech signals.
7. Study of LMS algorithms for speech enhancement.
8. Study of DCT algorithm for speech compression.

MINI PROJECT: Implementation of speech application algorithms using processor.

TEXT BOOKS:

1. **Digital Processing of Speech Signals,** L R Rabiner and R W Schafer, Pearson Education 2004.
2. **Digital Speech Processing, Synthesis and Recognition,** Sadoaki Furui, 2nd Edition, Mercel Dekker 2002.

REFERENCE BOOKS:

1. **Introduction to Data Compression,** Khalid Sayood, 3rd Edition, Elsivier Publications.
2. **Digital Speech,** A M Kondoz, 2nd Edition, Wiley Publications.

LEARNING MATERIAL:

http://nptel.ac.in/courses/117105081/

IoT and SMART SENSORS

Sub code: EI831 **Credit Pattern: 3:0:1**
Total Hours: 39 Hrs + 2 Hrs/Week Lab Session **Contact Hours: 05 Hrs/Week**

Pre-requisites: Transducers and Instrumentation, Signal Conditional Circuits, Computer Networks.

Course Objective: To introduce requirements, applications, protocols and standards in Internet of Things and Smart Sensor.

Course Outcomes:
Students will be able to,

1. Explain the basic design and requirement of IoT.
2. Identify the importance of different types of protocols and models used with IoT.
3. Analyze the requirements of components of smart sensors.
4. Determine the importance of communication protocol and standards that is used with smart sensors.
5. Improve the functionality of conventional systems using IoT.

Introduction to IoT: Definition & Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels. **08 Hrs**

IoT System Management: Introduction, Machine-to-Machine (M2M), Difference between IoT and M2M, SDN and NFV for IoT, Need for IoT System Management, SNMP, Network Operator Requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG. **08 Hrs**

Domain Specific IoTs: Applications, Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health & Lifestyle. **07 Hrs**

Smart Sensors, Signal Conditioning and Control: Introduction, Smart Sensor Model, SLEEPMODE^{TM} Operational Amplifiers, Rail – to – Rail Operational Amplifiers, Switched Capacitor Amplifier, 4 – to 20 mA Signal Transmitter, Analog to Digital Converter, MCU control, Modular MCU Design, DSP control. **08 Hrs**

Protocols and Standards for Smart Sensors: CAN protocol, CAN Module, Neuron Chips, MCU Protocols, IEEE 1451 working relationship, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE P1451.4. **08 Hrs**

LIST OF EXPERIMENTS:

1. Controlling LED and Switch through IoT.
2. Controlling LED based on LDR through IoT.
3. IoT based Temperature monitoring.
4. IoT based Pressure monitoring.
5. IoT based Waterlevel monitoring.
6. Sending data to cloud (Eg. Xively Cloud).
7. Experiment based on Web Application framewok (Eg. Django).
8. Experiment based on Web Application framewok .

MINI PROJECT: Design a simple IoT based Application.

TEXT BOOKS:

1. **Internet of Things – A hands-on approach**, Arshdeep Bahga and Vijay Madisetti, Universities Press (India) Private Ltd., 2015
2. **Understanding Smart Sensors**, Randy Frank, 2nd Edition, Artech House Publications, 2000.

REFERENCE BOOKS:

1. **Rethinking the Internet of Things**: **A Scalable Approach to Connecting Everything**, Francis daCosta and Byron Henderson, Apress Open, Intel Publication. 2014
2. **Learning Internet of Things**, Peter Waher, PACKT Publishing, 2015
3. **Smart Sensor Systems**, Gerard Meijer, John – Wiley and Sons, 2008

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/106105166/
2. http://nptel.ac.in/courses/108105064/34

LOW POWER VLSI

Sub code: IT832 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisites: Logic Design, CMOS IC Design.

Course Objective: To provide the basic knowledge low power VLSI, circuit elements and design issues, models of CMOS circuits.

Course Outcomes:

Student will be able to,

1. Explain the constraints in design of digital systems using VLSI technology.
2. Develop the knowledge to design low power CMOS circuits.
3. Examine the constraints in design of low power CMOS circuits.
4. Apply the design rules to develop low power systems and architectures.
5. Construct circuits using structured design methodology in Low power VLSI.

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.

12 Hrs

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.

10 Hrs

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy. Circuit level: Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library. Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic . **12 Hrs**

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. 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. **10 Hrs**

Algorithm & architectural level methodologies: Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis. **08 Hrs**

TEXT BOOKS:

1. **Practical Low Power Digital VLSI Design,** Gary K. Yeap, Kluwer Academic Publishers, 1998
2. **Low Power Design Methodologies,** Rabaey**,** Pedram, Springer India 2009

REFERENCE BOOK:

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

LEARNING MATERIAL:

nptel.ac.in/courses/106105034/

CRYPTOGRAPHY AND NETWORK SECURITY

Sub code: EI833 **Credit Pattern: 4:0:0**

Total Hours: 52 Hrs **Contact Hours: 04 Hrs/Week**

Pre-requisite: Computer Networks.

Course Objective: To introduce different cryptographic algorithms for various security applications.

Course Outcomes:

Students will be able to,

6. Explain the basic concepts of system security and attacks.
7. Compare various cryptographic techniques.
8. Design solutions for networking and security problems.
9. Develop solutions for networking and security problems.
10. Evaluate the security among the systems by using the firewall.

Network security introduction: The OSI security architecture, security attacks, security services, security mechanisms, a model for network security, classical encryption techniques symmetric cipher model, substitution techniques , transposition techniques , rotor machines Steganography. **10 Hrs**

Block ciphers and data encryption standard: Block cipher principles, data encryption standard, strength of DES, differential and linear cryptanalysis, block cipher design principles, advanced encryption standard, evaluation criteria of AES, AES cipher, more on symmetric ciphers, multiple encryption and triple DES, block cipher modes of operation RC4. **11 Hrs**

Public-key encryption and hash functions: Principles of public, key cryptosystems, RSA algorithm, key management, message authentication and hash functions, authentication requirements, authentication functions, message authentication, hash functions, security of hash functions and MACS, digital signatures, authentication protocols, digital signature standard**.** **11 Hrs**

Network security applications: Kerberos, X.509 authentication service, public key infrastructure, pretty good privacy, s/mime, IP security overview , IP security architecture, authentication header, encapsulating security payload, combining security associations, key management. **10 Hrs**

Web security: Secure socket layer and transport layer security, secure electronic transaction, system security intruders, intrusion detection, password management, malicious software, firewalls, trusted systems. **10 Hrs**

TEXT BOOK:

1. **William Stallings**, "Cryptography and Network security", 6th ed., Pearson Education, 2014.

REFERENCE BOOKS:

1. **Eric Malwald**, "Fundamentals of Network Security ", 4th ed., Pearson Education, 2010.
2. **Charlie Kaufman**, "Radis Perlman and Mike Speciner, Network Security– Private Communication in a Public World", 1st ed., Pearson Education,2009 .
3. **Buchmann, Springer** ,"Introduction to Cryptography", 2nd ed., Pearson Education, 2009.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/106105031/1

http://studentsfocus.com/cs6701-cns-notes-cryptography-network-security-lecture-handwritten-notes-cse-7th-sem-anna-university/

BIOMEDICAL SIGNAL PROCESSING

Sub code: EI 834 **Credit Pattern: 3:0:1**

Total Hours: 39Hrs+ 2Hrs/Week Lab Session **Contact Hours: 05 Hrs/Week**

Pre-requisites: Biomedical Instrumentation, Signals and systems, Digital signal processing.

Course Objective: To introduce the fundamentals of human physiological signal characteristics, event detection, signal modeling and noise elimination techniques.

Course Outcomes:

The students will be able to,

1. Explain the origin of biomedical signals, their characteristics.
2. Detect events and patterns in biomedical signals.
3. Apply classical spectral analysis techniques to evaluate/estimate biomedical signals.
4. Develop algorithms for noise and artifact removal in biomedical signals.
5. Demonstrate theoretical and practical skills to use signal processing algorithms.

Introduction to Biomedical Signals: The nature of biomedical signals, the action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis. **7 Hrs**

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination- The case of epileptic patients, overall performance. Data acquisition and classification of sleep stages, Dynamics of sleep-wake transitions, Event history analysis for modeling sleep. **8 Hrs**

Adaptive Interference/Noise Cancellation: A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest-descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 60Hz interference in ECG, canceling of maternal ECG in fetal ECG. **6 Hrs**

Cardiological Signal Processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording. **9 Hrs**

ECG Data Reduction Techniques: Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

6 Hrs

Power density function: Periodogram method of estimation of power density function

3 Hrs

LIST OF EXPERIMENTS:

1. Detection of QRS complex and heart rate measurement using differentiator method.
2. Detection of QRS complex and heart rate measurement using real time algorithm.
3. Signal Averaging to improve the SNR.
4. Design of Adaptive Noise Canceller for the removal of Interference and Noise in Bio signals.
5. Data Compression Techniques using lossy compression technique.
6. Data Compression Techniques using lossless compression technique.
7. Modeling of biosignals: AR modeling.
8. PSD estimation using peridogram method.

TEXT BOOKS:

1. **Biomedical Signal Processing Principles and Techniques,** D C Reddy, The McGraw-Hill publications, 2005.
2. **Biomedical Signal Analysis A case study approach,** Rangaraj M. Rangayyan, The John Wiley publications, 2012.

REFERENCE BOOK:

1. **Biomedical Digital Signal Processing,** Willis J. Tompkins, The Prentice Hall of India publications, 1993.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/108105101/7
2. https://swayam.gov.in/course/4443-biomedical-signal-processing
3. https://ocw.mit.edu/terms/